Guides to Chemical Risk Management

EPA 550-B-99-015
May 1999

Evaluating Chemical Hazards in the Community:

Using an RMP's Offsite Consequence Analysis

The Current Status of the Risk Management Program Rule

As of the publication date of this backgrounder, key elements of EPA's Risk Management Program Rule are still not final. Public access to the offsite consequence analysis data continues to be debated. EPA has not officially decided on how it will respond to Freedom of Information Act requests. The agency has said that while the offsite consequence analysis data will not be distributed to the public on the Internet, it will supply paper copies of the data upon request. Also, EPA intends to increase the reportable quantity of hydrocarbon fuels (i.e., propane). Concurrently, the U.S. Court of Appeals granted an interim stay of the Risk Management Program Rule as it applies to facilities using propane in a process. For the most current information, see http://www.epa.gov/ceppo.

For More Information

The National Safety Council is maintaining the Chemical Emergency Management Web site at www.nsc.org/xroads.htm as a resource supplement to this series of publications. The site is a directory of Risk Management Program-related links to organizations, regulations, chemicals, rules, and regulations involved in emergency management and the safe handling of chemicals. A selection of articles and papers written about the Risk Management Program Rule and local efforts to identify and analyze risk in the community is also included. The site will be constantly expanding as industry and communities develop new information required under the Risk Management Program Rule.

Other Publications in this Series

Other documents in the Guides to Environmental Risk Management Series are listed below:

- ❑ New Ways to Prevent Chemical Incidents
- ❑ How Safe Am I? Helping Communities Evaluate Chemical Risks
- ❑ What Makes a Hazard Hazardous: Working with Chemical Information
- ❑ Chemical Safety in Your Community: EPA's New Risk Management Program

These documents can be downloaded for free from the Chemical Emergency Management Web site at www.nsc.org/xroads.htm.

About this Document

The Environmental Health Center produced this guide under cooperative agreement CX 826604-01-0 with the U.S. Environmental Protection Agency. It is part of a series of publications on the Risk Management Program Rule and issues related to chemical emergency management.

ENVIRONMENTAL • HEALTH CENTER •

May 1999

Evaluating Chemical Hazards in the Community:

Using an RMP's Offsite Consequence Analysis

Chemical incidents that cause fatalities, injuries, and property damage occur all too frequently. Fortunately, catastrophic incidents such as the 1984 methyl isocyanante release in Bhopal, India, are extremely rare. But the potential for disaster is always present.

According to the Chemical Safety and Accident Investigation Board (CSB), for the years 1987 through 1996, an average of 60,000 chemical releases, spills, and fires occurred annually—42 percent of the incidents occurred at fixed facilities (Figure 1). The CSB estimates that during this 10-year period, 2,565 people were killed or injured by chemical incidents.

Hazardous substances in the community present both reporting opportunities and challenges. Chemical names, quantities, locations, and health effects, as well as populations vulnerable to a release, are key story elements. But frequently this information is difficult to obtain. The Risk Management Program Rule (RMP Rule), a new U.S. Environmental Protection Agency (EPA) regulation set to take effect June 21, 1999, will provide some answers by (1) requiring regulated facilities to conduct a hazard assessment and (2) making it available to the public.

The hazard assessment will consist of an inventory of listed substances, a five-year history of releases, and an offsite consequence analysis (OCA). The OCA is the centerpiece of the hazard assessment; it is an estimate of harm to people and the environment beyond the facility's fenceline that can result from a chemical release. The OCA answers four basic questions needed to understand a chemical hazard:

- ❑ What hazardous substance(s) could be released?
- ❑ How much of the substance(s) could be released?
- ❑ How large is the hazard zone created by the release?
- ❑ How many people could be injured?

