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Chemicals in the Environment

Public Access Information

Contents

The Three R's of Risk

Odelia Funke, Chief, *Information Access Branch*

This issue of ***Chemicals in the Environment*** focuses on topics and information relating to risk. Dealing with various aspects of risk is central to EPA's and OPPT's mission. But the term "risk" is ambiguous and controversial. It has also become a significant issue for political and policy debates regarding national environmental programs and regulations.

What is risk and how is it used in environmental decision-making? How does EPA communicate these issues to the public in order to solicit public input for policy, explain policy decisions or influence behavior? These questions delineate three important aspects of risk that EPA considers in its programs: risk ***assessment***, risk ***management***, and risk ***communication***.

EPA makes a distinction between risk *assessment* activities, which it defines as a scientific inquiry of the problem, and risk *management* activities, which it defines as the analysis and process to determine what should be done about any particular problem.

Risk assessment should be conducted based on scientific evidence. Risk management includes consideration of political, economic, social and moral choices. Each of these aspects of risk has elements of uncertainty (which vary from case to case) and each requires assumptions and judgments.

Risk assessment is currently a topic of considerable debate. Part of the controversy involves the kinds of definitions and assumptions scientists use, and part involves disagreements about how reliable risk calculations are. For example, how much risk (or harm) is "too much," something that should be controlled or prevented? What should assessors do to compensate for missing data? At what point is an effect "adverse" for humans or ecosystems?

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In explaining how OPPT addresses risk, the articles describe some of the issues we face and key concepts underlying our approach to risk assessment, management and communication. Other articles explain some of the tools we use in dealing with matters of risk.

Risk Assessment

Identifying risk and assessing its severity is the first stage. Risk is based not only on the properties or components of a material or pollutant, but also on who or what is exposed to it, and how they are exposed. Risk assessors therefore consider how toxic the material is, who or what may come into contact with it, and whether that contact could be harmful. This is primarily a scientific investigation, which involves collecting and analyzing data from many scientific disciplines. It requires complex analysis, and investigators never have complete information, so they must make assumptions and judgments — for example, they study effects on animals and use the results to judge effects on humans.

Risk Management

Risk management activities answer the question of what to do about risk. (Can a particular problem be prevented? How might it be controlled? How much control; who controls, and at what cost? Should protective measures be required or voluntary?) In the risk management stage, OPPT considers various policy options, decides what to do, and implements those policy choices. Opportunities for disagreement are even greater than in the assessment stage. OPPT must analyze what actions might effectively address a risk, how much each different approach would cost society, and what is the most feasible approach given statutory, economic and political constraints. Decisions determine not only how much protection is enough, but who pays. Risk management decisions are an attempt, based on the scientific findings, to balance a variety of requirements, needs and possibilities.

Risk Communication

Risk communication is an ongoing and intricate process. OPPT transmits information, proposed policies, and the rationale for decisions to the public, and solicits information about needs and expectations as well as responses to specific policy proposals from the public. It is a mutual process of education about risks and appropriate responses. Communication occurs through a wide variety of mechanisms and processes, both formal and informal. In the past several years, OPPT has increased its efforts to make information available to the public and has been working to identify groups who might be interested in this information. The Office has created new channels for dialogue with and comment from the public to improve communication, but this is an ongoing challenge.

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Risk Assessment in the Office of Pollution Prevention and Toxics

Joseph A. Cotruvo, Director, *Chemical Screening and Risk Assessment Division*

While all substances are hazardous or potentially harmful under some circumstances, most can be used safely. The fundamental question is what is the likelihood that harm will occur under any condition of production, use, misuse or release, and who is being subjected to that risk. Ultimately, that risk information is usually combined with benefit, cost, and other impact information in addition to legal and policy elements to arrive at a risk management decision.

Risk assessment is one of the many tools and often is the underpinning to important and costly regulatory and policy decisions aimed at reducing potential adverse effects. There has been a lot of controversy recently on the subject of risk assessment as though it were an arcane activity, which if only done "properly" would solve most of the controversy raised about the appropriateness of contested regulatory decisions. However, things are neither that simple nor that sinister.

