Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

OCT 27 1994

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2 - SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVES (SAMDA) - NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) (TAC NOS. M77222 AND M77223)

This letter provides TVA's response to the NRC's RAI dated October 17, 1994, concerning the subject.

Enclosure 1 responds to the NRC's additional questions. Enclosure 2 provides a revision to Category III.5 on page ES-25 of the Executive Summary, Revision 1, that was submitted to the NRC on October 7, 1994. This revision was requested by the NRC in a teleconference on October 18, 1994, with NRC S. Flanders, B. Pallo, and A. Pal.

If you should have any questions or comments, please telephone John Vorees at (615) 365-8819.

Sincerely,

Dwight E. Nunn
Vice President
New Plant Completion
Watts Bar Nuclear Plant

Enclosures
cc: See page 2

A030
1/1

OCT 27 1994

Enclosures
cc (Enclosures):
NRC Resident Inspector
Watts Bar Nuclear Plant
Rt. 2, Box 700
Spring City, Tennessee 37381

Mr. S. C. Flanders, Environmental Project Manager
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852

Mr. P. S. Tam, Senior Project Manager
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852

U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

50-390 TVA WATTS BAR 1

NRC REQUEST FOR ADDITIONAL INFORMATION RE SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVES (SAMDA), RESPONSE TO

REC'D W/LTR DTD 10/27/94....9411020050

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2
SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVE (SAMDA)
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI)

QUESTION 1

Provide documentation regarding the following:

a. why option III.3 (independent RCP seal cooling system with new EDG) has less risk reduction potential than option IV.2 (independent RCP seal cooling system without new EDG),

b. why option IV.3 (modify charging pump cooling from CCS to ERCW) has much more risk reduction potential than either of the above,

c. whether the risk reduction for options III.5 and III.6 is associated with eliminating the same risk contributors.

RESPONSE 1a

These enhancements are credited based on the sequences they can impact and the risk reduction factor associated with the particular enhancement.

Enhancement III.3 includes an independent reactor coolant pump (RCP) seal cooling system which has an independent source of AC power. This independent source of power is assumed to be required to operate the system under all conditions. That is, it is assumed that the independent RCP seal cooling system would be powered only by its own emergency diesel generator (EDG) and not by normal plant sources. Consequently, Enhancement III.3 is effective in reducing the frequency of both station blackout and non-station blackout sequences involving loss of RCP seal cooling. However, the overall unavailability (i.e., failure rate) of Enhancement III.3 includes the unavailability of the EDG along with the other hardware and operator failures which could preclude system operation.

Enhancement IV.2 does not include an EDG and is, therefore, powered from the shutdown boards. Therefore, this enhancement is only effective in reducing the frequency of non-station blackout events. However, because it does not include the EDG, the overall failure rate of the system is lower than Enhancement III.3.

This results in a trade off where Enhancement III.3 impacts more sequences, but is overall less reliable. The results of the analysis, for the specific core damage sequences in the WBN Updated Individual Plant Examination (IPE), was that the system without the EDG resulted in a larger risk reduction. This is due to the proportion of RCP seal loss-of-coolant-accident (LOCA) risk coming from sequences with shutdown boards available versus station blackout sequences.

RESPONSE 1b

Here again, the specific core damage contributors for Watts Bar dictate the computed risk reduction. In the case of Enhancement IV.3, the modification to the Centrifugal Charging Pump (CCP) cooling design has two benefits:
(1) eliminates the dependency on component cooling water (CCS) and
(2) eliminates a highly time-dependent operator action from the risk profile.
Consequently, this design change to provide essential raw cooling water (ERCW) cooling instead of CCS cooling to the CCP effectively eliminates the core damage contribution from loss of CCS. However, it has virtually no other benefit.

On the other hand, as described above in the answer to Question 1a, Enhancement III.3 addresses station blackout sequences as well as loss of CCS and other loss of RCP seal cooling sequences. However, unlike Enhancement IV.3, in the case of Enhancement III.3, an operator action is required to start the independent RCP seal cooling system. This action is very similar to the current operator action required to align ERCW cooling to the CCP as a backup to CCS. Therefore, it has little benefit in mitigating the sequences involving loss of CCS.

Therefore, based on the WBN-specific risk contributors from the various RCP seal LOCA scenarios, the net result is that Enhancement IV.3 has a larger benefit than Enhancement III.3.

RESPONSE 1c

Yes. For the purpose of bounding the risk reduction, the analysis for both of these enhancements conservatively assumed that the enhancement could extend the battery availability indefinitely.

QUESTION 2

Identify the total risk associated with events involving RCP seal LOCAs, and the distribution of this risk by APB and by type of initiator (i.e., station blackout, loss of component cooling water, loss of service water). Based on the June 1994 submittal, most of the risk reduction for RCP seal improvements appears to come from APB-7 and KRC R-20. However, R-20 is associated with small bypass (pp. 3-31 and 2-29). Explain this apparent discrepancy and whether this situation still exists in the updated analysis.

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2
SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVE (SAMDA)
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI)

RESPONSE 2

The risk contributors to RCP seal LOCA are itemized in the attached tables (pages E1-10 and E1-11) for each enhancement evaluated. These tables provide a summary of the core damage frequency reduction for each initiator due to implementation of each enhancement. The accident progression bin (APB) frequency reduction associated with each enhancement is provided in Tables 4.XXc in the SAMDA RAI response dated October 7, 1994.

In the original submittal (June 1994), a conservatism was introduced which overstated the APB frequency (and associated dose) reduction for all of the enhancements evaluated. The risk reductions calculated in the original value impact assessment included a conservatism which was due to a few low frequency plant damage states (PDSs) which were conservatively deleted from each of the enhancement cases. The base case (8.0E-5/yr CDF and 200 person-rem total dose) included these PDSs, but each of the sensitivity cases computed in the spreadsheets conservatively assumed them to be zero frequency. This resulted in the over-estimation of the benefit of the enhancements including the RCP seal improvements and the fifth diesel generator. The risk reduction from these low frequency PDSs was predominantly contributed from APB-7, KRC R-20.

In the revised Executive Summary and supporting analyses, this conservatism has been removed. Consequently, the risk reduction for RCP seal LOCA cases is being contributed by primarily APB-5, Long Term Containment Failures. For example, as shown in Table 4.10c in the October 7, 1994 SAMDA RAI response, of the total 8.47 person-rem eliminated by improved RCP seals, only 14 percent (1.2 person-rem) are contributed by APB-7. The majority of the risk reduction (77 percent) comes from reduction in the frequency of APB-5.

QUESTION 3

Based on the screening in Appendix B, firewater cooling to PD charging pumps (p. B-13) and firewater cooling to CCPs (p. B-15) were classified as having medium to high importance, yet, these improvements were not further assessed. Justify why these improvements were not considered in the more detailed analysis and why they would not be more cost effective than the options that were considered in detail.

RESPONSE 3

The Enhancement Screening Analysis Sheets in Appendix B of the Value Impact Assessment report provide a high-level summary of the review and evaluation process used in the identification of potential plant enhancements. At the

bottom of these sheets, a generalized "classification" is provided on the risk reduction potential of the item. This classification was based primarily on the type of core damage sequences impacted by the enhancement and the contribution of those type of sequences to core damage, not on the expected benefit of the specific enhancement. For example, if an enhancement could reduce the likelihood of RCP seal LOCA or station blackout core damage sequences, then it was generally classified as "medium" to "high" due to the large contribution to core damage from these types of sequences. Judgement was withheld at that point as to the specific benefit of the enhancement, unless it was known to be non-applicable. The identification of the specific enhancements to be quantitatively evaluated was done in an evolving, iterative process.

Some of the screening sheets in Appendix B of the Value Impact Assessment refer to numbered Analysis Sheets. These analysis sheets were an interim step used in screening of the large number of potential enhancements down to a limited list of those with the highest potential. The approach taken to these sheets was to identify high potential enhancements, perform screening evaluations with informal hand calculations or using the spreadsheets to assess which enhancements had the highest potential.

The option to provide fire water cooling to the positive displacement pump (PDP) could provide the same benefits as the independent seal injection system (Enhancement IV.2), however, many more operator actions would be required (e.g., align fire water to PDP, run power cables to the existing breaker cubicle). In addition, power would be required for a fire water pump, as the pumps are motor driven (on diesel backed buses). These considerations would result in reducing the benefit achieved due to human action failure probabilities. The benefit of Enhancement IV.2 is currently calculated to be 10.7 person-rem. Considering the reduced benefit, the cost to provide the fire water cross tie is judged not to be cost beneficial and was not evaluated in detail.

Fire water cooling for the CCPs would be less beneficial than ERCW cooling for the following reasons. First, the number of ERCW pumps which are potentially available is twice the number of fire pumps. Second, sufficient ERCW cooling water is available to the pumps from the current room coolers; providing fire water would require more extensive, and costly, modifications. Third, the operators are currently trained on aligning the ERCW cooling to CCP-1A. Adding CCP-1B to the training and procedure is judged to be more effective than adding a different alignment for fire water cooling. Based on these reasons, Enhancement IV.3 is considered more cost effective.

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2
SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVE (SAMDA)
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI)

QUESTION 4

Provide updated versions of the following Tables to reflect the results of the revised analysis:

- Tables 3-8, 3-9, 3-10, and 3-11,

- Tables 4-XXa and 4-XXb for the following design options: II.2, III.2, III.3, III.4, III.5, III.6, IV-2, IV-3.

RESPONSE 4

See attachment to this enclosure.

QUESTION 5

Provide a detailed description of the RCP seal LOCA model on which the latest core damage frequency estimates are based. Include a description of how the Watts Bar RCP seal LOCA model differs from: (a) the Westinghouse model, and (b) the RCP seal LOCA model utilized in the Sequoyah NUREG-1150 analysis. If NUREG-1150 model was used, describe whether any modifications or corrections to the model were made. Describe how the model was implemented in the Watts Bar IPE, and discuss any supporting analyses performed to validate or adapt this model for Watts Bar.

RESPONSE 5

The IPE RCP seal LOCA model is based on the NUREG-1150 model. A detailed description of the RCP seal LOCA model, on which the latest core damage frequency estimates are based, is provided in Section 3.3.3.4.4.1, "Time Window Based on Plant Thermal Hydraulics" of the WBN IPE, Revision 0. As stated in the section below, "the pump seal leak rates was based on the RCP seal LOCA study of Reference 3.3.3-10 for Westinghouse RCPs with the old style O-rings that exist in the Watts Bar reactor coolant pumps." Reference 3.3.3-10 is provided below as indicated on page 3.3.3-22 of the WBN IPE, Revision 0.

"3.3.3-10. NUREG/CR-5116-Vol. 1, "Results of Expert Opinion Elicitation on Internal Event Front-End Issues For NUREG-1150: Expert Panel," Sandia 88-0642, April 1988."

The following excerpt from Section 3.3.3.4.4.1 provides a discussion of the RCP seal LOCA model assumptions and implementation.

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2
SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVE (SAMDA)
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI)

"..... It is assumed in this analysis that a primary system leak from the RCP seals will occur after the systems (i.e., pumps) supplying cooling water to these seals have stopped because of the loss of all AC power and because no seal cooling is supplied from the charging pump. The model was also used to analyze scenarios in which the charging pump continues to provide cooling to RCP seals and thus, no pump seal loss of coolant accident (LOCA) occurs, or a specific time to core uncovery was specified based on other PRA model conditions. For those scenarios in which severe seal degradation occurs (no pump seal cooling), the leak rate from these seals is assumed to be within the range of 84 gallons per minute (gpm) to 1,920 gpm for the four pumps. A constant leak rate (initiated immediately when all onsite AC power is lost and seal cooling does not exist) of 84 gpm (four pumps) was used in this analysis as the leak rate for the first hour prior to the severe seal damage. The base model for the pump seal leak rates was based on the RCP seal LOCA study of Reference 3.3.3-10 for Westinghouse RCPs with the old style O-rings that exist in the WBN RCPs. These data were used to develop the probability leak rate model for this analysis shown in Table 3.3.3-15 and programmed into the model to calculate the time of core uncovery due to a pump seal LOCA."