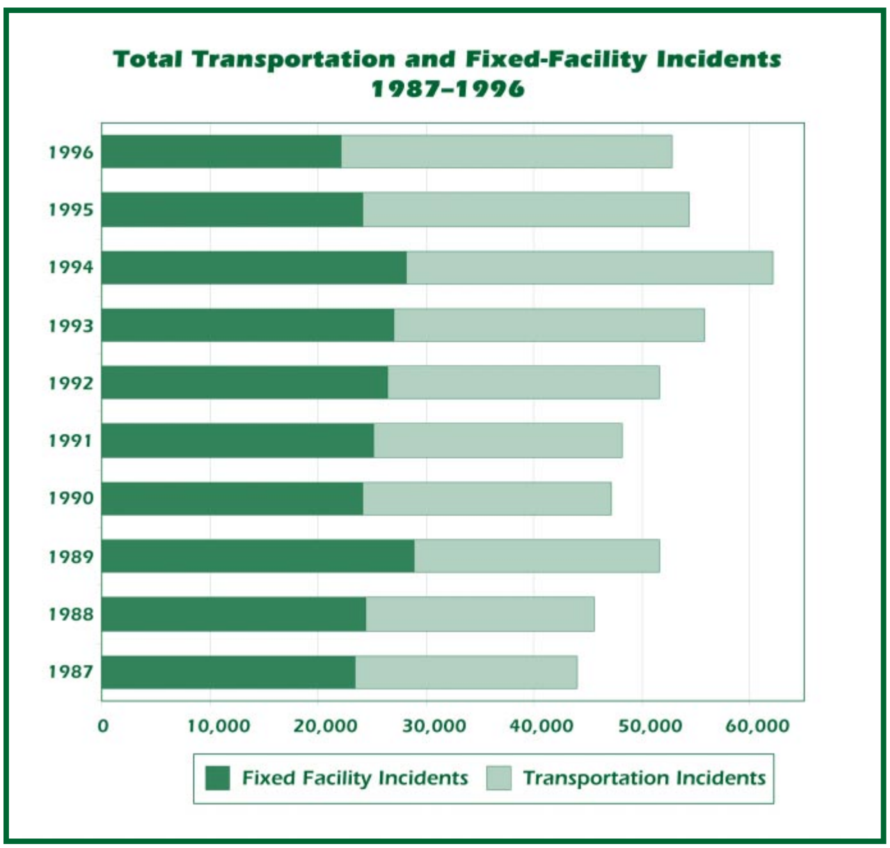

Figure 1: The CSB reported that an average of approximately 60,000 hazardous materials incidents occurred annually between 1987 and 1996—42 percent of the incidents occur at fixed facilities. These incidents were placed into five categories: fixed-facility, transportation, outside, other, and no data. This chart only reflects data on two categories and represents 85 percent of the total incidents (Chemical Safety and Hazard Investigation Board April 1999).

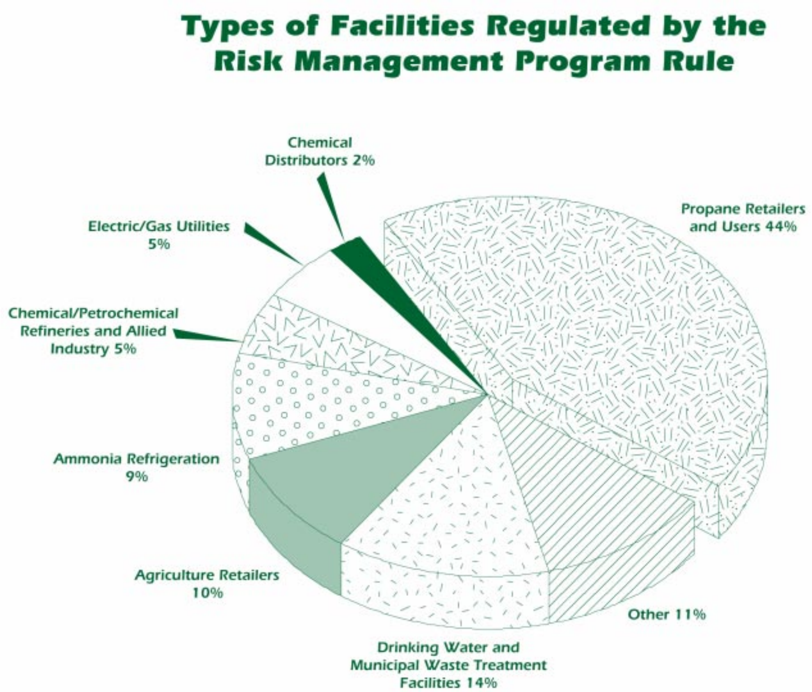

Figure 2: *Facilities that have more than specified threshold quantities of any of 77 acutely toxic substances or 63 flammable substances must submit an RMP. Initially, 44 percent of the 66,000 facilities affected by the Risk Management Program Rule were propane distributors and users. This number could change dramatically if proposed legislation to exempt propane from the RMP or an EPA proposal to raise the reporting threshold for hydrocarbon fuels become effective.*

