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Contract: VA-101-12-C-0006

## Discussion Points Concerning Blue Water Navy Claims

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Compensation Service

Department of Veterans Affairs

810 Vermont Ave., NW

Washington, DC 20420

August 23, 2013

Agent Orange Briefs:

Special Topics

 Brief No. 2

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**A. L. Young Consulting, Inc.**  
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August 23, 2013  
Mr. Michael D. Pharr  
Contract Officer's Representative  
Compensation Service  
Department of Veterans Affairs  
810 Vermont Ave., NW  
Washington, DC 20420

Dear Mr. Pharr,

Please find attached to this letter the Agent Orange Brief No. 2 titled : **“Discussion Points Concerning Blue Water Navy Claims.”** This Brief is the second of many Briefs that will be prepared upon request by Compensation Services to address special topics that are germane to issues supporting the *Agent Orange Investigative Report Series*. These Briefs will be prepared in fulfillment of Contract VA-101-12-C-0006, *Development of an Archival Directory of Agent Orange*

Sincerely,

Alvin L. Young, PhD  
Professor of Environmental Toxicology  
Colonel, USAF (Retired)

## **DISCLAIMER**

The conclusions reached in this report are based upon a comprehensive review of the historical records maintained in the publicly available files of the National Archives and Record Administration, and other archival repositories. However, the conclusions reached do not necessarily represent those of the Department of Veterans Affairs or any other Department or Agency of the United States Government.

This “Discussion Point Brief” is part of the *Agent Orange Investigative Report Series*, and should be considered as an amendable or living document. If additional authenticated documents or records are found that address the topic of this report, a re-evaluation of the conclusions may be necessary.

## DISCUSSION POINTS CONCERNING BLUE WATER NAVY CLAIMS

### BACKGROUND

The Department of Veterans Affairs contracted with the Institute of Medicine to conduct a study on whether the Vietnam veterans in the Blue Water Navy experienced a comparable range of exposures to herbicides and their contaminants (with a focus on dioxin) as the Brown Water Navy Vietnam veterans and those on the ground in Vietnam (i.e., specifically with regard to Agent Orange-TCDD exposure) [*Blue Water Navy Vietnam Veterans Exposure to Agent Orange, IOM, 2011*]. This study faced some very difficult evaluations since the Institute of Medicine has not defined what constitutes an exposure or a harmful dose of Agent Orange or its associated TCDD to Vietnam veterans, whether they were ground troops or Brown Water Navy sailors. Thus, the conclusion reached by the IOM was that **“the paucity of scientific data makes it impossible to determine whether Blue Water Navy veterans were exposed to Agent Orange-associated TCDD during the Vietnam War.”** Thus, notwithstanding the position of the IOM, it is possible to address from a practical and logical point of view the issues of Blue Water Navy exposure. This would require a different view of the historical records, the evaluation of spray drift, and an assessment of environmental fate.

### ALLEGATIONS BY THE BLUE WATER NAVY ASSOCIATION

The following are assumptions and allegations related to potential exposure of Blue Water Navy veterans to Agent Orange and its associated dioxin contaminant.

- Massive amounts of dioxin (TCDD) were contained in the Agent Orange and other 2,4,5-T herbicides that were sprayed over the jungles and water ways of South Vietnam, 1961 – 1970;
- The TCDD entered the aquatic environment and through solubility and movement on soil particles. The heavily contaminated water and sediments found their way to coastal lagoons and eventually to the open sea, where Blue Water Navy ships were stationed/patrolling within 5 miles of the coastlines of Vietnam;
- Simultaneously, RANCH HAND aircraft were conducting defoliation missions in and around coastal mangrove forests, and the drift from such missions directly exposed Navy veterans to the Agent Orange-TCDD; and,

- Since the water surrounding the ship was contaminated with TCDD, the multistage flash (MSF), multiple-effect distillation units on the ships concentrated the TCDD in the water by ten-fold.

