Frequently Asked Questions Regarding Acute Exposure Guideline Levels (AEGLs) and their Applications

FACT SHEET 64-016-0711

1. What are Acute Exposure Guideline Levels (AEGLs) and how are they determined?

AEGLs are concentrations of a chemical in air that represent a threshold level above which certain types of health effects are expected to begin to occur with increasing significance in an exposed population. For each chemical, AEGLs address three hazard severity levels (1-3, Level 3 being most severe) for five one-time exposure durations (10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours). To develop the values, the most current and nationally accepted standardized toxicological risk assessment models are used to evaluate published human and animal toxicity data. Of special note, since the relationship of concentration over time was not specifically quantified in earlier emergency planning values, the use of a time-extrapolation model (see FAQ #8) ensure that this relationship is addressed ,as it is known that this relationship can greatly influence effect levels for different exposure durations. For every chemical studied under the AEGL process, a detailed document is produced and reviewed through a multistage process.

2. Why was the AEGL program initiated, and who is involved?

After the 1984 Bhopal chemical plant accident, both industry and Federal organizations began initiatives to standardize emergency planning and response tools to include health effects levels for one-time chemical exposures. These efforts were not federally coordinated until 1996 when the National Advisory Committee (NAC) on AEGLs for Hazardous Substances was chartered under the Federal Advisory Committee Act to develop standardized emergency guideline levels. The NAC-AEGL is co-chaired by the U.S. Environmental Protection Agency (USEPA) and a chemical industry representative. It includes members from other Federal organizations (such as Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry Department of Transportation(DOT), Department of Defense), as well as states, and industry and academia. The NAC-AEGL process includes a public review period in the Federal Register (FR). After addressing FR comments, the NAC-AEGL provides Interim AEGLs to the National Research Council (NRC) Committee on Toxicology (COT) for review. While Interim AEGLs are citable and available on the USEPA's AEGL website, the Final AEGLs may be different from the Interim values. The Final AEGLs and official technical supporting documents are a product of the NRC-COT (not the U.S. EPA).

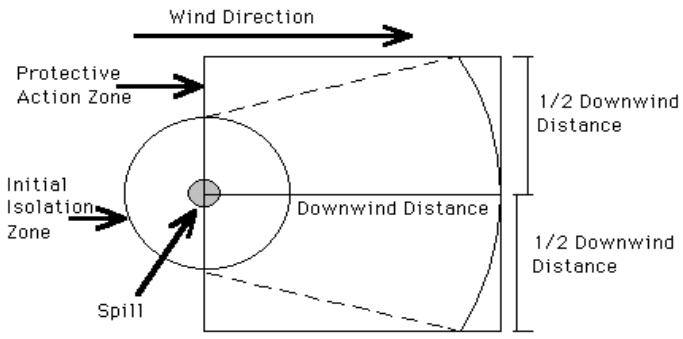
3. What values have been used in the past?

For almost 10 years various groups established emergency planning tools models, and health-based exposure guidelines. One of the most well known and used set of emergency exposure guidelines were the Emergency Response Planning Guidelines (ERPGs), established by the American Industrial Hygiene Association (AIHA). The ERPGs are essentially the predecessors of the AEGLs—and also provide three basic levels of health effects for one-time exposure to chemicals. However, ERPGs only address single exposure duration (1 hour), the models used to develop ERPGs are considered less advanced, and the process and documentation does not go through extensive Federal agency, or public review.

4. Is there specific guidance on how to use AEGLs or what actions should occur at each level?

It is not within the scope or charter of the NAC-AEGL committee to recommend specific actions to be taken at a given AEGL levels; therefore, the AEGLs are not published with required applications. However, there are some Federal agency-endorsed applications. For example, the U.S. Army with the Federal Emergency Management Agency (FEMA) established a policy where AEGL 2 is cited as the protective action criteria for the U.S. Chemical Stockpile Emergency Preparedness Program (CSEPP, 2003). Also, the DOT, in conjunction with Canada and Mexico directly applies AEGL Level 2 (or the ERPG 2) in development of the Protection Action Zone distances in the Emergency Response Guidebook (ERG 2008) (**Figure 1**). AEGL values also can be used in real-time response and management of incidents. The three AEGL health effect levels allow emergency planners and responders to prioritize resources and activities associated with a chemical release. The NAC-AEGL considers that such decisions are best left to local emergency planners and responders. As an example of a real-world application, Federal hazard analysts modeled daily conditions prior to removal operations of WWI munitions (arsine) in DC using community -approved notification and protective action guidance based upon the AEGL-2 (COE, 2007). Finally, a recent homeland security evaluation of procedures to decontaminate an airport cited use of AEGL 1 for clearance decision-making (Watson et al, in press). General guidance is provided by the USAPHC (**Figure 2**) regarding decisions at various AEGL levels consistent with these examples.

