CT-1497
PDR

Sandia National Laboratories

Albuquerque, New Mexico 87185

September 3, 1982

Dr. David Okrent
5532 Boelter Hall
University of California, Los Angeles
Los Angeles, CA 90024

Dear Dave:

Enclosed is a summary of the very limited review I have performed on the Site Consequence Analysis of the Limerick PRA. I apologize for it being late. Please let me know if you have any questions or desire additional information.

Sincerely,

Dave Aldrich

D. C. Aldrich, Supervisor
Safety & Environmental Studies
Division 9415

DCA:9415:mjc

Enclosure

Copy to: w/encl

Dr. J. Michael Griesmeyer
Advisory Committee on Reactor Safeguards
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

CT- 1497

Review of the Limerick PRA: Site Consequence Analysis

D. C. Aldrich, Supervisor
Safety and Environmental Studies,
Division 9415
Sandia National Laboratories
Albuquerque, NM 87185

In my limited review of the site consequence analysis portion of the Limerick PRA, I've attempted to focus only on those aspects of the modeling or evaluation that could significantly impact predicted results or major conclusions. I have the following comments and observations.

1. The study made use of the WASH-1400 consequence model, CRAC, with site meteorology and population data specific to the Limerick Site. Some slight modifications were made to the CRAC code, or to input assumptions:

   - The vertical dispersion parameter, σ_z, was altered to reflect higher ground-surface roughness than assumed in WASH-1400

   - The horizontal dispersion parameter, σ_y, was altered to more properly account for accident release duration

   - Plume rise assumptions were slightly modified

   - An average factor of 0.57 was included to account for reduced inhalation exposures for persons in buildings with windows and doors closed

   - Shielding factors for persons in buildings were significantly lower than assumed in WASH-1400 (lower implies better shielding) for two reasons. First, the Limerick analysis assumed that, in areas beyond the 25 mile evacuation distance, people would actively pursue sheltering in basements whenever they were available in homes or larger buildings. Basements provide a great deal of protection against external gamma radiation from deposited radionuclides. WASH-1400 did <u>not</u> assume active sheltering beyond the evacuated zone and assigned average shielding factors for persons continuing their "normal activities" (i.e., a mix of being indoors and outdoors, with no utilization of basements). Second, shielding factors were further slightly reduced to account for the large number of homes in the Northeast that are brick and have basements.

   - None of the above modifications is likely to have a <u>major</u> impact on predicted results. The assumption of active sheltering in areas beyond 25 miles won't have a significant impact on early fatality predictions, but could reduce predicted latent effects by a factor of 2 or so. I would expect the cumulative impact of all of the modifications to be a small (~ factor of 2) reduction in all predicted health impacts.

2. Over the past few years, a number of improvements and corrections have been made to the CRAC code, resulting in the release of CRAC2 from Sandia in 1981. Few of these improvements and corrections were included in the code used for the Limerick analysis. To partially evaluate what influence this might have on predicted results, I've attached some figures generated as part of the recent International Comparison Study of Reactor Accident Consequence Models.* The figures compare CCDFs (and means) predicted by CRAC, CRAC2, CRACIT and NUCRAC, for a moderately large release at a hypothetical site. Note that Figures 8-12 assume no immediate evacuation of persons near the plant, while Figure 13, CRAC, CRAC2 and CRACIT all agree relatively well. The wide range indicated in Figure 13 most likely reflects the variety of assumptions made, although differences in modeling also contribute.

3. To provide a direct comparison with WASH-1400 results, the Limerick Study made use of the WASH-1400 evacuation model and assumptions. These assumptions were based in part on a simple statistical evaluation of a small amount of evacuation data gathered by the EPA. The appropriateness of the assumed times (no delay, 1.2 mph "effective" radial speed) and distance (25 miles) are questionable for use at a specific site. (Note that choosing "better" estimates for delay time and speed is not easy! A 10 mile evacuation distance assumption would have been more realistic in light of current emergency planning requirements.) As I've discussed in my previous reviews for Zion and Indian Point, predicted early effects are very sensitive to assumed evacuation parameters, particularly to the delay time before public movement.

