

# Section 1

## Introduction

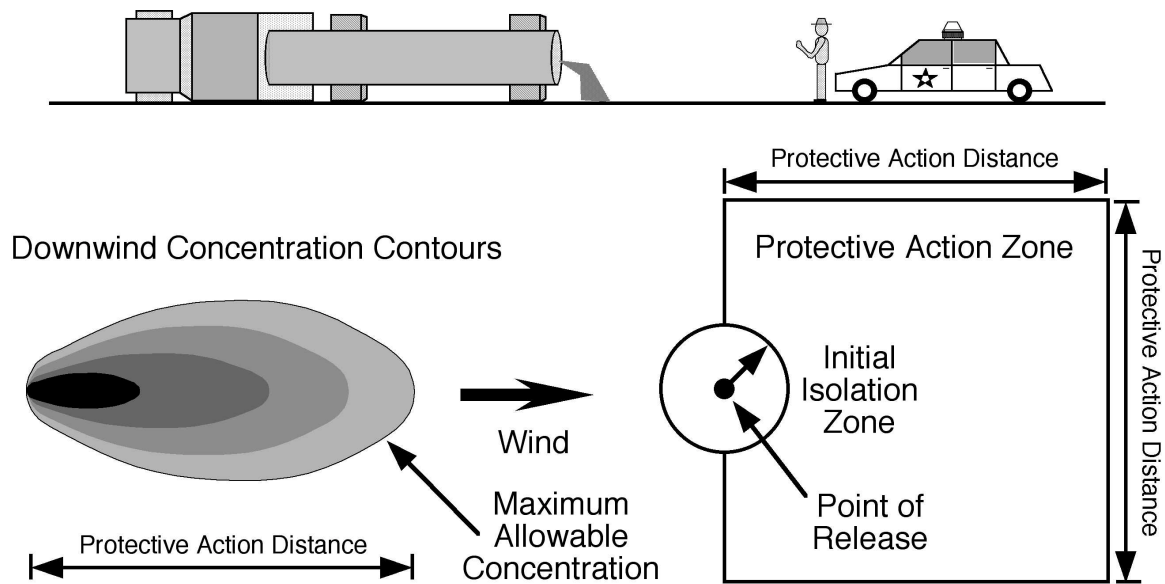
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Chemical spills that occur during the transport of toxic materials can pose significant hazards to the general public and to emergency response personnel who are the first to arrive at the scene. To help first responders determine whether a shipment is potentially hazardous and decide what actions should be taken if a toxic spill did occur, an Emergency Response Guidebook (ERG) is periodically published and updated. The U.S. Department of Transportation (DOT), Transport Canada (TC), and Secretariat of Transport and Communications of Mexico (STC) published the 2000 edition of the ERG (DOT et al. 2000). It is titled *2000 Emergency Response Guidebook* (hereafter referred to as 2000ERG). The ERG provides essential information on fire fighting, spill response, and potential public health effects. The ERG provides Initial Isolation Distances and Protective Action Distances (PADs) for a subset of the chemicals that are listed in the book: chemicals that are toxic by inhalation (TIH chemicals) and chemicals that produce TIH gases upon reaction with water (TIHWR chemicals). The Initial Isolation Distance defines the radius of the zone around the spill that should be accessed solely by people who are directly involved in emergency response. The PAD is the distance downwind from the source of the release that defines a zone in which persons should be either evacuated or sheltered-in-place, depending on the severity of the incident and the nature of the population (e.g., density, age, health).

This report was prepared to document and discuss the methodology used to prepare the 2000ERG Table of Initial Isolation and Protective Action Distances (hereafter referred to as the Table). The PADs in the Table were calculated to balance the need to adequately protect the public from exposure to potentially harmful substances against the risks and expenses that could result from overreacting to a spill. In determining the PADs, this balance was quantified in terms of a level of protection (i.e., the probability that the listed PAD will allow sufficient protection of the public). The level of protection adopted for the ERG was 90%. Clearly, a quantitative analysis of the level of protection requires a statistical approach to specify the PAD. The underlying technical basis for this statistical methodology is described in this report.

### 1.1 Overview of the Emergency Response Guidebook

Figure 1.1 illustrates the basic information presented in the ERG. As shown, the ERG is designed to be used by a first responder to determine the appropriate level of action during the first 30 minutes after a transportation accident involving hazardous materials. Although knowledgeable in the field of law enforcement and public protection, a first responder is usually not an expert in the transport of hazardous materials. Thus, the ERG is a compact source of essential information to use as a basis for making reasonable decisions, often under difficult conditions.



**Figure 1.1 Illustration Showing How the 2000ERG Defines the Initial Isolation and Protective Action Zones for Use by a First Responder**

To properly use the Table, a responder must determine the following:

- United Nations (UN) identification number and/or proper shipping name of the material being transported;
- Direction of the prevailing wind;
- Size of the release, i.e., a small (55 gal or less) spill or large (more than 55 gal) spill;
- Time of day or night; and
- Any special conditions that could preclude the use of the values given in the Table.

As illustrated by the contours shown in Figure 1.1, the downwind concentrations of vapor decrease as distance increases. At some distance downwind from the source of the release, the concentration reaches a level that no longer requires protective action. This distance is called the *Protective Action Distance* (PAD). The term *Protective Action Zone* refers to a square region that has side dimensions equal to the PAD and lies downwind and symmetrically about the accident location. The square shape was chosen to provide a simple, familiar way to define the zone and, more important, to account for the uncertainty in the plume trajectory, which is caused by the variability in wind direction and the possible effects of topographical features. The Table also provides an *Initial Isolation Distance*, which defines the radius of a circular zone that surrounds the accident site. Persons who are not involved in response activities should not be permitted within this *Initial Isolation Zone*. They could be exposed to life-threatening health



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effects downwind of the accident site and to dangerous concentrations upwind in the case of variable wind direction.

## 1.2 Organization of the Report

Section 2 presents a detailed overview of the methodology used to calculate the Initial Isolation Distances and PADs. Included in this discussion is an examination of issues related to the TIH list; treatment of generic compounds, mixtures, and solutions; treatment of chemical warfare agents (a new class added in the 2000ERG); and treatment of water-reactive materials. Section 3 provides details on the statistical scenario analysis applied to materials in the Table, as well as technical details on the consequence models used. Section 4 documents the health criteria, or threshold chemical concentrations, used to specify the Initial Isolation and Protective Action Distances. Section 5 discusses the safe distance distributions developed as a result of the analysis and describes how the PADs were determined from these distributions. Appendix A provides the 2000ERG Table of Initial Isolation and Protective Distances (DOT et al. 2000). Appendixes B–D contain details about chemical-specific data, including experiments conducted to identify and quantify TIH gas emission rates from water-reactive materials.

