

Atmospheric Dispersion Factors

What Are They and Why Do We Use Them?

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The atmosphere and its processes serve to dilute and disperse routine and accidental releases of gaseous effluents. To calculate the atmosphere's dilution and dispersal effect on effluents, a quantitative representation of this ability is needed. This is the atmospheric dispersion factor (also known as relative concentration or χ/Q value).

An atmospheric dispersion factor is the effluent concentration (χ) divided by the source strength (Q) at a given distance and direction from the source. Atmospheric dispersion factors are averaged and processed over different time frames, depending on the use to which they will be put. These values represent the atmosphere's ability to dilute and disperse effluents over the averaging period.

There are a number of different applications for atmospheric dispersion factors within the nuclear power industry. Basic to each application is straight-line Gaussian equation for calculating a short-term (one-hour) χ/Q value. These short-term χ/Q values are either used "as is" or are combined, averaged and sorted to support the application at hand. Typical applications within the nuclear power industry include the following:

1. *Assessing the maximum potential annual radiation dose to the public resulting from the routine release of radioactive materials.* These "routine release" χ/Q values support the implementation of the Offsite Dose Calculation Manual (ODCM) and are usually calculated in accordance with Regulatory Guide 1.111. For routine infrequent (batch) releases of short duration, factors averaged over the time of the release are used; for routine continuous releases, quarterly or annual average values are used.
2. *Assessing the potential dispersion of radioactive materials from design-basis accidents (DBA).* These "design-basis accident" χ/Q values are used to predict Exclusion Area Boundary (EAB), Low Population Zone (LPZ), and Control Room (CR) doses for the design-basis accidents described in Chapter 15 of a licensee's FSAR. They typically represent an atmospheric dispersion factor that is exceeded no more than five percent of the time for averaging periods of 0-2 hrs, 0-8 hrs, 8-24 hrs, 24-96 hrs, and 96-720 hrs. The EAB and LPZ values are typically generated in accordance with Regulatory Guide 1.145. The

NRC has recently issued, for the first time, a draft regulatory guide, DG-1111, that provides guidance for generating DBA χ/Q values for CR habitability assessments.

3. *Assessing the potential radiological consequences of an actual accidental release of radioactive material to the atmosphere.* These “emergency response” χ/Q values are typically incorporated within a licensee’s emergency response dose assessment model as part of a licensee’s Emergency Response Plan. Although there is no regulatory guidance concerning the development of χ/Q values for an emergency response dose assessment application, implementation of the hourly atmospheric dispersion algorithms presented in Regulatory Guide 1.145 would be appropriate.

This presentation will discuss the basic Gaussian dispersion model for deriving short-term (e.g., hourly) χ/Q values and how these resulting hourly χ/Q values are used to develop atmospheric dispersion factors for use in routine release, design-basis accident, and emergency response applications.