Figure 1. Emergency Response Guidelines User Guidance (2008)



Protective Action Zone

- Defines an area DOWNWIND from the incident in which persons may become incapacitated and unable to take protection action and/or incur serious or irreversible health effects.
- The 'downwind' distance is calculated based on chemical-specific information to include the AEGL-2 or ERPG-2. ERG 2008 provides these pre-calculated distances for each chemical, spill size, and time of day.

Protective Actions are: evacuation, shelter in place, or a combination of both.

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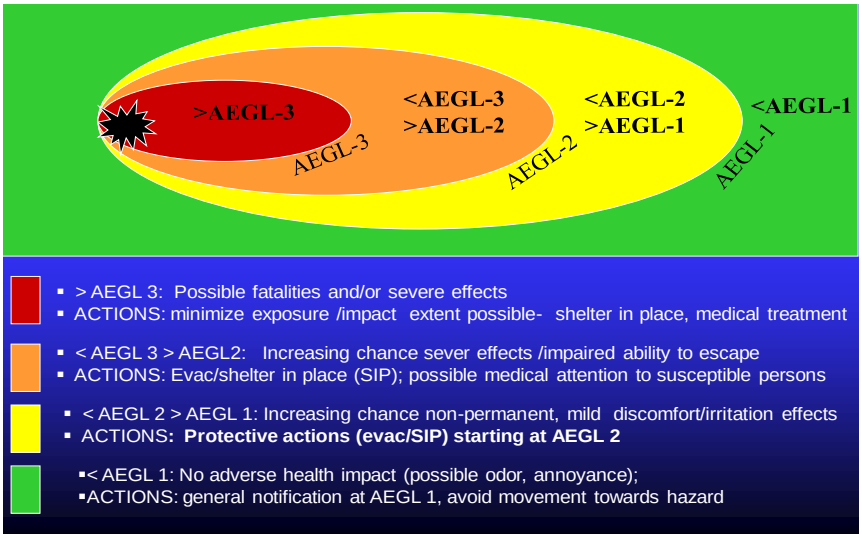
Figure 2. Suggested Applications for AEGLs
(also see USAPHC, *Basic Questions Regarding AEGLs*, 2011)



5. How are the AEGLs used to estimate health risks for incident decision making?

AEGLs can be used with computer air dispersion models to estimate chemical cloud or "plume" concentrations after a certain time; this is used to represent vulnerability or evacuation zones. See Figure 2 and other USAPHC Factsheet: ***Basic Questions Regarding AEGLs*, 2011**) are used to determine health risks and appropriate protective actions. These models generally require use of AEGL's time extrapolation model instead of a concentration (see FAQ #8). Models should address other factors (e.g., quantity and rate of release of the chemical (if known), volatility/ half life, temperature, wind speed and stability, and topographical characteristics).

6. The official AEGL-2 definition indicates 'incapacitating' or 'permanent' effects. These sound too serious for evacuation. Wouldn't the AEGL 1 be more appropriate?

The values themselves are appropriate for cited applications because: (1) based on the toxicological criteria and models used for estimations, including use of safety factors (uncertainty factors), the actual health effect caused by a specific chemical are not generally considered as severe as the generic definitions sound (see chemical specific AEGL technical documents or PHC Facts sheet on Nerve and HD Agent AEGLs; (2) health effects would begin ABOVE the AEGL-2 concentrations and initially only in the most susceptible people (like those already ill); (3) the levels represented by AEGL-1 are actually on the order of common everyday exposure occurrences (such as during pumping gas, cleaning) and are not generally a priority for evacuation which must be balanced with critical assets and logistical dangers.