4. According to Revision 4 (6/82) of the Limerick Study, core fission product inventories were calculated using the RADCICINDER code system. The resulting assumed cesium inventories are significantly smaller than in WASH-1400. I find this a bit puzzling. Using an updated version of ORIGEN, we have performed some inventory calculations for a large BWR that predict cesium inventories ~40% higher than those in WASH-1400. Assumed cesium isotope inventories can have a very large impact on predicted latent cancer fatalities and areas of interdicted land. Therefore, the discrepancy in inventories should be resolved.

*Aldrich, et al., "International Problem for Consequence Modeling: Results," presented at International ANS/ENS Topical Meeting on PRA, September 20-24, 1981, Port Chester, NY

5. Treatment of uncertainties in the consequence analysis was rather weak, particularly if compared to those for the Zion and Indian Point Studies. Additional calculations showing sensitivity to emergency response and other "key" assumptions would have been beneficial.

6. The question raised in Mike Griesmeyer's letter of May 18, 1982, - "Are the proposed interdiction and decontamination approaches practical for the actual areas involved?" - is a good one. However, I don't have a good answer. Essentially all consequence codes and analyses performed in this country have made the same assumptions in this area. Work is ongoing at Sandia to better estimate the extent to which interdiction and decontamination would be viable over the large areas currently predicted for severe accident categories.

Note: The results presented on this page are for comparison purposes only, and are not necessarily representative of potential reactor accidents.

