APPENDIX E

Frequently Asked Questions About Military Exposure Guidelines

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What are military exposure guidelines?

Military exposure guidelines (MEGs) are decision aids used to assess health risk to deployed forces from chemical exposures in the environment. The MEGs are designed specifically for use within the risk management framework (Field Manual 5-19) supporting the Commander's decision making process.

A MEG is a chemical concentration in air, water, or soil that represents an exposure threshold. There are several types of thresholds that refer to an increasing potential for mission-related health effects within the entire exposed military population. These thresholds are specifically linked to one part of the military risk management framework in FM 5-19.

Each MEG is an estimate of the exposure level above which certain types of health effects may begin to occur in individuals within the exposed population after an exposure of the specified duration. The severity of the health effects and percentage of the exposed population that might demonstrate the health effects may increase as concentrations increase above the MEG. The degree to which severity and/or incidence of health effects increase as exposure increases above a MEG is chemical-specific. Some of the MEGs are "screening levels" below which certain health effects would not be expected to occur within a deployed population under reasonable worst-case exposure conditions.

The MEGs are population-based; therefore, they are not designed for predicting health effects in specific individuals. The MEGs provide the basis for more detailed evaluation by appropriate health experts—they are not stand-alone action levels. They are often based on other U.S. Federal standards, such as unsafe levels use for emergency response planning or safe levels in the workplace as prescribed by the U.S. Occupation Safety and Health Administration. They are either the same values as U.S. federal agency standards or guidelines or they are adjusted to match the unique exposure scenarios or subpopulations of the deployed forces.

The MEGs have been developed for many chemicals; some chemicals have MEGs for different media (e.g., air, water, and soil) and for different exposure conditions and timeframes (e.g., for short-term exposures of 1 hour or 1 day, as well as for long-term, continuous 1-year exposures). The MEGs are designed to assess a variety of military exposure scenarios, such as a single release of large amounts of a chemical, temporary exposure conditions lasting hours to days, or for continuous ambient environmental conditions, such as a regional pollution.

What kind of MEGs are available and what does 'exceedance of a MEG' mean?

The currently available set of MEGs includes values for air, water, and soil for several different exposure durations arranged along differing military hazard severity levels from Negligible to Catastrophic (see Field Manual 5-19). For example, for a given chemical, there are four possible Air MEG values for the 1-hour exposure duration. The following table presents the standard interpretation and use of the MEGs.

Example of the Potential Types of Air MEGs for the 1-Hour Exposure Duration for a Hypothetical Chemical and the Standard Interpretation of the Hazard Severity Level Associated with Various Field Exposures

Exposure Estimate*	MEG Name	MEG Value	Hazard Severity Designation ‡
† 5 – 29 mg/m^3	1-hour Negligible MEG	5 mg/m^3	Negligible
30 – 149 mg/m^3	1-hour Marginal MEG	30 mg/m^3	Marginal
150 – 339 mg/m^3	1-hour Critical MEG	150 mg/m^3	Critical
≥ 340 mg/m^3	1-hour Catastrophic MEG	340 mg/m^3	Catastrophic

* This exposure estimate represents an average 1 hour exposure. Analytical error associated with measurements at the boundaries of the categories (e.g., 29 vs. 30 mg/m^3) must be acknowledged.
† Field exposures < 5 milligrams per cubic meter (mg/m^3) would not be considered to be a deployment hazard and would not be evaluated in a formal risk assessment.
‡ In reality, hazard severity blends together at the margins between each category, which reflects a graded series of health responses as exposure increases. For example, there is no practical measurement and toxicological distinction between 29 and 30 mg/m3 even though the selected severity categories will be different. The risk assessment method addresses exposures near the borders of the categories.

This standard approach for setting hazard severity levels within a risk assessment sets a useful framework, but it does not highlight the chemical-specific knowledge and the scientific uncertainties associated with the underlying data for any given assessment. The USAPHC (Prov) TG 230 provides additional details on what data the MEGs are based on and what it means to exceed a MEG (i.e., where a field exposure is greater than a MEG).

