



UNITED STATES
 NUCLEAR REGULATORY COMMISSION
 WASHINGTON, D. C. 20555

T
 6. 3044
 11/1/77
 Action - Zimmerman
 File 15



OCT 28 1977

MEMORANDUM FOR: Frank J. Arsenault, Acting Director
 Division of Safeguards, Fuel Cycle
 and Environmental Research

FROM: Robert F. Burnett, Director
 Division of Safeguards, Office of
 Nuclear Material Safety and Safeguards

SUBJECT: CONSEQUENCE ESTIMATION STUDY

Your memorandum to me of October 4, 1977, seeks our views concerning the relevance and use of clandestine fission explosive consequence estimates for drafting environmental impact statements; the value of authoritative estimates of CFE consequences to counterbalance nonauthoritative estimates; and the existence and adequacy of estimates currently available to NRC. You asked for these views by way of clarification of the NMSS qualified endorsement of the consequence estimation study; which endorsement did not extend to the consequences of a CFE. I hope you find the following responsive to that request.

Available estimates for the consequences of the detonation of a CFE are based, for the most part, on data derived from the nuclear weapons test program. Widely circulated consequence estimates for detonations in the range of one ton high explosive yield to one megaton equivalent are to be found in Willrich and Taylor's "Nuclear Theft: Risks and Safeguards". It is recognized that these data, derived primarily from Glasstone's "The Effects of Nuclear Weapons" may be significantly in error, and not directly applicable to the estimation of consequences in, for example, urban areas, since they do not take into consideration shielding and other effects urban structures may exert on CFE detonation phenomena.

Indeed, Taylor et al., in a study for the NRC ("Utility of Strategic Special Nuclear Materials for Unauthorized Purposes" - SECRET), point out with respect to determining weapons effects in urban areas, that data based on the classic work edited by Glasstone. . . "are, in many cases, oversimplified "cookie cutter" (estimates) that may be significantly in error. In several cases, particularly those involving explosives inside or adjacent to very large buildings, the simple-minded damage (estimates) may be qualitatively wrong. . ." Taylor et al., are referring, of course, to the shielding and other effects of structures which an adversary may not, or cannot take into account, possibly leading to erroneously high estimates of the damage capabilities of a nuclear device.

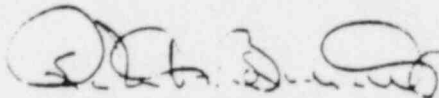
In anticipation that somewhat more data than were available in the open literature on consequences of nuclear explosions might be required for the Safeguards Supplement to the GESMO, NMSS GESMO staff sought an additional source for that information. The services of Harold Brode, an individual knowledgeable in the effects of nuclear weapons, were obtained and his calculations incorporated into the Safeguards Supplement (Draft Safeguards Supplement to the GESMO; pp. 3-34 to 3-35, July 31, 1977). Employing methods outlined in his paper "Review of Nuclear Weapons Effects" (Annual Review of Nuclear Science, Vol. 18; pp. 153-202, 1968), Brode calculated damage radii for various effects of nuclear explosions of 1 to 100 tons and 1 to 20 kilotons high explosive equivalent yields. It was granted here as well that damage estimates based on these calculations would err on the side of conservatism, in that they do not allow for shielding and other effects as may be present in urban or other environments. That is to say, direct application of these data to specific locations, urban or otherwise, would yield mortality and damage estimates in excess of those which would likely occur in an event within the explosive yield parameters examined.

Reviews of these estimates by outside consultants, the Commission and Commission staff, and NRC technical staff raised no significant questions concerning the use of these data in a supplement to the GESMO.

The figures for mortality and property damage which could be derived from the use of Brode's data (or, for that matter, from the use of Taylor's data as well, although it is not as detailed) for any environment in which property values and population densities are the prime variables, will inevitably lead to conservatism in the estimation of consequences of detonating a CFE. Attempts to refine these estimates through estimating the consequences of a CFE involve adopting a number of assumptions concerning the characteristics of a range of possible CFE designs. Additional assumptions would be introduced into the estimation methodology concerning spatial and temporal environmental characteristics, and the ranges of associated population densities. Consequence estimates for the detonation of a CFE would, by the nature of the parameters associated with the methodology for determining such estimates, encompass ranges of values which in themselves would appear to bear no unique utility or advantage over values obtainable through estimation methodologies currently available.

