Lawrence Livermore National Laboratory

Fission Energy and Systems Safety Program

June 9, 1997
NTFS97-136

Gordan English
682 Milford Drive
Kingston, Ontario
CANADA K7H 6B4

Mr. English:

Thank you for the opportunity to review your report. Overall, we found your report very interesting but inconsistent with some of the information provided in the Modal Study. The overall objective of the Modal Study was to assess the effectiveness of regulations by using a probabilistic risk assessment approach to estimate the level of protection provided by regulations. Previous risk studies primarily used engineering judgment to estimate levels of damage and associated radioactive material releases and radiation environments. The Modal Study used engineering analysis, to the extent possible, to reduce the reliance on engineering judgment to improve risk estimates.

As described in Chapter 4.0, the Modal Study defines damage states or response regions in terms of effective strain and temperature. Twenty regions were defined to assess the damage to the cask and the potential radiological releases. A greater or lesser number of response regions could have been defined to perform the overall assessment (which involved engineering calculations, analysis, models and judgment) to estimate the radiological releases and their associated probabilities. The models for cask responses, radioactive releases, and distribution for the accident parameters were new developments, based on the state-of-the-art computer codes, limited test data on radioactivity releases, and limited historical accident data. The Modal Study applies only to spent fuel casks that would be certified by the NRC and are designed, manufactured, operated, and maintained in accordance with national codes and standards which have margins of safety imbedded in them. Current practice is to use tough, ductile material such as austinetic stainless steel for construction and to follow the ASME Code Section III, Subsection NB for design and fabrication to assure that the spent fuel cask will maintain its structural integrity even under the most extreme accident conditions. Using this overall approach and these assumptions, LLNL performed the Modal Study to improve risk estimates compared to previous studies.

Your review report with comments on the Modal Study is very extensive. In addition to previous comments from LLNL, the following comments are offered:

1. Page IV: The G. English report implies that the impact limiter was used to partially protect the cask for impacts on a pin. In fact, the Modal Study assumed that impact limiters were *not* involved for impact on a pin or coupler. No credit is given for the impact limiter.

2. Page V: The report states that no information is provided on fire characteristics. A discussion on equivalent fire effects is provided in the Modal Study, pages F-15 through F-31.

3. Page VI: The report implies that LLNL did not explicitly calculate the risk for low-frequency events < .6%. The bulk of the Modal Study did evaluate the risks for low

9706300270 970609
PDR TOPRP EXILLL
C PDR

probabilities in the range of .6% → .013%. The risk associated with values below .013% were estimated to be 10 times higher than the risk associated with the highest calculated risks (see pg. 8-20).

4. Page X: The report implies that the IMPASC codes used in the Modal Study is not documented. The IMPASC code is part of the current SCANS code which is thoroughly documented, benchmarked, and used throughout the world. A copy of SCANS was previously sent to you.

5. Page. 4-1: LLNL agrees with AAR as noted in your footnote. Most of the damage was due to the 11-day fire; that is why that accident was selected for the fire assessment example.

7. Page 4-5: The report implies that some accident frequencies in the Modal Study is for sever accidents only. Ridihalgh and Eggers data were for severe accidents only as defined by themselves. Although we incorporated their data—particularly for derailment—for estimating specific scenarios, it has been presumed to apply to all accidents, i.e., given any accident, the probability that a specific scenario occurs is based on all accidents, not just severe ones.

8. Page 6-5: The report states that only 10% of the fuel rods are assumed failed for strains between 2% and 30%. The Modal Study assumed that 100% (all) of the spent nuclear fuel rods have failed for strains greater than 2%. See Figure 8-7 in Modal Study.

9. Page D-1: The report states that the finite element meshes used were too coarse to accurately predict strains through the cross-section of the inner liner. *The purpose of the analyses was not to predict the detailed strain distribution in the package liner, but rather to estimate the general state of strain damage in the liner.* In fact, the results are fairly accurate for membrane stresses, and for bending stresses within the center three quarters of the inner liner. Since the Modal Study discusses the general state of stress and strain in the package liner, and not extreme fiber (or peak) stresses, it was considered adequate to use fairly coarse meshes.

LLNL appreciates your interest in the Modal Study. If you have any questions regarding our comments on your report, please contact me at (510) 423-0159.

Sincerely,

Larry E. Fischer
Associate Program Leader
Fission Energy and Systems Safety Program

cc:
R. Boyle (DOT)
R. Franczak (AAR)
W. Lake (DOE)
S. Frant-Shankman (NRC)