## DISCUSSION OF ALLEGATIONS

### 1. DISCUSSION POINT: We basically know how much TCDD was in Agent Orange and other 2,4,5-T-containing tactical herbicides used in South Vietnam.

**FINDINGS:** In 1973, The Department of Air Force collected and subsequently analyzed 525 samples of Agent Orange from inventories stored on Johnston Island, Central Pacific Ocean, and at the Naval Construction Battalion Center, Gulfport, Mississippi. The mean concentration of the TCDD in the pooled datasets was calculated to be 1.88 ppm (parts per million). Analyses of 557 samples of 2,4,5-T produced during the years Agent Orange was used in Vietnam and subsequently collected by NIOSH was calculated to have an average concentration of 1.88 ppm, if that 2,4,5-T would have been in Agent Orange. What this means is that the dioxin concentration of the 2,4,5-T used in Agent Orange had the same dioxin concentration as commercial products containing 2,4,5-T in the United States at the same time. Thus, the total amount of TCDD in the Agent Orange used in Vietnam was between 230 and 265 pounds. In addition, the estimated amount of TCDD in the earlier tactical herbicides Purple, Pink and Green sprayed in Vietnam was approximately 55 pounds. Thus, the total amount of TCDD in South Vietnam was between 285 and 320 pounds [*Young et al, 2<sup>nd</sup> Agent Orange and Dioxin Remediation Workshop, Hanoi, Vietnam 18-20 June 2007, ESPR 15 (2): 113-118, 2008*].

Experience from dioxin studies at NCBC and Johnston Island suggested that between 2 and 4% of the available dioxin would have been leaked onto or into the soils associated with RANCH HAND operations in Vietnam. Approximately 96% to 98% of all Agent Orange was aerially applied via RANCH HAND or US Army Chemical Corps helicopters. Studies conducted in Puerto Rico, 1963-1966 indicated that less than 6% of the herbicide penetrated through triple canopy jungle [*Tschirley, Response of Tropical and Subtropical Woody Plants to Chemical Treatments, USDA CR-13-67, 1968*]. Because of the extreme sensitivity of TCDD

to photodegradation, both in the air, or on leaf, soil, or water surfaces films, it is likely that 95% of the dioxin in Agent Orange would have persisted for no more than 2 hours in sunlight and 6 hours in shade [Crosby, Wong, *Environmental Degradation of 2,3,7,8-Tetrachlorodibenzo-p-dioxin, TCDD, Science 195: 1337-1338, 1977*].

**CONCLUSION:** Assume the worst case scenario that 10% of the available dioxin persisted and was bound in soils that would have leached into the aquatic systems within South Vietnam. [Another way of placing this scenario in perspective: Since the area of South Vietnam was approximately 6.7 million square miles and an estimated 15% of the land area of South Vietnam was sprayed with tactical herbicides (*NAS estimate*), then the likely worst case scenario would be that 32 pounds of TCDD were sprayed, and potentially persisted, within 1 million square miles of jungles and associated drainage system.] The results of a 2007 study of soil and water samples in the Ma Da area of III Corps, an area repeatedly sprayed with Agent Orange, did not provide evidence that the detected dioxins (mostly OCDD) that bound to groundwater colloids were leftover from the Vietnam War [Hofman, Wendelborn, *Colloid Facilitated Transport of Poly-chlorinated Dibenzo-p-dioxins and Dibenzofurans (PCDD/Fs) to the Groundwater at Ma Da Area Vietnam, ESPR, 14, 2007*]

**CONCLUSION OF THE IOM:** “Given the paucity of information and the variability and uncertainty in the available information, the Committee concludes that it is not possible to estimate the likely concentrations of TCDD in marine waters at the time of the Vietnam War.”

