SECRET

December 12, 1962

Dr. Vincent McRae
Technical Assistant
Office of Science and Technology
Executive Office Building
Washington 25, D. C.

Dear Dr. McRae:

I am enclosing a copy of the draft TAB report recently submitted for Dr. Gerald Johnson's comment. Also enclosed is a copy of the DASA-DODDAC supporting report as I discussed with you. If you have no use for this report I would appreciate its return.

I am also sending some material for you to thumb through having to do with how the TAB program is being set up, our approach to the nuclear war study problem and the scope of the problem as we see it. Much of this material is preliminary or even in draft and I would appreciate it if you would receive it accordingly. If you need more information please let me know.

Sincerely yours,

Distribution: DASA-DODDAC Report, Cy 14 (NE) SRD
The Biological & Environmental...Weapons, cy 1-C SRD

Hal Hollister, Chief
Technical Analysis Branch
Division of Biology and Medicine

cc: Dr. Lough

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12/12/62

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(July 14, 1947)

U. S. ATOMIC ENERGY COMMISSION

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DATE MAILED

Dec. 12, 1962

TO

Dr. Vincent V. McRae
Technical Assistant
Office of Science and Technology
Executive Office Building
Washington 25, D. C.
Attn: Mr. Graff Rm. 207

FROM

Mr. Hal Hollister, Chief
Technical Analysis Branch
Division of Biology and Medicine
US Atomic Energy Commission
Germantown, Md.

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	11/26/62	Preliminary draft of "Nuclear War Damage Assessment in the Government in Relation to the needs of the TAB Program Conf. DI		
		A group of papers in draft form with cover sheet entitled "Illustrative material explaining both the thinking and budgetary actions for the TAB Program." OUO		
		Methods.... and Over-View .... with covering note dated Sept. 13, 1962 OUO		
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Briefing of Dr. McRae, December 12, 1962:

1. Government damage assessment (by computer) is very gross as now done; we both agreed on that
2. He feels that a total program should include appropriate experimental work to be effective; on this I agreed but pointed out that right now experimentation is not the first order of business
3. He described his idea of the total program as one directed to the question of what happens and what to do after one comes out of shelter; this is much as Harold Mitchell has portrayed the problem, with which I agree (but up to date, now plans for TAB include the whole recovery problem)
4. In speaking generally of post-attack work, he indicated a feeling that it would have to be placed in one or more (probably more) technical centers (which I also agree with)

With respect to TAB program:

1. There is no question about a close working relationship with analysis groups in the DOD; the only question is how (this is apropos a TAB-WSEG tie, or for an institute)
2. We are not necessarily talking, especially at first, about a large technical analysis group; rather a small group (1x to 3x JIGSAW) located in a large technical center

ORIG: TAB rdr
cc: Dr. Lough

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11/26/62
Preliminary

NUCLEAR WAR DAMAGE ASSESSMENT IN THE GOVERNMENT IN RELATION TO THE NEEDS OF THE TAB PROGRAM

The following paragraphs give a brief discussion of our understanding of damage assessment activities within the Government. Details have not been verified.

1. By "damage assessment" is meant at least two things: (i) receiving actual information, eye-witness or from instruments or otherwise, after an actual attack and summarizing/analyzing this information to arrive at an over-all assessment of damage before detailed on-the-spot assessment can be put together; (ii) in peacetime, using assumptions about an attack along with conceptual models for damage estimation to arrive at an over-all assessment of damage, all hypothetical. The first of these clearly puts emphasis on speed of communications and speed of calculation. The second would seem to require more emphasis on a research point of view.