Table 3.3.3-15 presented below, is based on the interpretation of the information provided in the documentation for the NUREG-1150 seal LOCA model. This table represents the model utilized in the assumptions regarding the RCP seal LOCA leak flow rates used in the WBN IPE and provides the probability distribution of RCP seal LOCA leak flow rates for given times following station blackout conditions. Each row in the table has eleven possible RCP seal LOCA leak flow rates with a given probability for the time periods indicated following the occurrence of station blackout. As noted in the table, the highest probability condition, 0.5302, represents RCP seal LOCA leak flow rates of 84 gpm for the first hour and 1000 gpm for times greater than 1 hour. As described in the excerpt below, the RCP seal LOCA was assumed to be composed of liquid until the reactor coolant liquid inventory decreases to a level below that of the RCP seals, whereas the RCP seal leakage becomes steam. In addition, the conservative assumption is made that the reactor coolant system is not depressurized which would further decrease the RCP seal LOCA flow rates. Provided below is an excerpt from pages 3.3.3-18 and 3.3.3-19 which provides additional information regarding the seal LOCA model.

"Furthermore, with the auxiliary feedwater system operating, if the operator depressurizes the steam generators, as instructed in the station blackout procedures, primary system pressure will decrease. A decrease in primary system pressure will lower the differential pressure across the RCP seals and therefore decrease the pump seal leak rate and increase the time to core uncovery. However, the seal LOCA data provided in Reference 3.3.3-10 showed little effect of primary system

depressurization and, thus, were conservatively neglected in this model.

The time to core uncovery following the loss of onsite power with auxiliary feedwater available is calculated in the model based on the leak rate probability distribution for each time increment following station blackout, as provided in Table 3.3.3-15, and the reactor coolant inventory loss required for core uncovery of 8,345 cubic feet (Reference 3.3.3-11).

However, as the reactor coolant liquid inventory decreases to a level below that of the pump seals, the leakage out the seals becomes steam, and the leakage mass flow rate decreases considerably. The model developed accounts for the two-phase (liquid/steam) flow through the seals. The liquid leakage is considered subcooled at full-power pressure having a density of 45 pounds per cubic foot per information obtained per telecon with Westinghouse. Because the primary coolant is being cooled by the auxiliary feedwater supplying cooling to the steam generators and discharging from the steam generators via the pressure relief valves until primary coolant material circulation stops, the primary coolant temperature will approach the saturation temperature at the steam generator relief valve setting pressure (1,300 psia). Thus, the steam leakage through the pump seals was considered to be saturated steam at 1,300 psia, continuing to leak at the volumetric time-dependent leak rate that occurs at the time the seals are uncovered by liquid (Table 3.3.3-15). The model also considers the amount of steam produced by the decay heat at the time of seal uncovery, and uses the lesser of the volumetric leak rate (Table 3.3.3-15) or that being produced by the decay heat. Even though the model accounts for two-phase flow through the pump seals that lengthens the time of core uncovery from an all-liquid leakage model and accounts for steam generator cooling to reduce the primary pressure to 1,300 psia, it is still conservative as it does not account for continued reflux cooling by the steam generators to further reduce the primary pressure and to continue removing decay heat....."

Based upon References 1 and 2, the RCP seal leakage based upon the limiting flow through the Number 2 seal will be approximately 21 gpm per pump (84 gpm total for 4 RCPs). Additionally, Reference 3 indicates that the maximum RCP leakage will be approximately 480 gpm (1920 gpm total for 4 RCPs). As indicated by Table 3.3.3-15, the probability distribution accounts for the lower bound, 84 gpm, and the upper bound, 1920 gpm, and the indicated range of leakage flow rates between these bounds for the elapsed times following loss of cooling to the RCP seals.

The RCP seal LOCA model used in the updated WBN IPE is the same RCP seal LOCA model utilized in the WBN IPE, Revision 0 as described above.

References:

1. WCAP-10541, Revision 2, Supplement 1, "High Temperature Extrusion Qualification Testing of Seals Eastern 7228A O-Ring Compound," Westinghouse Electric Corporation, April 1988. Westinghouse Proprietary Class 2. Not publicly available.

2. WCAP-10541, Revision 2, Supplement 2, "Analysis and Transient Behavior of the Westinghouse 8-Inch Design No. 2 RCP Seal During a Loss-of-All-Seal-Cooling Event Representative of a Loss-of-All-AC-Power," Westinghouse Electric Corporation, April 1988. Westinghouse Proprietary Class 2. Not publicly available.

3. WCAP-10541, Revision 2, "Reactor Coolant Pump Seal Performance Following a Loss of All AC Power," Campen, C.H., and Tauche, W.D., Westinghouse Owners Group, December 1986. Westinghouse Proprietary Class 2. Not publicly available.

Table 3.3.3-15. Seal LOCA Flow Rates (GPM) with and without Primary Depressurization

Probability	Cumulative Probability	Flow Rate (in GPM) versus Time after Station Blackout					
		0-1.0 (hours)	1.0-1.5 (hours)	1.5-2.5 (hours)	2.5-3.5 (hours)	4.5-5.5 (hours)	5.5+ (hours)
0.2712	.2712	84	84	84	84	84	84
0.0151	.2863	84	84	84	244	244	244
0.0161	.3024	84	84	244	244	244	244
0.0181	.3205	84	244	244	244	244	244
0.0120	.3325	84	244	433	433	433	433
0.0059	.3384	84	244	433	433	480	698
0.1120	.4504	84	244	1,000	1,000	1,000	1,000
0.0136	.4640	84	480	1,000	1,000	1,000	1,000
0.5302	.9942	84	1,000	1,000	1,000	1,000	1,000
0.0016	.9958	84	1,230	1,230	1,230	1,230	1,230
0.0042	1.0000	84	1,920	1,920	1,920	1,920	1,920

COMPARISON OF CORE DAMAGE FREQUENCY CONTRIBUTORS FOR EACH RCP SEAL ENHANCEMENT CASE

Initiator	Base Case	Change Charging Pump Oil Cooling to ERCW		Improved Seal Material		Independent Seal Cooling System		Independent Seal Cooling System (wo DG)	
		Enhancement CDF	Delta CDF	Enhancement CDF	Delta CDF	Enhancement CDF	Delta CDF	Enhancement CDF	Delta CDF
LOSP	8.85E-06	8.20E-06	6.50E-07	8.41E-06	4.39E-07	8.35E-06	4.99E-07	8.46E-06	3.87E-07
SLOCAN	1.01E-05	1.01E-05	1.00E-09	1.01E-05	2.10E-08	1.01E-05	2.30E-08	1.01E-05	3.00E-08
LBSD	5.99E-06	1.24E-06	4.75E-06	2.98E-06	3.01E-06	2.58E-06	3.41E-06	1.66E-06	4.34E-06
FLPH1B	4.44E-06	3.40E-06	1.04E-06	3.79E-06	6.45E-07	3.71E-06	7.31E-07	3.51E-06	9.28E-07
FLPH1A	3.80E-06	3.38E-06	4.21E-07	3.80E-06	1.60E-09	3.80E-06	1.80E-09	3.80E-06	2.30E-09
SGTR	4.10E-06	3.77E-06	3.33E-07	4.03E-06	7.00E-08	4.02E-06	7.93E-08	4.00E-06	1.01E-07
PLMFW	3.10E-06	2.41E-06	6.92E-07	2.79E-06	3.16E-07	2.74E-06	3.58E-07	2.65E-06	4.54E-07
LASD	2.25E-06	1.59E-06	6.64E-07	2.24E-06	1.54E-08	2.23E-06	1.74E-08	2.23E-06	2.21E-08
LLOCA	2.49E-06	2.49E-06	0.00E+00	2.49E-06	0.00E+00	2.49E-06	0.00E+00	2.49E-06	0.00E+00
MLOCA	1.44E-06	1.44E-06	0.00E+00	1.44E-06	0.00E+00	1.44E-06	0.00E+00	1.44E-06	0.00E+00
ERCWTL	1.70E-06	1.70E-06	0.00E+00	1.70E-06	0.00E+00	1.70E-06	0.00E+00	1.70E-06	0.00E+00
TTIE	1.27E-06	7.60E-07	5.06E-07	9.69E-07	2.96E-07	9.30E-07	3.36E-07	8.40E-07	4.26E-07
RTIE	1.19E-06	5.42E-07	6.51E-07	8.14E-07	3.79E-07	7.64E-07	4.29E-07	6.48E-07	5.45E-07
SLOCAI	1.28E-06	8.73E-07	4.11E-07	1.22E-06	6.03E-08	1.22E-06	6.84E-08	1.20E-06	8.68E-08
CCSA	6.93E-07	0	6.93E-07	5.55E-08	6.38E-07	0	6.93E-07	0	6.93E-07
EXMFW	7.07E-07	6.01E-07	1.06E-07	6.65E-07	4.21E-08	6.59E-07	4.77E-08	6.47E-07	6.05E-08
TLMFW	6.68E-07	5.66E-07	1.02E-07	6.26E-07	4.19E-08	6.21E-07	4.75E-08	6.08E-07	6.03E-08
LVBB1	6.05E-07	5.18E-07	8.69E-08	6.04E-07	9.60E-10	6.04E-07	1.08E-09	6.04E-07	1.38E-09
LVBB2	5.55E-07	2.09E-07	3.46E-07	3.86E-07	1.69E-07	3.64E-07	1.92E-07	3.12E-07	2.43E-07
LRCP	2.66E-07	1.86E-07	8.03E-08	2.20E-07	4.65E-08	2.14E-07	5.26E-08	1.99E-07	6.68E-08
LOCV	4.76E-07	4.01E-07	7.47E-08	4.45E-07	3.06E-08	4.41E-07	3.47E-08	4.32E-07	4.41E-08
CCSTL	3.74E-07	0	3.74E-07	2.99E-08	3.44E-07	0	3.74E-07	0	3.74E-07
LDAAC	3.28E-07	2.69E-07	5.81E-08	2.98E-07	2.99E-08	2.94E-07	3.38E-08	2.85E-07	4.30E-08

COMPARISON OF CORE DAMAGE FREQUENCY CONTRIBUTORS FOR EACH RCP SEAL ENHANCEMENT CASE

Initiator	Base Case	Change Charging Pump Oil Cooling to ERCW		Improved Seal Material		Independent Seal Cooling System		Independent Seal Cooling System (wo DG)	
		Enhancement CDF	Delta CDF	Enhancement CDF	Delta CDF	Enhancement CDF	Delta CDF	Enhancement CDF	Delta CDF
LDBAC	3.19E-07	2.66E-07	5.34E-08	2.90E-07	2.97E-08	2.86E-07	3.36E-08	2.77E-07	4.27E-08
ELOCA	2.67E-07	2.67E-07	0.00E+00	2.67E-07	0.00E+00	2.67E-07	0.00E+00	2.67E-07	0.00E+00
ISI	2.56E-07	1.38E-07	1.18E-07	1.78E-07	7.84E-08	1.67E-07	8.88E-08	1.43E-07	1.13E-07
LDCAC	1.86E-07	1.32E-07	5.38E-08	1.57E-07	2.90E-08	1.53E-07	3.28E-08	1.44E-07	4.17E-08
LDDAC	1.18E-07	6.86E-08	4.93E-08	8.93E-08	2.87E-08	8.55E-08	3.25E-08	7.67E-08	4.12E-08
ERCWB	1.33E-07	1.04E-07	2.89E-08	1.33E-07	0.00E+00	1.33E-07	0.00E+00	1.33E-07	0.00E+00
ERCWA	1.12E-07	1.43E-08	9.78E-08	1.12E-07	0.00E+00	1.12E-07	0.00E+00	1.12E-07	0.00E+00
MSIV	8.65E-08	5.03E-08	3.62E-08	6.56E-08	2.10E-08	6.28E-08	2.37E-08	5.64E-08	3.02E-08
IMSIV	9.87E-08	5.82E-08	4.04E-08	9.56E-08	3.09E-09	9.52E-08	3.50E-09	9.42E-08	4.45E-09
FLTB	5.92E-08	3.33E-08	2.59E-08	5.60E-08	3.20E-09	5.56E-08	3.63E-09	5.46E-08	4.61E-09
VS	7.53E-08	7.53E-08	0.00E+00	7.53E-08	0.00E+00	7.53E-08	0.00E+00	7.53E-08	0.00E+00
SLBOC	4.24E-08	3.12E-08	1.13E-08	2.69E-08	1.55E-08	2.48E-08	1.76E-08	2.01E-08	2.24E-08
MSVO	2.82E-08	1.18E-08	1.64E-08	1.75E-08	1.07E-08	1.61E-08	1.21E-08	1.28E-08	1.54E-08
SLBIC	1.86E-08	1.33E-08	5.30E-09	1.86E-08	0.00E+00	1.86E-08	0.00E+00	1.86E-08	0.00E+00
CPEX	1.32E-08	5.25E-09	7.91E-09	8.57E-09	4.59E-09	7.96E-09	5.20E-09	6.56E-09	6.60E-09
FLAB3R	8.02E-09	5.73E-09	2.29E-09	6.52E-09	1.49E-09	6.32E-09	1.69E-09	5.87E-09	2.15E-09
VI	2.98E-09	2.98E-09	0.00E+00	2.98E-09	0.00E+00	2.98E-09	0.00E+00	2.98E-09	0.00E+00
FLAB2	7.98E-10	7.98E-10	0.00E+00	7.98E-10	0.00E+00	7.98E-10	0.00E+00	7.98E-10	0.00E+00
FLAB3C	9.75E-10	9.75E-10	0.00E+00	9.75E-10	0.00E+00	9.75E-10	0.00E+00	9.75E-10	0.00E+00
Sum	5.8E-05	4.6E-05	1.3E-05	5.2E-05	6.8E-06	5.1E-05	7.7E-06	4.9E-05	9.2E-06

