A-2

DISTRIBUTION
CENTRAL FILE
AEB R/F
MThadani
WPasedag
Plant File
AD/RP RF

MAY 28 1982

MEMORANDUM FOR: Paul S. Check, Director
Clinch River Breeder Reactor Program Office, NRR

FROM: R. W. Houston, Assistant Director
for Radiation Protection
Division of Systems Integration

SUBJECT: EVALUATION OF CLASS 9 ACCIDENTS FOR THE CRBR ENVIRONMENTAL REVIEW

In response to your request to L. G. Hulman, dated 3/31/82, the Accident Evaluation Branch (AEB) has re-evaluated the risks resulting from a Class 9 accident at CRBR site.

Per your request, AEB has utilized as a basis the Class 9 accident scenario in the existing FES. The event chosen in the FES results in release into the outer containment of 100% of the noble gases, 10% of the volatiles including halogens, and 1% of the solid fission products and fuel (including plutonium). Radionuclides are assumed to be released to atmosphere as a result of the failure of the containment 24 hours after their release from the core. The accident probability of one chance in one hundred thousand per year provided in your request was used in the present analysis. Since our evaluation is based on the methodologies of the Reactor Safety Study and the related follow-on work on calculation of light water reactor (LWR) consequences, our methods at present do not account for the large quantities of sodium present in the CRBRP in place of the large quantities of water present in the LWRs.

The results of the AEB analysis indicate that the calculated risks for the selected CRBR accident release are substantially below the risks that the staff has presented in the environmental statements of light water reactors which have been licensed since the issuance of the Comission's June, 1980 Statement of policy. Based on this analysis the AEB has revised its 12/18/81 transmittal to you by including the findings of the present analysis. The revised input is enclosed.

This evaluation was performed, and the attached input prepared by Mohan Thadani X28941. The addendum on the liquid pathway was prepared by R. Codell (HGEB), and reported in AEB transmittal to you dated 12/19/82.

Original signed by
R. Wayne Houston
R. Wayne Houston, Assistant Director
for Radiation Protection
Division of Systems Integration

XA

8206080467

Enclosure: As stated

cc: H. Denton W. Pasedag G. Lear
E. Case M. Thadani
R. Mattson R. Codell
P. Leech
J. Swift

*See Previous Concurrence Sheet

| DSI:AEB * | DSI:AEB* | DSI:AEB* | DSI:AD/RP |
|---|---|---|---|
| MThadani:ye | WPasedag | LHulman | RWHouston |
| 5/ /82 | 5/ /82 | 5/ /82 | 5/ /82 |

ACCIDENT EVALUATION BRANCH INPUT TO THE FINAL
ENVIRONMENTAL STATEMENT UPDATE FOR
CLINCH RIVER BREEDER REACTOR PLANT

Addendum to Section 7.1

## 7.1 PLANT ACCIDENTS INVOLVING RADIOACTIVE MATERIALS

The staff has examined the Clinch River Breeder Reactor Plant (CRBRP) Final Environmental Statement (FES) with a view to updating the FES reflecting any plant-site features or regulatory framework changes that have occurred since the FES was issued in February 1977. The staff finds that since the issuance of the FES no plant-site changes have occurred that would materially change the environmental impacts or risks accidents as reported in the FES. Since the issuance of the FES, however, the Commission has issued a Statement of Interim Policy (June 13, 1980) that provides guidance on the considerations to be given to nuclear power plant accidents under NEPA. Among other things the Commission's statement indicated that "this change in policy is not to be construed as any lack of confidence in conclusions regarding the environmental risks of accidents expressed in any previously issued (Environmental Impact) statements, nor, absent a showing of --- special circumstances, as a basis for opening, reopening, or expanding any previous or ongoing proceeding."

The staff in its environmental review of the CRBRP application concluded that the CRBRP did constitute a special circumstance that warranted consideration of Class 9 accidents in the Environmental Statement. Since the CRBRP reactor was very different from the conventional light water reactor plants for which the safety experience base is much broader, the staff included in the CRBRP FES a discussion of the potential impacts and risks of such accidents. As noted in the Statement of Interim Policy, the fact that the staff had identified this case as a special circumstance was one of the considerations that led to the promulgation of the June 13, 1980 Statement.

In examining the CRBRP FES, as issued in 1977, the staff has considered the guidance of the Interim Policy Statement which was provided for "Future NEPA Reviews." We have concluded that the discussion of accidents as presented in the FES generally meets that guidance except for consideration of the risks due to liquid pathways. A discussion of the liquid pathway risks is included below.

The staff has also performed some new calculations to provide an additional perspective on the risk associated with the atmospheric release pathway for a hypothetical Class 9 accident at the CRBR, as discussed below:

A probabilistic risk analysis such as the Reactor Safety Study, WASH-1400, attempts to portray the complete spectrum of possible Class 9 event sequence. Such a probabilistic risk analysis has not been performed for the CRBR as currently designed. Therefore, for the purpose of estimating the risks of Class 9 events at the CRBR site comparable to the risks presented in environmental statements for LWRs, the staff has selected, as representative of the Class 9 event category, a specific release of radioactivity from the CRBR core with an associated estimate of a probability of its occurrence.