Chemical risk assessment is, in fact, a rather straightforward, but not simple or uncontroversial, concept. It is an attempt to objectively analyze information on the 1) hazard, 2) exposure, and 3) dose-response of a substance to arrive at a prediction of the probability that adverse effects could occur to humans or the environment. The great difficulty is the necessity of making those predictions in the absence of complete and definitive data in each of those three areas. We must often use animal data to project the human health hazard, given limited data on actual human exposure, dosimetry (measurement of the amount of exposure), mechanism (how a chemical affects the human body), population distribution, and higher risk groups. Even human epidemiology studies often raise more questions than they answer.

Because of this lack of solid information, there is usually considerable uncertainty associated with any quantitative conclusion that results. Further, this lack of data means scientists must rely on assumptions, extrapolations, and judgments, and as a result, conclusions are often value-laden. However, risk assessment does not have a corner on the uncertainty market; other impact assessments (such as cost/benefit) often have just as much uncertainty, because many underlying factors cannot be accurately measured or predicted.

EPA and OPPT are strongly committed to improving risk assessments and improving the understanding of their content by emphasizing ***peer review*** and ***risk characterization*** as key elements in the process.

Given the uncertainties and complexities and lack of "definitive" information, peer review is an essential element of a credible assessment. It is important to seek critical reviews of an assessment from knowledgeable scientists who were not parties to its preparation. These independent reviewers help us determine whether there are deficiencies and whether the assessment is objective, credible and consistent with mainstream scientific thinking. Peer reviewers should represent the full spectrum of credible perspectives, regardless of affiliation. In 1995, as part of an EPA-wide effort, OPPT formalized its policy to set standards for peer review of important risk assessments.

Finally, the way we communicate the results of an assessment is critical to our credibility and the users' understanding. It is essential that the assessment be ***characterized*** (described) in such a way that it is understandable to a range of readers (including the decision makers) and that the thought process for developing the conclusion is transparent. This means we should clearly differentiate between facts, default assumptions, and judgments. We should point out uncertainties and describe possible alternative interpretations.

OPPT conducts a wide variety of risk assessments to support a number of different programs and decisions. These differ in structure and intensity depending on their intended use. In general, all of these assessments are a team effort. Human and ecological hazard information is reviewed by the Health and Environmental Review Division; exposure information is provided by the Economics, Exposure and Technology Division. These two reviews are converted into a risk assessment by staff of the Chemical Screening and Risk Assessment Division.

For example, in the New Chemicals Program, several thousand submissions of new chemicals are received each year, and often little or no toxicity or exposure data are provided by the submitting companies. The New Chemicals Team has, over the years, developed streamlined evaluation processes using: *historical information*, *expert judgment* based on information on other

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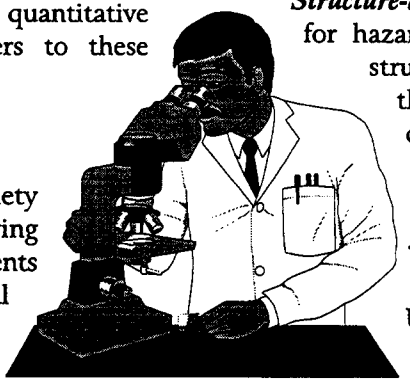
Hazard Identification and Dose-Response Assessment

Joe Merenda, Director, *Health and Environmental Review Division*

In the context of risk assessment, ***hazard identification*** focuses on the qualitative question "What are the potential dangers?" while ***dose-response assessment*** deals with the quantitative question "How much danger is there?" Hazard identification and dose-response assessment must be teamed with exposure assessment (in a qualitative or quantitative form) to yield practical answers to these questions.



