COMMENT ON THE CAPSTONE DEPLETED URANIUM (DU) AEROSOL CHARACTERIZATION AND RISK ASSESSMENT STUDY

Dear Editors:

WE NOTED that nowhere in the issue of *Health Physics*, March 2009, devoted to "The Capstone Depleted Uranium (DU) Aerosol Characterization and Risk Assessment Study" (Parkhurst and Guilmette 2009) were nanoparticles considered or even mentioned. The smallest particles considered were approximately 0.7 μm in diameter (Holmes et al. 2009). Perhaps DU atoms may have entered the brain via olfactory pathways (Tjälve and Henriksson 1999) or carbon nanoparticles, i.e., buckyballs or fullerenes (Kroto et al. 1985), may have been produced when DU burned as the armor piercing shells struck a target (Krupka et al. 2009). Recent research has indicated the possibility of nanotoxicity to the lung and via lungs to other body compartments. (Oberdörster et al. 2005). One may ask, is it possible that the carbon fullerenes could also capture individual DU molecules that can be taken in the nasal mucosa and transported through the olfactory nerve further into the brain (Persson et al. 2003; Dorman et al. 2009)?

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RESPONSE TO LYKKEN AND MOMČILOVIĆ

Dear Editors:

WE APPRECIATE the opportunity to respond to the letter from Lykken and Momcilovic regarding the Capstone depleted uranium (DU) aerosol study, in which they raise the question of the potential for creation of DU nanoparticles and the risk of exposure and concomitant health effects.

This issue can be addressed at two different levels: 1) whether DU nanoparticles could have been produced, and 2) whether persons within the aerosol environment could have been exposed to these nanoparticles. We cannot rule out the possibility that DU nanoparticles could have resulted from the highly energetic interaction of a large-caliber DU penetrator and DU (Abrams only) or non-DU (Abrams or Bradley) armor. However, based on visual and instrumental analysis of hundreds of microscopic samples derived from cascade impactor stages, filter samples, moving filter samples and collected bulk powders, little to no evidence was obtained that demonstrated the existence of DU nanoparticles. As pointed out in Krupka et al. (2009), nanoparticles from assumed vaporization-condensation mechanisms were certainly observed in the photomicrographs (see for example Figs. 8, 9 and 11 from Kruka et al. 2009). However, based on analysis using

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energy-dispersive spectroscopy, the ultrafine aerosols were uniformly determined to have originated from Al or Fe from the vehicle armor. Therefore, the likelihood that significant quantities of DU nanoparticles were created during the DU penetration of armor is not supported by the data. Additionally, during the first experiment in which a DU penetrator impacted non-DU armor, a Lovelace parallel-flow diffusion battery (PFDB) was employed (Holmes et al. 2009) with a useful particle-size sampling range of 5–500 nm. Although not included in the Krupka paper, analysis of photomicrographs from the PFDB stages did not conclusively demonstrate DU nanoparticles.

As a second point of discussion, let us assume that DU nanoparticles might have been created, but in relatively small, unobservable quantities. Given that the initial atmospheric aerosol concentrations within both the Abrams and Bradley were high, up to tens of grams per cubic meter, coagulation and agglomeration of primary aerosol particles occurred readily and very rapidly within the crew compartment atmosphere. The photomicrographs shown in Krupka et al. (2009), which are representative of the aerosols collected, depict highly heterogeneous particles, in which components from several metals were seen to combine. In some cases, ultrafine aerosols formed a weblike mesh that contained identifiable small DU particles (but not nanoparticles). The end result of the agglomeration processes was to produce respirable and nonrespirable particles of DU and armor metals. Deposition and clearance of particles with these aerodynamic sizes are well understood and can be modeled using the Human Respiratory Tract Model of ICRP Publication 66 (1994). The point is that the deposition and clearance behavior of any nanoparticles would have been subsumed by the aggregate particles on which they resided.

We are well aware of the dosimetry and toxicology of nanoparticles, particularly their abilities to penetrate membranes through which larger particles cannot penetrate. However, for the reasons outlined above, we cannot envision any circumstances under which residents of armored vehicles struck by DU munitions could have been exposed to DU nanoparticles.

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