The History of the RMP Rule

The RMP Rule builds on the earlier emergency planning and community right-to-know efforts implemented under the Emergency Planning and Community Right To Know Act of 1986 (EPCRA). Under EPCRA, facilities are required to file reports if the quantities of the hazardous chemicals exceed specified thresholds. In 1987, EPCRA launched another important right-to-know program called the Toxics Release Inventory. Under this program, facilities report emissions of hazardous substances to EPA. With these programs, EPCRA extended right-to-know beyond the workplace and into the community.

In 1990, Congress took additional measures to protect communities from hazardous chemicals by including accident prevention and emergency preparedness measures in the Clean Air Act Amendments of 1990. Section 112(r) of the Clean Air Act authorizes EPA to develop regulations that prevent and prepare for accidental releases. These regulations are contained in the Accidental Release Prevention Requirements: Risk Management Program Rule, also known as the RMP Rule (40 CFR Part 68). The RMP Rule focuses on preventing accidental chemical releases, reducing risk to the community from exposure to hazardous chemicals, and minimizing the consequences of releases on the environment. The RMP's primary goal is to protect communities from releases of toxic or flammable chemicals that are prone to cause immediate, serious harm to public and environmental health. Flammable and toxic chemicals that can cause severe, acute health effects are covered under the rule; pyrotechnic and explosive chemicals are not.

Facilities such as chemical plants, oil refineries, propane retailers, fertilizer warehouses, ammonia users, and water treatment plants, must comply with the EPA's RMP Rule by submitting a summary of their risk management plans (RMPs) to EPA by June 21, 1999 (Figure 2). The RMPs must be submitted if any process at a site contains more than specified amounts of 140 hazardous substances, such as propane, ammonia, or chlorine.

Hazard Versus Risk

Understanding the distinction between hazard and risk is central to using the OCA as one of the tools for determining how a community can manage hazardous chemicals. The OCA analyzes hazards. The RMP Rule does not require a risk assessment.

A *hazard* is something that is capable of causing harm. The bigger the hazard, the greater the capacity to cause harm (DiNardi 1997). The hazard is based on properties intrinsic to the material and the level and duration of exposure. For example, hydrofluoric acid is toxic, propane is flammable. Little can be done to change these characteristics.

The severity of the hazard often depends on exposure. The extent of exposure can be influenced by the quantity of the substance released, the circumstances of the release (for example,