Hazard Identification

Chemicals can present a wide variety of hazards to humans, other living organisms, and non-living components of our environment. Biological effects often considered in hazard identification include: lethality to exposed organisms; temporary or permanent impairment of normal biological functions; heritable genetic change; increases or decreases in the population size and range of one or more species; and the overall health and productivity of ecosystems. Potential non-biological effects include: reduced visibility from airborne particulates; damage to historic structures by air pollutants; and climate change from global warming.

Biological and non-biological effects can interact, further complicating things. For example, the primary reason for concern about depletion of stratospheric ozone (a non-biological effect) is its secondary biological effects, including increased skin cancer risk to humans and potential effects on aquatic populations.

There are two key elements of hazard identification: (1) identifying potential hazards and (2) weighing the evidence of whether or not a particular hazard is likely to be of practical significance. Both elements require a combination of knowledge and judgment. Hazard identification depends on knowledge or inference of the properties and effects of the specific chemical being addressed, along with broad knowledge and understanding of relevant scientific areas such as chemistry, biochemistry, biology, toxicology, and ecology.

Well-designed and executed studies of a chemical's ability to cause a particular effect are the preferred basis to conclude whether or not that chemical can cause nerve damage in humans, reduced growth and survival in aquatic invertebrates, or any of a myriad of other potential hazards. Often, though, no studies are available of a specific chemical's ability to cause a particular type of adverse health or environmental effect. This is especially true for newly-developed chemicals that must be reviewed by OPPT scientists before companies can manufacture or import them.

Structure-activity relationships provide an essential tool for hazard identification in such cases. In brief, structure-activity approaches attempt to predict the hazards of a chemical from qualitative or quantitative analysis of hazard data for other chemicals having structures or properties similar to the chemical in question. *[See page 7 for more information on OPPT's Structure Activity Team.]*

Uncertainty is a major element in most hazard identification efforts. Key factors that often contribute to uncertainty include:

- lack of sufficient test data for the chemical of interest or for suitable analogs. *(Structure-activity can go only so far in substituting for actual test data.)*
- testing in surrogate species. *(How well do data from laboratory strains predict potential effects in humans or other species?)*
- conflicting evidence. *(Genetic tests in microbes may suggest that a chemical could cause cancer in humans, but if a limited study of the chemical in mice shows no evidence of cancer, which evidence should be given more weight?)*
- unanticipated effects. *(Until relatively recently, no one knew to look for a chemical's potential to destroy stratospheric ozone.)*

Dose-Response Assessment

The goal of dose-response assessment is to provide a numerical basis for translating exposure information into an evaluation of risk. Although hazard identification may have documented a chemical's ability to cause a particular health or environmental effect, whether that hazard is of great or little practical concern depends on how anticipated exposure levels compare to exposure levels at which the adverse effect is expected. Dose-response assessment typically uses one of two basic approaches: *reference levels* or *unit risk*.

The "reference level" approach generally is used when a chemical's effects are presumed to be significant only if some threshold amount of exposure is exceeded. The lowest exposure level at which the effect of concern has

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Risk Assessment in OPPT *(continued from page 3)*

similar chemicals, and *modeled exposure potential*, based upon their knowledge of physical/chemical properties, manufacturing processes and uses. Thus, our scientists can conduct rapid and specific assessments suited to the legally required decision to accept, disallow, or conditionally allow production of the new chemical within 90 days.

OPPT also uses risk assessments to evaluate chemicals already in production. The Toxics Release Inventory (TRI) contains data on hundreds of chemicals released by manufacturing. A limited assessment (dependent upon numerous factors) contributes to TRI listing and delisting decisions. OPPT also provides Chemical Fact Sheets for outside users. These provide basic information on the toxicity of various chemicals with conclusions as to the significance for humans and ecological health, without quantifying exposures or evaluating estimated risks.

The Existing Chemicals Risk Assessment process produces screening level assessments in the first stage of the Risk Management (RM1) process. These assessments inform the initial judgment as to whether there is sufficient concern about a chemical in production to warrant a more detailed assessment later in the RM process. Here, data should be available, often from OPPT data sets, for a preliminary assessment although seldom is it alone sufficient if a more comprehensive follow-up analysis is needed. More detailed information might be needed for a major impact decision, and the Chemical Testing Program could be a vehicle for generating more data.