**2. DISCUSSION POINT: There are available studies that refute the allegation that lagoons within Vietnam were heavily contaminated by TCDD.**

**FINDINGS:** Numerous studies have found that TCDD tightly binds to soil/sediment particles and in those matrices has a long persistence time. Ecological studies conducted at Eglin AFB Florida where massive amounts of Agents Purple and Orange were sprayed between 1962 -1970, found that in contaminated soils that were not subjected to sunlight the remaining, less than 5% of the total TCDD, persisted for more than 20 years [Young, Newton, Long

*Overlooked Historical Information on Agent Orange and TCD Following Massive Applications of 2,4,5-T-Containing Herbicides, ESPR 11 (4): 2009-221, 2004].* Erosion studies conducted at the Agent Orange Storage Site at NCBC, Gulfport, Mississippi, showed that very little contaminated soil left the site, despite high rainfalls similar to those in Vietnam, and that movement of the contaminated soil particles was confined to less than 2 miles within the drainage system [Young et al, *Herbicide Orange Site Treatment and Environmental Monitoring: Summary and Recommendations for Naval Construction Battalion Center, Gulfport, MS, TR-OEHL-79-169, 1979*].

A very sophisticated study was reported by Piazza et al [*Marine Pollution Bulletin, 2010*] of the analyses of sediments collected from nine Central Vietnam coastal lagoons. Their conclusions:

*Samples from nine Central Vietnam coastal lagoons, together with three soils and sediments collected in two freshwater reservoirs of the Thua Thien-Hue Province, were analyzed for polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs). Total concentrations are low, from 192 to 2912 pg/g (parts-per-trillion) and depth profiles in Tam Giang-Cau Hai sediment cores show only minor changes over time in PCDD/F input and composition. Octachlorodibenzo-p-dioxin OCDD (not found in Agent Orange) is the prevailing congener (approximately 90%), indicating combustion as the main PCDD/F source to these coastal systems. 2,3,7,8-tetrachloro-p-dioxin (TCDD) largely sprayed together with Agent Orange over the study area during the war (1961-1971), is absent or very low. This result supports the hypothesis of strong degradation soon after spraying.*

It should be noted that the nine coastal lagoons were near Hue, Da Nang, Quang Ngal, Qui Nhone, Phu Yen, Cam Ranh, Ninh Thuai, and Dam Nai.

**CONCLUSIONS:** The coastal lagoons would have been the logical locations where Agent Orange-TCDD would have been present, if significant, i.e., measureable quantities, of TCDD had moved with soil and sediment particles from



the rivers of Vietnam. Thus, there is no supporting evidence that TCDD moved into the open sea, where Blue Water Navy ships were stationed/patrolling along the coastlines of Vietnam.

**CONCLUSIONS OF THE IOM:** “A substantial fraction of particles and humic acid material to which TCDD would be bound would settle in river mouths and estuaries because of estuarine dynamics and chemistry, although it is puzzling that recent studies found minimal residual TCDD in sediment dated back to Agent Orange spraying during the War.”

- 3. DISCUSSION POINT: There are available studies documenting the distance that Agent Orange drifted when applied at an altitude of 100 feet above ground level (AGL) and flying at an air speed of 140 knots.**

**FINDINGS:** Tests at Eglin AFB Florida [*Harrigan, ET (1970): Calibration Tests of the UC-123K/AA 45-Y-1 Spray System. ADTC-TR-70-36*] showed that 87% of the herbicide would have impacted the vegetation within one minute and within or near to the swath. The remaining 13% of the herbicide would take longer to settle due to vortices at the wing tips, drift, or evaporation. Harrigan’s calculations showed that even <100 µm size droplets would have impacted vegetation within 3 minutes of spraying. Since spray missions were always taken in calm or near-calm wind conditions there was no time for significant lateral movement or “spray drift.” RANCH HAND records indicated that 35% of defoliation missions were cancelled due to weather [*Young, The History, Use, Disposition and Environmental Fate of Agent Orange, Springer 2009*].