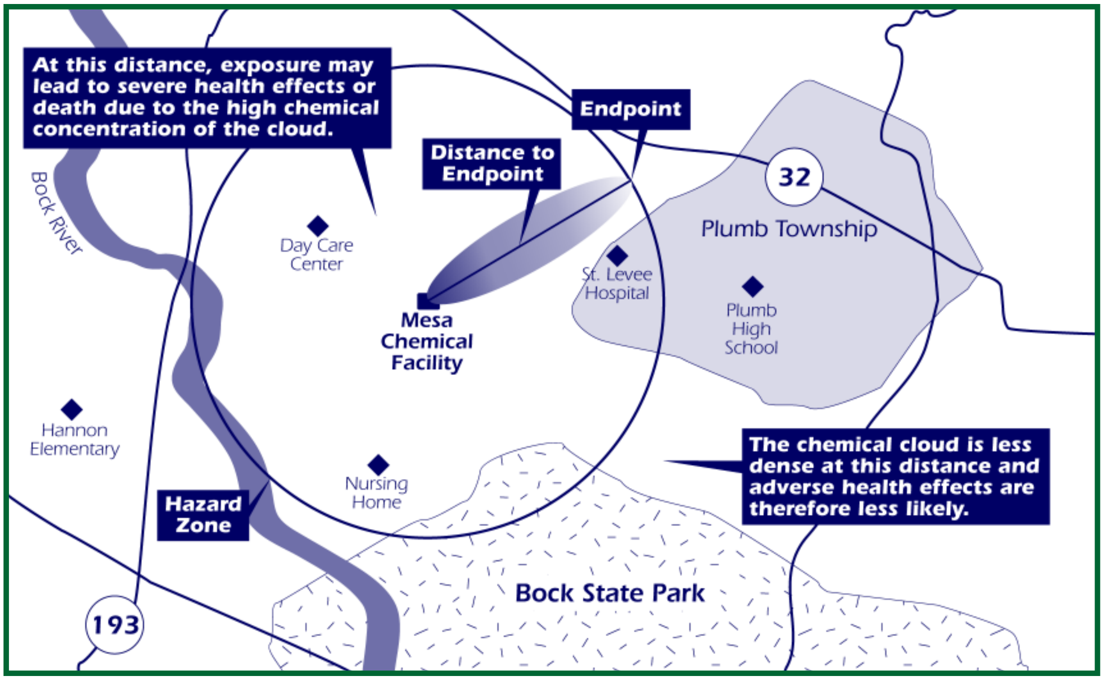

Figure 3: *This is a typical map found in an RMP, showing hazardous areas, vulnerable populations, and sensitive environments. This map shows the endpoint, distance to endpoint, and the hazard zone for one possible scenario. The hazard zone is a circle because wind variability could cause the toxic cloud or fire effects to go in a number of directions.*

weather conditions, topography, mitigation measures), and the proximity to the point of release. The severity of the hazard can be reduced, for example, by lowering the quantity of the chemical stored onsite or by improving facility or process design.

Risk is a measure of probability. The greater the risk, the more likely the hazard will cause harm (DiNardi 1997). Ideally, risk should be quantified—for example, a 10 percent probability that a certain event will occur. Too frequently, however, data on rates of equipment failure and human error are unavailable, so it is not possible to reliably quantify the risk of a chemical release.

Nevertheless, we know from experience that certain events happen more frequently than others do—for example, releases frequently occur during transfer operations or process startups. Catastrophic events, like the Bhopal tragedy, occur rarely and would be considered high-hazard, low-risk events. An incident that occurs frequently but does not generate an offsite consequence would be considered a low-hazard, high-risk event.

Predicting the Distance to Endpoint

Potential offsite consequences of accidental chemical releases are predicted by air dispersion models, which estimate the area that may become hazardous under certain conditions. The models integrate information about chemical properties and release conditions and forecast the scenario's distance to endpoint.

Though the flow of some dense gases and vapors will be guided by terrain features, wind direction will generally control movement, creating hazards downwind from the point of release. Since it is not possible to reliably predict when accidents will occur or what the wind direction will be when they do occur, released gases and vapors may travel in any direction. Therefore, the total area that may be affected by a release is represented by a circle with its center at the point of release. The radius of the circle represents the distance to endpoint (Figure 3).

The area within the circle is the hazard zone. The OCA identifies vulnerable populations and sensitive environmental areas within this circle. Hazard zones can easily be displayed graphically on local maps that show vulnerable populations, such as nearby homes, schools, nursing homes, businesses, or parks and recreational areas. These vulnerable populations are referred to in the RMP Rule as public receptors. Environmental receptors, such as vulnerable parks and designated wildlife and wilderness areas, may also be identified.

Models in the Real World

A facility can use EPA's chemical-specific endpoints or other emergency air dispersion models to calculate the distance to endpoint. The RMP Rule does not specify which model should be used other than the model should be one that (1) is publicly available, (2) accounts for the required modeling conditions, and (3) is recognized by industry as acceptable.

The advantage of using an air dispersion model is that it may be more accurate than EPA's methodology for predicting the mixing of pollutants in air and the distance to endpoint. However, the results of any model should be viewed cautiously since few of the fundamental algorithms used by all of the models can be verified in actual field tests.

Models are designed to simulate reality—a very complicated set of variables and interrelations that is difficult to understand and replicate. Differences in the methods used to combine the effects of each variable can result in hazard distances that vary widely; predicted hazard distances often lie within a band of uncertainty.