There have also been extensive assessments conducted in the course of TSCA implementation for substances like asbestos and formaldehyde. These can be extremely detailed and lengthy and require significant resources.

A risk assessment is only one component of the risk management decision. It is a living analysis that should reflect the best information and thinking on that subject as important new information is developed in this rapidly changing field. We should expect to be challenged and always be open to newer, better ideas. In this way, the uncertainties in this analytic construct will be reduced and it will come closer and closer to describing reality.

This does not mean that a risk management decision to act or not to act must always await the next pending piece of data. A risk assessment is a snapshot in time and risk management judgments must be made on the merits of available information and in a timely manner.

Hazard Identification and Dose-Response Assessment *(continued from page 4)*

reliably been demonstrated (or the highest exposure at which that effect has been absent in an appropriate study) provides the starting point to define a reference level. This level is adjusted to account for any known differences between the test species and the target species and, more significantly, for key elements of uncertainty anticipated in applying the study results to the population to be protected.

Such uncertainty factors often include: the possibility that the target species will be more sensitive to the chemical's effects than the test species; use of limited duration testing to predict effects of long-term exposure; and variation in susceptibility to the effect among individuals in the exposed population. Risk is judged by comparing anticipated exposure with the relevant reference level. An exposure far below the reference level implies low risk of that hazard, while an exposure considerably above the reference level suggests a cause for concern.

The "unit risk" approach attempts to describe mathematically how the likelihood of a particular effect depends on exposure. This is the approach generally is used for cancer-causing chemicals, for which any exposure is presumed to present some risk, with the risk increasing as the exposure increases. Laboratory test data showing the percentage increase of animals developing tumors at different exposure levels are used to estimate a chemical's cancer unit risk. The latter can then be used, along with anticipated exposures to the chemical, to estimate (very roughly) how many cancer cases might occur in a particular population size.

A variety of factors contribute to uncertainty in the unit risk and risk estimates based on it. These often include: qualitative or quantitative differences in how humans and the test species absorb and metabolize the chemical or respond biologically to the chemical and its metabolites; and uncertainty in the reliability of risk estimates for large populations exposed to low levels of a chemical that are based on exposing relatively small numbers of laboratory animals to high levels.

Ranking and Screening Risks in the OPPT Existing Chemicals Program

Jim Darr, *Health and Environmental Review Division*

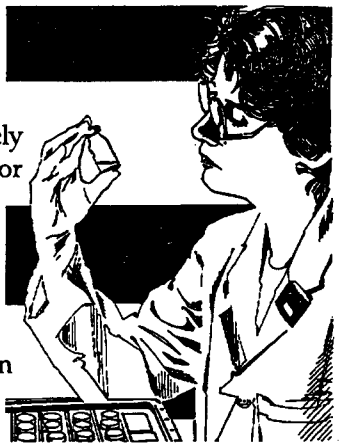
Background and Purpose

The primary objective of the Office of Pollution Prevention and Toxics (OPPT) Existing Chemicals Screening Program is to identify health and environmental risks and to promote risk reduction and pollution prevention. A complementary objective is the identification of testing needs.

The basic criteria employed in screening are:

- Toxics Substance Control Act (TSCA) Jurisdiction
- Toxicity Factors
- Exposure Factors
- Assessment/Regulatory Status
- Testing Needs
- Opportunities for Risk Reduction and Pollution Prevention

Screening decisions are based on limited information and professional judgment. For example, toxicity evaluations typically are based on readily available data supplemented by Structure-Activity predictions. Potential exposure may be estimated from an analysis of production and use patterns.



The "universe" of chemicals of primary interest to the TSCA program consists of the approximately 14,000 non-polymeric chemicals or chemicals that are submitted by companies that are intended for manufacture and are produced in annual quantities greater than 10,000 lbs. Most screening efforts focus on a subset of high production volume chemicals, that is, those chemicals produced in annual quantities greater than one million pounds. OPPT, the Chemical Manufacturers Association, and the Synthetic Organic Chemical Manufacturers Association have developed a mechanism for manufacturers to voluntarily provide key use and exposure data that assist OPPT's screening of high production volume chemicals.

