

## An Approach to Detect Health Risk of Dioxins

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**ABSTRACT:** March 19, 1999, the renovation of the runway of the Bo-Fai airfield in Hua Hin, Prachubk-erikhan, Thailand, unearthed chemicals which were left over from the project "Ranch Hand Operation" held during the Vietnam war era. The chemical mixtures were analyzed by the US EPA, the Department of Medical Sciences (DMSc), Ministry of Public Health (MoPH) and the Pollution Control Department (PCD), the Ministry of Science Technology and Environment (MOSTE) of Thailand. The samples were found to contain several defoliants used in the operation. They were 2,4-D, 2,4,5-T, Dicamba, Cocycydelic acid, and Dioxins. Due to the complexity of the issue, the multiplicity of possible health effects, and the socio-economic implications for imports and exports, the Thai Society of Toxicology submitted a proposal to request World Health Organization (WHO), Geneva. The assistance is for the area of chemical safety and called for immediate action to explore the magnitude of risk involved with Dioxins. In this paper we present our approach to health risk assessment which takes into an account the epidemiological studies of high-risk group exposed to the Ranch Hand operation. Dioxins are endocrine disruption chemicals which public concerns are developed due to presumption that a hazard exists ([www.epa.gov/dioxins/html](http://www.epa.gov/dioxins/html)) for which current methodologies are deemed insufficient. The recent concepts of how oxidative stress toxicants may affect health end points and biomarkers of exposure of exposed individuals are discussed. While research activities are undergoing, The Thai Society of Toxicology do not anticipate significant risk to local residents and the environment due to our concurrence with opinion from the international experts invited by the World Health Organization proposed to the local experts at a workshop in Bangkok.

### I. INTRODUCTION

The role of toxicologist is to assist in assessing the adverse effects of substances to which humans and wildlife are exposed. Endocrine disruptors are thought to interfere with the normal functioning of human and wildlife endocrine systems. These include reproductive cancers, decreases in sperm quality and quantity; cancer of the breast, prostate and testes (Furst *et al.*, 1991). Reproductive system problems have also been of concern in wildlife species. A number of organizations both regional and international responded to the perception that less than adequate attention was being paid to this area of toxicology. Development of strategies to detect exposure and defined adverse effects may lead to better risk assessment.

Health risk assessment of possible toxic effects relies on the knowledge of defined criteria to be evaluated following an exposure (Anonymous, 1983). Many of these criteria are assessed by many expert groups,

which include the recent WHO/IPCS publications.

The Society of Toxicology of Thailand was invited by the Pollution Control Department the Ministry of Science and technology to become a member of a working groups assigned to investigate the incidence. The Society was also requested to assist the government to reduce the risk from chemical exposure at the community level. We requested the World Health Organization that the experienced experts come to Thailand to assist in risk assessment and planning for possible future research.

### II. METHODS AND STUDY DESIGN

1. Conduct a meeting of local scientists involved with Dioxin issues as a preparation for gathering all existing data. A one -day meeting held at the Department of Medical Sciences, Ministry of Public Health on 16 July 1999. Approximately 50 people from 19 organizations involved with the Bor Fai incident, covering professional societies, mass-media, government and academia, participated in this meeting.

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2. Dispatch of the experts to Thailand and excursion to the Bor-Fai area.

3. Preliminary interview and sample collection of population exposed to 2,4,5,T (samples were sent for porphyrin profiles and possible lipid metabolites, to University of Leicester, UK).

4. The workshop was held in Bangkok, and the field trip to Hua Hin, was on October 12-13, 1999. The participants were the related and responsible organizations, as well as WHO focal points and designated centers of IPCS.

5. Summarize of the findings, recommendations and plans for future work.

6. Disseminate the report to stake holders.

### III. RESULTS

The report of preliminary walk-through at Bo-Fai Airport and the supposedly test site for defoliants is attached as appendix of this paper. The publication of the Outcome of the Consultation: Risk Analysis of Dioxins in Prachuabkirikhan Provinces was submitted to WHO and related agencies (Pavitravov and Singhaseni, 1999). The work was the effort of the cooperation among the Thai Society of Toxicology, the Chemical Society of Thailand and the DMSc. The outcome of the consultation process yield a more fruitful effort to the future direction of any chemicals problem or accidents that may or probably will arise in the future in Thailand. Such a summary is tabulated

in the future direction plan.

### IV. SUMMARY AND DISCUSSION

The Thai scientist and policy makers learned about the US experiences during several past decades in dealing with chemical spills. These include: having standard procedures for emergency-response activities (usually local authorities), a well-organized and multi-disciplinary approach, and disclosure of information to the public with empathy and honesty by using lay language.

