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Subject: DEC Comments on NUREG/CR-6595 Rev. 1

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Michael J Barrett
10/16/2003 10:06 AM
To: dmo@nrc.gov. nrcrep@nrc.gov
cc: H Duncan Brewer/Gen/DukePower@DukePower
Subject: DEC Comments on NUREG/CR-6595 Rev. 1

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The attached comments contains the DEC comments on the recently released version of NUREG/CR-6595. This is a Microsoft Word document. Please let me know if another format is required.

(See attached file: DEC Comments on NUREG CR-6595 Rev 1.doc)

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E-RIDS = ADM-03
Add = DAN O'Neal (DMO)

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DEC Comments on NUREG/CR-6595 Rev. 1

The stated objective of NUREG/CR-6595 is to develop a relatively simple approach that can be interfaced with a level 1 PRA with a minimum of additional work. The framework provided succeeds in this objective to the extent that the approach is relatively straightforward to implement. However, with the understanding that the approach is likely to form the basis for estimating the large early release frequency for various risk informed plant changes, certain aspects of the simplified event tree quantifications are judged to be overly conservative.

According to RG-1.174, PRA evaluations in support of regulatory decisions should be as realistic as practicable. The conditional probabilities for early containment failure during SBO for the ice condenser containment have been revised upward from those values in the original publication based on the work reported in NUREG/CR-6427. This NUREG is an assessment of the direct containment heating (DCH) issue for ice condenser containments. It is not, nor was it intended to be, a best estimate treatment of the potential for early containment failure in ice condenser containments.

NUREG/CR-6427 concluded, and DEC concurs, that hydrogen combustion and not direct containment heating is the more important phenomena with respect to ice condenser containment integrity during station blackouts. However, NUREG/CR-6427 was never intended to be a best estimate study on the consequences of hydrogen combustion in ice condenser containments.

NUREG/CR-6427 also concluded that, for the SBO sequences, uncertainties in the containment loads are dominated by uncertainties in the hydrogen combustion phenomena and the amount of clad oxidized during core degradation. DEC concurs with this assessment and observes that the assumptions on which the NUREG/CR-6427 analysis is based are very conservative with respect to these two sources of uncertainty. The following examples are provided.

Hydrogen Combustion

- The analysis ignores the possibility of ignition prior to vessel breach. Early ignition depletes the available hydrogen and reduces the challenge to containment integrity to subsequent hydrogen deflagrations.
- Assumption that combustion occurs at vessel breach for the low pressure vessel failures. The mechanisms that would guarantee ignition for low pressure vessel failures when the lower containment compartments and the cavity might well be steam inerted are not described in NUREG/CR-6427. With no debris dispersal to form the basis for the existence of an ignition source, the probability of ignition would seem to be more appropriately associated with some random occurrence.
- While the potential for ignition for the high pressure vessel breach case would seem to be intuitively higher, the assumption that ignition is assured may be conservative for this case as well. Given the potential for highly inerted conditions in the cavity and lower compartment, ignition in these regions could be difficult to achieve. While the conditions in the ice condenser and upper

compartment are far more conducive to ignition the report notes that "CONTAIN predicts very little debris transport to the upper dome." The lack of line of site transport paths and the nature of the lower compartment geometry are cited as reasons for the difficulty of transporting particles to the ice chest.

Hydrogen Source

- A conservatively high hydrogen source is assumed in the CONTAIN analyses. The report states that, " ... corresponds to oxidation of 58.8 percent of the total core zirconium inventory." This corresponds to the high end (approximately the 95th percentile) of the distribution as given in NUREG/CR-6338.
- The median value for the fraction of clad oxidized was cited as approximately 40%. A mean or median value for the expected hydrogen generation would be a more appropriate selection for the estimation of the containment challenge associated with hydrogen combustion.

The split fractions supplied in NUREG/CR-6595 will certainly find their way into licensee applications for risk informed plant changes. Retaining overly conservative estimates for early containment failure probabilities will result in an overestimation of the LERF associated with these plant changes. This will likely require that the licensee expend additional resources to develop a detailed model in order to address the potential for early containment failure with a more realistic treatment. Such an effort may not be required if more realistic early containment failure split fractions are provided in NUREG/CR-6595. The extra effort to develop more detailed models would be expected to lead to higher costs both for the licensee preparation as well as the NRC review of risk informed submittals.

The conditional early containment failure probabilities included in the original release of NUREG/CR-6595 were based on the work provided in the IPEs and in NUREG/CR-4551. NUREG/CR-4551 provided a detailed and sophisticated analysis of the potential for early containment failure. A significant amount of research has been completed since the publication of NUREG/CR-4551 and better estimates of the potential for early containment failure could certainly be developed by updating that analysis. However, the objective of the analysis in NUREG/CR-6427 was not to be an update of the NUREG/CR-4551 work DEC concludes that the early containment split fraction provided in NUREG/CR-6595 Rev. 1 which are based on the analysis in NUREG/CR-6427 are overly conservative and the values form the original are more appropriate.