OPPT has developed a variety of techniques to cope with the wide variety of problems and uncertainties encountered in reviewing this large and diverse set of chemicals. The various approaches and techniques employed in the screening program fall into two basic categories: ***reactive and proactive.***

Reactive Screening - Single Chemical Reviews

TSCA Section 8(e) "substantial risk" notices submitted by industry are the major input to reactive screening. The data most commonly submitted to OPPT are from toxicologic studies but some exposure studies such as environmental monitoring or product contamination analyses are also submitted. OPPT performs an initial sorting of Section 8(e) studies by means of a "triage" or priority setting review that assigns a high, medium, or low level of concern to each study. Studies flagged as high concern undergo further screening according to the criteria listed above.

Studies submitted under TSCA Section 4 and assessments conducted under the Organization for Economic Cooperation and Development's Screening Information Data Sets (SIDS) program are also major inputs to OPPT's screening program. Additional initiatives for screening high production volume chemicals are also being studied.

Proactive Screening - Cluster Reviews

OPPT believes that it must take the initiative to identify health and environmental risks beyond those brought to our attention by external data submissions. These proactive efforts involve the systematic analysis of defined lists of chemicals or sets of data that indicate potential concerns. A key proactive effort is the review of "clusters" of chemicals. A cluster is simply a group of chemicals related by defined characteristics. These characteristics may include chemical structure, physical/chemical properties, use/exposure patterns, or who might be exposed to it. Two major efforts to rank clusters of chemicals are:

1) The Use Cluster Scoring System (UCSS), which ranks industrial and commercial uses of chemicals by a wide variety of hazard and exposure factors. The UCSS considers both health and ecological hazards and ranks exposures to workers, consumers, the general population, and ecological receptors.

2) The Source Ranking Database (SRD), which ranks consumer and commercial products with respect to the risks they present through indoor air exposures. The SRD considers both acute and chronic health hazards and ranks exposures by using data on products, settings (e.g. home, school, or office), and populations. (Note: The SRD is not currently available to the public.)

Information Products

The creation of user-friendly information products is an important output from the screening program. Oftentimes, the most efficient and effective way to achieve risk reduction is to make relevant hazard and risk information readily available to the people who make the day-to-day decisions regarding the manufacture, processing and use of chemicals. Screening information products include the 8(e) Triage database, SIDS assessment documents, and exposure profiles on high volume chemicals. The development of products derived from the Use Cluster Scoring System and the Source Ranking Database is also being studied.

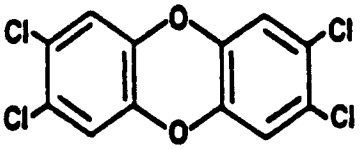
For more information about ranking and screening risks, contact Jim Darr at (202) 260-3441. For more information about the Source Ranking Database, contact Christina Cinalli, (202) 260-3913.

OPPT Structure Activity Team

Pauline Wagner, *Health and Environmental Review Division*

The OPPT Structure Activity Team (SAT) is an interdisciplinary team of chemists, biologists, toxicologists, and technical information specialists who evaluate the potential environmental fate, health effects, and environmental hazards of new and existing chemicals. For over fifteen years the SAT has been a leader in developing and applying the principles of chemical structure-biological activity to the hazard assessment of chemicals for which data are either sparse or non-existent.

Historically, the mission of the SAT has been focused on the New Chemicals Program, Section 5 of the Toxic Substances Control Act (TSCA), where a determination of "unreasonable risk to human health and/or the environment" must be made within a 90-day time period on each of approximately 2,000 chemicals submitted every year. In order to accomplish this task, the SAT has



not only expanded upon traditional structure-activity relationships (SARs), but has developed new methods of assessing the hazards presented by various classes of chemicals, particularly in the area of toxicity to aquatic organisms. A recent comparative study with the European Union (EU) conducted jointly with EU scientists has demonstrated conclusively that the methods developed by the SAT are appropriate and valid.