2. There are several groups engaged in making damage assessments by calculation:

a. The National Resources Evaluation Center (NREC) Office of Emergency Planning, is primarily concerned with damage on the United States, its civilian population and economy. The computer group is staffed by Army Corps of Engineers personnel. The basic technical and economic information for estimating damage is gotten from other agencies such as Agriculture, Labor, etc. Some model development is supported by NREC itself. Emphasis is on damage assessment in sense (i), (hence the classified location in relation to post-attack civilian command and control) but with a tendency toward more emphasis on (ii).

b. The Department of Defense Damage Assessment Center (DODDAC) is administratively a part of DASA.1/ It emphasizes military damage but has some capability for civilian population and economic damage

1/ As of this date. Indications are it will be transferred to the new Defense Communications Agency, thus emphasizing damage assessment in sense (i), with a close relationship to military command and control.

assessment. Capability includes effects on the Sino-Soviet Bloc as well as on the U.S.A. The staffing, as for DASA itself, is primarily rotating military personnel. This group is a year or two old. It also uses models and data primarily developed elsewhere though there is some interest in the staff of DODDAC to develop better models for themselves. Emphasis is on damage assessment in both senses (i) and(ii) about equally.1/

(c) The Air Force Deputy Chief of Staff for Intelligence maintains a damage assessment capability within AFCIN. Primary technical responsibility is located in the Targets Division, especially the Physical Vulnerability Branch. Staffing there is military and civilian, primarily military. Emphasis is on damage assessment in relationship to Air Force offensive military planning, i.e., targets abroad (damage assessment in sense (ii)). The P.V. Branch has developed a considerable amount of information on the physical vulnerability of targets to blast. They have also developed a fallout prediction model.

(d) The non-civil service Institute for Defense Analysis Weapons Systems Evaluation Group has some damage assessment capability, probably less detailed than any of the above but more likely to lend itself to flexibility appropriate to research. (WSEG's fallout model has been used by DODDAC and NREC.) This is clearly damage assessment only in sense (ii). The important feature of this group is, however, that they have an extensive scientific staff in such fields as physics, mathematics, economics, and operations research (but not biology).

(e) The RAND Corporation has been engaged in work supporting damage assessment, including the development of a quick-running

1/ But see footnote on page 1

computer model for SAC. It is difficult to cite RAND's experience formally. The nature of their organization tends to blend this experience in with much of their other applied theoretical analysis work. RAND's general scientific capability is well known.

(f) Standard Research Institute, Technical Operations, Inc. ...

3. A complete nuclear attack problem - starting from the attack assumptions, the shelter and population assumptions, through to an estimate of the prompt effects - is well beyond the present scientific and administrative capability of TAB to carry out. Nevertheless, demands for comprehensive effects assessment exist because such information is the principal input to the longer-term effects estimate. To begin to meet them, TAB depends upon cooperative arrangements with NREC or DODDAC. These damage assessment groups, TAB, and the problem "customer," whoever he may be, have so far worked in roughly the following relationship:

(a) The "customer" poses the problem. This may be done fairly comprehensively, including specification of exact targeting, weapons sizes, shelter assumptions, etc., or more intuitively, by simply asking a question, in which case the more complete problem specifications are worked out between TAB and the damage assessment group.1/

(b) The specific targeting assumptions are not provided by, or necessarily even known to, TAB.

(c) To carry out the prompt damage assessment estimates, (e.g., prompt casualties and fatalities, livestock exposure, land contamination levels, etc.) the damage assessment group relies upon previously developed or acquired information, mainly of two parts:

1/ It is usually this step that gives the problem its (usually high) degree of classification.

(i) calculation models, whose purpose is obvious; examples are a fallout model, an infinity plane radiation dose model, a radioactivity decay model, a biological injury model, etc.

(ii) a so-called "data base," whose purpose is to provide the initial input conditions for the problem, e.g., the initial distribution of the population, or of shelters, or of livestock, land area, etc.

(d) Up to now TAB has not controlled either the models nor the data base. TAB has been able, however, to request changes in the models - mostly extensions found to be feasible which would lead to estimates not previously carried out, e.g., cumulative gamma dose (in addition to equivalent residual dose), deposition levels for specific radionuclides (in addition to deposition of gross mixed fission products), etc. TAB has also been able to arrange for consideration of more complicated conditions of shelter occupancy.

But these extensions are mainly just that, with the result that TAB estimates are tied to the methods and assumptions used by the damage assessment groups. Some of these are not in areas of subject matter familiar to TAB, or even AEC, but others are.