Three issues stand out as lessons learned in Thailand. The first one is the Communication. Government agencies need to have better coordination and communication among lead and related agencies as well as with the public and professional organizations. This task is not easy, but should be a long-term goal. Public involvement in the process should start before, during, and after the event. The second issue dealing with the post-accident monitoring. Clear responsibility with adequate resources should be assigned to local health agencies in post-accident monitoring with full public participation. The third and important issue is the collaboration among professional associations. The professional groups need to collaborate and offer their collective expertise to both government agencies and the public using multidisciplinary approaches. Government capability can still be strengthened at present, and professional organi-

#### Future Direction Plan

Topic	Actions
Inventory information	<ul style="list-style-type: none"> <li>- Legislation to ensure adequate information are available for government in prevention and management</li> <li>- Public participation/right-to-know. Information should be released in normal and emergency situation.</li> </ul>
Exposure and Risk analysis	<ul style="list-style-type: none"> <li>- Assessment of who, where, and do the exposure occur</li> <li>- Application of patient based ID linkages and smart card technology, through one person database approach; potential targets included workers exposed to specific chemicals in selected industries</li> <li>- Develop baseline bio-monitoring as background data for Thailand</li> <li>- Possibility of long-term representative bio-specimen collection and extensive epidemiological study</li> </ul>
Clean-up/Prevention measures-	<ul style="list-style-type: none"> <li>- Increase technical capability</li> <li>- More effective environmental pollution prevention and occupational exposure prevention</li> </ul>
Resources/Capacity Building	<ul style="list-style-type: none"> <li>- Identify government agencies and non-government foundations for potential funding.</li> <li>- Long-term goal of capacity building in both government and academic settings</li> </ul>
Analytic capability	<ul style="list-style-type: none"> <li>- Qualified laboratory hardware such as High resolution GC-MS and well-trained personnel are required. The Quality Assurance issue has to be strengthened.</li> </ul>

zations have a role to support government capacity at all levels. The need to establish a working relationship among professional associations is a primary requirement. Such a closed collaboration will enhance all efforts to protect the environment and the workplace through the development of surveillance system remediation efforts and coordinated responses to crises.

### ACKNOWLEDGEMENT

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On 10 and 11 October 1999 Prof. Dr. Martin van den Berg, Dr. Peter Furst and Dr. Marie Haring Sweeney visited two sites near Hua Hin in Southern Thailand which are known or suspected to be contaminated with 2,3,7,8-TCDD (TCDD) as a result of the use of defoliants in the 1960s. This expert assessment took place on request of Dr. Maged Younes of the WHO/IPCS in Geneva and we were officially invited by the Thai Society of Toxicology.

#### We visited two sites:

a) Hua Hin/Bo Fai Airport where drums and containers were found as described in the US EPA Report of Emergency Response Team. (Allen *et al.*, Sept., 1999).

b) A supposed test site for defoliants near the Army Base close to Hua Hin from which no further official information was available to us.

In this report we present our initial opinions regarding risk for humans and the environment. Our opinions reflect our impressions of the site visits. We give conclusions and recommendations regarding the (possible) contamination of both sites and possible risks for human and environmental health.

#### Site visits:

1. Hua Hin/Bo Fai Airport.

We visited Hua Hin/Bo Fai Airport and viewed the area where drums and plastic containers were found. Although the containers were broken, it is suspected that they contained 2,4,5-T and 2,3,7,8-TCDD (Site A) as well as other chemicals. In addition, we also looked at the site on the airport where the contaminated soil was reburied and the proposed area where the future containment facility is to be built.

Regarding the Hua Hin/Bo Fai Airport location, we agree with the conclusions of the US EPA report and the risk assessment for humans and environment, which is included therein. We also conclude that once the contaminated material is appropriately contained, there is no further risk for human and environmental

### Appendix 1

Report on Preliminary Walk-Through at Bo-Fai Airport and the Supposedly Test Site for and test site for defoliants Prachuabkirikhan Province, Thailand. October 12<sup>th</sup> 1999, Bangkok, Thailand

#### Participants:

Prof. Dr. Martin van den Berg<sup>1</sup>, Dr. Peter Furst<sup>2</sup>, Dr.

health for the area.