In recent years, the SAT has increasingly been called upon to screen existing chemicals for potential hazard to human health and/or the environment. Using the SAR principles developed for new chemicals and creating innovative search strategies to identify both published and unpublished data, the SAT has been able to effectively screen over 3,500 existing chemicals, not only for OPPT, but also for a variety of other EPA Offices and other government agencies. These efforts aid in furthering the Agency goal of protecting human health and the environment.

The SAT is recognized internationally as a unique scientific endeavor for its success in predicting potential hazards for chemicals with inadequate or absent hazard data. Subsequently to the successful joint EU/EPA comparative study, the methods employed by the SAT have been studied by the Canadian, Japanese, and Australian governments in order to more effectively screen chemicals that are of concern in their respective countries. Domestically, the SAT has interacted with the U.S. chemical industry to share the SAR principles routinely used in evaluating new chemicals. This type of cooperation will result in the strengthening of environmental protection through the use of less toxic chemicals.

For more information, call Pauline Wagner, (202) 260-3981. More information about the Structure Activity Team and its work is available in "The New Chemicals Process at the Environmental Protection Agency (EPA): Structure-Activity Relationships for Hazard Identification and Risk Assessment," Toxicology Letters *79(1995):67-73.*

The OPPT Cancer Expert System

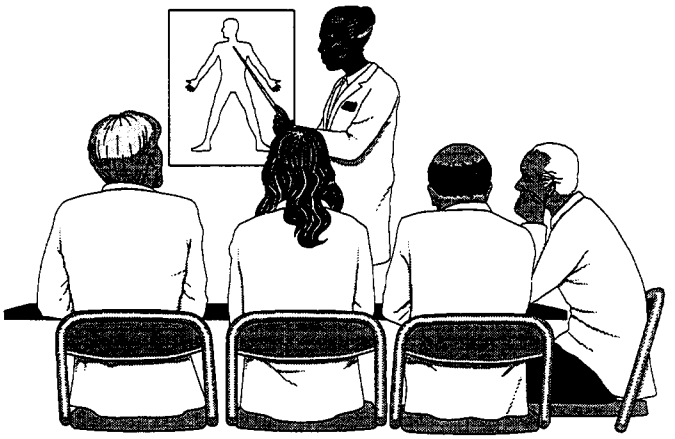
Ernest V. Falke, Ph.D., Senior Scientist, *Health and Environmental Review Division*

The Office of Pollution Prevention and Toxics (OPPT) has been developing a Cancer Expert System (OncoLogic). This system is a user-friendly computer-based system which will be used to predict whether a chemical is likely to cause cancer. The basis for the system is a network of Structure Activity Relationship (SAR) "knowledge rules," which are based on the relationship between a chemical's structure and its biological and chemical activities, developed by OPPT experts in cancer hazard assessment. The finished product contains more than 30,000 rules.

The data and information for the knowledge rules have been acquired from research conducted by OPPT's experts and other researchers, much of which has been summarized in *Chemical Induction of Cancer* (seven volumes of which have been published over the past two decades); the assessment of thousands of new chemicals in the Toxic Substances Control Act (TSCA) Premanufacturing Notification (PMN) Program under which manufacturers are required to submit health and safety studies to EPA for review; and the ongoing review of relevant National Cancer Institute/National Toxicology Program animal studies; and EPA toxic substances and pesticides databases.

The system consists of four subsystems for fibers, polymers (large molecules built up by linking repeated subunits of simple reactive chemicals known as monomers), metals/metalloids, and organic chemicals. Using the system, one can evaluate virtually any type of chemical class.

