September 17, 2003

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

Patrick D. O'Reilly
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FROM: Mark F. Reinhart, Chief **/RA/**
Licensing Section
Probabilistic Safety Assessment Branch
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SUBJECT: RESULTS OF THE PILGRIM GENERATING STATION SDP PHASE 2 NOTEBOOK BENCHMARKING VISIT

During June, 2003, NRC staff and contractors visited the Entergy office in White Plains, NY to compare the Pilgrim Significance Determination Process (SDP) Phase 2 notebook and licensee's risk model results to ensure that the SDP notebook was generally conservative. The Pilgrim PRA did not include most external initiating events (only fire initiators) 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 Pilgrim were compared with the licensee's risk model. The results of the SPAR model benchmarking effort will be documented in the next revision of the SPAR (revision 3) model documentation.

The benchmarking visit identified that there was good correlation between the Phase 2 SDP Notebook and the licensee's PRA. The results indicate that the Pilgrim Phase 2 notebook was generally more conservative in comparison to the licensee's PRA. The revision 1 SDP notebook will capture 86% (results matched or overestimated the licensee's PRA by one order of magnitude) of the risk significance of inspection findings. A summary of the results of comparisons of hypothetical inspection findings between SDP notebook and the licensee's PRA are as follows.

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

3.5% Underestimates Risk Significance (non-conservative)
44% Match Risk Significance
42 % Overestimates Risk Significance by 1 Order of Magnitude
7 % Overestimates Risk Significance by 2 Orders of Magnitude
0 % Overestimates Risk Significance by 3 Orders of Magnitude
3.5% Overestimates Risk Significance by 4 Orders of Magnitude

The Rev-1 SDP notebook has been significantly 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 PRA has increased from 14 to 25. In addition, the number of underestimations decreased from 7 to 2. However, the number of overestimations slightly increased from 24 to 30.

The licensee's PRA 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 Pilgrim SDP Phase 2 Notebook and the licensee's PRA.

Attachments: As stated

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Attachments: As stated

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*See previous concurrence

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SUMMARY REPORT ON BENCHMARKING TRIP

TO THE PILGRIM GENERATING STATION

June 17-19, 2003

J. C. Higgins

Energy Sciences and Technology Department
Brookhaven National Laboratory
Upton, N.Y. 11973-5000

August, 2003

ATTACHMENT A

Table of Contents

List of Tables

1 Introduction

The Pilgrim SDP Notebook was originally prepared in 2000-2001. The Pilgrim notebook was reviewed prior to this benchmarking visit in order to identify potential changes that may be needed in order to address generic NRC changes for the Rev. 1 notebook update. The licensee provided comments on the original notebook version via email (Ref. 3) to BNL, and these were also addressed in the revisions. A summary of the changes made were provided to the licensee prior to the benchmarking visit and are listed in Attachment 2. A list of questions was also provided to the licensee in order to facilitate discussions about the notebook. The licensee provided additional comments on changes in the notebook by Ref. 4. This facilitated the onsite benchmarking by identifying early those areas where the notebook and the PRA differed and allowed the team to focus efforts on these key areas.

On June 17-19, 2003, the NRC conducted an SDP Benchmarking visit with the Pilgrim PRA staff in the Entergy office in White Plains, NY (Attachment 1 provides a list of participants). The purpose of this visit was to validate the underlying assumptions of the draft Rev. 1, SDP Phase 2 Notebook. The validation was conducted by soliciting comments from the licensee's PSA staff, reviewing differences between the underlying assumption of the notebook and the licensee's PSA, and comparing the safety significance of hypothetical inspection findings using both the notebook and the PSA. The outcome of this SDP Benchmarking visit is the issuance of Rev. 1 of the SDP notebook. The SDP notebook is used by inspectors to determine the safety significance of inspection findings.

2 Summary of Results from Benchmarking

The benchmarking visit identified that the notebook was generally conservative when compared to the licensee's PRA. The comparison of the significance between the licensee's PRA and the SDP Phase 2 notebook for hypothetical inspection findings is provided in Table 1. A summary of the results of the risk characterization of hypothetical findings by the SDP notebook are as follows.