ENCLOSURE 1
ATTACHMENT

TABLES 3-8, 3-9, 3-10, 3-11

TABLES 4-6a and 4-6b
TABLES 4-10a and 4-10b
TABLES 4-11a and 4-11b
TABLES 4-13a and 4-13b
TABLES 4-14a and 4-13b
TABLES 4-16a and 4-16b
TABLES 4-17a and 4-17b

Table 3-8 PDS SUMMARY SPREADSHEET

End State Totals for Group(s) MELT
Total Frequency = 8.0402e-05
Calculated Frequency = 5.8495e-05

End State RM3 Frequency Initiators	AGI 5.31e-08 5.20e-08	AGS 2.08e-10 0.00	ANI 2.06e-09 0.00	ANS 4.38e-09 4.97e-09	ARL 6.35e-11 0.00	ATL 5.38e-10 0.00	ATV 4.99e-08 7.83e-08	BCI 4.10e-06 3.68e-06	BCS 1.79e-08 1.11e-08	BEI 6.35e-09 4.47e-09
CCSA										
CCSTL										
CPEX										
ELOCA								2.66e-07	1.27e-09	
ERCWA										
ERCWB										
ERCWTL										
EXMFW								1.51e-08		
FLAB2										
FLAB3C										
FLAB3R										
FLPH1A										
FLPH1B										
FLTB										
IMSIV								1.88e-09		
ISI								2.73e-09		
LASD										
LBSD										
LDAAC										
LDBAC										
LDCAC										
LDDAC										
LLOCA	1.61e-08			4.97e-09				2.45e-06	9.01e-09	4.47e-09
LOCV								1.08e-08		
LOSP								1.42e-07		
LRCP										
LVBB1										
LVBB2										
MLOCA	3.59e-08							6.63e-07	8.68e-10	
MSIV										
MSVO										
PLMFW								1.09e-07		
RTIE										
SGTR								2.60e-09		
SLBIC										
SLBOC										
SLOCAI										
SLOCAN										
TLMFW								1.48e-08		
TTIE										
VI							2.98e-09			
VS							7.53e-08			

Table 3-8 PDS SUMMARY SPREADSHEET (continued)

End State RM3 Frequency Initiators	BES 1.24e-11 0.00	BGI 1.80e-08 3.33e-09	BGS 2.73e-11 0.00	BII 2.62e-09 1.47e-09	BIS 1.39e-12 0.00	BNI 3.75e-09 0.00	BPL 5.01e-09 1.59e-09	CGI 4.14e-11 0.00	CNI 4.81e-09 0.00	CNS 1.01e-08 1.01e-08
CCSA										
CCSTL										
CPEX										
ELOCA										
ERCWA										
ERCWB										
ERCWTL										
EXMFW										
FLAB2										
FLAB3C										
FLAB3R										
FLPH1A										
FLPH1B										
FLTB										
IMSIV										
ISI										
LASD										
LBSD										
LDAAC										
LDBAC										
LDCAC										
LDDAC										
LLOCA		1.60e-09		1.47e-09			1.59e-09			
LOCV										
LOSP										
LRCP										
LVBB1										
LVBB2										
MLOCA		1.73e-09								1.01e-08
MSIV										
MSVO										
PLMFW										
RTIE										
SGTR										
SLBIC										
SLBOC										
SLOCAI										
SLOCAN										
TLMFW										
TTIE										
VI										
VS										

Table 3-8 PDS SUMMARY SPREADSHEET (continued)

End State RM3 Frequency Initiators	CTL 1.28e-09 1.32e-09	DCI 7.20e-07 7.19e-07	DCS 3.28e-09 1.85e-09	DGI 6.35e-09 3.67e-09	DGS 1.45e-11 0.00	DNI 2.27e-09 0.00	DPL 8.16e-10 0.00	EGB 1.27e-10 0.00	EGI 7.55e-08 6.84e-08	EGS 1.18e-10 0.00
CCSA										
CCSTL										
CPEX										
ELOCA										
ERCWA										
ERCWB										
ERCWTL										
EXMFW										
FLAB2										
FLAB3C										
FLAB3R										
FLPH1A										
FLPH1B										
FLTB										
IMSIV										
ISI										
LASD										
LBSD										
LDAAC										
LDBAC										
LDCAC										
LDDAC										
LLOCA										
LOCV										
LOSP										
LRCP										
LVBB1										
LVBB2										
MLOCA	1.32e-09	7.19e-07	1.85e-09	3.67e-09						
MSIV										
MSVO										
PLMFW									7.94e-09	
RTIE										
SGTR										
SLBIC										
SLBOC										
SLOCAI										
SLOCAN									5.90e-08	
TLMFW										
TTIE									1.55e-09	
VI										
VS										

Table 3-8 PDS SUMMARY SPREADSHEET (continued)

End State RM3 Frequency Initiators	EIB 3.35e-06 3.43e-06	ENB 4.66e-07 4.40e-07	ENI 3.65e-05 2.71e-05	ENS 2.13e-06 1.27e-06	ETL 8.99e-08 6.92e-08	FCB 6.70e-08 6.56e-08	FCI 2.24e-05 1.42e-05	FCS 9.11e-08 3.98e-08	FEI 4.27e-09 1.84e-09	FGI 4.28e-07 3.20e-07
CCSA			5.74e-07	3.51e-09			5.84e-08			3.00e-08
CCSTL			3.05e-07							
CPEX			1.18e-08							
ELOCA										
ERCWA			1.12e-07							
ERCWB			1.19e-07							
ERCWTL			1.53e-06	7.27e-09	2.22e-09					
EXMFW			1.09e-07			2.00e-09	2.67e-07			
FLAB2			7.98e-10	0.00	0.00		0.00			0.00
FLAB3C										
FLAB3R			8.37e-10	0.00	0.00		0.00			0.00
FLPH1A			3.76e-06	1.91e-08	4.14e-09		0.00			0.00
FLPH1B			3.91e-06	1.86e-08	3.75e-09		7.08e-09			1.95e-08
FLTB			6.43e-09	0.00	0.00		1.17e-09			0.00
IMSIV			6.30e-09				4.07e-08			
ISI			1.62e-07				4.49e-08			
LASD			1.93e-06	8.64e-08			1.02e-07			5.52e-09
LBSD			5.72e-06	1.20e-07	6.09e-09		5.54e-08			3.23e-08
LDAAC			7.64e-08	2.19e-09			5.89e-08			
LDBAC			7.87e-08	2.10e-09			5.00e-08			
LDCAC			6.65e-08				3.30e-08			
LDDAC			7.42e-08				3.25e-08			
LLOCA										
LOCV			7.55e-08				1.84e-07			
LOSP			5.01e-06	5.38e-07	2.55e-09		2.16e-09			3.18e-10
LRCP			1.16e-07				1.28e-07			2.20e-10
LVBB1			1.47e-09				3.42e-07			9.88e-09
LVBB2			3.19e-07				1.24e-07			2.73e-09
MLOCA										
MSIV			5.56e-08				2.46e-08			
MSVO			2.01e-08				2.94e-09			
PLMFW			7.89e-07	9.16e-09		2.22e-08	1.78e-06	3.76e-09	1.84e-09	1.88e-09
RTIE			9.47e-07	8.77e-09			8.98e-09			2.34e-09
SGTR	3.43e-06	4.40e-07	1.43e-07			3.94e-08	6.51e-09			
SLBIC				1.06e-08			8.00e-09			
SLBOC			3.08e-08				4.22e-09			
SLOCAI			1.70e-07	3.46e-07	3.92e-08		6.67e-07			1.92e-08
SLOCAN			4.13e-08	8.58e-08	1.12e-08		9.62e-06	3.60e-08		1.95e-07
TLMFW			1.04e-07			2.05e-09	2.46e-07			
TTIE			7.52e-07	8.26e-09			3.34e-07			1.86e-09
VI										
VS										

Table 3-8 PDS SUMMARY SPREADSHEET (continued)

End State RM3 Frequency Initiators	FGS 2.60e-09 0.00	FII 1.97e-09 0.00	FNI 5.92e-07 5.58e-07	FNS 1.18e-09 0.00	FPL 2.34e-08 8.71e-09	FTL 1.93e-10 0.00	GGI 2.76e-09 0.00	GNB 4.75e-10 0.00	GNI 4.69e-06 3.02e-06	GNS 1.67e-06 1.57e-06
CCSA			2.70e-08							
CCSTL			6.91e-08							
CPEX										1.38e-09
ELOCA										
ERCWA										
ERCWB			5.07e-09						8.53e-09	
ERCWTL									1.58e-07	
EXMFW			2.11e-09							1.95e-07
FLAB2			0.00						0.00	0.00
FLAB3C										
FLAB3R			1.45e-09						0.00	0.00
FLPH1A			8.66e-09						4.10e-09	0.00
FLPH1B			2.03e-07						2.78e-07	0.00
FLTB			0.00						0.00	2.28e-08
IMSIV										2.19e-08
ISI										3.86e-08
LASD									2.15e-08	3.45e-09
LBSD			4.22e-08						4.68e-09	
LDAAC			1.50e-09							1.69e-07
LDBAC			1.49e-09							1.67e-07
LDCAC			1.46e-09						1.39e-08	9.54e-09
LDDAC			1.44e-09							8.34e-09
LLOCA										
LOCV			1.48e-09							1.37e-07
LOSP			1.18e-08						2.48e-06	1.71e-07
LRCP			4.22e-09							1.44e-08
LVBB1			2.69e-08							6.80e-09
LVBB2			5.45e-09						1.02e-08	6.58e-09
MLOCA										
MSIV										6.31e-09
MSVO										5.18e-09
PLMFW			3.05e-08						1.00e-08	1.02e-07
RTIE			3.65e-08						1.52e-08	1.22e-07
SGTR										3.71e-08
SLBIC										
SLBOC										7.45e-09
SLOCAI			1.27e-08							2.76e-08
SLOCAN			3.49e-08		8.71e-09					6.30e-09
TLMFW			2.03e-09							1.88e-07
TTIE			2.73e-08						9.53e-09	9.60e-08
VI										
VS										

Table 3-8 PDS SUMMARY SPREADSHEET (continued)