To date, the first three subsystems are essentially complete and are operational. The core structure (for example, chemical structure input and reasoning / justification software) of the Organic Chemicals Subsystem has been completed. Additionally, approximately 60% of the chemical classes to be evaluated in the Organic Chemicals Subsystem have been incorporated into the Cancer Expert System. The system will automatically generate a cancer hazard concern level (six levels ranging from low to high) together with text presenting the scientific rationale used to establish the concern level.

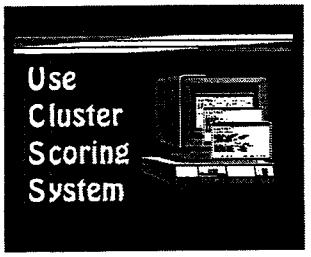


The functional arm of the system can modify the cancer concern level for a chemical based upon additional biological testing data that correlate with carcinogenicity independent of the chemical's structure (for example, the ability of a chemical to affect the internal operations of a cell or its DNA).

The Cancer Expert System is expected to be complete in July 1996. Please contact Ernest V. Falke (202) 260-3433 (Internet: Falke.Ernest@epamail.epa.gov) for more information.

The Use Cluster Scoring System: A Use-Based Approach to Setting Priorities

Daniel Fort, *Economics, Exposure, and Technology Division*



EPA's Office of Pollution Prevention and Toxics (OPPT) is developing a system for use in screening and prioritizing chemicals. This system is known as the Use Cluster Scoring System (UCSS). The UCSS was designed around the idea of identifying and analyzing clusters of chemicals that can be used to do a particular task. For example, instead of considering a single chemical used as a paint stripper, a set of chemicals that act as paint strippers is considered. By screening and scoring these "use clusters," resources may be more directly focused upon effective risk reduction through work with manufacturers or users.

EPA's Science Advisory Board (SAB) reviewed the system in 1995 and found that "clustering chemicals by intended functions could provide efficient risk screening, as well as improved pollution prevention opportunity identification." The UCSS may also help other public and private sector organizations in identifying clusters of potential concern and providing an initial indication of potentially safer substitutes for classes of chemicals.

The UCSS currently consists of over 380 "use clusters" comprising over 3,500 chemicals. The system contains hazard and exposure information aggregated from many databases that are currently used across EPA as well as other government agencies. Also, the system uses predictive methodologies to determine hazard and exposure for chemicals lacking specific data. Beyond cluster and chemical scores, the UCSS retains and displays all underlying data for chemicals and clusters for further consideration by users.

In response to the SAB's recommendations, modification of the system will be implemented. It is anticipated that the UCSS will be made available through the Internet in early 1996.

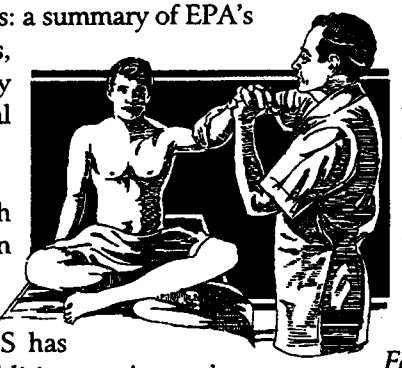
For more information, contact Daniel Fort at (202) 260-1694, FAX (202) 260-0981 (Internet: fort.daniel@epamail.epa.gov) or Jay Jon at (202) 260-7971, FAX (202) 260-0981 (Internet: jon.jay@epamail.epa.gov).

Integrated Risk Information System

Vanessa Vu, Deputy Director, *Health and Environmental Review Division*

The Integrated Risk Information System (IRIS) database, produced by the U.S. Environmental Protection Agency (EPA) since 1986, is a database containing EPA's consensus scientific positions on potential human health effects that may result from long-term exposure to environmental pollutants. Currently, IRIS contains summary information on the hazard identification and dose-response assessment of the potential carcinogenic and non-carcinogenic effects for both inhalation and oral exposure of over 500 substances.

IRIS contains full bibliographic citations for each substance file, directing the user to the primary cited studies and pertinent scientific information. In addition, IRIS substance files may contain one or more of three supplementary information sections: a summary of EPA's Office of Water's Health Advisories, a summary of EPA regulatory actions, and a summary of physical and chemical properties.