4. A major question for TAB's future is thus posed: what relationships or arrangements for damage assessment as an applied research problem are desirable? TAB probably has several choices:

(a) Major reliance upon two Government damage assessment groups (NREC and DODDAC) for support, perhaps tied into an effort by TAB toward improving both the models and the data

base used and a commitment by the groups to use the "improved" methods of estimation at least for calculations in support of TAB's studies.

(b) Development of an entirely separate damage assessment capability with superficially similar objectives but actually a quite different orientation and differing characteristics. The orientation would be toward applied research or analysis and the development would center in a place where a competent research and analysis staff was already established.

(c) Some combination of (a) and (b).

5. Table I-A illustrates some ideas on the development of a research-oriented computer damage assessment system.

TABLE I-A Preliminary

Requirements for a Computer Damage Assessment System for TAB Studies

1. The basic objective for such a system is to provide a way of calculating an estimate of the direct effects of a multi-weapon attack on some large geographical area such as the U. S. within reasonable limits of time and expense; the calculation must, furthermore, meet certain requirements as specified below.

2. Such an estimate serves primarily as the input for the subsequent estimation of longer-term effects.

3. The calculation should include an estimate of the associated error, which will be of two types: systemmatic (resulting from incorrect assumptions), and pseudo-random (resulting from the use of a sample to represent a whole population). Investigation of the effect of such errors on the calculation as a whole is particularly important. Such an investigation can be carried out primarily through so-called sensitivity analyses (choose different assumptions and see how the results change) and repeated random sampling (so that variances can be estimated).

4. The calculation should include a degree of technical detail concerning free-field and attenuated weapons effects and target response so that the detail of the estimates will be in keeping with the questions to which the estimates are supposed to relate. Thus, if somebody wants an estimate of the first generation genetic effects of internal emitters, we must make an internal emitter calculation, which requires considerable attention to detail in estimating debris partitioning, fractionation, particle size, foliar retention, etc. Or, if we are to look at the post-attack availability of livestock, we must pay some attention to their pre-attack distribution and vulnerability.

Characteristics of a Computer Damage Assessment System for TAB Studies

1. The geographical area of interest will be represented as a two-dimensional surface on a sphere or plane. Thus, a coordinate system is used.

2. This surface can be sampled systematically by the definition of a grid-mesh. Perhaps two sizes of mesh should be used. A mesh point will represent the unit area.

3. Such a point sees all weapon events affecting it, as determined by models representing blast pressure, thermal radiation, prompt ionizing radiation, and residual radiation (local fallout) vs. distance and time.

4. There is an auxiliary routine for sampling the grid points randomly, with a choice of sample size. Stratified random sampling is also possible.

5. Means and variances will be computable for all important output quantities studied.

6. Inputs will consist of four types:

   a. Assumptions about the attack itself
   b. Assumptions about the attack environment (winds, etc.)
   c. Assumptions about the distribution of pre-attack resources and populations
   d. Assumptions about free-field and attenuated weapons and target responses

7. Resource information (e.g., shelter protection available) can be put into the system in either of two ways:

   a. Into the coordinate system, point by point
   b. As a statistical distribution function which can be sampled.

8. Small systematic differences can be studied by re-running identical random samples with altered initial conditions, and treating the individual differences as a normally distributed random variate.

8. Outputs will be detailed enough to show the shape of an appropriate statistical distribution or of an ordinary mathematical function of space and time.

9. The print-out possibilities will be flexible.

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UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D.C.

September 13, 1962

A NOTE ON THE ENCLOSURE

Enclosed is an outline summary of the AEC/TAB program on the biological and environmental consequences of nuclear war as we are beginning to conceive of it. This document includes an examination of implications on national policy of such studies as we propose to undertake (outline topic #1). This is done because we feel it is quite important to develop such a potentially broad program as ours with some fairly clear notion of goals.

Because of the policy implications of this document it has been marked "Official Use Only". We would appreciate your cooperation in regarding this as for your use and that of your interested immediate staff. We would like to have your reactions.

