Site Visit to the U.S. Army
Environmental Support Group

March 7, 1986
Washington, D.C.

Advisory Committee on the CDC Study of the Health of Vietnam Veterans

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FOR CIRCULATION TO COMMITTEE ONLY
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Introduction

At the January 31, 1986 meeting of the Advisory Committee on the CDC Study of the Health of Vietnam Veterans, Mr. Richard Christian of the Environmental Support Group (ESG) invited the committee to visit his operation. The ESG is responsible for locating troops and spray paths in Vietnam. On March 7, a subset of this committee (Drs. Becker, Greenhouse and Weiss) conducted a site visit to the ESG; they were accompanied by Rita Schinnar (consultant to the Committee), Heather Miller (IOM Program Officer), and Professor Wesley Yates (University of California, Davis), an agricultural engineer and recognized expert in herbicide drift who has agreed to serve as an advisor to the committee on issues relating to herbicide spray. This report summarizes the March 7th site visit.

Those attending this site visit (hereafter referred to in this document as the subcommittee) heard a brief description of a pilot study now in progress at ESG that will be completed by early May. The objectives of the pilot study were (1) to identify problems in implementing strategies to locate troops and fixed wing sprays (Ranch Hand sprays) in Vietnam, and (2) to determine whether or not a sufficient number of veterans with possible exposure to Agent Orange can be identified using these methods.

The subcommittee was also shown a video tape of actual rotary wing and ground spray activities in Vietnam as well as Ranch Hand

operations. There was discussion about the techniques and frequency of perimeter sprays, and about the factors which affect spray concentration and, therefore, exposure (thickness of foliage, sun, wind drift, temperature, season, droplet concentration). ESG estimates (from Services Herbs and Ranch Hand Tapes) that approximately 10% of all Agent Orange used in Vietnam was applied by ground sprays, the remainder having been applied through Ranch Hand missions. Dr. Bricker of ESG estimated that only about 30% of the herbicide reached the ground when there was foliation coverage. He added that perimeter sprays applied the herbicide on previously sprayed areas where growth was sparse and ground more accessible to the herbicide.

ESG Operations

ESG has identified a total of 122 combat battalions which, between 1966 and 1969, operated in the III Corps tactical zone for at least a 1.5 year period. III Corps zone was the site of the most intensive Agent Orange spraying. From these 122 combat battalions, 65 were identified as having spent the longest period of time in that zone, and only these 65 will be included in the main Agent Orange Study (should it go forward). The main study will include 325 companies from these 65 battalions. ESG is charged with identifying the daily locations of operation for these companies from the last 3 months of 1966 through the first 3 months of 1969, using a hierarchical system of military record analysis to ascertain or infer the location of units. By relating information on unit location to information on location of Ranch Hand spraying of Agent Orange, ESG will classify the

companies as "exposed" or "not exposed" (i.e., either falling within or outside an exposure area). Finally, by reviewing military personnel files and identifying individual veterans serving in the respective companies, ESG expects to supply the CDC with the names of 8,500 subjects with "high" likelihood of exposure and 8,500 subjects with "no" or "little" likelihood of exposure. The CDC, in turn, expects to interview 12,000 subjects and conduct physical examinations on 4,000 of them.

To identify individuals with potential exposure to Agent Orange, the ESG is currently using the definition of "within 2 miles and 3 days" or "within 2 miles and 6 days" of a spray. ESG does not distinguish between "low" exposure and "no" exposure, but only attempts to determine whether or not a company was within the exposure area. The current study design calls for 2 cohorts, both to be selected from the III Corps tactical zone.

The pilot study includes 7 battalions (approximately 35 companies). These battalions were selected because they met the following criteria established by CDC:

(1) they had records available for the period October 1966 to March 1969;

(2) they had known "hits" and sizeable exposure to herbicide; and

(3) they required the least amount of record "gap" filling.