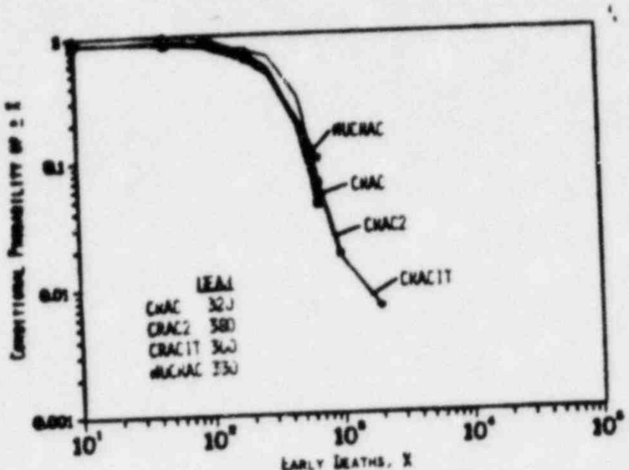

Figure 8. Problem 6, BWR1, Uniform Population

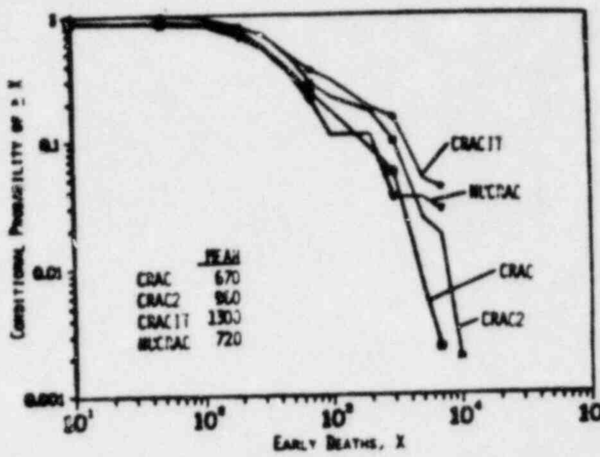

Figure 9. Problem 6, BWR1, Realistic Population

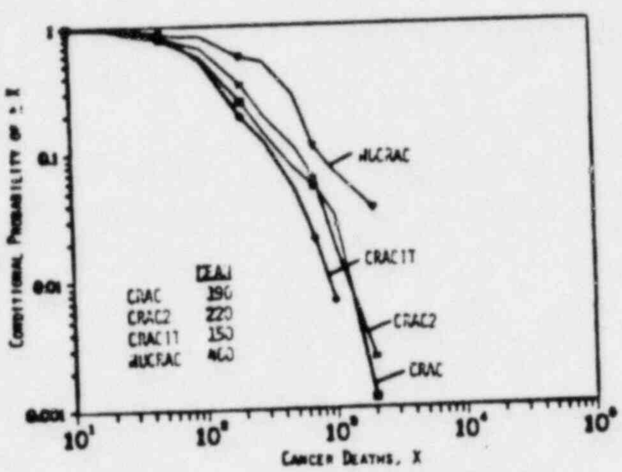

Figure 10. Problem 6, BWR1, Realistic Population

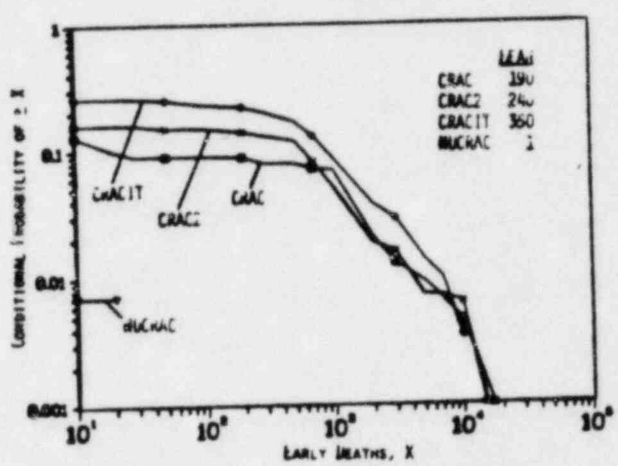

Figure 11. Problem 6, BWR2, Realistic Population

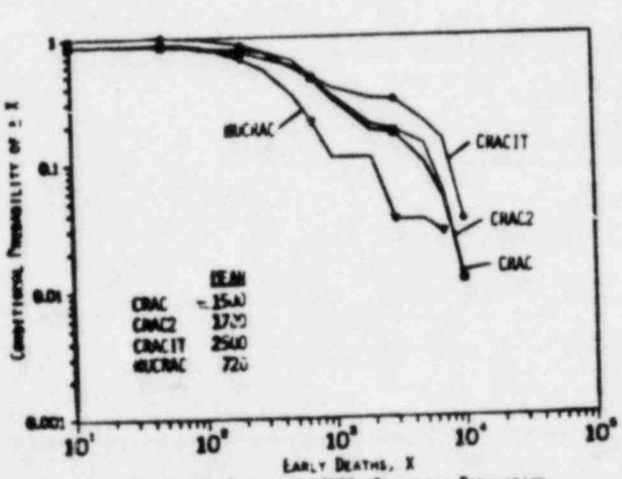

Figure 12. Problem 6, BWR3, Realistic Population

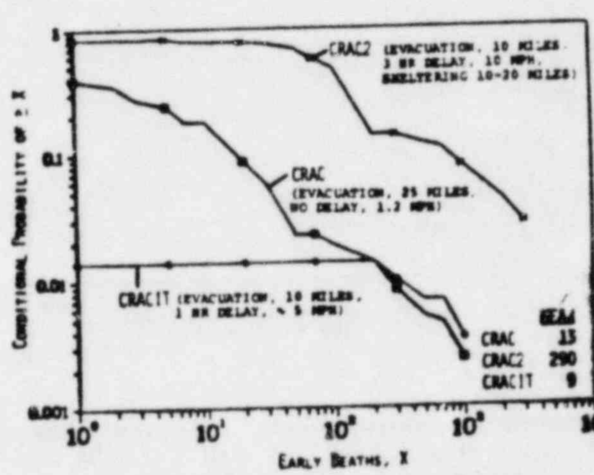

Figure 13. Problem 7, BWR1, Realistic Population