End State	GTL	HCB	HCI	HCS	HEI	HGI	HGS	HNI	HNS	HRL	INI
RM3	1.77e-07	3.48e-09	1.36e-06	3.14e-09	1.24e-10	1.09e-06	7.34e-09	1.08e-07	2.12e-10	9.88e-10	6.83e-10
Frequency	1.62e-07	1.37e-09	1.09e-06	0.00	0.00	3.54e-07	1.57e-09	1.03e-07	0.00	0.00	0.00
Initiators											
CCSA											
CCSTL											
CPEX											
ELOCA											
ERCWA											
ERCWB											
ERCWTL											
EXMFW	2.50e-08		9.15e-08								
FLAB2	0.00							0.00			
FLAB3C											
FLAB3R	0.00							5.73e-09			
FLPH1A	0.00							0.00			
FLPH1B	0.00							0.00			
FLTB	2.98e-09							2.59e-08			
IMSIV	2.87e-09		2.50e-08								
ISI	4.22e-09		3.35e-09								
LASD			9.89e-08			3.58e-10		2.42e-10			
LBSD			4.24e-09					6.38e-09			
LDAAC	1.86e-08		1.45e-09								
LDBAC	1.84e-08		1.45e-09								
LDCAC			6.09e-08			7.00e-10					
LDDAC			1.40e-09								
LLOCA											
LOCV	1.75e-08		4.97e-08								
LOSP	4.04e-09		1.24e-07			3.51e-07	1.57e-09	9.49e-09			
LRCP			3.43e-09								
LVBB1			1.79e-07			1.24e-09		3.81e-08			
LVBB2			6.96e-08					1.76e-08			
MLOCA											
MSIV											
MSVO											
PLMFW	1.21e-08		2.23e-07			3.45e-10					
RTIE	1.45e-08		3.75e-08			4.12e-10					
SGTR	4.02e-09	1.37e-09									
SLBIC											
SLBOC											
SLOCAI	2.19e-09										
SLOCAN											
TLMFW	2.41e-08		8.80e-08								
TTIE	1.14e-08		2.37e-08			3.28e-10					
VI											
VS											

Table 3-9

WBN UPDATED IPE PLANT DAMAGE STATE/RELEASE CATEGORY TRANSFORMATION MATRIX (PDS KRC Base Case 9/23/94)

Level 1 Output Key Plant Damage State (KPDS)	PDS Frequency	Level 2 Input Key Plant Damage State (KPDS)	PDS Frequency	KEY RELEASE CATEGORY FREQUENCY										
				R01	R01DI	R01I	R01IF	R01SI	R01SIF	R01SUI	R01SUIF	R03SI	R03SIF	R03SUI
ATV	7.83e-08	ATV	7.83e-08											
BCI	3.68e-06	BCI	3.68e-06											
EGI	6.84e-08	EGI	6.84e-08											
EIB	3.76e-06	EIB	3.76e-06											
ENB	4.40e-07	ENB	4.40e-07											
ENI	2.71e-05	ENIYA	2.12e-05											
ENS	1.27e-06	ENIYB	7.76e-07											
FCI	1.42e-05	ENIYN	5.16e-06											
FGI	3.20e-07	ENSYA	2.95e-07											
FNI	5.58e-07	ENSYB	9.32e-08											
GNI	3.02e-06	ENSYC	9.99e-08											
HCI	1.09e-06	ENSYN	7.79e-07											
HGI	3.54e-07	FCI	1.42e-05											
HNI	1.03e-07	FGI	3.20e-07											
KNI	0.00	FNI	5.58e-07											
KNS	1.57e-06	GNIYA	2.12e-06		4.60e-07		5.65e-08							
LCI	0.00	GNIYN	8.94e-07		1.94e-07	2.38e-08								
LNI	0.00	HCI	1.09e-06											
OTHERS	0.00	HGI	3.54e-07	1.96e-08	4.48e-08									
		HNI	1.03e-07		6.49e-09									
		KNI	0.00		0.00		0.00							
		KNSYA	1.57e-06		1.60e-07				2.03e-08		9.05e-10		2.35e-08	
		KNSYC	0.00		0.00			0.00		0.00		0.00		0.00
		LCI	0.00		0.00									
		LNIYA	0.00											
		LNIYC	0.00		0.00	0.00								
		OTHERS	0.00											
		KRC GROUPI		1.96e-08	8.65e-07	2.38e-08	5.65e-08	0.00	2.03e-08	0.00	9.05e-10	0.00	2.35e-08	0.00
		KRC GROUP II												
		KRC GROUP III												
		KRC GROUP IV												
		KRC SUBTOTAL		1.96e-08	8.65e-07	2.38e-08	5.65e-08	0.00	2.03e-08	0.00	9.05e-10	0.00	2.35e-08	0.00

Table 3-9 (continued)
WBN UPDATED IPE PLANT DAMAGE STATE/RELEASE CATEGORY TRANSFORMATION MATRIX (PDS KRC Base Case 9/23/94)

Level 2 Input Key Plant Damage State (KPDS)	KEY RELEASE CATEGORY FREQUENCY												
	R03SUIF	R03UI	R03UIF	R04	R04IF	R07SLUIF	R091	R09UI	R11I	R11IF	R11UI	R17L	R17LU
ATV													
BCI												1.41e-07	
EGI			5.48e-10										3.06e-09
EIB													
ENB													
ENIYA												3.36e-07	
ENIYB										7.70e-07			
ENIYN									5.11e-06				
ENSYA													
ENSYB													
ENSYC													
ENSYN													
FCI				7.74e-08								4.80e-07	
FGI												2.73e-07	
FNI												4.76e-07	
GNIYA			8.50e-11										1.60e-06
GNIYN		3.58e-11					4.83E-07	1.87E-07			4.44e-09		
HCI				8.69e-09								5.39e-08	
HGI												2.82e-07	
HNI												9.53e-08	
KNI			0.00										0.00
KNSYA	4.44e-08					7.47e-07							
KNSYC													
LCI					0.00							0.00	
LNIYA													
LNIYC												0.00	
OTHERS													
KRC GROUP I	4.44e-08	3.58e-11	6.33e-10	8.61e-08	0.00								
KRC GROUP II						7.47e-07							
KRC GROUP III							4.83E-07	1.87E-07	5.11e-06	7.70e-07	4.44e-09	2.14e-06	1.61e-06
KRC GROUP IV													
KRC SUBTOTAL	4.44e-08	3.58e-11	6.33e-10	8.61e-08	0.00	7.47e-07	4.83E-07	1.87E-07	5.11e-06	7.70e-07	4.44e-09	2.14e-06	1.61e-06

Table 3-9 (continued)
WBN UPDATED IPE PLANT DAMAGE STATE/RELEASE CATEGORY TRANSFORMATION MATRIX (PDS KRC Base Case 9/23/94)

Level 2 Input Key Plant Damage State (KPDS)	KEY RELEASE CATEGORY FREQUENCY							KEY RELEASE CATEGORY GROUP FREQUENCY			
	R17U	R18	R19	R20	R21	R22	OTHERS	I	II	III	IV
ATV			7.83e-08					7.83e-08			
BCI	2.67e-06					8.46e-07		2.27e-08		2.81e-06	8.46e-07
EGI	6.48e-08							5.48e-10		6.79e-08	
EIB				3.76e-06					3.76e-06		
ENB				4.40e-07					4.40e-07		
ENIYA					2.07e-05			1.70e-07		3.36e-07	2.07e-05
ENIYB								6.21e-09		7.70e-07	
ENIYN								4.12e-08		5.11e-06	
ENSYA				2.95e-07					2.95e-07		
ENSYB				9.32e-08					9.32e-08		
ENSYC				9.99e-08					9.99e-08		
ENSYN				7.79e-07					7.79e-07		
FCI					9.12e-06	4.55e-06		7.74e-08		4.80e-07	1.37e-05
FGI					4.45e-08			2.56e-09		2.73e-07	4.45e-08
FNI					7.75e-08			4.46e-09		4.76e-07	7.75e-08
GNIYA								5.21e-07		1.60e-06	
GNIYN								2.19e-07	0.00	6.75e-07	
HCI					1.02e-06			8.69e-09		5.39e-08	1.02e-06
HGI								7.21e-08		2.82e-07	
HNI								8.22e-09		9.53e-08	
KNI		0.00						0.00		0.00	
KNSYA		1.10e-08						2.60e-07	1.31e-06		
KNSYC		0.00						0.00	0.00		
LCI		0.00			0.00	0.00		0.00		0.00	0.00
LNIYA						0.00					0.00
LNIYC		0.00						0.00		0.00	
OTHERS											
KRC GROUP I		1.10e-08	7.83e-08								
KRC GROUP II				5.47e-06							
KRC GROUP III	2.74e-06										
KRC GROUP IV					3.10e-05	5.40e-06					
KRC SUBTOTAL	2.74e-06	1.10e-08	7.83e-08	5.47e-06	3.10e-05	5.40e-06	0.00	1.49e-06	6.78e-06	1.30e-05	3.64e-05
PDS TOTAL											

Table 3-10
WBN KEY RELEASE CATEGORY/ACCIDENT PROGRESSION BIN
TRANSFORMATION MATRIX (KRC-APB NEW BASE CASE 9/23/94)

KRC ID	KRC Freq.	APB Frequencies										SubTotal
		1	2	3	4	5	6	7	8	9	10	
R01	1.96e-08			1.96e-08								1.96e-08
R01DI	8.65e-07			8.65e-07								8.65e-07
RO1I	2.38e-08			2.38e-08								2.38e-08
R01IF	5.65e-08			5.65e-08								5.65e-08
R01SI	0.00	0.00										0.00
R01SIF	2.03e-08	2.03e-08										2.03e-08
R01SUI	0.00	0.00										0.00
R01SUIF	9.05e-10	9.05e-10										9.05e-10
R01UI	1.31e-09			1.31e-09								1.31e-09
R01UIF	3.10e-09			3.10e-09								3.10e-09
R02IF	0.00			0.00								0.00
R03	7.64e-09				7.64e-09							7.64e-09
R03I	4.18e-08		4.18e-08									4.18e-08
R03IF	1.86e-07		1.86e-07									1.86e-07
R03SI	0.00	0.00										0.00
R03SIF	2.35e-08	2.35e-08										2.35e-08
R03SUI	0.00	0.00										0.00
R03SUIF	4.44e-08	4.44e-08										4.44e-08
R03UI	3.58e-11				3.58e-11							3.58e-11
R03UIF	6.33e-10				6.33e-10							6.33e-10
R04	8.61e-08		8.61e-08									8.61e-08
R04IF	0.00				0.00							0.00
R04UIF	2.27e-08				2.27e-08							2.27e-08
R05SLI	0.00	0.00										0.00
R05SLIF	3.93e-07	3.93e-07										3.93e-07
R05SLUI	0.00	0.00										0.00
R05SLUIF	1.71e-07			1.71e-07								1.71e-07
R07SLUI	0.00	0.00										0.00
R07SLUIF	7.47e-07	7.47e-07										7.47e-07
R09I	4.83e-07					4.83e-07						4.83e-07
R09UI	1.87e-07					1.87e-07						1.87e-07
R11I	5.11e-06					5.11e-06						5.11e-06
R11IF	7.70e-07					7.70e-07						7.70e-07
R11UI	4.44e-09					4.44e-09						4.44e-09
R17L	2.14e-06					2.14e-06						2.14e-06
R17LU	1.61e-06					1.61e-06						1.61e-06
R17U	2.74e-06						2.74e-06					2.74e-06
R18	1.10e-08							1.10e-08				1.10e-08
R19	7.83e-08							7.83e-08				7.83e-08
R20	5.47e-06							5.47e-06				5.47e-06
R21	3.10e-05								3.10e-05			3.10e-05
R22	5.40e-06										5.40e-06	5.40e-06
Others	0.00											0.00
APB Subtotals	5.77e-05	1.23e-06	3.14e-07	1.14e-06	3.10e-08	1.03e-05	2.74e-06	5.56e-06	3.10e-05	0.00	5.40e-06	5.77e-05
Total Frequency												5.77e-05

Table 3-11

WBN VALUE-IMPACT ASSESSMENT MATRIX (APB-PD NEW BASE CASE 9/23/94)

APB ID	BASE CASE APB FREQUENCY (EVENTS/RX-YR)	REVISED APB FREQUENCY (EVENTS/RX-YR)	BASE CASE POPULATION DOSE RATE (Man-REM/YR)	REVISED POPULATION DOSE RATE (Man-REM/YR)	BASE CASE POPULATION DOSE (Man-REM)	REVISED POPULATION DOSE (Man-REM)	AVERTED POPULATION DOSE (Man-REM)
1	0.00	1.23e-06	0.00	6.29e-01	0.00	25.14	-25.14
2	4.54e-07	3.14e-07	1.11e-01	7.66e-02	4.43	3.06	1.37
3	1.41e-06	1.14e-06	6.04e-01	4.87e-01	24.15	19.48	4.67
4	5.18e-08	3.10e-08	2.35e-02	1.41e-02	0.94	0.56	0.38
5	1.45e-05	1.03e-05	1.33e+00	9.48e-01	53.34	37.92	15.42
6	3.26e-06	2.74e-06	9.36e-02	7.85e-02	3.74	3.14	0.60
7	8.29e-06	5.56e-06	4.53e+00	3.04e+00	181.38	121.67	59.71
8	4.62e-05	3.10e-05	1.24e-02	8.29e-03	0.50	0.33	0.16
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	8.91e-06	5.40e-06	1.39e-03	8.43e-04	0.06	0.03	0.02
TOTAL	8.31e-05	5.77e-05	6.71e+00	5.28e+00	268.54	211.34	57.19