The event analyzed is that described in the FES (Table 7.2, f.n.11). Specifically, an accident is postulated which results in a core release of 100% of the noble gases and volatiles, 10% of the solid fission product inventory and 10% of the plutonium inventory.* In this scenario, the volatiles, including halogens, are reduced to 10% of the core inventory and the solid fission products and fuel are reduced to 1% of the core inventory during passage out of the reactor vessel and into the outer containment building. Containment leakage is taken as proportional to the square root of the pressure for 24 hours, at which time containment integrity is assumed to be lost and all airborne material released to the environment.

*In addition to these elements, activation products of the primary coolant (i.e. radioactive isotopes of sodium) would be released to the containment in accidents involving the loss of primary coolant. Although it is recognized that these isotopes could be substantial contributors to the accident source term, the present analytical models used by the staff are not readily amenable to an explicit inclusion of these isotopes in the quantitative analysis described herein.

The probability of this representative event has been estimated to be not greater than one in one hundred thousand per reactor year. This probability was selected for the new calculations discussed here in consideration of the nature of the representative sequence, in comparison with the results of other probabilistic risk ansyses, and in consideration of the staff's objective that there be no greater than one chance in a million per year for potential consequences greater than 10 CFR Part 100 guidelines for an individual plant.

ATMOSPHERIC PATHWAYS

The potential atmospheric pathway radiological consequences of this release have been calculated by the consequence model used in the RSS (NUREG-0340) adapted and modified to the specific CRBRP site. The model used one year site meteorology data, projected population for the year 2010 extending throughout regions of 80-km (50-mi) radius and 56-km (350-mi) radius from the site, and habitable land fractions within the 563-km (350-mi) radius.

The results of the calculations are summarized in table 7-1A as expectation values, or averages of environmental risk per year of reactor operation. These averages are instructive as an aid to the comparison of radiological risks associated with CRBR accident releases and those associated with risks calculated for recently evaluated LWRs. The table shows the average risk associated with population dose, early fatalities, latent fatalities, and cost of evacuation and protective actions.

TABLE 7.1A
Average Values of Environmental Risks
due to Selected CRBR Accident

| Environmental Risk (Per Reactor Year) | Average Value |
|---|---|
| Population exposure | |
| Person-rems within 80 km | 8 |
| Total person-rems | 12 |
| Early Fatalities | 0.0000004 |
| Latent cancer, fatalities | |
| All organs excluding thyroid | 0.0007 |
| Thyroid only | 0.00005 |
| Cost of protective actions and decontamination | $156* |

*1980 dollars

It should be noted that these results do not fully account for the effects of the sodium coolant on the radioactive source term. For example, inclusion of the effects of sodium is expected to reduce the quantity of iodine available for leakage. The large mass of sodium aerosol also contributes to the agglomeration and settling of aerosols in the primary containment. On the other hand, the sodium activation products would be released together with the primary coolant, thereby adding to the amount of radioactive material released to the containment. On balance, it is expected that these effects would not be so large as to invalidate the conclusions of these calculations. Further consideration of this subject will be included in the staff's review of the Probabilistic Risk Assessment for this plant, and in the staff's Safety Evaluation Report.

The assessment of environmental risks of atmospheric pathways, assuming reasonable protective action, shows that they are significantly lower than similarly calculated values for light water reactors currently being licensed for operation. See, for example, FES for Calloway (NUREG-0813), DES for Seabrook Station (NUREG-0895), FES for Susquehanna Station (NUREG-0564), and DES for Skagit (NUREG-0894) for the environmental risks of light water reactors.

LIQUID PATHWAYS

Surface water hydrologic properties at CRBRP should be similar to those used for the Liquid Pathways Generic Study (LPGS) small river site which was based on the Clinch - Tennessee - Ohio - Mississippi rivers system, although the river uses and populations in the LPGS were based upon national averages and have not been directly compared to the CRBRP. The groundwater characteristics at Clinch River do not indicate any unusual adverse transport characteristics.

Additionally, the CRBRP is a considerably smaller plant than LPGS case (CRBRP is 1121 MWt vs. 3425 MWt assumed for LPGS), and contrary to the Light Water Reactors characteristics, CRBRP does not contain any large storage of water which could serve as a potential "prompt source" to to the environmental liquid pathways. Therefore, only the radioactive material leached from the core debris by the local groundwater is likely to be transported to the Clinch River. This source was found in the LPGS to be considerably smaller than the "prompt source". Therefore, based on the preliminary appraisal of the liquid pathways, the staff concludes that the liquid pathways impacts of CRBRP would be probably smaller than those for the LWRs analyzed in the LPGS "Small River" site case.

## CONCLUSION

The foregoing sections have evaluated the environmental impacts of a severe accident including potential radiation exposure to the population as a whole, the risk of near - and long-term adverse health effects that such exposures could entail, and the potential economic and societal consequences of accidental contamination of the environment. The overall assessment of environmental risk of accidents, assuming reasonable protective action, shows that it is significantly lower than the risk from light water reactors currently being licensed for operation, and the conclusions reached in the FES remain unchanged by this evaluation.