Some OCA's will predict a very large distance to endpoint. Facilities must quantify distances up to 25 miles. Still, estimating distances beyond six miles tends to be particularly uncertain because of local variations in meteorological conditions and topography. For example, atmospheric turbulence is a major factor in determining how quickly a toxic cloud will mix with the surrounding air and be diluted. And how quickly a cloud will be diluted to below the endpoint value will affect the distance it travels. It is dangerous to assume that atmospheric turbulence and wind speed and direction will remain constant from the point where a pollutant is being released (Evans 1998).

Worst-Case and Alternative Release Scenarios

All RMPs are required to contain an OCA for a worst-case release scenario (Figure 4). If both regulated toxic and flammable substances are present in a process, separate scenarios for each type of substances must be prepared. Many facilities will also need to prepare alternative release scenarios.

Worst-case scenarios assume there is a rapid,

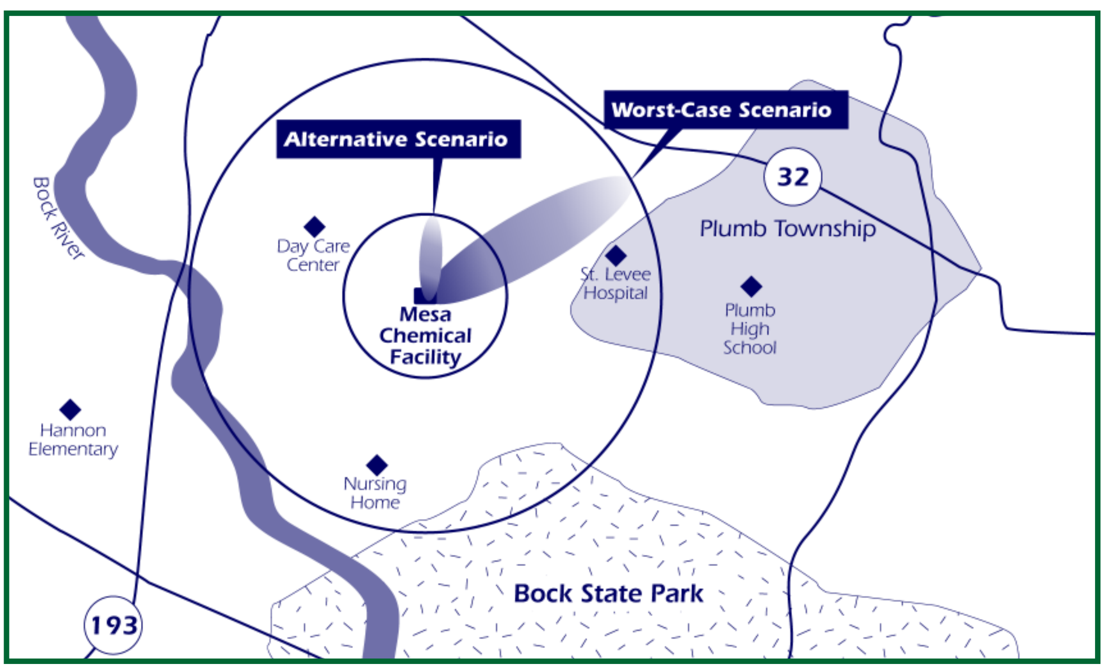

Figure 4: This map shows a worst-case scenario and a more likely alternative scenario for a typical facility. The differences between the size of the hazard zone in a worst-case and an alternative scenario can be based on a number of factors, including the facility's emergency response capability, accident history, or design improvements.

ground-level release of the greatest possible amount of a chemical from a single vessel or pipe. Passive mitigation devices, such as dikes and containment walls around the process, may be assumed to capture or control the release if they would be likely to survive the incident.

However, active mitigation devices that require human, mechanical, or other energy to manage releases must be assumed to fail in the worst-case scenario. In addition, weather conditions are assumed to be very mild, producing minimal mixing of the toxic gas or vapor cloud. These conditions produce a large, stable cloud with a persistent, high chemical concentration—the most severe type of hazard. EPA states that the maximum hazard zone for worst-case scenarios may be quantified for distances up to 25 miles. (Note: Some scenarios may extend further than 25 miles, but will not be quantified beyond that point.)