USER-PROVIDED DATA	
EXPECTED REMAINING PLANT LIFE (YEARS)	40

TABLE 4-6a
SUMMARY OF PDS AND KRC RESULTS ENHANCEMENT CASE II.2
ACCELERATE AVAILABILITY OF FIFTH EMERGENCY DIESEL GENERATOR

BASE CASE RESULTS				ENHANCEMENT CASE RESULTS				
LEVEL 1 OUTPUT KPDS	BASE CASE KPDS FREQUENCY	LEVEL 2 INPUT KPDS	BASE CASE KPDS FREQUENCY	KPDS FREQUENCY	KRC GROUP FREQUENCY			
					I	II	III	IV
ATV	7.83E-08	ATV	7.83E-08	7.83E-08	7.83E-08			
BCI	3.68E-06	BCI	3.68E-06	3.68E-06	2.27E-08		2.81E-06	8.46E-07
EGI	6.84E-08	EGI	6.84E-08	6.84E-08	5.48E-10		6.79E-08	
EIB	3.76E-06	EIB	3.76E-06	3.76E-06		3.76E-06		
ENB	4.40E-07	ENB	4.40E-07	4.40E-07		4.40E-07		
ENI	2.71E-05	ENIYA	2.12E-05	2.07E-05	1.66E-07		3.28E-07	2.02E-05
ENS	1.27E-06	ENIYB	7.76E-07	7.58E-07	6.06E-09		7.52E-07	
FCI	1.42E-05	ENIYN	5.16E-06	5.03E-06	4.03E-08		4.99E-06	
FGI	3.20E-07	ENSYA	2.95E-07	2.76E-07		2.76E-07		
FNI	5.58E-07	ENSYB	9.32E-08	8.72E-08		8.72E-08		
GNI	3.02E-06	ENSYC	9.99E-08	9.35E-08		9.35E-08		
HCI	1.09E-06	ENSYN	7.79E-07	7.29E-07		7.29E-07		
HGI	3.54E-07	FCI	1.42E-05	1.42E-05	7.74E-08		4.80E-07	1.37E-05
HNI	1.03E-07	FGI	3.20E-07	3.20E-07	2.56E-09		2.73E-07	4.45E-08
KNI	0.00	FNI	5.58E-07	5.58E-07	4.46E-09		4.76E-07	7.75E-08
KNS	1.57E-06	GNIYA	2.12E-06	1.96E-06	4.80E-07		1.48E-06	
LCI	0.00	GNIYN	8.94E-07	8.24E-07	2.02E-07	0.00	6.22E-07	
LNI	0.00	HCI	1.09E-06	1.08E-06	8.66E-09		5.37E-08	1.02E-06
OTHERS	0.00	HGI	3.54E-07	2.76E-07	5.63E-08		2.20E-07	
		HNI	1.03E-07	1.01E-07	8.01E-09		9.29E-08	
		KNI	0.00	0.00	0.00		0.00	
		KNSYA	1.57E-06	1.56E-06	2.58E-07	1.30E-06		
		KNSYC	0.00	0.00	0.00	0.00		
		LCI	0.00	0.00	0.00		0.00	0.00
		LNIYA	0.00	0.00				0.00
		LNIYC	0.00	0.00	0.00		0.00	
		OTHERS	0.00	0.00				
		TOTALS	5.8E-05	5.66E-05	1.41E-06	6.69E-06	1.26E-05	3.59E-05

TABLE 4-6b
TRANSLATION OF KRC FREQUENCIES TO APBs ENHANCEMENT CASE II.2
ACCELERATE AVAILABILITY OF FIFTH EMERGENCY DIESEL GENERATOR

KRC ID	BASE KRC FREQ	CASE KRC FREQ	APB FREQUENCIES									
			1	2	3	4	5	6	7	8	9	10
R01	1.96E-08	1.53E-08			1.53E-08							
R01DI	8.65E-07	8.03E-07			8.03E-07							
R01I	2.38E-08	2.19E-08			2.19E-08							
R01IF	5.65E-08	5.21E-08			5.21E-08							
R01SI	0.00	0.00	0.00									
R01SIF	2.03E-08	2.01E-08	2.01E-08									
R01SUI	0.00	0.00	0.00									
R01SUIF	9.05E-10	8.97E-10	8.97E-10									
R01UI	1.31E-09	1.20E-09			1.20E-09							
R01UIF	3.10E-09	2.86E-09			2.86E-09							
R02IF	0.00	0.00			0.00							
R03	7.64E-09	5.97E-09				5.97E-09						
R03I	4.18E-08	4.08E-08		4.08E-08								
R03IF	1.86E-07	1.82E-07		1.82E-07								
R03SI	0.00	0.00	0.00									
R03SIF	2.35E-08	2.33E-08	2.33E-08									
R03SUI	0.00	0.00	0.00									
R03SUIF	4.44E-08	4.40E-08	4.40E-08									
R03UI	3.58E-11	3.30E-11				3.30E-11						
R03UIF	6.33E-10	6.26E-10				6.26E-10						
R04	8.61E-08	8.61E-08		8.61E-08								
R04IF	0.00	0.00				0.00						
R04UIF	2.27E-08	2.27E-08				2.27E-08						
R05SLI	0.00	0.00	0.00									
R05SLIF	3.93E-07	3.89E-07	3.89E-07									
R05SLUI	0.00	0.00	0.00									
R05SLUIF	1.71E-07	1.69E-07			1.69E-07							
R07SLUI	0.00	0.00	0.00									
R07SLUIF	7.47E-07	7.40E-07	7.40E-07									
R09I	4.83E-07	4.45E-07					4.45E-07					
R09UI	1.87E-07	1.72E-07					1.72E-07					
R11I	5.11E-06	4.99E-06					4.99E-06					
R11IF	7.70E-07	7.52E-07					7.52E-07					
R11UI	4.44E-09	4.09E-09					4.09E-09					
R17L	2.14E-06	2.06E-06					2.06E-06					
R17LU	1.61E-06	1.48E-06					1.48E-06					
R17U	2.74E-06	2.74E-06						2.74E-06				
R18	1.10E-08	1.09E-08							1.09E-08			
R19	7.83E-08	7.83E-08							7.83E-08			
R20	5.47E-06	5.39E-06							5.39E-06			
R21	3.10E-05	3.05E-05								3.05E-05		
R22	5.40E-06	5.40E-06										5.40E-06
OTHERS	0.00	0.00										
TOTALS	5.77E-05	5.66E-05	1.22E-06	3.08E-07	1.07E-06	2.93E-08	9.91E-06	2.74E-06	5.48E-06	3.05E-05	0.00	5.40E-06

TABLE 4-10a
SUMMARY OF PDS AND KRC RESULTS
ENHANCEMENT CASE III.2 - INSTALL IMPROVED RCP SEALS

BASE CASE RESULTS				ENHANCEMENT CASE RESULTS				
LEVEL 1 OUTPUT KPDS	BASE CASE KPDS FREQUENCY	LEVEL 2 INPUT KPDS	BASE CASE KPDS FREQUENCY	KPDS FREQUENCY	KRC GROUP FREQUENCY			
					I	II	III	IV
ATV	7.83E-08	ATV	7.83E-08	7.83E-08	7.83E-08			
BCI	3.68E-06	BCI	3.68E-06	3.68E-06	2.27E-08		2.81E-06	8.46E-07
EGI	6.84E-08	EGI	6.84E-08	6.84E-08	5.48E-10		6.79E-08	
EIB	3.76E-06	EIB	3.76E-06	3.76E-06		3.76E-06		
ENB	4.40E-07	ENB	4.40E-07	4.40E-07		4.40E-07		
ENI	2.71E-05	ENIYA	2.12E-05	1.62E-05	1.30E-07		2.58E-07	1.59E-05
ENS	1.27E-06	ENIYB	7.76E-07	5.95E-07	4.76E-09		5.90E-07	
FCI	1.42E-05	ENIYN	5.16E-06	3.95E-06	3.16E-08		3.92E-06	
FGI	3.20E-07	ENSYA	2.95E-07	2.83E-07		2.83E-07		
FNI	5.58E-07	ENSYB	9.32E-08	8.95E-08		8.95E-08		
GNI	3.02E-06	ENSYC	9.99E-08	9.60E-08		9.60E-08		
HCI	1.09E-06	ENSYN	7.79E-07	7.48E-07		7.48E-07		
HGI	3.54E-07	FCI	1.42E-05	1.42E-05	7.71E-08		4.78E-07	1.36E-05
HNI	1.03E-07	FGI	3.20E-07	2.93E-07	2.34E-09		2.50E-07	4.07E-08
KNI	0.00	FNI	5.58E-07	2.68E-07	2.15E-09		2.29E-07	3.73E-08
KNS	1.57E-06	GNIYA	2.12E-06	2.10E-06	5.16E-07		1.59E-06	
LCI	0.00	GNIYN	8.94E-07	8.85E-07	2.17E-07	0.00	6.68E-07	
LNI	0.00	HCI	1.09E-06	1.09E-06	8.69E-09		5.39E-08	1.02E-06
OTHERS	0.00	HGI	3.54E-07	3.42E-07	6.96E-08		2.72E-07	
		HNI	1.03E-07	9.96E-08	7.91E-09		9.17E-08	
		KNI	0.00	0.00	0.00		0.00	
		KNSYA	1.57E-06	1.57E-06	2.60E-07	1.31E-06		
		KNSYC	0.00	0.00	0.00	0.00		
		LCI	0.00	0.00	0.00		0.00	0.00
		LNIYA	0.00	0.00				0.00
		LNIYC	0.00	0.00	0.00		0.00	
		OTHERS	0.00	0.00				
		TOTALS	5.8E-05	5.08E-05	1.43E-06	6.73E-06	1.13E-05	3.14E-05

TABLE 4-10b
TRANSLATION OF KRC FREQUENCIES TO APBs
ENHANCEMENT CASE III.2 - INSTALL IMPROVED RCP SEALS

KRC ID	BASE KRC FREQ	CASE KRC FREQ	APB FREQUENCIES									
			1	2	3	4	5	6	7	8	9	10
R01	1.96E-08	1.89E-08			1.89E-08							
R01DI	8.65E-07	8.57E-07			8.57E-07							
R01I	2.38E-08	2.36E-08			2.36E-08							
R01IF	5.65E-08	5.59E-08			5.59E-08							
R01SI	0.00	0.00	0.00									
R01SIF	2.03E-08	2.03E-08	2.03E-08									
R01SUI	0.00	0.00	0.00									
R01SUIF	9.05E-10	9.04E-10	9.04E-10									
R01UI	1.31E-09	1.29E-09			1.29E-09							
R01UIF	3.10E-09	3.07E-09			3.07E-09							
R02IF	0.00	0.00			0.00							
R03	7.64E-09	7.38E-09				7.38E-09						
R03I	4.18E-08	3.22E-08		3.22E-08								
R03IF	1.86E-07	1.42E-07		1.42E-07								
R03SI	0.00	0.00	0.00									
R03SIF	2.35E-08	2.35E-08	2.35E-08									
R03SUI	0.00	0.00	0.00									
R03SUIF	4.44E-08	4.43E-08	4.43E-08									
R03UI	3.58E-11	3.54E-11				3.54E-11						
R03UIF	6.33E-10	6.32E-10				6.32E-10						
R04	8.61E-08	8.57E-08		8.57E-08								
R04IF	0.00	0.00				0.00						
R04UIF	2.27E-08	2.27E-08				2.27E-08						
R05SLI	0.00	0.00	0.00									
R05SLIF	3.93E-07	3.92E-07	3.92E-07									
R05SLUI	0.00	0.00	0.00									
R05SLUIF	1.71E-07	1.70E-07			1.70E-07							
R07SLUI	0.00	0.00	0.00									
R07SLUIF	7.47E-07	7.46E-07	7.46E-07									
R09I	4.83E-07	4.78E-07					4.78E-07					
R09UI	1.87E-07	1.85E-07					1.85E-07					
R11I	5.11E-06	3.92E-06					3.92E-06					
R11IF	7.70E-07	5.90E-07					5.90E-07					
R11UI	4.44E-09	4.39E-09					4.39E-09					
R17L	2.14E-06	1.77E-06					1.77E-06					
R17LU	1.61E-06	1.59E-06					1.59E-06					
R17U	2.74E-06	2.74E-06						2.74E-06				
R18	1.10E-08	1.10E-08							1.10E-08			
R19	7.83E-08	7.83E-08							7.83E-08			
R20	5.47E-06	5.42E-06							5.42E-06			
R21	3.10E-05	2.60E-05								2.60E-05		
R22	5.40E-06	5.38E-06										5.38E-06
OTHERS	0.00	0.00										
TOTALS	5.77E-05	5.08E-05	1.23E-06	2.60E-07	1.13E-06	3.07E-08	8.54E-06	2.74E-06	5.51E-06	2.60E-05	0.00	5.38E-06