2. Former Test Site near the Army Base of Pranburi (Thanarath Army Camp)

Between 1969-1971, defoliants were tested in an area behind the military base near Hua Hin. This information was obtained from a report by the Thai Military and the Thai-translated synopsis of the Technical Report 79, Thailand Defoliation Test Program (Darrow *et al.*, July 1966) obtained from the US Embassy in Thailand. (We did not read the reports because they were in Thai.) The defoliants were mixed and loaded onto planes at Hua Hin/Bo Fai Airport, Thailand. Presently it is not known how many flights occurred, the exact area of the test site and how many liters of defoliant were dispersed. Additional information about the test flights was obtained from interviews of elderly villagers from Tubtai, who may have been living in the area at the time of the testing (although there was no formal village at that time), and one individual who worked at the airport in 1964-65 and reported that he mixed defoliants for the US army. None of this information could be verified in the time allocated for visit. Eyewitnesses indicated that spraying was confined to a relatively uninhabited, flat area located east of Khao Hin Theon. Base on the accounts of an eyewitness, the areas where defoliants were thought to be sprayed were estimated to be approximately 50 meters wide and one kilometer long. In addition, one mission was flown each day if the weather was good. Therefore, we estimate that a maximum of 200 flights were made over the testing area. This is based on the statements of the airport employee that flights occurred during a period of about 6 to 8 months. Given these parameters, the test sight may be estimated to be 5 to 10 square kilometers.

**Recommendations for the test site near the Army base (Thanarath Army Camp):**

2,3,7,8-TCDD adsorbs (binds) strongly to soil particles (Beck *et al.*, 1990). This strong adsorption is caused by physicalchemical properties of 2,3,7,8-TCDD, primarily hydrophobicity. Additionally, due to this strong adsorption, migration of 2,3,7,8-TCDD to the deeper layers of the soil is unlikely. The binding affinity also depends on the organic content of the soil, which is usually high in these regions. As a result, the bioavailability of these compounds for direct human

intake is considered low, particularly so many decades since the application.

Furthermore, due to the heavy rainfall in this area, erosion of the top layers of the soil is likely. The expected contaminated top layer is more than likely washed off after 30 years. As a result, soil analysis is not considered feasible in these areas as long as the precise location of the spray plots remains unknown.

A likely area for further analysis might be shallow, marshy sites where soil, transported by run-off, accumulates. These "sedimentation" areas could provide some indication if 2,3,7,8-TCDD contamination is still present in the area and, depending on how deep the 2,3,7,8-TCDD is located, how recent the contamination might have occurred. These analyses could be the basis of further research and subsequent risk assessment for humans and the environment.

In view of the fact that 30 years have past since the application of defoliants in the area, the strong adsorption of 2,3,7,8-TCDD on soil, and the high potential for soil erosion, the present risks for humans and the environment are probably minimal. However, we advise that some minimal (limited) analyses from the sedimentation areas be conducted to support our opinion. This should only be done once suitable sedimentation sites are located.

Based on comments of some local residents of the area, the possibility that individuals who were residing in the spray area at the time of the application had direct contact with 2,3,7,8-TCDD cannot be excluded. In our opinion it is unlikely that these individuals would exhibit any long-term health effects of exposure to 2,3,7,8-TCDD. Based on our limited knowledge of the parameters of the test-spraying program, we presume the potential exposure was limited to less than one year and that all of the defoliants sprayed in the area did not contain 2,3,7,8-TCDD. In addition, studies of US Army Veterans who were stationed in Vietnam and had likely exposure to defoliants reported no significant adverse health effects in this population. Furthermore, the status of other populations with high, long-term occupational exposure to 2,3,7,8-TCDD reported few exposure-related, non-cancer outcomes. It is important to note that the exposure of these occupationally exposed populations was 100 to 1000 times higher than the general population exposure. However, these occupational exposed popula-

tions have experienced increases in mortality from all cancers. This finding has not been observed among communities with heavy environmental (soil) contamination, such as in Missouri, US.

Currently, there is an ongoing study to evaluate the health status of older residents of Tubtai Village. Further epidemiological studies should not be considered until the results of the current study have been evaluated fully and peer reviewed.

We also considered the possibility that defoliants might have affected the Pranburi freshwater basin. More than one eyewitness noted that the planes did not spray southwest of the mountain range bordering the southern side of the test area near the Army Camp. Thus, there appears to be little threat for 2,3,7,8-TCDD contamination of this freshwater lake, which is also scheduled to be used as water supply for the Hua Hin community and surrounding areas. A

few sediment analyses from this reservoir could confirm this suggested absence of 2,3,7,8-TCDD.

**Conclusions:**

We consider the ongoing remediation efforts at the Hua Hin/Bo Fai Airport to be appropriate for protecting human and environmental health. In addition, we do not consider the former test area adjacent to the Thanarath Army Camp to be a significant risk to local residents and the environment at the present time. However, it should be recognized that these conclusions are based on information made available to us during the two-day site visit, the recently published report of the USEPA and personal observations. If in the future additional relevant information is made available, these conclusions may require further re-evaluation.