Alternative release scenarios are based on more realistic factors and must have an offsite endpoint, if possible. Facilities are given more latitude in designing these events. Alternative scenarios may be based on the facility's five-year accident history or on a review of process hazards conducted as part of the RMP Rule's accident prevention requirements. Unlike worst-case scenarios, the weather conditions are assumed to be typical for the area. In addition, these more likely scenarios assume that both active and passive mitigation systems operate as intended.

Facilities that do not maintain any chemicals that could cause an offsite impact and that have not had any accidents with an offsite consequence in the past five years are considered low hazard and are not required to submit the alternative scenario analysis.

The Value of Worst-Case Scenarios

Characterizing danger only by using worst-case scenarios can be misleading and unnecessarily alarming. Worst-case scenarios estimate the maximum possible area that might be affected by an accidental release. They help ensure that potential hazards to public health are not overlooked. They are not intended to represent a "public danger zone." Nor do worst-case scenarios reflect whether processes are safe. Both safe and unsafe processes using the same chemicals at the same quantity will have similar hazards.

The objectives of the worst-case scenario are (1) to create an awareness

Where to Find EPA's Chemical-Specific Endpoints

*Many facilities appear to be using EPA's chemical-specific endpoints for toxics and flammables. EPA's RMP Offsite Consequence Analysis Guidance includes a table of values for chemical-specific endpoints. EPA's endpoints are intentionally designed to be conservative, erring on the side of greater public protection. EPA's methodology is automated in a computerized application called RMP*Comp™. The program can be downloaded from EPA's Web page for Chemical Accident Prevention and Risk Management Planning at http://www.epa.gov/swercepp/ds-epds.htm.*

The ready availability of these tools will help to standardize the results provided from various facilities and will enable emergency planners, community members, and facilities to more easily compare and evaluate RMP data from various processes.

Endpoints

The term "endpoint" is frequently used in the RMP Rule. Endpoints are used when facilities and emergency planners perform OCAs to predict areas that may become hazardous if dangerous chemicals are released.

For accidents involving flammable chemicals, the distance to endpoint represents the area in which people could be hurt. An explosion could shatter windows and damage buildings, possibly causing injuries because of flying glass or falling debris. Therefore, a flammable endpoint represents a blast wave capable of breaking glass (one pound per square inch of pressure) or radiant heat intense enough to blister human skin.

A toxic endpoint defines the outer boundary of a concentration considered hazardous to the community. For accidents involving toxic chemicals, the distance is based on the ability of a victim to escape the area. Most people can be exposed to an endpoint concentration for one hour without suffering irreversible health effects or other symptoms that would make it difficult to escape. People within the distance to endpoint are likely to be exposed to higher concentrations and greater hazards. Individuals exposed to higher concentrations for an extended period may be seriously injured.

Worst-Case and Alternative Release Scenario Parameters

Factor	Worst-Case Release Scenario	Alternative Release Scenario
Event selection	Produces greatest distance to an offsite endpoint	More likely than worst-case scenario based on the 5-year accident history or failures identified in analysis of process hazards
Mitigation	Can consider the effect of passive systems that survive the event	Can consider effect of passive and active systems that survive the event
Toxic endpoint	From Appendix A of RMP Rule	From Appendix A of RMP Rule
Flammable endpoint	Blast wave pressure from the explosion of the vapor cloud	Blast wave from the explosion of the vapor cloud or radiant heat
Wind speed/atmospheric stability class	3.4 miles per hour and F class stability, unless higher wind or less stable atmosphere can be shown at all times in last 3 years	6.7 miles per hour and D class stability or typical conditions for the site
Outdoor temperature/ humidity	Highest daily maximum temperature in the prior 3 years and average humidity Liquids, other than gases	Typical conditions for the site
Temperature of released substance	liquefied by refrigeration, are released at highest outdoor temperature during the prior 3 years or the process tempera-ture, whichever is higher	The appropriate process or outdoor temperature
Surface roughness/nearby obstacles	Urban or rural, as appropriate	Urban or rural, as appropriate
Dense or neutrally buoyant gases	Model accounts for gas density	Model accounts for gas density
Height of release	Ground level	Determined by scenario
Amount released	Greatest possible amount from a single vessel or pipe	Determined by scenario
Toxic gas release rate	All in 10 minutes	Determined by scenario
Toxic liquid releases	■ Instantaneous release ■ Pool area is 1 centimeter deep or size of passive mitigation area ■ Rate at which it evaporates must be calculated	Determined by scenario
Distance to endpoint	Greatest offsite distance, up to 25 miles	Offsite, if appropriate