Some of the characteristics for battalions, such as "gaps" and "hits", were known from previous exercises in matching battalion locations with locations of sprays. A "gap" is defined as no location for 1 day

for 1 unit. If a unit had more than 60 gaps in a year, or if there were 30 consecutive gaps, that unit would be excluded from the study.

In the pilot study, the ESG makes reference to every military record possible to help track the locations of these companies. Each record is searched for location by grid coordinates, and each coordinate identified from records is verified by an artillery expert. The ESG told the subcommittee that its ability to make determinations on company locations has been hampered by CDC-imposed constraints. The ESG also pointed out that there is a considerable loss of numbers of veterans with potential exposure from the study because of CDC's stringent eligibility requirements. Specific examples of the ESG's objections to these requirements include:

(1) Inability to extrapolate location from non-grid data:
the ESG believes that for companies with missing grid locations or with missing dates, one can reconstruct location from careful analysis of battalion daily journals and ORLL (Operation Reports - Lessons Learned) reports. Using what is referred to as "contextual analysis," the ESG employs a fixed algorithm to fill in gaps, and feels confident in its ability to fill in the gaps by interpreting the contents of these records. ESG is using the contextual approach in the pilot study, but thus far has not been authorized to do so in the main study.

(2) Selection of subjects:
the ESG said that it could identify several cases where individuals had 10 or more exposures but were excluded from

the study because they do not meet another CDC eligibility criterion which specifies that subjects have 180 days of combat in a line unit within 1 year. If such subjects had 170 days of combat and were then moved into a headquarters unit they were not included in the study, regardless of the number of exposures which occurred prior to transfer.

(3) Selection of subjects:

All headquarters people are automatically excluded from the study. It has been presumed that one cannot keep track of the duties and activities of people on headquarters premises. However, the ESG believes (on the basis of personal observations and experiences of their personnel in Vietnam) that headquarters and firebase personnel may actually be more exposed than other field personnel due to repeated spraying of the perimeters of these bases by non-Ranch Hand operations. Ranch Hand operations were designed to drop 2-3 gallons of herbicide per acre, while perimeter sprays released 5-6 gallons per acre directly on previously sprayed areas with less dense vegetation. Perimeter sprays occurred approximately every 5 weeks. Another argument that the ESG presented which raises questions about the exposure of field troops involved the potential for exposure immediately after or during a Ranch Hand spraying. Fighter jets flew ahead of Ranch Hand planes to protect these slow, low flying aircraft from ground fire. It was well known that the fighters would occasionally have to strafe the spray path (approximately 260 feet wide, give or take 20 feet), thus decreasing the likelihood that Army

personnel would be located directly under a spray path.

(4) The ESG has instituted a quality control system. 5 percent of records abstracted in the morning and 5 percent of records abstracted in the afternoon are reviewed every day. When discrepancies or gaps were identified, a two person team worked out a solution to the problem. Because consensus among judges was used rather than assessment by a series of independent judges, the issue of interjudge reliability is moot. Quality control is also applied to gap filling and to keypunch operations. It should be noted, however, that when mistakes are corrected and gaps are filled, the ESG does not record the places or numbers of such occurrences. Hence, it is not possible to determine the proportion of data affected by quality control measures.

The following is a synopsis of the subcommittee's reactions to the pilot study and to other issues raised at the ESG site visit.

- The subcommittee is satisfied that the ESG is capable of determining locations and filling gaps using a contextual approach, and notes that the ESG exhibits a high degree of competence in recording data gathered from these activities.
- Although there is a significant amount of inference used to establish the locations of troops, the subcommittee was satisfied with the ESG's documented Standard Operating Procedure to fill in gaps, and was also satisfied with the methods used by teams or pairs to resolve questions which arose during contextual analysis.