3.5%	Underestimates Risk Significance (non-conservative)
44%	Match Risk Significance
42 %	Overestimates Risk Significance by 1 Order of Magnitude
7 %	Overestimates Risk Significance by 2 Orders of Magnitude
0 %	Overestimates Risk Significance by 3 Orders of Magnitude
3.5%	Overestimates Risk Significance by 4 Orders of Magnitude

The benchmarking team noted a few reasons why the notebook is generally more conservative than the PRA. The principle reasons are as follows:

- On failure of CHR & CV, the PRA assumed containment failure, but not necessarily core damage. The notebook assumed containment failure leads to core damage. The PRA termed this a "core vulnerable" state and provided some credit (0.15 to 1.0) for preventing core damage.

- The PRA credited certain recovery actions that were not included in the notebook.

- Failure rate data in several areas of the PRA were notably lower than assumed in the notebook. This led to colors closer to green based on the RAW values than in the notebook.

3 Proposed Revisions to Rev. 0 SDP Notebook

3.1 Benchmarking Details

Benchmarking Methodology

The licensee's PSA information used during this benchmarking visit was based on the updated 2003 version of the Pilgrim PSA. The baseline PRA core damage frequency (CDF) from internal events was 6.68E-6 core damage events/reactor-year, including internal flooding, which was about 0.2 % of CDF. If the internal flooding contribution was removed, the CDF would be 6.67E-6 core damage events/reactor-year.

During the beginning of the benchmarking visit, the team reviewed the notebook with the licensee's staff and obtained comments from the licensee. These comments were incorporated, as appropriate, into the notebook prior to the onsite benchmarking.

The team computed the break points in RAW values for the different SDP colors based upon a current PSA total internal events CDF of 6.68E-6 core damage events/reactor-year. The team pre-selected components and human actions, as listed in Table 1, that would be evaluated for the effect of having the component or human action fail. The team developed the color corresponding to failure of each item. The latest revised version of the notebook was used to develop the color corresponding to failure of each item and compared that to the color that would be implied by the item's RAW value from the PSA. Table 1 tabulates the results of the benchmarking of both the Rev. 0 and the modified Rev. 1 worksheets that are contained in the risk-informed inspection notebook for Pilgrim.

In developing the colors from the notebooks, the team evaluated all sequences in each worksheet that contained the item (component or human action). A number was obtained for each re-evaluated sequence. A "counting rule" was used to cascade lower value sequences to higher value ones as follows. For example, three sequences of value 8 (shorthand for an estimated sequence frequency of 1E-8 events/reactor-year) were equivalent to one sequence of value 7. Likewise, 3 sequences of value 7 (3-7s) were equivalent 1 sequence of value 6 (1-6). Also, 3-6s were equal to 1-5, and so on. Colors were developed as follows:

Sequences of value 7, 8, and higher	Green
Sequences of value 6	White
Sequences of value 5	Yellow
Sequences of value 4	Red
Sequences of value 3 or less	Double Red.

Non-conservative Benchmark Results

For this benchmarking there were two items that were non-conservative, EDG B and a switchgear room HVAC fan.

EDG B was White while the RAW indicated Yellow. The failure probability in the PRA for both EDGs was approximately 1E-2 (this would imply a credit of 2), while the notebook credited the EDGs as a multi-train system and gave a credit of 3. The licensee's RAW was 2.62 while the White-Yellow threshold was 2.50. Further our benchmark had 2 whites, almost giving a Yellow. Thus, the notebook was close to matching, but slightly non-conservative. A test case was run where the team reduced the base case credit on the LOOP worksheet for EAC from 3 to 2. This gave a match for EDG B. This situation with higher EDG failure probabilities in the PRA than in the notebook had been noted at several BWRs.

The switchgear room HVAC fan was Green while the RAW indicated White. HVAC is only needed for switchgear rooms. The cooling to these rooms is provided by recirculation fans without cooling water. By PRA analysis, these fans were only needed during a LLOCA. Increases in switchgear room temperature on loss of HVAC results in power supply degradation for electrical components in the 4160 VAC, 480 VAC, & 125 VDC systems. The PRA used an initiating event frequency for LLOCA of 1E-4 events/reactor-year while the notebook used an NRC generic frequency for LLOCA that places it in Row V. If the initiating frequency for LLOCA was changed LLOCA to Row IV, there would be a match.