The fact that a chemical concentration measured in the field is greater than a MEG should never, by itself, be interpreted to mean there is a notable or definitive risk of a specific health effect in an exposed individual. The MEGs are not stand-alone action levels. The MEGs are decision tools used within a risk assessment which informs decision makers about the potential need for actions for adjustments to military operations, potential medical treatment, long-term health surveillance. Because MEGs are derived from protective 'threshold' estimates that often have low confidence, exceeding a MEG only indicates a potential for specified health effects increase among some members of the exposed military population. However, the significance of the increased risk (i.e., type of health effects, severity, and number or personnel) will depend

on many factors. These factors include chemical-specific, dose-response relationships, exposure-time profiles, and the frequency of human susceptibility factors (underlying illnesses, health behaviors (e.g., smoking) and at-risk genes) within the exposed population that may predispose certain individuals to certain effects.

What types of health effects are considered when developing a MEG?

When short-term MEGs are generated, health effects that may develop immediately or shortly after an exposure are considered. Generally speaking, acute/short term effects occur after single relatively brief or short-term exposures (minutes to days). Reversible and irreversible health effects are considered when developing these MEGs. Some of the short-term MEG categories also consider increased risk for developing cancer.

When long-term MEGs are generated, health effects that may develop or continue post-deployment (e.g., months or years later) are considered. In general, the long-term Negligible MEGs are protective of both cancer and the most sensitive health endpoints other than cancer that have been identified in toxicological or epidemiological studies.

How accurately does a MEG estimate a threshold for the possibility of health effects?

The quantity and quality of the health effects and toxicological data upon which the MEGs are based varies substantially across the chemicals. Since existing toxicological databases and health criteria were utilized to develop the MEGs, the quality and extensiveness of toxicological and epidemiological information underlying these guidelines is comparable and as variable as that used by other Federal agencies for worker and civilian applications.

The overall confidence that certain kinds of health effects will not occur within a population when field exposures are below a MEG is generally high. The overall confidence that effects will occur in the population when exposures are above a MEG ranges from low to moderate for most chemicals and health effects. In most cases, some type of margin of safety has been built into a MEG value to address the uncertainty resulting from gaps in toxicological data. This means that MEGs typically reflect levels that are lower than effect levels determined in scientific studies. The amount lowered (safety margin) depends on the extent of scientific uncertainties for that chemical and effect. Some MEGs, especially those for long-term exposures and health effects, have a safety margin that is several orders of magnitude lower than what would be considered safe for the animals studied in the laboratory.

What is a "screening-level" MEG?

The most commonly used MEG is the long-term (1-year) Negligible MEG, which is the lowest MEG concentration for a chemical. This 1-year Negligible MEG is often used as a "screening level" in that it addresses the worst case deployment exposure conditions (most frequent and continuous long-term exposure conditions, e.g. soldiers continuously exposed "on-the-job" 24 hours a day, 7 days a week, for 1 whole year). The screening-level MEG is used as the initial basis to compare field sampling data to determine if there is a potential hazard. As long as sample data for a detected chemical is below the screening level MEG, then there is no hazard

and, thus, no operational risk. If concentrations are above the 1-year Negligible MEG, then a chemical exposure may pose a military hazard and it requires further assessment, to include comparison to the other available MEGs for that chemical.

How are MEGs used?

Within the context of a health risk assessment, MEGs are used to determine the significance of field exposures to the military mission at a specific location or for a specific operation. The MEGs are used to rank the hazard severity of the exposure. See the section called "*What kind of MEGs are available and what does 'exceedance of a MEG' mean?*" to understand how severity is ranked.

The severity rank is then combined with estimates of hazard probability to estimate the operational risk of the field exposure (the hazard). Risk is estimated using the following risk matrix.

Military Risk Assessment Matrix

HAZARD SEVERITY	HAZARD PROBABILITY				
	Frequent (A)	Likely (B)	Occasional (C)	Seldom (D)	Unlikely (E)
Catastrophic (I)	Extremely High	Extremely High	High	High	Moderate
Critical (II)	Extremely High	High	High	Moderate	Low
Marginal (III)	High	Moderate	Moderate	Low	Low
Negligible (IV)	Moderate	Low	Low	Low	Low

Source: Army Field Manual 5-19

Can MEGs be used to estimate the number of personnel that will develop certain health effects?

The MEGs are not designed for determining casualty estimates. In general, there will not be adequate toxicity data, exposure data, and modeling to support the development of casualty estimates for most chemicals and pollutants. While the severity of the health effects and percentage of personnel potentially demonstrating health effects will generally increase as concentrations increase above the MEG, it is not considered reasonable to estimate the number of individuals that will have specific effects using the MEGs.