TABLE 4-11a
SUMMARY OF PDS AND KRC RESULTS
ENHANCEMENT CASE III.3 - INSTALL INDEPENDENT RCP SEAL COOLING SYSTEM

BASE CASE RESULTS				ENHANCEMENT CASE RESULTS				
LEVEL 1 OUTPUT KPDS	BASE CASE KPDS FREQUENCY	LEVEL 2 INPUT KPDS	BASE CASE KPDS FREQUENCY	KPDS FREQUENCY	KRC GROUP FREQUENCY			
					I	II	III	IV
ATV	7.83E-08	ATV	7.83E-08	7.83E-08	7.83E-08			
BCI	3.68E-06	BCI	3.68E-06	3.68E-06	2.27E-08		2.81E-06	8.46E-07
EGI	6.84E-08	EGI	6.84E-08	6.84E-08	5.48E-10		6.79E-08	
EIB	3.76E-06	EIB	3.76E-06	3.76E-06		3.76E-06		
ENB	4.40E-07	ENB	4.40E-07	4.40E-07		4.40E-07		
ENI	2.71E-05	ENIYA	2.12E-05	1.56E-05	1.25E-07		2.48E-07	1.52E-05
ENS	1.27E-06	ENIYB	7.76E-07	5.72E-07	4.58E-09		5.67E-07	
FCI	1.42E-05	ENIYN	5.16E-06	3.80E-06	3.04E-08		3.77E-06	
FGI	3.20E-07	ENSYA	2.95E-07	2.81E-07		2.81E-07		
FNI	5.58E-07	ENSYB	9.32E-08	8.90E-08		8.90E-08		
GNI	3.02E-06	ENSYC	9.99E-08	9.55E-08		9.55E-08		
HCI	1.09E-06	ENSYN	7.79E-07	7.44E-07		7.44E-07		
HGI	3.54E-07	FCI	1.42E-05	1.42E-05	7.70E-08		4.78E-07	1.36E-05
HNI	1.03E-07	FGI	3.20E-07	2.91E-07	2.32E-09		2.48E-07	4.03E-08
KNI	0.00	FNI	5.58E-07	2.34E-07	1.87E-09		2.00E-07	3.25E-08
KNS	1.57E-06	GNIYA	2.12E-06	2.10E-06	5.15E-07		1.58E-06	
LCI	0.00	GNIYN	8.94E-07	8.84E-07	2.17E-07	0.00	6.67E-07	
LNI	0.00	HCI	1.09E-06	1.09E-06	8.69E-09		5.39E-08	1.02E-06
OTHERS	0.00	HGI	3.54E-07	3.40E-07	6.93E-08		2.71E-07	
		HNI	1.03E-07	9.90E-08	7.86E-09		9.11E-08	
		KNI	0.00	0.00	0.00		0.00	
		KNSYA	1.57E-06	1.57E-06	2.60E-07	1.31E-06		
		KNSYC	0.00	0.00	0.00	0.00		
		LCI	0.00	0.00	0.00		0.00	0.00
		LNIYA	0.00	0.00				0.00
		LNIYC	0.00	0.00	0.00		0.00	
		OTHERS	0.00	0.00				
		TOTALS	5.8E-05	5.00E-05	1.42E-06	6.72E-06	1.11E-05	3.08E-05

TABLE 4-11b
TRANSLATION OF KRC FREQUENCIES TO APBs
ENHANCEMENT CASE III.3 - INSTALL INDEPENDENT RCP SEAL COOLING SYSTEM

KRC ID	BASE KRC FREQ	CASE KRC FREQ	APB FREQUENCIES									
			1	2	3	4	5	6	7	8	9	10
R01	1.96E-08	1.89E-08			1.89E-08							
R01DI	8.65E-07	8.56E-07			8.56E-07							
R01I	2.38E-08	2.35E-08			2.35E-08							
R01IF	5.65E-08	5.58E-08			5.58E-08							
R01SI	0.00	0.00	0.00									
R01SIF	2.03E-08	2.03E-08	2.03E-08									
R01SUI	0.00	0.00	0.00									
R01SUIF	9.05E-10	9.04E-10	9.04E-10									
R01UI	1.31E-09	1.29E-09			1.29E-09							
R01UIF	3.10E-09	3.07E-09			3.07E-09							
R02IF	0.00	0.00			0.00							
R03	7.64E-09	7.35E-09				7.35E-09						
R03I	4.18E-08	3.09E-08		3.09E-08								
R03IF	1.86E-07	1.37E-07		1.37E-07								
R03SI	0.00	0.00	0.00									
R03SIF	2.35E-08	2.35E-08	2.35E-08									
R03SUI	0.00	0.00	0.00									
R03SUIF	4.44E-08	4.43E-08	4.43E-08									
R03UI	3.58E-11	3.53E-11				3.53E-11						
R03UIF	6.33E-10	6.31E-10				6.31E-10						
R04	8.61E-08	8.57E-08		8.57E-08								
R04IF	0.00	0.00				0.00						
R04UIF	2.27E-08	2.27E-08				2.27E-08						
R05SLI	0.00	0.00	0.00									
R05SLIF	3.93E-07	3.92E-07	3.92E-07									
R05SLUI	0.00	0.00	0.00									
R05SLUIF	1.71E-07	1.70E-07			1.70E-07							
R07SLUI	0.00	0.00	0.00									
R07SLUIF	7.47E-07	7.46E-07	7.46E-07									
R09I	4.83E-07	4.78E-07					4.78E-07					
R09UI	1.87E-07	1.85E-07					1.85E-07					
R11I	5.11E-06	3.77E-06					3.77E-06					
R11IF	7.70E-07	5.67E-07					5.67E-07					
R11UI	4.44E-09	4.38E-09					4.38E-09					
R17L	2.14E-06	1.73E-06					1.73E-06					
R17LU	1.61E-06	1.59E-06					1.59E-06					
R17U	2.74E-06	2.74E-06						2.74E-06				
R18	1.10E-08	1.10E-08							1.10E-08			
R19	7.83E-08	7.83E-08							7.83E-08			
R20	5.47E-06	5.41E-06							5.41E-06			
R21	3.10E-05	2.64E-05								2.64E-05		
R22	5.40E-06	5.38E-06										5.38E-06
OTHERS	0.00	0.00										
TOTALS	5.77E-05	5.00E-05	1.23E-06	2.53E-07	1.13E-06	3.07E-08	8.32E-06	2.74E-06	5.50E-06	2.64E-05	0.00	5.38E-06

TABLE 4-13a
SUMMARY OF PDS AND KRC RESULTS
ENHANCEMENT CASE III.4- PROVIDE ACCUMULATORS FOR TURBINE DRIVEN AFW PUMP

BASE CASE RESULTS				ENHANCEMENT CASE RESULTS				
LEVEL 1 OUTPUT KPDS	BASE CASE KPDS FREQUENCY	LEVEL 2 INPUT KPDS	BASE CASE KPDS FREQUENCY	KPDS FREQUENCY	KRC GROUP FREQUENCY			
					I	II	III	IV
ATV	7.83E-08	ATV	7.83E-08	7.83E-08	7.83E-08			
BCI	3.68E-06	BCI	3.68E-06	3.68E-06	2.27E-08		2.81E-06	8.46E-07
EGI	6.84E-08	EGI	6.84E-08	6.84E-08	5.48E-10		6.79E-08	
EIB	3.76E-06	EIB	3.76E-06	3.30E-06		3.30E-06		
ENB	4.40E-07	ENB	4.40E-07	4.13E-07		4.13E-07		
ENI	2.71E-05	ENIYA	2.12E-05	1.53E-05	1.23E-07		2.43E-07	1.50E-05
ENS	1.27E-06	ENIYB	7.76E-07	5.62E-07	4.49E-09		5.57E-07	
FCI	1.42E-05	ENIYN	5.16E-06	3.73E-06	2.98E-08		3.70E-06	
FGI	3.20E-07	ENSYA	2.95E-07	2.85E-07		2.85E-07		
FNI	5.58E-07	ENSYB	9.32E-08	9.00E-08		9.00E-08		
GNI	3.02E-06	ENSYC	9.99E-08	9.65E-08		9.65E-08		
HCI	1.09E-06	ENSYN	7.79E-07	7.52E-07		7.52E-07		
HGI	3.54E-07	FCI	1.42E-05	1.40E-05	7.60E-08		4.71E-07	1.34E-05
HNI	1.03E-07	FGI	3.20E-07	3.21E-07	2.56E-09		2.73E-07	4.45E-08
KNI	0.00	FNI	5.58E-07	5.58E-07	4.46E-09		4.76E-07	7.75E-08
KNS	1.57E-06	GNIYA	2.12E-06	1.82E-06	4.47E-07		1.37E-06	
LCI	0.00	GNIYN	8.94E-07	7.67E-07	1.88E-07	0.00	5.78E-07	
LNI	0.00	HCI	1.09E-06	8.14E-07	6.51E-09		4.04E-08	7.67E-07
OTHERS	0.00	HGI	3.54E-07	3.50E-07	7.13E-08		2.79E-07	
		HNI	1.03E-07	7.61E-08	6.04E-09		7.00E-08	
		KNI	0.00	0.00	0.00		0.00	
		KNSYA	1.57E-06	1.55E-06	2.58E-07	1.30E-06		
		KNSYC	0.00	0.00	0.00	0.00		
		LCI	0.00	0.00	0.00		0.00	0.00
		LNIYA	0.00	0.00				0.00
		LNIYC	0.00	0.00	0.00		0.00	
		OTHERS	0.00	0.00				
		TOTALS	5.8E-05	4.86E-05	1.32E-06	6.23E-06	1.09E-05	3.01E-05

TABLE 4-13b
TRANSLATION OF KRC FREQUENCIES TO APBs
ENHANCEMENT CASE III.4 - PROVIDE ACCUMULATORS FOR TURBINE DRIVEN AFW PUMPS