Thank you very much,

Hal Hollister

Hal Hollister, Chief
Technical Analysis Branch
Division of Biology and Medicine

See "Distribution" folder for addressees

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THE TAB PROGRAM: AN OVERVIEW[1]
(Outline)

I. Purpose and importance to national security policy of information on post-attack environment (Why study nuclear war?)

-Is it possible that previous decisions have been made without an adequate understanding of the post-attack environment?

e.g., decision to produce the hydrogen bomb
e.g., decision to locate ICBM's on land and in "hard" sites which are likely to attract heavy attack with such consequences as heavy local fallout from ground bursts
e.g., decision to defend Western Europe with nuclear weapons

-Nuclear strategy and weapons programs should preferably be adopted with an adequate understanding of their potential biological and environmental consequences

A. Strategy and foreign policy

-TAB's program becomes more important with any shift in emphasis from all-out (or spasm) war to controlled war

e.g., President Kennedy's special message on the defense budget on March 28, 1961: "Our weapons systems must be usable in a manner permitting deliberation and discrimination as to timing, scope, and targets..."

-The formulation of strategic policy, military planning, and weapons development and procurement require an understanding of the prewar and wartime constraints which can affect the post-attack situation

e.g., should targets be limited to military objectives? Is reliance on a relatively invulnerable system like Polaris which can be used against cities but not against "hard" missile bases likely to lead to a war in which people and property are primary targets?

e.g., what would be the consequences of a major shift in fission to fusion ratios?

e.g., how much early warning is important?

1/ For presentation to the joint ACBM-Biomedical Program Directors' meeting, Germantown, September 13, 1962

B. Air defense:

-given a reasonably accurate forecast of reliability what protection would be afforded by:

1. a defense against ICBM's only?
2. a defense against manned bombers but not ICBM's?
3. a defense against both ICBM's and bombers?
4. a defense designed to protect only our retaliatory forces?
5. a defense designed to protect people and cities?

C. Civil defense:

Planning for civil defense requires a realistic understanding of what we are planning against; e.g., the effect which fire, radiation, epidemics, malnutrition and radiation from internal emitters, within a context of intense psychological shock, social disorganization, economic breakdown and civic disorder, will have on countermeasures and subsequent recovery potential.

D. Recovery:

-despite its obvious importance, this problem has never been studied adequately, which may be part of the reason why the nation's civil defense program has had hard going in Congress
- some questions are:

-in what circumstances is recovery possible?
- how is recovery effected by prewar offensive and defensive postures?
-are there feasible military constraints which allow for building a recovery "hedge" into national strategy and weapons programs?
-what kinds of wars lead to what levels of recovery potential?

E. The spread of nuclear weapons to other nations:

-four countries now have nuclear arsenals
- nineteen more, including Communist China, are capable of producing nuclear weapons (according to a report by a committee of the American Academy of Arts and Sciences).
-this kind of development could generate nuclear wars of unknown consequences. Both minor and major powers might become involved.

F. Arms control:

Changes in policy which appear to be small could make large differences in the kinds of war that might be fought and their consequences.

e.g., a cut-off in weapons production and/or a reduction in the size of stockpiles
e.g., limits on delivery systems
e.g., the establishment of nuclear free zones

e.g., institutionalization of a stable balance of terror implemented by the presence of large opposing nuclear arsenals

II. The TAB Study Program:

A. General focus: biology

-the general subject is the biological, including the bioenvironmental or ecological consequences of nuclear war
-the emphasis on biology does not exclude other subjects, but biology is the central focus toward which other subject matter should point

B. Primary study fields:

1. bioeconomics: application of rational theories of value and decision-making processes to problems on ecological systems

2. bioengineering: application of biological science (and its underlying physical sciences) to control or alteration of our environment with due consideration to economic and social factors (agriculture, forestry, fisheries, etc.)

3. medicine and health, with special attention to recovery:

   a. communicable diseases
   b. cancer and other latent effects
   c. genetics
   d. possible malnutrition in combination with other effects
   e. interacting effects; e.g., physical and emotional strain resulting from exposure to weather, disease, and shock, etc.
   f. suggest the need for pre-war establishment of post-attack policies and standards for a - e

4. food and agriculture problems

5. radiobiology and radioecology

-because this is an AEC program, even within the biological core there is an inner core of subject matter: the biological effects of radiation (and to some extent, blast and thermal radiation) generated by nuclear war

C. Secondary fields of study:

-these subjects are important because they provide an information base and affect the analyses of the core subject