The MEGs are preventive medicine guidelines designed for use in determining a qualitative level of risk posed to an exposed military population. The qualitative risk rank is specified in terms that are derived from the military risk management model (see Field Manual 5-19). The MEGs cannot be used as a planning tool for estimating the loss of effectiveness of personnel to perform daily duties due to incapacitation or other health effects without knowing the actual level and duration of exposure to a specified chemical.

Can MEGs be used to determine which personnel will develop health effects?

The MEGs are population-based and are not designed for predicting health effects in specific individuals. While it is true that for many chemicals there are certain types of human susceptibility factors or underlying health conditions that may predispose persons to develop effects, the available information is inadequate to predict specific cases with certainty. Many, if not most, MEGs are based on civilian health criteria designed to address certain key susceptible subgroups in the civilian population (e.g., asthmatics). Even though these subgroups make up a small fraction of any given military population, the intent in using these guidelines was to ensure protective estimates that would address these Service members.

The general human factors that play a role in susceptibility to chemical exposures include the following:

- Gender: For example, females are more susceptible to effects from exposures to benzene and nerve agents.

- Underlying heath conditions: For example, asthmatics (estimated 2-5 percent of troops) are more susceptible to effects from exposure to PM matter as well as other air pollutants and certain acid gases.

- Other health factors: For example, susceptibility generally changes with age, fitness level, dehydration, fatigue, nutritional status/anemia, tobacco use, and so forth.

Why were MEGs developed for Soldiers instead of using U.S. civilian health standards?

While there are some specific exceptions, in general, civilian exposure standards and guidelines are not sufficient for the military Force Health Protection mission for several reasons. For example, those guidelines are not specific to the exposure scenarios faced by deployed personnel. In general, deployed personnel can experience exposure rates (for example, amount of air inhaled, amount of water consumed) that are higher than their civilian counterparts. While an existing civilian exposure standard or guideline can often form the basis for a MEG value, the MEG development process often makes population-specific adjustments to address different exposure rates or exposure durations.

In addition, civilian standards and guidelines are generally not aligned to the military risk management hazard severity levels used to rank risks for Commanders. The MEG development process takes adjusted-civilian guidelines and aligns them according to the severity levels of Negligible, Marginal, Critical, and Catastrophic. These categories are used by preventive medicine personnel to rank risks according to mission and force health protection metrics.

Notably, U.S. short-term emergency response guidelines, such as the AEGLs and ERPGs, are examples of civilian guidelines that do align with aligned to the military risk management hazard severity levels. When available, these are used as MEGs.

Who should use MEGs? When should MEGs be used?

The MEGs (and USAPHC (Prov) TG 230) are designed for preventive medicine and medical personnel trained in the identification and evaluation of environmental health hazards. Within the Army, these individuals function at or above the Health Service Support Level II, according to DA Pam 40-11 Section 3–2 (DA Pam, 2006). The MEGs are designed for use in the context of a health risk assessment for use within the military risk management framework (see FM 5-19, 2006). The DOD (DoDI 6490.03, 2006) and Joint Staff (CJCS 2007) policy states that MEGs are to be used to assess environmental chemical exposures that occur during military deployments. Since MEGs have been specifically developed for military deployment conditions, unless otherwise indicated, they should be used in place of other civilian or occupational standards during deployments.

The risk assessment guidance provided in USAPHC (Prov) TG 230 serves as an objective base from which to make educated determinations within this framework. Risk assessors should have a basic understanding of the underlying toxicological and health basis for the MEGs. They should be familiar with basic methods of exposure assessment for chemicals in the environment. Finally, it is necessary that the risk assessor appreciate the uncertainties associated with sampling and with the assumptions used for estimating representative exposure levels and possess a high degree of understanding of basic risk communication principles. This guidance does not replace the need for basic technical training in these areas; nor does it provide guidance for sample planning or collection.

Where can I learn more?

The USAPHC (Prov) TG 230 provides risk assessment guidance on how to interpret field data using the MEGs. Also, USAPHC (Prov) RD 230 provides methodological details on how the MEGs were developed. These reference materials and guidance can be obtained electronically at: http://phc.amedd.army.mil/tg.htm.