Conservative Benchmark Results

The 2 items that were 4 orders of magnitude conservative were the DC chargers D11 & D12. The PRA has a RAW of 1.0 for the chargers, giving a Green, while the notebook gives a double Red (DR). The DR was obtained from two '4' sequences and then the counting rule which added another '4.' Three '4' sequences thus gave a '3' sequence. The 125 VDC system has two buses, A and B. Bus A is supplied by Battery D1 and Charger D11. Bus B is supplied by Battery D2 and Charger D12. Swing Charger D14 can supply either Bus A or Bus B, but it must be manually aligned. This was evaluated similar to the failure of a DC bus (for one year), except we gave a credit of 1 for manual alignment of the swing charger. The PRA used an HEP of 4.9E-3 for aligning the swing charger. Also, the PRA modeled the batteries and the chargers with a fault tree "and" logic, meaning that both need to fail. We, more realistically, assumed consequential failure of the batteries in our coloring. The PRA battery failure probability is 3.7E-5 for one day and 1.35E-2 for one year. Thus, given an initiating event and a failed charger, the PRA model still assumes that the batteries will last 24 hours with a failure probability of 3.7E-5. The combination of these two items, plus the overall general conservatism of the notebook, accounts for the four orders of conservatism.

The 4 items that were 2 orders of magnitude conservative were: an SRV fails to open, Feedwater pump trip on ATWS, one SLC pump, and operator action to initiate containment spray mode of RHR.

An SRV failing to open (fto) was benchmarked as Red and had a White RAW value. There are 4 SRVs and only 2 were needed to open; hence, the benchmarking was done by evaluating DEP and Overpressure. However, the loss of the redundancy rule (Rule 2.3) of NRC 0609 required that the credit for the SRVs be reduced by one on DEP; this is a conservative method

of evaluation. Further, the Red was obtained by accumulation of many lower level sequences (there were no direct 4 sequences).

The Feedwater pump trip (FWPT) on ATWS benchmarked as Yellow but the RAW was 1.05 which gave a Green. The Feedwater pump trip (FWPT) on ATWS would be automatically actuated at the same time as the recirculation pump trip. Per the licensee's analysis, both must occur to prevent core damage. Thus, the worksheet models them separately and both benchmark as Yellow, as do most other single functional failures on ATWS. This was due to the NRC generic Row V placement of ATWS. The licensee's initiating event frequency for ATWS was 5.8E-6 events per RY, which would be Row VI, if used. Most of the other ATWS functions (e.g., SLC, LC, INH, Overfill) all have RAW values of 1.28 (White) and benchmark as one order conservative due to the difference in initiating event frequency. The licensee was unable to explain why FWPT had a lower RAW than the other ATWS functions.

One SLC pump, also from the ATWS worksheet, benchmarked as Yellow while the RAW gave a Green. This was because the PRA success criterion for SLC is 1/2 pumps within 15 minutes, but the NRC generically uses 2/2 pumps for BWRs. Thus, as modeled in the worksheet, failure of one pump on an ATWS lea to core damage whereas in the PRA model there was still a second pump that could be successful up to the 15 minute point.

The operator action to initiate containment spray mode of RHR benchmarked as Red but the RAW gave a White. For CHR on almost all worksheets, the notebook credited RHR in *either* the Suppression Pool Cooling (SPC) mode *or* the containment spray mode. When the team benchmarked the operator action for the SPC mode, the notebook was one order of magnitude conservative (believed due to the extra credit that Pilgrim gives after failure of both CHR and CV). Benchmarking the containment spray mode gives identical results. However, the Pilgrim model did not appear to give equal credit to the two modes. This was most likely due to the common cause failure modeling that considers the SPC mode first. Thus, the containment spray mode had less importance in the PRA and, hence, the White RAW.

The notebook overall also had 24 items that were 1 order of magnitude conservative. These were: HPCI, RCIC, PCS steam, PCS feed, SRV fails to close, RHR pump A or B, RHR HX A or B, CV valve 5042B, CV valve 5025, RPT (both trains), IA compressor, 125 VDC bus D9, DC battery D1 or D2, and operator actions (DEP, CHR with fire water pump in containment spray mode, RHR in SPC mode, Inhibit, LC, SLC, Overfill, and CV). These were not examined individually but can be generally traced to the following four reasons that were observed during the benchmarking visit.

- On failure of CHR & CV, the PRA assumed containment failure, but not necessarily core damage (as this notebook does). The PRA termed this a "core vulnerable" state and provideed some credit (0.15 to 1.0) for preventing core damage.

- The PRA credited certain recovery actions that were not included in the notebook (e.g., Feedwater on TPCS).