about potential hazards at the facility and in the community and (2) to motivate a reduction of these hazards. Tim Gablehouse of the Jefferson County, Colorado, Local Emergency Planning Committee (LEPC) stressed that the issue of worst-case scenarios should not be the focus of public discussion. Instead, it should lead to an emphasis on emergency response, risk communication, and prevention efforts. The purpose of the RMP is not to generate unnecessary fear, but to educate the public about hazard reduction and emergency response.

Local emergency planning organizations can use RMPs to prepare response plans and allocate resources. Knowing who is vulnerable saves time and resources when preparing communications strategies; locating equipment; and establishing industry, community, and government working relationships.

Alternative Release Scenarios

Based on more likely conditions, alternative release scenarios offer more realistic, useful emergency planning information for the facility and the public. Facilities are given latitude in selecting credible release conditions for these scenarios and can use accident history information or other knowledge of the process for selecting the hypothetical incident.

Questions Reporters Might Ask a Facility Manager

- ❑ What hazardous chemicals do you have at the site that could endanger workers and the community? What quantities are kept onsite? What are their health effects?
- ❑ How many people could be injured in a worst-case release scenario and in a more likely alternative release? What public receptors (e.g., schools, nursing homes, and residences) did you identify? Are local emergency responders capable of handling the number of people that could be injured by such incidents? What environmental receptors (e.g., parks, wildlife sanctuaries, and wetlands) did you identify?
- ❑ What have you done to minimize Y2K and other computer problems that could affect process controls and result in a release?
- ❑ Have you secured your computer systems from outside sabotage?
- ❑ What steps have you taken to ensure site security? To fortify chemical stores?
- ❑ Did you use EPA's methodology to determine your worst-case and alternative scenario distances to endpoint? If not, what method did you use, and why is it better than EPA's? How do the distances compare with the ones based on EPA's guidance?
- ❑ Can you provide a tour of the site to show how you are reducing the likelihood of a release? Can we bring our own experts?
- ❑ How is the facility reducing its hazards? By substituting less hazardous chemicals? By reducing chemical quantities? By improving safety designs and worker/contractor training?
- ❑ How will these hazard reduction initiatives increase safety?
- ❑ Is the facility willing to share its OCAs and process hazard analysis with the community?
- ❑ Do you have an uninhabited buffer zone around the site's borders to protect neighbors?

Annotated List of Accident Prevention References and Links

References and links to documents or Internet sites should not be construed as an endorsement of the views contained therein.

Federal Information

EPA's Chemical Emergency Preparedness and Prevention Office
http://www.epa.gov/ceppo

This EPA office maintains a comprehensive Web page that includes chemical accident prevention and risk management planning information. EPA will maintain an online database of all RMPs—in RMP*Info. However, RMP*Info will not contain the OCA data.

RMP Offsite Consequence Analysis Guidance (http://www.epa.gov/swercepp/acc-pre.html) is for owners and operators to use when analyzing OCAs. RMP*Comp™ (http://response.restoration.noaa.gov/chemaids/rmp/rmp.html) is a software package that performs the calculations described in the *RMP Offsite Consequence Analysis Guidance*. These are available free through the Internet.

Another useful EPA publication is *General Guidance for Risk Management Programs* (http://www.epa.gov/swercepp/acc-pre.html). Chapter 4 of this guidance specifically addresses OCAs. Chapter 11, Communication with the Public, includes information on how facilities can address public questions about OCAs and hazards.

