

II. METHODOLOGY

Our investigation of DU as a potential cause of Gulf War veterans' illnesses adopted a risk assessment methodology patterned on the US Environmental Protection Agency's. This process, outlined in Tab D, estimates the health risk from contaminant concentrations, exposure duration, and contaminant toxicity characteristics. It consists of four steps: hazard identification, toxicity assessment, dose assessment, and risk characterization, defined below:

- Hazard identification -- who was exposed, and how? Which incidents warrant a full investigation?
- Toxicity assessment -- what are the known medical effects of human exposure to DU? At what levels of exposure do these effects occur? How can the effects be diminished?
- Dose assessment -- how much DU were soldiers exposed to? How much did they take into their bodies? What chemical or radiological doses do these intakes represent?
- Risk characterization -- using validated toxicity and dose information, what medical effects can be anticipated? How serious are they? What is the risk they will occur?^[11] How can the effects be communicated to those affected?

Performing this assessment for DU involves the cooperative efforts of several organizations:

- the Office of the Special Assistant for Gulf War Illnesses (OSAGWI) for hazard identification and risk characterization;
- the RAND Corporation for toxicity assessment;
- the US Army Center for Health Promotion and Preventive Medicine (USACHPPM) for dose assessment (exposure and risk assessment);
- the Department of Veterans Affairs (VA) and Department of Defense DU medical surveillance programs for medical follow-up.

The Office of the Special Assistant for Gulf War Illnesses focused on determining what happened, what exposures may have occurred, and who may have been exposed. The Office divided exposures into levels and categories to relate them to toxicity and dose information.

To develop a toxicity assessment, the RAND Corporation conducted an independent review of available peer-reviewed medical and scientific literature on uranium's known medical and health effects, concentrating on the health effects of internalized uranium.

USACHPPM completed the exposure and risk characterization by estimating the amount of DU that may have been taken into the body for each of the 13 exposure scenarios (Table 1). Since the chemical intakes and radiological doses were not directly measured when the incidents occurred, USACHPPM used the best available data, combined with scientific and engineering principles and data from relevant tests, to develop its human exposure and health risk characterization. Specific USACHPPM activities included:

- reviewing test data on DU's behavior during fires and impacts with armor;
- evaluating the usefulness and appropriateness of this data in modeling the amount of DU a soldier might take in and retain in the body through inhalation or ingestion;
- identifying data gaps; and
- estimating the radiological and chemical doses for each of the 13 activities involving possible DU exposure.

The VA, in cooperation with the DoD, has medically evaluated 33 friendly fire victims (Level I

veterans) since 1993. These veterans, about half still retaining embedded DU fragments, received the highest DU exposures. In 1998 the VA and the DoD expanded the follow-up program to offer urine uranium evaluations to all Level I veterans and to those level II veterans who worked in or on DU contaminated vehicles.

Finally, we incorporated the results of USACHPPM's dose assessments and RAND's medical literature review, both peer reviewed, and results from medical follow-up to clearly and concisely discuss those risk estimates for each of the 13 exposure scenarios.

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