- Failure rate data in several areas of the PRA were notably lower than assumed in the notebook (e.g., HPCI and RCIC each at ~5E-2, and Feedwater at ~1E-4). This led to colors closer to green based on the RAW values than in the notebook.

- Operator action HEPs were generally lower than the notebook credited in the notebook (E-6 for RHR when used for the CHR function).

3.2 Specific Changes to the Rev. 0 SDP Notebook for Pilgrim Nuclear Power Plant

A number of changes were made to the Pilgrim Rev. 0 notebook in the process of developing the Rev. 1 notebook. Some of these were made prior to the onsite benchmarking effort. Additionally, at the conclusion of the benchmarking, further changes were made to the notebook in order to minimize the differences between the notebook and the licensee's PSA, while maintaining consistency with the NRC notebook construction rules. Refer to Attachment 2 for a summary of the changes.

3.3 Generic Change in IMC 0609 for Guidance to NRC Inspectors

Rule 2.3 when used for SRVs seems to generate excessive conservatism.

3.4 Generic Change to the SDP Notebook

Need to reconsider the manner in which we model, credit, and color PCS steam and PCS feed.

4 Discussion on External Events

The licensee's updated PSA does not have an quantitative external events model.

5 References

1. Pilgrim Nuclear Power Station (PNPS) PRA dated April 2003.
2. Risk-informed Inspection Notebook for Pilgrim Generating Station, Revision 1.
3. Email from C. Yeh to NRC & BNL dated 4/3/2003.
4. Email from C. Yeh to NRC & BNL dated 6/5/2003.

Table 1: Summary of Benchmarking Results for Pilgrim

Internal Events CDF is 6.68 E-6 events/reactor-year including internal flooding of 0.2%
at a 1 E-11 truncation limit
RAW thresholds are W = 1.15, Y = 2.50, R = 15.97, DR = 150.7

Component Out of Service or Failed Operator Action	SDP Worksheet Results (Before)	Pilgrim Basic Event	Pilgrim RAW ratio	Color by Pilgrim RAW	SDP Worksheets Results (After)	Comments
Component						
HPCI	R	HCI-TDP-FR-PM205	2.01	W	Y	conservative 1 order
RCIC	Y	RCI-TDP-FS-PM206	1.50	W	Y	conservative 1 order
PCS steam	R	TBV-RCK-NO-BPV	2.35	W	Y	conservative 1 order
PCS feed	R	FWS-CONTROL	2.47	W	Y	conservative 1 order
1 SRV fto	Y	ADS-SRV-CC-RV3A	1.19	W	R	conservative 2 orders
1 SRV ftc	R	P1	1.88	W	Y	conservative 1 order
CS pump A	G	LCS-MDP-FR-P215A	1.01	G	G	Match
RHR- pump A	Y	LCI-MDP-FS-P203A	1.32	W	Y	conservative 1 order
RHR- pump B	Y	LCI-MDP-FS-P203B	1.30	W	Y	conservative 1 order
RHR HX A	R	LCI-HTX-VF-E207A	120.2	R	DR	conservative 1 order
RHR HX B	R	LCI-HTX-VF-E207B	117.6	R	DR	conservative 1 order
1 CV valve (5042B)	R	CIV-AOV-CC-5042B	7.91	Y	R	conservative 1 order
1 CV valve (5025)	R	CIV-AOV-CC-A5025	7.91	Y	R	conservative 1 order
1 SSW pump	G	SSW-MDP-FS-P208D	9.07	Y	Y	Match
1 condensate pump	G	CDS-STR-PG-P101B	1.03	G	G	Match
SLC pump	G	SLC-MDP-FS-MDP2A	1.00	G	Y	conservative 2 orders
RPT 1 train	G	CD calculation	1.0	G	G	Match
RPT both trains	Y	CD calculation	1.61	W	Y	conservative 1 order
EDG DGA	W	EDG-ENG-FS-EDGA	2.21	W	W	Match
EDG DGB	W	EDG-ENG-FS-EDGB	2.62	Y	W	non-conservative
SBO DG	G	OSP-SBO	1.27	W	W	Match
4KV (Bus A5)	R	AC4-BAC-ST-A5	628.6	DR	DR	Match

