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June 28, 1979

Mr. Mike Hawkins
U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Washington, DC 20555

Dear Mr. Hawkins:

Bill Immerman has brought to my attention the fact that you have inherited the indirect management responsibility for the Consequences of Adversary Actions in the Nuclear Power Fuel Cycle" program, the contract for which was let through BNL. This program in various phases has been in existence for three years. Therefore, it would seem that a summary of its history might be helpful to you.

In the late spring of 1976 phase 1 of a three phase program was implemented at SAI, funded by NRC through the Technical Support Office of BNL. Phase one was intended to prepare a comprehensive set of descriptions of radionuclide releases which might conceivably result from adversary actions in the nuclear power fuel cycle. The final report of phase 1 was also to contain initial estimates of the consequences of these events in terms of health effects and property damage. The final report of this work (Adversary Actions in the Nuclear Power Fuel Cycle: I. Reference Events and their Consequences) went through several iterations, the final version being dated October 1977. It has not been published, apparently in anticipation of a more complete report at the end of the final phase of the effort.

Consequence estimates of Phase 1 were performed using the Reactor Safety Study methodology code CRAC (Consequence of Reactor Accident Code) and initial estimates of release inventories for each event. Phase II was intended to examine the shortcomings of that approach and to describe available methods, if any, which might more adequately deal with the wide range of release characteristics of interest in this study. The final report of that phase (Adversary Actions in the Nuclear Power Fuel Cycle: II. Assessment of Methodology for Consequence Estimation, 23 March 1977) was updated in November 1977. This report was intended primarily as a guide for the implementation of Phase 3 of the study. Therefore, it was not published.



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Phase 3 of the program, an all-out effort to use the most applicable available technology to estimate the character of each postulated release and the consequences thereof, was begun in the late summer of 1977. It was due to be completed in one year. The method of consequence estimation (NUCRAC) was to be built on the framework of the old CRAC. Thus, the code could be used to produce interim results at various stages of completion. In the spring of 1978, Mr. Dave Mathews, NRC(NMSS), requested that consequence values be generated for several events pertaining to spent fuel storage. This was done and the results presented in an interim report (Adversary Actions in the Nuclear Power Fuel Cycle: Events at a Spent Fuel Storage and Receiving Facility, May, 1978).

Phase 3 of the project was not completed on schedule. In fact it is still not completed. The reason for this is the difficulty encountered in attempts to modify a very large and complicated consequence estimation model (CRAC) to handle ranges of parameters which it was not originally intended to treat. The two major areas of modification were the pathways to man for radionuclides in the biosphere and the atmospheric transport of released particulates. The existing CRAC pathway model consisted of two compartments, milk and all other foodstuffs, which were used to determine a representative individual dose. This was then multiplied by a supposed exposed population to obtain population dose and expected latent cancer incidence. This model depended heavily of the weapons-fallout-like nature of postulated reactor accident releases and suffered from the lack of any explicit measures to conserve released activity within the pathways considered. The NUCRAC replacement routine contains six pathways: milk, meat, fresh vegetables, corn, wheat and other. Population dose is calculated on the basis of total activity consumed, specifically taking into account conservation of activity at each step. This model was implemented in NUCRAC in the fall of 1978.

The creation of a new atmospheric transport routine has been by far the greatest headache and source of delay within the program. CRAC treated such transport as resulting from a single puff of particulates, vapors and gases. Particle size was assumed to be a uniform 1 μ activity median aerodynamic diameter (AMAD) everywhere. Air and ground concentrations were calculated on the basis of an undepleted cloud which was normalized to conserve activity subsequent to the transport calculation. NUCRAC on the other hand must treat some particle releases having AMAD values as high or higher than 100 μ, having varying densities and covering many kinds of terrain. Also, it is felt that the model must take into account the continuous depletion of the cloud in order to avoid overestimating concentrations at large distances from the source. Accomplishing all this within the basic CRAC format with its radially

varying atmospheric conditions has been a most difficult task, though we have been encouraged in our efforts by Roger Blond, the NRC guardian of CRAC.

The basic model for atmospheric transport in NUCRAC was initially implemented in the fall of 1978. However, difficulties were encountered almost immediately. As each such problem has been disposed of a new one has cropped up. In fact, though the theoretical model on which this routine is based has remained unchanged, the logic of its implementation within NUCRAC has been completely changed from that tested a year ago. We are currently testing this latest version and will generate the consequence data base for the final report as soon as we are satisfied that the program is behaving as designed.

It is our intent to first produce a new data base to replace that found in the interim report on spent fuel storage-related events. This is being done in order to support the needs of NRC(NMSS) in a timely manner and will not impact the final report production schedule, once NUCRAC is in order. I expect that the final report will be in your hands one month after that occurs, which I believe to be shortly.

If you have any questions regarding issues raised in this letter or on other matters, please call me at (312) 885-6800.

Sincerely,

Dean C. Kaul

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