KRC ID	BASE KRC FREQ	CASE KRC FREQ	APB FREQUENCIES									
			1	2	3	4	5	6	7	8	9	10
R01	1.96E-08	1.94E-08			1.94E-08							
R01DI	8.65E-07	7.68E-07			7.68E-07							
R01I	2.38E-08	2.04E-08			2.04E-08							
R01IF	5.65E-08	4.85E-08			4.85E-08							
R01SI	0.00	0.00	0.00									
R01SIF	2.03E-08	2.01E-08	2.01E-08									
R01SUI	0.00	0.00	0.00									
R01SUIF	9.05E-10	8.96E-10	8.96E-10									
R01UI	1.31E-09	1.12E-09			1.12E-09							
R01UIF	3.10E-09	2.66E-09			2.66E-09							
R02IF	0.00	0.00			0.00							
R03	7.64E-09	7.56E-09				7.56E-09						
R03I	4.18E-08	3.03E-08		3.03E-08								
R03IF	1.86E-07	1.37E-07		1.37E-07								
R03SI	0.00	0.00	0.00									
R03SIF	2.35E-08	2.33E-08	2.33E-08									
R03SUI	0.00	0.00	0.00									
R03SUIF	4.44E-08	4.39E-08	4.39E-08									
R03UI	3.58E-11	3.07E-11				3.07E-11						
R03UIF	6.33E-10	6.20E-10				6.20E-10						
R04	8.61E-08	8.25E-08		8.25E-08								
R04IF	0.00	0.00				0.00						
R04UIF	2.27E-08	2.27E-08				2.27E-08						
R05SLI	0.00	0.00	0.00									
R05SLIF	3.93E-07	3.89E-07	3.89E-07									
R05SLUI	0.00	0.00	0.00									
R05SLUIF	1.71E-07	1.69E-07			1.69E-07							
R07SLUI	0.00	0.00	0.00									
R07SLUIF	7.47E-07	7.39E-07	7.39E-07									
R09I	4.83E-07	4.14E-07					4.14E-07					
R09UI	1.87E-07	1.60E-07					1.60E-07					
R11I	5.11E-06	3.70E-06					3.70E-06					
R11IF	7.70E-07	5.57E-07					5.57E-07					
R11UI	4.44E-09	3.80E-09					3.80E-09					
R17L	2.14E-06	1.99E-06					1.99E-06					
R17LU	1.61E-06	1.38E-06					1.38E-06					
R17U	2.74E-06	2.74E-06						2.74E-06				
R18	1.10E-08	1.09E-08							1.09E-08			
R19	7.83E-08	7.83E-08							7.83E-08			
R20	5.47E-06	4.94E-06							4.94E-06			
R21	3.10E-05	2.48E-05								2.48E-05		
R22	5.40E-06	5.32E-06										5.32E-06
OTHERS	0.00	0.00										
TOTALS	5.77E-05	4.86E-05	1.22E-06	2.49E-07	1.03E-06	3.09E-08	8.20E-06	2.74E-06	5.03E-06	2.48E-05	0.00	5.32E-06

this enhancement is similar to Item III.3, except the battery life could be extended essentially indefinitely.

TABLE 4-14a
SUMMARY OF PDS AND KRC RESULTS ENHANCEMENT CASE III.5 - INSTALL DC LOAD SHEDDING ANALYSIS AND PROCEDURE ENHANCEMENT CASE III.6 - PROVIDE PORTABLE BATTERY CHARGER

BASE CASE RESULTS				ENHANCEMENT CASE RESULTS				
LEVEL 1 OUTPUT KPDS	BASE CASE KPDS FREQUENCY	LEVEL 2 INPUT KPDS	BASE CASE KPDS FREQUENCY	KPDS FREQUENCY	KRC GROUP FREQUENCY			
					I	II	III	IV
ATV	7.83E-08	ATV	7.83E-08	7.83E-08	7.83E-08			
BCI	3.68E-06	BCI	3.68E-06	3.70E-06	2.28E-08		2.83E-06	8.52E-07
EGI	6.84E-08	EGI	6.84E-08	6.84E-08	5.48E-10		6.79E-08	
EIB	3.76E-06	EIB	3.76E-06	3.76E-06		3.76E-06		
ENB	4.40E-07	ENB	4.40E-07	4.40E-07		4.40E-07		
ENI	2.71E-05	ENIYA	2.12E-05	2.03E-05	1.63E-07		3.23E-07	1.98E-05
ENS	1.27E-06	ENIYB	7.76E-07	7.45E-07	5.96E-09		7.39E-07	
FCI	1.42E-05	ENIYN	5.16E-06	4.94E-06	3.96E-08		4.91E-06	
FGI	3.20E-07	ENSYA	2.95E-07	2.66E-07		2.66E-07		
FNI	5.58E-07	ENSYB	9.32E-08	8.41E-08		8.41E-08		
GNI	3.02E-06	ENSYC	9.99E-08	9.02E-08		9.02E-08		
HCI	1.09E-06	ENSYN	7.79E-07	7.03E-07		7.03E-07		
HGI	3.54E-07	FCI	1.42E-05	1.42E-05	7.74E-08		4.80E-07	1.37E-05
HNI	1.03E-07	FGI	3.20E-07	3.20E-07	2.56E-09		2.73E-07	4.45E-08
KNI	0.00	FNI	5.58E-07	5.58E-07	4.46E-09		4.76E-07	7.75E-08
KNS	1.57E-06	GNIYA	2.12E-06	1.32E-06	3.23E-07		9.94E-07	
LCI	0.00	GNIYN	8.94E-07	5.55E-07	1.36E-07	0.00	4.18E-07	
LNI	0.00	HCI	1.09E-06	1.03E-06	8.24E-09		5.11E-08	9.70E-07
OTHERS	0.00	HGI	3.54E-07	1.79E-07	3.65E-08		1.43E-07	
		HNI	1.03E-07	9.87E-08	7.84E-09		9.09E-08	
		KNI	0.00	0.00	0.00		0.00	
		KNSYA	1.57E-06	1.52E-06	2.52E-07	1.27E-06		
		KNSYC	0.00	0.00	0.00	0.00		
		LCI	0.00	0.00	0.00		0.00	0.00
		LNIYA	0.00	0.00				0.00
		LNIYC	0.00	0.00	0.00		0.00	
		OTHERS	0.00	0.00				
		TOTALS	5.8E-05	5.50E-05	1.16E-06	6.62E-06	1.18E-05	3.55E-05

TABLE 4-14b
TRANSLATION OF KRC FREQUENCIES TO APBs
ENHANCEMENT CASE III.5 - INSTALL DC LOAD SHEDDING ANALYSIS AND PROCEDURE
ENHANCEMENT CASE III.6 - PROVIDE PORTABLE BATTERY CHARGER

KRC ID	BASE KRC FREQ	CASE KRC FREQ	APB FREQUENCIES									
			1	2	3	4	5	6	7	8	9	10
R01	1.96E-08	9.93E-09			9.93E-09							
R01DI	8.65E-07	5.90E-07			5.90E-07							
R01I	2.38E-08	1.48E-08			1.48E-08							
R01IF	5.65E-08	3.50E-08			3.50E-08							
R01SI	0.00	0.00	0.00									
R01SIF	2.03E-08	1.97E-08	1.97E-08									
R01SUI	0.00	0.00	0.00									
R01SUIF	9.05E-10	8.77E-10	8.77E-10									
R01UI	1.31E-09	8.10E-10			8.10E-10							
R01UIF	3.10E-09	1.92E-09			1.92E-09							
R02IF	0.00	0.00			0.00							
R03	7.64E-09	3.87E-09				3.87E-09						
R03I	4.18E-08	3.99E-08		3.99E-08								
R03IF	1.86E-07	1.78E-07		1.78E-07								
R03SI	0.00	0.00	0.00									
R03SIF	2.36E-08	2.28E-08	2.28E-08									
R03SUI	0.00	0.00	0.00									
R03SUIF	4.44E-08	4.30E-08	4.30E-08									
R03UI	3.58E-11	2.22E-11				2.22E-11						
R03UIF	6.33E-10	6.00E-10				6.00E-10						
R04	8.61E-08	8.56E-08		8.56E-08								
R04IF	0.00	0.00				0.00						
R04UIF	2.27E-08	2.28E-08				2.28E-08						
R05SLI	0.00	0.00	0.00									
R05SLIF	3.93E-07	3.81E-07	3.81E-07									
R05SLUI	0.00	0.00	0.00									
R05SLUIF	1.71E-07	1.65E-07			1.65E-07							
R07SLUI	0.00	0.00	0.00									
R07SLUIF	7.47E-07	7.23E-07	7.23E-07									
R09I	4.83E-07	3.00E-07					3.00E-07					
R09UI	1.87E-07	1.16E-07					1.16E-07					
R11I	5.11E-06	4.91E-06					4.91E-06					
R11IF	7.70E-07	7.39E-07					7.39E-07					
R11UI	4.44E-09	2.75E-09					2.75E-09					
R17L	2.14E-06	1.98E-06					1.98E-06					
R17LU	1.61E-06	9.97E-07					9.97E-07					
R17U	2.74E-06	2.75E-06						2.75E-06				
R18	1.10E-08	1.06E-08							1.06E-08			
R19	7.83E-08	7.83E-08							7.83E-08			
R20	5.47E-06	5.35E-06							5.35E-06			
R21	3.10E-05	3.01E-05								3.01E-05		
R22	5.40E-06	5.40E-06										5.40E-06
OTHERS	0.00	0.00										
TOTALS	5.77E-05	5.50E-05	1.19E-06	3.04E-07	8.17E-07	2.73E-08	9.04E-06	2.75E-06	5.44E-06	3.01E-05	0.00	5.40E-06

TABLE 4-16a
SUMMARY OF PDS AND KRC RESULTS
ENHANCEMENT CASE IV.2 - INSTALL INDEPENDENT RCP SEAL COOLING SYSTEM (W/O NEW EDG)

BASE CASE RESULTS				ENHANCEMENT CASE RESULTS				
LEVEL 1 OUTPUT KPDS	BASE CASE KPDS FREQUENCY	LEVEL 2 INPUT KPDS	BASE CASE KPDS FREQUENCY	KPDS FREQUENCY	KRC GROUP FREQUENCY			
					I	II	III	IV
ATV	7.83E-08	ATV	7.83E-08	7.83E-08	7.83E-08			
BCI	3.68E-06	BCI	3.68E-06	3.68E-06	2.27E-08		2.81E-06	8.46E-07
EGI	6.84E-08	EGI	6.84E-08	6.84E-08	5.48E-10		6.79E-08	
EIB	3.76E-06	EIB	3.76E-06	3.76E-06		3.76E-06		
ENB	4.40E-07	ENB	4.40E-07	4.40E-07		4.40E-07		
ENI	2.71E-05	ENIYA	2.12E-05	1.44E-05	1.15E-07		2.29E-07	1.41E-05
ENS	1.27E-06	ENIYB	7.76E-07	5.28E-07	4.22E-09		5.24E-07	
FCI	1.42E-05	ENIYN	5.16E-06	3.51E-06	2.81E-08		3.48E-06	
FGI	3.20E-07	ENSYA	2.95E-07	2.83E-07		2.83E-07		
FNI	5.58E-07	ENSYB	9.32E-08	8.94E-08		8.94E-08		
GNI	3.02E-06	ENSYC	9.99E-08	9.59E-08		9.59E-08		
HCI	1.09E-06	ENSYN	7.79E-07	7.47E-07		7.47E-07		
HGI	3.54E-07	FCI	1.42E-05	1.42E-05	7.70E-08		4.77E-07	1.36E-05
HNI	1.03E-07	FGI	3.20E-07	2.91E-07	2.32E-09		2.48E-07	4.04E-08
KNI	0.00	FNI	5.58E-07	1.73E-07	1.38E-09		1.47E-07	2.40E-08
KNS	1.57E-06	GNIYA	2.12E-06	2.12E-06	5.21E-07		1.60E-06	
LCI	0.00	GNIYN	8.94E-07	8.94E-07	2.19E-07	0.00	6.74E-07	
LNI	0.00	HCI	1.09E-06	1.09E-06	8.69E-09		5.39E-08	1.02E-06
OTHERS	0.00	HGI	3.54E-07	3.54E-07	7.21E-08		2.82E-07	
		HNI	1.03E-07	9.80E-08	7.78E-09		9.02E-08	
		KNI	0.00	0.00	0.00		0.00	
		KNSYA	1.57E-06	1.57E-06	2.60E-07	1.31E-06		
		KNSYC	0.00	0.00	0.00	0.00		
		LCI	0.00	0.00	0.00		0.00	0.00
		LNIYA	0.00	0.00				0.00
		LNIYC	0.00	0.00	0.00		0.00	
		OTHERS	0.00	0.00				
		TOTALS	5.8E-05	4.84E-05	1.42E-06	6.72E-06	1.07E-05	2.96E-05

TABLE 4-16b
TRANSLATION OF KRC FREQUENCIES TO APBs
ENHANCEMENT CASE IV.2 - INSTALL INDEPENDENT RCP SEAL COOLING SYSTEM (W/O NEW EDG)