Component Out of Service or Failed Operator Action	SDP Worksheet Results (Before)	Pilgrim Basic Event	Pilgrim RAW ratio	Color by Pilgrim RAW	SDP Worksheets Results (After)	Comments
4 KV Train B Bus	R	AC4-BAC-ST-A6	518.8	DR	DR	Match
ECCS HVAC - selected components	-	Train B Switchgear room fan	1.24	W	G	non-conservative
1 CRD pump	G	CRD-MDP-FS-P209B	1.00	G	G	Match
IA compressor	-	IAS-MDC-FS-K104A	1.00	G	W	conservative 1order
Nitrogen system	Y		1.00	G	G	Match
1 RBCCW pump	Y	RBC-MDP-FR-202D	2.72	Y	Y	Match
1 TBCCW pump	R	TBC-MDP-FR-110B	1.00	G	G	Match
125 VDC Bus A	R	DC1-BDC-ST-D4BUS	401.9	DR	DR	Match
125 VDC Bus B	R	DC1-BDC-ST-D5BUS	315.0	DR	DR	Match
125 VDC Bus D9	-	DC2-BDC-ST-D9	1.35	W	Y	conservative 1 order
Feedwater pump trip on ATWS	-		1.05	G	Y	conservative 2 orders
DC Battery D1	-	DC1-BAT-HW-125D1	1.00	G	W	conservative 1 order
DC Battery D2	-	DC1-BAT-HW-125D2	1.00	G	W	conservative 1 order
DC Charger D11	-	DC1-BCC-HW-D11	1.00	G	DR	conservative 4 orders
DC Charger D12	-	DC1-BCC-HW-D12	1.00	G	DR	conservative 4 orders
1 MD Fire Pump	W	FXT-MDP-FS-P135	1.40	W	W	Match
1 DD Fire Pump	W	FXT-ENG-FS-P140	4.29	Y	Y	Match
1 SP vac. bkr	R	Not modeled	-	-	Y	Not modeled in PRA
2 SP vac. bkrs.	R	Not modeled	-	-	R	Not modeledin PRA
Failed Operator Actions						
DEP	R	ADS-XHE-FO-X1*	38.83	R	DR	conservative 1 order
CHR with FW pump in cont. spray mode	Y	FXT-XHE-FO-DWS	1.33	W	Y	conservative 1 order
RHR SPC mode	Y	SPC-XHE-FO-W1	4.02	Y	R	conservative 1 order
RHR cont. spray mode	Y	DWS-XHE-FO-W2	1.4	W	R	conservative 2 orders

Component Out of Service or Failed Operator Action	SDP Worksheet Results (Before)	Pilgrim Basic Event	Pilgrim RAW ratio	Color by Pilgrim RAW	SDP Worksheets Results (After)	Comments
LI with FW cross tie	R	FXT-XHE-FO-V4T2	3.71	Y	Y	Match
SUCXF	-		1.0	G	G	Match
INH for ATWS	Y	IX	1.28	W	Y	conservative 1 order
LC for ATWS	Y	C1 & C1-TM	1.28	W	Y	conservative 1 order
SLC for ATWS	Y	C1 & C1-TM	1.28	W	Y	conservative 1 order
Overfill for ATWS	Y	UH	1.28	W	Y	conservative 1 order
CV	R	CIV-XHE-FO-DTV	13.37	Y	R	conservative 1 order
R1	G	OSP-2	1.0	G	G	Match
R6	-	OSP-6	1.0	G	G	Match
R8	-	OSP-8	1.0	G	G	Match
RLOOP 14 hours	G	OSP-14	1.51	W	W	Match
operate SBO DG	G	OSP-SBO	1.27	W	W	Match
Fire water injection on LOOP	G	FXT-XHE-FO-V4T2	3.71	Y	Y	Match
DC load shed	-	DC-SHED	1.04	G	G	Match

Notes:

1. Pilgrim RAW for internal events, average maintenance case. This is based on an Internal Events CDF of 6.68E-6 events per RY including internal flooding of 0.2%.

2. The ΔCDF used in RAW value calculations represented the change in CDF due to the component being out of service for 1 year.

3. For a component such as a pump, we examined the RAW values for the basic events both for “failure to start” and “failure to run,” and either selected the highest (more conservative) value here or used a synthesized RAW value separately calculated by the licensee that included all failure modes. Where the basic event column indicates by CDF calculation, the licensee separately calculated a RAW by setting all the appropriate system events to true (or failed) and resolving the model to obtain the new higher CDF.

