REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**ER 1-8428**
SRP Section:	**Environmental Report**
Application Section:	**APR1400 Environmental Report**
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Question No. EIS ACC/SA-15

10 CFR 51.55(a) requires each applicant for a standard design certification under subpart B of 10 CFR Part 52 (i.e., 10 CFR 52.47(b)(2)) to submit with its application a separate document entitled, "Applicant's Environmental Report—Standard Design Certification." The environmental report must address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives in the design to be certified.

The environmental standard review plan (ESRP) Section 7.2, Severe Accidents, of NUREG 1555 directs the staff to evaluate and independently confirm severe accident risks and analyses presented in an Environmental Report (ER) (i.e., the APR1400 ER, “Applicant’s Environmental Report – Standard Design Certification,” found under ML15006A038 and the proprietary technical report, “Severe Accident Mitigation Design Alternatives (SAMDAs) for the APR1400,’under ML15012A105) of accidents involving radioactive material that can be postulated for the plant under review. The scope of this review should include probability-weighted consequence (i.e., risks) analysis for severe accidents, including dose and socioeconomic risk impacts based on plant specific data in sufficient detail to appropriately evaluate the risks for severe accidents.

The staff requires the following additional information in order to complete its review of the environmental impacts of severe accidents and to ensure appropriate documentation of the applicant’s assessment in the APR1400 Environmental Report.

Provide a revised base case analysis by adding modeling of a non-evacuating cohort with appropriate justification and supporting references. As stated in Section 4.6.3, Cohort Modeling, of NUREG/CR-7009, MACCS Best Practices as Applied in the State-of-the-Art Reactor Consequence Analyses (SOARCA) Project, “…only two cohorts were used in Sample Problem A with percentages of 95 percent for the general public and 5 percent for the non-evacuating public. The percentages were adjusted to 99.5% and 0.5%, respectively, in the final NUREG-1150 report. In SOARCA the population fractions were developed based on the

actual site population data [shown in Table 4-21].” Note that the evacuation cohort population fraction in the final NUREG-1150 (Cohort 2) and in SOARCA (Cohort 6) were set to 0.005, or 0.5 percent. The staff does not consider that assuming 100 percent evacuation (i.e., not having an evacuation cohort specified in the MACCS calculations) is reasonable to apply for the base case analysis.

The NRC staff request that any revisions to the ER or supporting technical reports be provided as a markup as part of the response to this RAI.

Response – (Rev.4)

Using the recently-updated PRA results, the SAMDA report was revised, including Level 3 analysis. The revised Level 3 analysis (Appendix A of APR1400-E-P-NR-14006-P, Rev. 1) uses 99.5% evacuation / 0.5% non-evacuation parameters to establish the base case. The base case population dose and offsite economic cost results were applied the SAMDA cost benefit analysis. The base case mode is also used as the starting point of all Level 3 sensitivity cases.

DCD Sections 19.2.6.4 and 19.2.6.5 will be updated to reflect the latest costs determined in the SAMDA analysis as shown on Attachment.

DCD Sections 19.2.6.5 will be updated to reflect the editorial correction for the latest costs determined in the SAMDA analysis as shown on Attachment.

Impact on DCD

DCD will be revised as discussed above.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

The SAMDA Report is revised as discussed above.

The potential SAMDA items not screened are further evaluated to determine the potential benefits that could be achieved, if implemented.

19.2.6.4 Risk Reduction Potential of Design Improvements

Each of the potential SAMDAs not screened are evaluated to determine the potential benefits. In evaluating the benefits, a detailed modification is not necessarily considered because exact design details would only be defined once a design option is chosen. SAMDA benefit evaluation is performed using bounding techniques to estimate risk reduction that would be possible.

Evaluation of potential benefits is performed using the methodology described in NEI 05-01 and is performed as follows: 1) the potential reduction in CDF is estimated; 2) the reduction in source term release is estimated; 3) and the potential benefit to offsite consequences is determined and presented in monetary terms.

The important basic events (i.e., FV > 0.5%) from the at-power and LPSD PRA importance analyses have been reviewed, and the basic events included in the top 100 cutsets have been also reviewed. The cost benefits of the basic events associated with ~~93~~ 86 SSCs have been reviewed. The total maximum benefit calculated for improving the SSCs associated with the reviewed basic events would be small and much lower than the cost of any plant design change to improve performance of the SSCs.

19.2.6.5 Cost Impacts of Candidate Design Improvements

The unmitigated risk monetary value is calculated using the methodology given in NEI 05-01 for the performance of cost-benefit analyses. The value of unmitigated risk can be used to represent the maximum benefit that could be achieved if all risk was eliminated for at-power events. The methodology of the Producer Price Index (Reference 40) determines the present worth net value of public risk according to the following formula:

$$NPV = (APE + AOC + AOE + AOSC) - COE$$

Where:

NPV = present value of current risk ($),

APE = present value of averted public exposure ($),

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AOC= present value of averted offsite property damage costs ($),

AOE= present value of averted occupational exposure ($),

AOSC= present value of averted onsite costs ($)

COE= cost of any enhancement implemented to reduce risk ($).

~~NPV = ($76,826 + $ 100,973 + $ 4,216 + $ 840,820) – $0 = $1,022,835~~

NPV = ($49,877 + $63,933 + $3,817 + $791,541) - $0 = $ 909,168

This value can be viewed as the maximum risk benefit attainable if all core damage scenarios from internal events are eliminated over the 60-years plant life. The detailed calculation is provided in Section 4 of Reference 38.

The conversion factor used for assigning a monetary value to on-site and off-site exposures was $2,000/person-rem averted, which is consistent with the NRC's regulatory analysis guidelines presented in NEI 05-01. The occupational exposure associated with severe accidents was assumed at 23,300 person-rem/accident. This value includes a short-term component of 3,300 person-rem/accident and a long-term component of 20,000 person-rem/accident. These estimates are consistent with the "best estimate" values presented in Subsection 5.7.3 of NUREG/BR-0184 (Reference 41). In calculating base risk, the accident-related onsite exposures were calculated using the best estimate exposure components applied over the on-site cleanup period. For onsite cleanup, the accident-related on-site exposures were calculated over a 10-year cleanup period. Costs associated with immediate dose, long-term dose and total dose are calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events.

The parameters that influence the cost-benefit analyses of the SAMDA evaluations were examined to determine if a change in value for one of the parameters would change the conclusions of the evaluation. Equations for each of the four types of averted costs each contain a term for the real discount rate and evaluation period. Therefore, a change in either of those terms would have a direct impact on the averted costs calculated.

NEI 05-01 recommends using a 7% discount rate for cost-benefit analyses and suggests that a 3% discount rate should be used for sensitivity analyses on the maximum benefit and the unscreened SAMDAs to indicate the sensitivity of the results to the choice of discount rate. The NPV for a 3% discount rate is calculated to be ~~$1,145,569~~ (Reference 42). Using

~~$964,323~~

$1,645,106