KRC ID	BASE KRC FREQ	CASE KRC FREQ	APB FREQUENCIES									
			1	2	3	4	5	6	7	8	9	10
R01	1.96E-08	1.96E-08			1.96E-08							
R01DI	8.65E-07	8.65E-07			8.65E-07							
R01I	2.38E-08	2.38E-08			2.38E-08							
R01IF	5.65E-08	5.65E-08			5.65E-08							
R01SI	0.00	0.00	0.00									
R01SIF	2.03E-08	2.03E-08	2.03E-08									
R01SUI	0.00	0.00	0.00									
R01SUIF	9.06E-10	9.06E-10	9.06E-10									
R01UI	1.31E-09	1.31E-09			1.31E-09							
R01UIF	3.10E-09	3.10E-09			3.10E-09							
R02IF	0.00	0.00			0.00							
R03	7.64E-09	7.64E-09				7.64E-09						
R03I	4.18E-08	2.86E-08		2.86E-08								
R03IF	1.86E-07	1.26E-07		1.26E-07								
R03SI	0.00	0.00	0.00									
R03SIF	2.35E-08	2.35E-08	2.35E-08									
R03SUI	0.00	0.00	0.00									
R03SUIF	4.44E-08	4.44E-08	4.44E-08									
R03UI	3.58E-11	3.57E-11				3.57E-11						
R03UIF	6.33E-10	6.32E-10				6.32E-10						
R04	8.61E-08	8.57E-08		8.57E-08								
R04IF	0.00	0.00				0.00						
R04UIF	2.27E-08	2.27E-08				2.27E-08						
R05SLI	0.00	0.00	0.00									
R05SLIF	3.93E-07	3.93E-07	3.93E-07									
R05SLUI	0.00	0.00	0.00									
R05SLUIF	1.71E-07	1.71E-07			1.71E-07							
R07SLUI	0.00	0.00	0.00									
R07SLUIF	7.47E-07	7.47E-07	7.47E-07									
R09I	4.83E-07	4.83E-07					4.83E-07					
R09UI	1.87E-07	1.87E-07					1.87E-07					
R11I	5.11E-06	3.48E-06					3.48E-06					
R11IF	7.70E-07	5.24E-07					5.24E-07					
R11UI	4.44E-09	4.43E-09					4.43E-09					
R17L	2.14E-06	1.67E-06					1.67E-06					
R17LU	1.61E-06	1.60E-06					1.60E-06					
R17U	2.74E-06	2.74E-06						2.74E-06				
R18	1.10E-08	1.10E-08							1.10E-08			
R19	7.83E-08	7.83E-08							7.83E-08			
R20	5.47E-06	5.41E-06							5.41E-06			
R21	3.10E-05	2.42E-05								2.42E-05		
R22	5.40E-06	5.38E-06										5.38E-06
OTHERS	0.00	0.00										
TOTALS	5.77E-05	4.84E-05	1.23E-06	2.41E-07	1.14E-06	3.10E-08	7.95E-06	2.74E-06	5.50E-06	2.42E-05	0.00	5.38E-06

TABLE 4-17a
SUMMARY OF PDS AND KRC RESULTS
ENHANCEMENT CASE IV.3 - CHANGE CHARGING PUMP COOLING FROM CCS TO ERCW

BASE CASE RESULTS				ENHANCEMENT CASE RESULTS				
LEVEL 1 OUTPUT KPDS	BASE CASE KPDS FREQUENCY	LEVEL 2 INPUT KPDS	BASE CASE KPDS FREQUENCY	KPDS FREQUENCY	KRC GROUP FREQUENCY			
					I	II	III	IV
ATV	7.83E-08	ATV	7.83E-08	7.83E-08	7.83E-08			
BCI	3.68E-06	BCI	3.68E-06	3.68E-06	2.27E-08		2.81E-06	8.46E-07
EGI	6.84E-08	EGI	6.84E-08	6.84E-08	5.48E-10		6.79E-08	
EIB	3.76E-06	EIB	3.76E-06	3.57E-06		3.57E-06		
ENB	4.40E-07	ENB	4.40E-07	4.14E-07		4.14E-07		
ENI	2.71E-05	ENIYA	2.12E-05	1.28E-05	1.03E-07		2.03E-07	1.25E-05
ENS	1.27E-06	ENIYB	7.76E-07	4.70E-07	3.76E-09		4.66E-07	
FCI	1.42E-05	ENIYN	5.16E-06	3.12E-06	2.49E-08		3.09E-06	
FGI	3.20E-07	ENSYA	2.95E-07	2.80E-07		2.80E-07		
FNI	5.58E-07	ENSYB	9.32E-08	8.87E-08		8.87E-08		
GNI	3.02E-06	ENSYC	9.99E-08	9.51E-08		9.51E-08		
HCI	1.09E-06	ENSYN	7.79E-07	7.41E-07		7.41E-07		
HGI	3.54E-07	FCI	1.42E-05	1.36E-05	7.38E-08		4.58E-07	1.30E-05
HNI	1.03E-07	FGI	3.20E-07	2.21E-07	1.77E-09		1.89E-07	3.08E-08
KNI	0.00	FNI	5.58E-07	7.25E-08	5.80E-10		6.18E-08	1.01E-08
KNS	1.57E-06	GNIYA	2.12E-06	2.10E-06	5.16E-07		1.59E-06	
LCI	0.00	GNIYN	8.94E-07	8.86E-07	2.17E-07	0.00	6.69E-07	
LNI	0.00	HCI	1.09E-06	8.14E-07	6.51E-09		4.04E-08	7.67E-07
OTHERS	0.00	HGI	3.54E-07	3.52E-07	7.17E-08		2.80E-07	
		HNI	1.03E-07	6.55E-08	5.20E-09		6.03E-08	
		KNI	0.00	0.00	0.00		0.00	
		KNSYA	1.57E-06	1.57E-06	2.60E-07	1.31E-06		
		KNSYC	0.00	0.00	0.00	0.00		
		LCI	0.00	0.00	0.00		0.00	0.00
		LNIYA	0.00	0.00				0.00
		LNIYC	0.00	0.00	0.00		0.00	
		OTHERS	0.00	0.00				
		TOTALS	5.8E-05	4.51E-05	1.39E-06	6.50E-06	9.99E-06	2.72E-05

TABLE 4-17b
TRANSLATION OF KRC FREQUENCIES TO APBs
ENHANCEMENT CASE IV.3 - CHANGE CHARGING PUMP COOLING FROM CCS TO ERCW

KRC ID	BASE KRC FREQ	CASE KRC FREQ	APB FREQUENCIES									
			1	2	3	4	5	6	7	8	9	10
R01	1.96E-08	1.95E-08			1.95E-08							
R01DI	8.65E-07	8.57E-07			8.57E-07							
R01I	2.38E-08	2.36E-08			2.36E-08							
R01IF	5.65E-08	5.60E-08			5.60E-08							
R01SI	0.00	0.00	0.00									
R01SIF	2.03E-08	2.03E-08	2.03E-08									
R01SUI	0.00	0.00	0.00									
R01SUIF	9.05E-10	9.05E-10	9.05E-10									
R01UI	1.31E-09	1.30E-09			1.30E-09							
R01UIF	3.10E-09	3.08E-09			3.08E-09							
R02IF	0.00	0.00			0.00							
R03	7.64E-09	7.60E-09				7.60E-09						
R03I	4.18E-08	2.55E-08		2.55E-08								
R03IF	1.86E-07	1.11E-07		1.11E-07								
R03SI	0.00	0.00	0.00									
R03SIF	2.35E-08	2.35E-08	2.35E-08									
R03SUI	0.00	0.00	0.00									
R03SUIF	4.44E-08	4.44E-08	4.44E-08									
R03UI	3.58E-11	3.54E-11				3.54E-11						
R03UIF	6.33E-10	6.32E-10				6.32E-10						
R04	8.61E-08	8.03E-08		8.03E-08								
R04IF	0.00	0.00				0.00						
R04UIF	2.27E-08	2.27E-08				2.27E-08						
R05SLI	0.00	0.00	0.00									
R05SLIF	3.93E-07	3.93E-07	3.93E-07									
R05SLUI	0.00	0.00	0.00									
R05SLUIF	1.71E-07	1.71E-07			1.71E-07							
R07SLUI	0.00	0.00	0.00									
R07SLUIF	7.47E-07	7.47E-07	7.47E-07									
R09I	4.83E-07	4.79E-07					4.79E-07					
R09UI	1.87E-07	1.85E-07					1.85E-07					
R11I	5.11E-06	3.09E-06					3.09E-06					
R11IF	7.70E-07	4.66E-07					4.66E-07					
R11UI	4.44E-09	4.40E-09					4.40E-09					
R17L	2.14E-06	1.43E-06					1.43E-06					
R17LU	1.61E-06	1.59E-06					1.59E-06					
R17U	2.74E-06	2.74E-06						2.74E-06				
R18	1.10E-08	1.10E-08							1.10E-08			
R19	7.83E-08	7.83E-08							7.83E-08			
R20	5.47E-06	5.19E-06							5.19E-06			
R21	3.10E-05	2.20E-05								2.20E-05		
R22	5.40E-06	5.19E-06										5.19E-06
OTHERS	0.00	0.00										
TOTALS	5.77E-05	4.61E-05	1.23E-06	2.17E-07	1.13E-06	3.09E-08	7.25E-06	2.74E-06	5.27E-06	2.20E-05	0.00	5.19E-06

ENCLOSURE 2

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVES
EXECUTIVE SUMMARY REVISION 1 REVISED PAGE(S)

OCTOBER 26, 1994

III.5 - Provide DC Load Shed Analysis & Procedure

The WBN DC power system is supported by four 125V vital batteries. In response to the Station Blackout Rule (10 CFR 50.63), it was determined that these batteries were sufficient as designed to cope for at least four hours under station blackout conditions. This enhancement involves the development of engineering analyses and procedures which would extend battery life by optimally shedding unnecessary DC loads under station blackout conditions. The benefit of this enhancement is that it would allow operation of the turbine driven AFW pump for a longer period of time and would facilitate restoration of offsite power after 4 hours by ensuring availability of breaker control power. The re-assessment of this enhancement was performed using the re-baselined results and the similar assumptions as the original analysis. However, due to the implementation of the 500kV crosstie, the benefit of this enhancement is reduced. This is due to the fact that the 500kV crosstie effectively reduces the contribution of non-weather related losses of offsite power. With those events eliminated, the probability of recovery of offsite power is greatly reduced. Consequently, the credit for improving the likelihood of recovery of offsite power was reduced from a factor of ten to a factor of two. (continued on page ES-25a)

III.6 - Provide Portable Battery Charger

This enhancement would provide a portable, diesel driven battery charger which would assure DC power would be available under station blackout conditions. The benefit of this enhancement is similar to item III.5, except the battery life could be extended essentially indefinitely. The re-assessment of this enhancement was performed using the re-baselined results and the similar assumptions as the original analysis. However, due to the implementation of the 500kV crosstie, the benefit of this enhancement is reduced. This is due to the fact that the 500kV crosstie effectively reduces the contribution of non-weather related losses of offsite power. With those events eliminated, the probability of recovery of offsite power is greatly reduced. Consequently, the credit for improving the likelihood of recovery of offsite power was reduced from a factor of ten to a factor of two.

III.7 - Install AC Independent Coolant Injection System

This enhancement would provide an AC independent coolant injection system which could be used under station blackout conditions (as well as others) to provide feed and bleed cooling of the RCS. The system evaluated included an independent emergency diesel generator, a pump and associated controls necessary to provide adequate makeup to the RCS. The re-assessment of this

III.5 - Provide DC Load Shed Analysis & Procedure **(continued from page 25)**

The existing station blackout strategy involved development of load shedding practices in order to extend battery availability. The option considered here assumes that a more detailed time dependent analysis and strategy could be developed to further improve these times.

In order to extend the time that the vital batteries are available to supply power to critical DC loads during a station blackout, load shedding and/or sequencing along with a calculation that determines the battery voltage versus time would be required. The voltage-time profile calculation is an iterative process that consists of keeping a cumulative total of the ampere-hours removed from the battery's cells during each segment or period. It calculates the battery voltage versus time to show the battery voltage and state (on, off, starting, etc) of the operating loads. The battery load in amperes is required for each segment or period. To determine the total battery load for a given segment, the operational mode for each load on the battery is evaluated and determined. An operational analysis that defines the state of the individual battery loads versus time is an input for calculating the battery's voltage profile and is also expected to require iteration to determine if functions can be further delayed or reduced from that in the station blackout analysis. As part of this, additional sequencing on and off of systems to provide additional reductions in battery loads would be considered.