4. For the SP vacuum breakers, where the basic event column is noted as “not modeled,” the PRA did not separately model the failure to remain closed at the beginning of the accident, and so a PRA RAW value was not available for this mode. The PRA did model failure of the vacuum breakers in their vacuum relief mode.

5. When comparing the modified SDP worksheet color to the color by the Pilgrim RAW, we found many that were conservative. Each color of conservatism represents approximately one order of magnitude in ΔCDF. In the comments column, we indicate by how many orders of magnitude the item is conservative.

6. The 2 items that were 4 orders of magnitude conservative were the DC chargers D11 & D12. There were no items 3 orders of magnitude conservative.

7. The 3 items that were 2 orders of magnitude conservative were: an SRV fails to open, Feedwater pump trip on ATWS, one SLC pump, and operator action to initiate containment spray mode of RHR.

8. The 24 items that were 1 order of magnitude conservative were: HPCI, RCIC, PCS steam, PCS feed, SRV fails to close, RHR pump A or B, RHR HX A or B, CV valve 5042B, CV valve 5025, RPT (both trains), IA compressor, 125 VDC bus D9, DC battery D1 or D2, and operator actions (DEP, CHR with fire water pump in containment spray mode, RHR in SPC mode, Inhibit, LC, SLC, Overfill, and CV).

9. The 2 items that were non-conservative were: EDG B and a switchgear room HVAC fan.

Table 2: Comparative Summary of the Benchmarking Results

	Rev. 0 SDP Worksheets		Rev. 1 SDP Worksheets, as Modified	
	Number of Cases	**Percentage**	**Number of Cases**	**Percentage**
SDP: Non-Conservative	7	15.6	2	3.5
SDP: Conservative	24	53.3	30	52.6
by one order	18	40	24	42.1
by two orders	5	11.1	4	7.0
by three orders	1	2.2	0	0
by four orders	0	0	2	3.5
SDP: Matched	14	31.1	25	43.9
Total	45	100	57	100

Notes:

1. Before the benchmarking, there were 7 non-conservative items. After the benchmarking, there was 2 non-conservative items.

2. Before the benchmarking, there were 24 (53.3%) conservative items. After the benchmarking, there were 30 (52.6%) conservative items, 24 by one order, 4 by two orders, none by three orders, and 2 by four orders of magnitude. These conservative items and non-conservative items are listed in Table 1 and are discussed in Section 3.1 above.

ATTACHMENT 1

List of Participants

US NRC

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ATTACHMENT 2

Notebook Changes at BNL Prior to Onsite Visit

- Addressed, as possible, Entergy comments received by email from C. Yeh to NRC & BNL dated 4/3/2003.
- Updated some initiating event frequencies and moved LOOP to Row II and LSSW to Row V.
- Added Loss of AC Bus (LOAC) worksheet and ET.
- Updated Table 2 to latest format and corrected some support systems.
- Added FWPT and VSS to Table 2.
- Made editorial changes throughout.
- Added base case credits to the worksheet sequences and updated footnotes to worksheets.
- Changed base credit for DEP from 2 to 3 (except MLOCA), and CV from 1 to 2.
- Added train information to worksheets.
- Removed double credit for condensate in the TRANS worksheet.
- Added EC function to SLOCA & MLOCA worksheets.
- Standardized function names across the worksheets.
- Removed credit for the stuck-open relief valve
- Changed credit for RPT on ATWS to multi-train.
- Changed success criteria for DEP on LODC worksheets to 2/4 SRVs.
- Added HPCI to HPI function on LSSW.

Notebook Changes Made During & After Benchmarking Visit

- Updated the initiating event frequencies in Table 1.
- Added event trees and worksheets for LOACB, LOIA, & LORBCCW.
- Updated Table 2 information and footnotes.
- Added SSW pumps to CHR on all worksheets.
- Updated all operator action credits based on PRA HEPs and generic NRC positions.
- Updated credit for LI on all worksheets.
- Dropped EC from SLOCA.
- Modified SORV event tree to require LPI.
- On LLOCA, changed EC to single train (need 10/10 vacuum breakers).
- Redid the LOOP event tree and worksheet to include four recovery times, split HPI into HPCI & RCIC, and added the actions for failure to block the HPCI suction transfer and DC load shed.
- Updated the credits in the ATWS worksheet.
- On LODCA & B, added credit for condensate and feedwater pumps.
- On LOACA & B, updated the list of equipment lost for a LOAC.
- ON LSSW, dropped credit for CV.