- The subcommittee raised concerns about the degree of "blindness," on the part of individuals determining location, to a unit's level of exposure; however, they were assured by the ESG that location decisions are made independent of any information on exposure.
- The subcommittee was satisfied with the ESG's quality control program. However, they would like to see the ESG monitor the changes which occur from quality control measures in a more precise fashion.
- The subcommittee was concerned about the use of discrete categories to define exposure (e.g., exposure vs. non-exposure), and instead favors measuring exposure as a continuous variable. Indeed, the subcommittee favors the use of continuous variables whenever possible. The use of discrete categories in data collection stages essentially discards valuable information, and such data can be stratified for subsequent analyses.
- The subcommittee was perplexed about criteria established by CDC to select subjects, especially the 180 day cutoff for combat time and the exclusion of headquarters-based individuals exposed to perimeter sprays.
- The subcommittee strongly favors reinstituting the third cohort in the study (i.e., noncombat nonexposed veterans selected from areas in Vietnam outside the III Corps tactical zone) in order to have a comparison group of truly unexposed veterans. The subcommittee is less concerned about differences in samples imposed by selection of the third cohort from outside the III Corps tactical zone than it is

about the potential for exposure misclassification for individuals selected exclusively from within this zone.

- The subcommittee was impressed by several factors that were illustrated in the video tape on ground sprays. Airplanes and helicopters varied greatly in the precision of spray deposition of the herbicide. Spray from helicopters was often delivered through uneven-size holes crudely drilled into pipes attached to the helicopter or through equipment designed for insecticide application which produced much finer atomization which in turn carries a higher potential for drift. The equipment used in rotary wing sprays illustrated in the video tape represented technological improvisation - such devices were not designed for herbicide spraying; by contrast, fixed wing aircraft delivered standard size droplets (367 microns) from equipment specifically designed for this task. Leaks and crudely constructed equipment had the capacity to significantly vary the amount of herbicide delivered.
- The subcommittee was impressed by the contribution of wind to actual spray delivery. The video tape illustrated that, in the presence of wind, substantial horizontal deviation from the expected perpendicular spray path occurs. The subcommittee questioned the exposure of a person standing within 1 km of the spray path under windy conditions.
- The subcommittee was also impressed by the type of spraying that occurred from non-Ranch Hand delivery. Ground sprays used every conceivable type of vehicle and hand carried equipment. River banks, communication lines, and open

highways were regularly sprayed, as were the perimeters of headquarters and fire bases. The video tape clearly showed handlers of the herbicide who wore no protective garments, no masks, and sometimes not even a shirt. Individuals spraying from the back of trucks and men spraying from helicopters with open doors were visibly sprayed themselves as wind blew the droplets back on them. The ESG presented anecdotal data describing herbicide "spray fights," where men would hose each other down with Agent Orange or other substances just "for fun."

- The information on aborted missions also raised questions for the subcommittee. An aborted mission would dump up to 970 gallons of Agent Orange within a very small area. Data was presented on one aborted mission in which the dump occurred on a headquarters as the plane tried to land shortly after takeoff upon discovery of an engine malfunction. In at least one instance, headquarters personnel were exposed to the preponderance of 970 gallons of Agent Orange. There are 9 aborted missions on record which led to dumps plus 1 crash. The altitudes at which the dumps occurred varied from 150 feet to 5,500 feet.

The subcommittee met in closed session in the afternoon to summarize their impressions from the site visit. The subcommittee made the following observations:

* The subcommittee is concerned about the exposure which occurred though non-Ranch Hand sprays. While the Ranch Hand Study showed no significant increase in mortality or morbidity for men participating in fixed wing operations**, the subcommittee wondered about the risk for those who lived on the ground with low-dose chronic exposure from perimeter and other ground sprays. There was potential for exposure through air, water, dirt, food and "just clean fun." They expressed concern about the men who conducted the ground sprays and the ones who hosed each other for a good time. The subcommittee would like to see verification of anecdotal reports.