Aerial photograph taken in 1968 in II Corps of a typical defoliation mission showing the demarcation of the spray pattern. Photograph courtesy of the Plant Science Laboratories, Fort Detrick, Maryland.

**CONCLUSIONS:** The allegation that “wind borne” spray drift from RANCH HAND Agent Orange missions would move 5 miles off shore to impact personnel on Navy Blue Water ships is questionable and unlikely.

**CONCLUSIONS OF THE IOM:** “Most [RANCH HAND] sorties were flown in the morning when a sea breeze was expected. Thus, the daily timing of the sorties favored sea-breeze conditions [i.e., the breeze from the ocean to the land] which would have minimized spray drift over coastal waters.”

**4. DISCUSSION POINT: Blue Water Navy personnel frequently cite a study conducted by the National Research Centre for Environmental Toxicology (NRCET), Australia, for the Royal Australian Navy that demonstrated the plausibility of TCDD exposure to sailors via distilled water.**

**FINDINGS:** The title of the NRCET publication was “*Examination of the Potential Exposure of Royal Australian Navy (RAN) Personnel to Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans via Drinking Water, 2002.*” A review of this report was conducted by personnel within the Directorate of

Toxicology, US Army Center for Health Promotion and Preventive Medicine in 2007. Key comments included:

- The process was not clearly documented and is certainly not correlated with actual concentrations of 2,3,7,8-TCDD or other contaminants in estuarine water from the time period between 1961 and 1971;
- The contaminants added to the “solvent-cocktail mixture” were most likely several orders of magnitude higher than found in Vung Tau Harbor during the War;
- The frequent rinsing of the condenser in this experiment was certainly not practical aboard ship and certainly not during the distillation process;
- It was uncertain how sediment from the water intake was processed or removed from the distillation unit, and the validity of adding salt and “a known concentration of suspended sediments”;
- The authors acknowledged that the placing of a copper heating element into the distillation flask created several problems that negated some portions of the experiment; and,
- It was a long stretch to connect the experiment performed with exposure of Navy personnel to TCDD during Vietnam era.

**CONCLUSIONS:** Even if this “laboratory” experiment could be authenticated on Blue Water Navy Ships, the issue of the likely concentrations of TCDD in marine waters at the time of the Vietnam War has not been addressed. This is where logical thinking and common sense can provide some reality as to whether the Blue Water Navy could have been exposed to TCDD via potable water.

**CONCLUSIONS OF THE IOM:** “The application of these findings to actual shipboard distillation systems requires knowledge of several factors not addressed in this experiment. The significance of this study’s findings for contaminant exposures on Blue Water Navy ships is highly uncertain.”

**ADDITIONAL COMMENTS:** Today’s most sophisticated analytical capability will permit the accurate measurement of 2,3,7,8-TCDD at less than 1 part-per-trillion (1 ppt). We do not know the biological significance of this detection level. How can we express such a concentration? One of the “Fathers” of TCDD chemistry was Dr. Warren Crummett [*Decades of Dioxin: Limelight on a*

*Molecule, Printed by Xlibris Press, 2002*]. Dr. Crummett expressed the meaning of 1 ppt (1 picogram per gram) as: “1 drop of vermouth in a pool of gin covering the area of football field - 43 feet deep. What if the dilution were 1 part per quadrillion (1 femtogram per gram): 1 drop of vermouth in a pool of gin covering 1000 football fields, 43 feet deep.”

Vietnam had a coast line greater than 700 miles, and if the Navy ships were located within 5 miles of the shoreline, that would constitute an approximate area of 3,500 square miles (just less than half of the size of the State of New Jersey) at an undetermined depth (volume). Common sense tells us that there was never a sufficient quantity of TCDD applied in Vietnam to ever be measurable (even by a factor ten) in the waters off the coast of Vietnam.

**FINAL CONCLUSION:** There is no historical or scientific evidence to conclude that Blue Water Navy Veterans were exposed to Agent Orange-TCDD.