7. The generic AEGL level descriptions do not provide a clear understanding of the specific health effects associated with a chemical I am evaluating—how can I get this information?

Final AEGLS are published by the NRC in reports that are available for viewing via the Internet available at National Academy Press (NAP) (www.nap.edu) or hardcopy purchase. Each report is a volume containing technical basis of the AEGLs based on available toxicity data. (Also for sulfur mustard and nerve agent AEGLs see USAPHC Fact Sheets on health effects.)

8. How do I account for durations >10 min and <24 hrs other than those for which AEGLs are derived?

AEGL derivation includes use of a chemical- and effect- specific time extrapolation model where the **C**oncentration to the "**n**" power multiplied **t**ime ($\mathbf{C^n x\ T}$) is used to estimate the concentration for each of the durations. While the NAC-AEGLs default is that the value of n = 1 can be used when extrapolating from shorter to longer exposure durations, and a value of n = 3 can used when extrapolating from longer to shorter durations – the Chemical specific "n" data is considered and chemical specific values and constants are cited in the technical support documents (FAQ#7). The actual "n" value may vary between exposure durations.

9. What about exposures less than 10 minutes or greater than 8 hours?

The toxicity data representing a one-time exposure to a chemical should generally not be extrapolated to durations much beyond the exposure durations used in the actual laboratory studies. Since toxicological data used to derive AEGLs is most often based on durations of >30 minutes to a few hours, any user extending the AEGL model to exposure durations outside this range is doing so based on his/her own judgment. For example, if the underlying study used to establish the AEGL was a 4-hour or greater study, it may be deemed reasonable to extend the model to a period as long as 24 hours, but a 30-minute study may not support such an extension. Extending the AEGL model beyond 24-hour durations is not advised **(instead see FAQ # 10)**. For exposure durations that are < 10 minutes, available data may be limited and difficult to use or quantify with any confidence or precision. Extrapolation to brief exposures (e.g., <2 minutes) should be only considered if such limited specific exposure durations are of sole interest.

10. What are "PALS" and how do they compare to AEGLs?

Provisional Advisory Levels (PALs) are temporary values developed by the USEPA to assist in chemical incident emergency planning and decision-making that involves continuous exposure durations for 24 hr, 30 days, 90 days and 2 years, as data permit. Like AEGLs, the PALs for airborne exposures reflect three health effects severity levels (1-3). PALS are not official USEPA guidelines, regulatory standards, or required for use. They have not been promulgated or publically reviewed through the Federal Register like AEGLs nor are they endorsed by the NRC. They are reference criteria for assessment of unique conditions when a chemical hazard in expected to persist and pose a continuous exposure hazard for an extended duration. Especially for volatile chemicals, these conditions would be rare but may arise (e.g., enclosed, cold environments). In some cases, reentry or clearance of more persistent chemical agents or toxic industrial chemicals may consider 24-hour PAL-1 as a reasonable goal. PAL values for certain chemicals are available by specific request [see www.epa.gov/NHSRC/news/news121208.html. In addition, some have been published in journal articles.

REFERENCES: **USAPHC Factsheets:** Basic Facts Regarding Chemical Exposure Standards and Guidelines (2011); Basic Questions Regarding Acute Exposure Guideline Levels (AEGLs) in Emergency Planning and Response (2011); Detailed Facts Regarding Health Effects Associated with AEGLs for Nerve agents, Sulfur mustard, 2010; **NRC, 2001;** *Standing Operating Procedures for Developing Acute Exposure Guideline Levels for Hazardous Chemicals*. National Academy Press, Wash, D.C. http://www.nap.edu/index.html. **CSEPP 2003;** Chemical Stockpile Emergency Preparedness Program, Policy Paper #20, signed by U.S .Army and FEMA. **COE, 2007;** Site Specific Public Protection Plan, Investigation of Burial Pit 3 at 4825 Glenbrook Road Spring Valley FUDS, Wash, D.C. Baltimore COE; W912DR-05-D-0022/ 004. ERPG, 2008; **Emergency Response Guidebook: http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/user.aspx; Watson AP, et al, "Developing Health-based Pre-planning Clearance Goals for Airport Remediation Following Chemical Terrorist Attack Parts 1 and iiHuman and Ecological Risk Assessment" (January 2011).**