** [Ranch Hand Study summary from Michael Gough's "Dioxin, Agent Orange: The Facts:

The Ranch Hand Study compared the mortality statistics of the 1,269 men who participated in fixed wing Agent Orange spray missions to a cohort of other Air Force members who flew the same type of aircraft in Vietnam but who did not spray Agent Orange. To increase the power of the study, the non-Ranch Hand cohort was 5 times the size of the Ranch Hand cohort. The Ranch Hand cohort included men who shipped, handled and loaded Agent Orange, those who flew spray missions, and those who cleaned planed and equipment.

Overall death rates analyzed by race and occupation of subjects (i.e. pilot, navigator, flight engineer-enlisted, and other enlisted men) showed no statistically significant differences between the cohorts. Ranch Hand enlisted men,

who are thought to have a greater opportunity for exposure, has the same mortality rates as Ranch Hand officers. Mortality statistics by specific cause of death showed an increase in rates in Ranch Handers for homicide and digestive system disorders, but lower rates for cancer. No difference, however, was statistically significant.]

* The subcommittee expressed concern about the definitions currently used to determine exposure. Issues related to the use of continuous versus discrete variables to measure exposure as well as wind dispersion and distance covered by spray have already been discussed (above). However, there remain questions about time, including the relationship of troop location to spray location with respect to time, and the half-life of dioxin (dislodgeable from plant surfaces? on soil? in human tissue?). The committee questions how "time" and residues will be built into the determination of exposure.

* The subcommittee was impressed by the amount of information available to the ESG on issues related to spraying, including wind direction and velocity, temperature, time of spray, season, the specific substance sprayed, and type of aircraft used. However, there is some concern that such data appear "hard," and in fact, may be much "softer." It must be remembered that these data were collected under combat conditions and that accuracy remains a question.

* The subcommittee had questions about scoring individual exposures. The criteria used to define exposure and to define who will be included in the study seem arbitrary and

confusing. For example, if an individual was under a "dump" from an aborted mission, he would be coded as having a single hit. However, the actual exposure he received might be very much higher than that experienced by an individual 1 kilometer from a flight path on a windy day (who would nonetheless receive the same exposure score). If the individual experienced the dump within the confines of a headquarters base, as was the case for the aborted landing mission, he would not qualify for inclusion in the study. The subcommittee concurred with the ESG that there appear to be many exposed individuals who will be excluded from the study as it is now designed. The subcommittee questions the rationale for excluding headquarters-based companies from the study. They would like an explanation on how combat and noncombat duty relate to exposure, given that both types of duty can occur in a combat zone, and that both appear to give an individual the potential for exposure. In addition, the ESG has data on 1,100 individuals in the chemical units that were attached to each battalion. Chemical units were responsible for herbicide supply, and for herbicide distribution in non-Ranch Hand sprays. It is not clear that only chemical unit personnel were involved in ground sprays; other personnel may also have been used. However, the subcommittee concurred with the ESG that some special examination of these individuals is important. The subcommittee concluded that there appear to be different kinds of exposure, and that individuals were exposed under a variety of conditions; these issues need to be addressed

more carefully. The subcommittee finds the current definition of exposure to be inadequate.

* The subcommittee feels that the range which exists in types of exposure makes a strong argument for reinstating the third cohort (noncombat, nonexposed) in the Agent Orange study, since it appears that everyone in the combat zone had the opportunity for exposure.

* The subcommittee is under the impression that, in the main study, the ESG will only be responsible for determining the locations of companies and spray paths. Dr. Carl Keller's Science Panel of the Agent Orange Interagency Working Group is currently trying to define "exposure." The subcommittee strongly believes that the ESG should only be responsible for providing CDC with the raw data on locations. There was considerable interest expressed by individuals at the ESG in participating in modeling exposure data. The ESG has two of its employees on Keller's exposure-definition group (Christian and Bricker). The subcommittee does not feel that the ESG is qualified to conduct such analyses, and suggests that CDC should be responsible for all data analyses.