1. primary weapons effects, both free-field and attenuated
2. prompt damage assessment
3. shelter protection
4. population distribution
5. livestock distribution
6. design of computer programs

-many existing ones are not intended for research and are cumbersome for TAB's purposes

D. Direction of study program: problem oriented

-TAB's role is to ask and to stimulate others to ask fruitful questions (not detailed observational data or inquiry directed to inadequate questions). This is achievable through "feed back" and difficult study and analysis by an interdisciplinary research staff, supplemented by special-purpose contracts which in effect extend the reach of the TAB staff.
-the primary objective is not to advance the frontiers of knowledge in fundamental areas of science. (There is no plan to sponsor experimental research.)
-the primary objective is to enhance the ability of the Government to think fruitfully about those aspects of nuclear war included in our subject matter by
  a. formulating a point of view toward the subject
  b. applying this point of view by making theoretical analyses of particular problems, and
  c. developing ideas for other studies to be carried out by groups in other agencies.
-TAB is not responsible for operational planning of civil defense and post-attack reorganization or for the procurement of experimental research data on any aspect of the subject

III. Standards for evaluating TAB's performance:

A. TAB's efforts must influence the Government's viewpoint toward the biological and ecological aspects of the post-attack environment

B. TAB must identify major omissions in existing research programs in order to prevent unexpected shortages of information and insights on problems which will arise in the future

C. TAB must stimulate the growth of other analytical groups to work on the many problems which are outside the scope of TAB's own direct program but essential to an understanding of the post-attack environment.

Thus, TAB is to be thought of as a "think" group. Hopefully, the program will be formulated within and guided by these constraints.

IV. Major routes of communication for the information developed through the TAB program

A. TAB is asked to carry out specific studies of nuclear war effects for various Government agencies

1. these requests of themselves provide leverage which TAB can use to improve the quality of information developed by others relating to studies
   e.g., cooperation with damage assessment groups
2. the results of the studies are presented in written form, offering an opportunity to comment upon the adequacies of present information or analysis methods and to suggest improvements
3. the very nature of the requests is an indicator of what others in the Government may be concerned about as they study nuclear war

B. TAB endeavors to develop and keep up direct personal contacts with other Government agencies such as OCD, OEP, USDA, DOD

C. Within the DBM program, immediate opportunities for wide contacts in such fields as radiobiology, ecology, health physics, weapons effects, etc., exist

D. Numerous opportunities exist for discussion with the Commission and its staff and the advisory groups, or for more formal communication, as the TAB program develops

E. By supplementing TAB's own staff by study contracts with other groups, the program is extended to include other people who can contribute themselves and by discussion with still others.

F. TAB will probably undertake some formal study of Government organization for working on post-attack problems.

Appendix

The following items suggest the scope of a look at nuclear war, focussing on the post-attack bioenvironmental situation.[1]

The pre-attack preparations

- -early warning
- -shelter

Kind of war

- -size of attack
- -geographical distribution of weapon bursts
- -size of weapons
- -fission yield
- -type of burst (air, land surface, etc.)
- -time of year, month, etc., and duration of attack
- -weather conditions

Prompt effects

- -blast
- -thermal radiation
- -prompt ionizing radiation
- -residual radiation (fallout)
- -indirect effects, e.g., fire

Survival

Recuperation

- -economic
- -social and political
- -environmental
  - -demographic
  - -agricultural
- -medical
- -genetic

The post-attack environment presents problems, or unsettled questions, that are at least as diverse in nature and scope as our present-day environment presents. Look at the following brief list, for example:

Agriculture and food

- Soil management
- soil-plant relations
- animal husbandry and hygiene
- crop ecology
- irrigation, fertilization, pesticide, tillage, and other practices
- diseases and pests
  - -and, of course, all of the problems of food after it leaves the farm
- nutrition

[1] Adapted from Herman Kahn

Land Management

- Range management
- forest management
- river basin management
- wild lands management
- reservoir management

Ecology

- inter-species relations
- depressions or eruptions of populations
- epidemics, infestations, extinction

Public health

- direct weapon effects
- sequelae
  - communicable diseases
  - combined stresses

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