In addition to model RMPs developed by other entities, a section of EPA's Web site for Chemical Accident Prevention and Risk Management Planning (http://www.epa.gov/swercepp/ap-ingu.htm) provides guidance documents regarding model risk management program plans for specific industries. These documents contain chapters that are similar to Chapter 4 of *General Guidance for Risk Management Programs*, instructing industries how to conduct OCAs for the specific chemicals they typically use. Already available model plans include the following:

- ❑ Risk Management Program Guidance for Ammonia Refrigeration
- ❑ Risk Management Program for Propane Users and Small Retailers
- ❑ Risk Management Program Guidance for Propane Storage Facilities
- ❑ Risk Management Program Guidance for Chemical Distributors
- ❑ Risk Management Program Guidance for Warehouses
- ❑ Risk Management Program Guidance for Wastewater Treatment Plants

EPA's Resource Conservation and Recovery Act, Underground Storage Tank, Superfund, and EPCRA Hotline
http://www.epa.gov/epaoswer/hotline

This site provides information on how to contact the EPA-sponsored Hotline that addresses the Risk Management Program Rule. Other information resources are also provided. Many related documents, including those listed on the EPA site above, can be ordered by calling (800) 424-9346 or (703) 412-9810 in the Washington, D.C., area.

Chemical Safety and Hazard Investigation Board (CSB)
http://www.chemsafety.gov

The Chemical Safety and Hazard Investigation Board Web site has information about incidents investigated by the board, as well as a library of chemical safety documents and information on the year 2000 issue.

Background Documents

The 600K Report: Commercial Chemical Incidents in the United States, 1987–1996
http://www.csb.gov/1999/news/n9916.htm

Chemical Safety and Hazard Investigation Board. 1999. *The 600K Report: Commercial Chemical Incidents in the United States, 1987–1996*.

Why the 10-Kilometer and 1-Hour Limits?
www.nsc.org/xroads.htm

Evans, Mary. 1999. Dr. ALOHA: Why the 10-kilometer and 1-hour limits? *CAMEO Today* (May/June 1998).

The Occupational Environment: Its Evaluation and Control

DiNardi, S.R. 1997. The occupational environment: Its evaluation and control. *AIAH*.

Organizational Contacts

Chemical Manufacturers Association

Contact: James Solyst, Team Leader, Information Management/Right-To-Know
Address: Chemical Manufacturers Association
1300 Wilson Boulevard
Arlington, VA 22209
Phone: (703) 741-5233
E-mail: jim_solyst@mail.cmahq.com

U.S. Environmental Protection Agency

Contact: Carole Macko, Communications Team Leader, Chemical Emergency Preparedness and Prevention Office
Address: U.S. Environmental Protection Agency
401 M Street, SW 5104
Washington, DC 20461
Phone: (202) 260-7938
E-mail: macko.carole@epamail.epa.gov

Working Group on Community Right-to-Know

Contact: Paul Orum, Coordinator
Address: Working Group on Community Right-to-Know
218 D Street, SE
Washington, DC 20003
Phone: (202) 544-9586
Web site: www.rtk.net/wcs
E-mail: orum@rtk.net

Gablehouse & Epel

Position: Timothy R. Gablehouse, Attorney and Counselor at Law
Address: Gablehouse & Epel
1050 Seventeenth Street, Suite 1730
Denver, CO 80265
Phone: (800) 818-0050
Web site: http://www.gablehouse-epel.com
E-mail: Gablehouse@aol.com

"The OCA is the centerpiece of the hazard assessment; it is an estimate of harm to people and the environment beyond the facility's fenceline that can result from a chemical release."

Printed on Recycled Paper

The Environmental Health Center (EHC) is a division of the National Safety Council, an 85-year-old nonprofit, nongovernmental organization. The National Safety Council is a national leader on accident prevention and home, workplace, auto, and highway safety issues.

The National Safety Council established EHC in 1988 to undertake environmental communications activities aimed at helping society and citizens better understand and act knowledgeably and responsibly in the face of potential environmental health risks. Since that start, EHC has built a strong record of effective, nonpartisan communication on environmental health risks and challenges.

May 1999

ENVIRONMENTAL HEALTH CENTER
A Division of the National Safety Council
1025 Connecticut Avenue, NW • Suite 1200
Washington, DC 20036
www.nsc.org/ehc.htm
(202) 293-2270