* In addition, the subcommittee, upon examination of the membership roster of Keller's Science Panel, was concerned about the thinness of expertise in certain areas. They expressed interest in knowing exactly who will be responsible for defining exposure and what criteria they will use to make this determination. Staff cautioned the subcommittee that he who finalizes the definition of exposure will be the one to determine if the Agent Orange Study will go forward. Staff

reminded subcommittee members that this is not an appropriate role for this committee.

[In response to the concern of the subcommittee regarding the panel defining exposure, and to similar concerns expressed by the CDC, staff have made an appointment with Dr. Keller to discuss the process and progress of his group in defining exposure.]

* The subcommittee would like to ask the CDC to clarify why they dropped the third cohort, why they are using cutoffs to define exposure, and how it derived criteria for eligibility.
* The subcommittee concluded that the ESG appears to be doing a reasonable job of determining locations, and the subcommittee is of the opinion that the contextual approach improves the quality of the data. However, they would like to see the ESG record the number of gaps filled in by contextual analysis, as well as the number of times disagreements are found in the data.

NATIONAL ACADEMY OF SCIENCES
2101 CONSTITUTION AVENUE
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INSTITUTE OF MEDICINE
MEMORANDUM

TO: Dr. Samuel W. Greenhouse
Dr. Scott T. Weiss
Dr. Marshall H. Becker
Ms. Rita Schinnar

FROM: Heather Miller HM

DATE: February 11, 1986

SUBJECT: Site Visit to the Environmental Support Group (ESG)

At the January 31 meeting, Mr. Christian extended an invitation to the committee to visit the ESG. Another invitation was extended by Dr. Flynn of DoD. Due to time constraints at the meeting, Mr. Christian was unable to describe the methods used to locate troops and sprays. He would appreciate the opportunity to present this information to you.

The date of the site visit will be March 7, as we discussed over the phone. In order to arrive en masse, we should meet at 9:00am in my office which is in the Joseph Henry building at the intersection of 21st and Pennsylvania Avenue, N.W., Room 751. Mr. Christian is expecting us at 9:30am. Should we get separated, his office is located in Room 210, 1730 K St., N.W. and his telephone number is 653-1828.

In addition to discussions about Ranch Hand spray location methods, Mr. Christian would also like to talk about ground perimeter spraying and aerosol dispersion factors. He would like to show us a videotape of the ground spray operations. Dr. Spear, the advisor to the committee on herbicide exposure, is unfortunately not available on March 7. I am now looking into the possibility of finding another individual with his expertise (in herbicide spray drift and ground spray issues) to participate in this site visit.

Our visit with Mr. Christian will probably take up most of the morning. I would like to meet with you after lunch to discuss the important points from the morning's presentation. I feel that it is important to be able to put in writing a brief summary of Mr. Christian's presentation as well as any assessment you may wish to make. This will enable us to keep the entire committee informed of issues and concerns as they evolve. In the event that you feel that a formal statement should be made to CDC, this summary will be extremely useful in drafting such a document. I would expect that we could complete this discussion by 4:00pm.

If you would like help with hotel reservations, please call Deborah Herbert at . If you have any other questons or problems, don't hesitate to call me at the same number. I am more easily reached in the morning. I look forward to seeing you March 7. In the mean time, you might want to take another look at Book 4: Exposure Assessment (brown handout book) which provides some background information on ESG issues.

INSTITUTE OF MEDICINE
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March 7, 1986

AGENDA

9:00am	Meet at the NAS, Joseph Henry Building Room 751, 21st Street, N.W. and Pennsylvania Avenue
9:30am	ESG Presentation Room 210, 1730 K Street, N.W.
12:30pm	Lunch - NAS - Joseph Henry Building
1:30pm	Deliberations, Preparation of Summary Statement NAS, JH-750
4:00pm	Adjourn