In summary, the position of NMSS staff that continuing to fund an effort to add refinements to presently available methods for estimating consequences of a nuclear explosion, in terms of mortality and property damage, is not responsive to NMSS needs, is based on the opinions that developing a more refined methodology for estimating consequences of detonating a CFE of assumed characteristics in some model or model environments is unlikely to affect NRC policy as regards safeguards or environmental issues; the NRC is capable of credibly examining, on case by case bases, non-authoritative estimates of the consequences of a CFE with the data and resources presently available; and the existing conservatisms in safeguards philosophy, as well as in the methods for estimating the consequences of such an event, are felt to be adequate and appropriate to NRC's missions, responsibilities, and objectives.

We appreciate your interest and the opportunity for continuing dialogue on this matter. If we can provide you with further information, please contact T. S. Sherr.



Robert F. Burnett, Director
Division of Safeguards, NMSS

cc: C. V. Smith, Jr.



June 14, 1977

Dr. John Cusack
Technical Support Organization
Brookhaven National Laboratory
Upton, New York 11973

Dear Dr. Cusack:

Reference my letter to you, dated 13 May 1977, pertaining to a proposal for the continuation of the consequence estimation analysis effort (BNL Contract No. 374708-S (Task 2)).

On Thursday, 2 June 1977, I met with you and members of the Nuclear Regulatory Commission Safeguards Research staff concerning the referenced proposal. As a result of that meeting, it is my understanding that general agreement exists concerning the scope of work and level of effort to be applied in Phase 3 of the Consequence Estimation project. In reaching this understanding, particular attention was paid to the description of contract deliverables as presented in the Schedule and Report section of the referenced proposal. As a result, this description has been somewhat modified to be more consistent with Phase 3 project goals as discussed at the meeting. A copy of the modified section is enclosed and is intended to replace that portion of the referenced proposal.

If you have any questions concerning this matter, please call me at (312) 885-6800.

Sincerely,

Dean C. Kaul
Dean C. Kaul
Principal Investigator

May 13, 1977



Dr. John Cusack
 Technical Support Organization
 Brookhaven National Laboratory
 Upton, New York 11973

Dear Dr. Cusack:

Reference

- a. Letter from Larry Kull (SAI) to John Bergren (USNRC), pertaining to a proposal for consequence estimation research, dated 15 March 1976 (Encl. 1).
- b. My letter to you, pertaining to a proposal for the continuation of the consequence estimation analysis effort (BNL Contract No. 374708-S (Task 2)), dated 12 April 1977 (Encl. 2).

A little more than one year ago, a contract was let according to the general tasks laid out in Reference a. for the analysis of the consequences of adversary actions in the nuclear power fuel cycle. The objective of this program was to provide a state-of-the-art estimate of the consequences of selected reference events to be used in a manner analogous to the Reactor Safety Study, i.e., to affect procedures and priorities, in this case within the safeguards system.

Of the three phases originally envisioned, two have been funded, completed, and the final reports submitted for your review. The objectives of these two phases were to produce a definitive listing of candidate reference events along with a first approximation of the relative consequences of each and to lay out a plan by which consequences could be evaluated in a manner which is consistent with the state-of-the-art of the various sciences involved.

On the basis of the favorable and constructive comments received concerning the results of the first two phases, I have submitted a proposal (Reference b) for the interim support of Phase III of program effort. The goal of this phase would be to implement the acquisition and development of the methodology as recommended in Phase II and apply it to the reference events as selected in Phase I. The proposal for interim support contains a general description of the work to be pursued in Phase 3 and an estimate of the total cost as well as that of the smaller portion of work for which a specific estimate is provided.

Page 2
May 13, 1977
Dr. John Cusack

This letter forwards a proposal for the completion of Phase III as a whole. As such, it is consistent with my earlier submission, which may be used if incremental funding is desired.

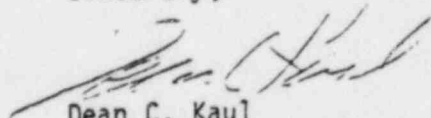
Project Organization

Though specific descriptive parameters may vary from event to event, the methodology sequence used in consequence estimation for each is virtually identical. Therefore the proposal is not organized along the lines of reference event categories but along the lines of that sequence by which the many disparate technical disciplines are strung together to produce viable consequence estimates. That sequence of technical disciplines has been broken down to produce a work scope in five parts, each corresponding to a section of the Phase II final report. These parts are:

1. Nuclear Explosives,
2. Environmental Release,
3. Atmospheric Transport,
4. Pathways to Man and Human Dosimetry, and
5. Health Effects and Property Damage.

Each has been subdivided in specific tasks which reflect the relative level of effort required for the acquisition, modification and development of methodologies in each technical area.

Sincerely,



Dean C. Kaul
Principal Investigator