EPA's goal is to develop high quality human health information based on credible science. Since October 1994, new or revised scientific information put on IRIS has undergone external review, in addition to Agency's final review by EPA scientists across programs and regions. IRIS users are cautioned that IRIS does not contain human exposure information.

The data in IRIS, combined with specific exposure information, can be used to help characterize the public health risks of a given situation. This risk characterization can then serve as input for a risk management decision designed to protect public health.

There are currently two means of public access to the IRIS data base. The primary method of access for the public is TOXNET, the TOXicology Data NETwork, which is maintained on-line by the National Library of Medicine (NLM), National Institutes of Health. IRIS on TOXNET is updated monthly to reflect new or revised assessments. IRIS users can gain access to TOXNET by direct call or through several widely used telecommunications networks. IRIS is also available through NLM's International MEDLARS Centers. The second means of public access to IRIS is to purchase high-density diskettes from the National Technical Information Service (NTIS). IRIS diskettes are updated quarterly rather than monthly.

For more information on IRIS and how to access it, contact the IRIS Information Hotline, National Center for Environmental Assessment — Cincinnati Office, Office of Research and Development, U.S. EPA, 26 West Martin Luther King Drive, Cincinnati, Ohio 45268, Telephone: (513) 569-7254, Fax: (513) 569-7159.

For further information on gaining access to IRIS via TOXNET, contact the IRIS Representative, Specialized Information Services Division, National Library of Medicine, 8600 Rockville Pike, MD 20894, Telephone: (301) 496-6531. For information on ordering IRIS diskettes, contact the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, Telephone: (703) 487-4650.

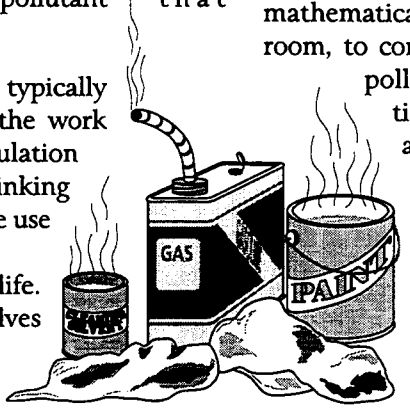
Exposure Assessment

Thomas Murray, Chief, *Exposure Assessment Branch, Economics, Exposure, and Technology Division*

Exposure assessment attempts to answer the questions, "How much of a pollutant is out there?" and "To what amounts are we exposed?" Exposure occurs through contact with a pollutant; such contact can occur by inhaling air, drinking water, eating food, or touching a variety of products that contain the pollutant.

The concentration of the pollutant in these media and the length of contact are important components of exposure assessment. The results of an exposure assessment are considered along with the hazard assessment, which attempts to answer the general question, "How hazardous is the pollutant?" Together, the answers to these two questions are used to determine whether there is a risk posed by the pollutant that requires Agency attention.

Exposure assessments in OPPT typically include occupational exposures in the work place, exposures to the general population from pollutants in the air and drinking water, consumer exposure through the use of household products, and environmental exposure to aquatic life. In general, exposure assessment involves three steps, which can be performed at a simple, screening level or as an extensive, in-depth look at a pollutant's life-cycle.



Chemical Properties and Fate

The first step in assessing exposure is predicting the behavior of a pollutant in the environment. We review available data sources for information on water solubility and vapor pressure, which is used in estimating occupational and consumer exposures. We also use information on decay rates in the atmosphere, surface water, soil, and ground water to estimate exposures to the general population and the environment.

In addition, based on the way the pollutant is expected to be discharged, we look at other ways that the pollutant's behavior may affect its concentration and ultimate fate in the environment. For example, pollutants discharged to surface water are likely to undergo wastewater treatment, so we predict a probable rate of pollutant removal during treatment.

Concentrations

Once we have an idea of the pollutant's behavior in the environment, we look at how much and where it is released. These release estimates are generated using industrial engineering expertise and typical production volumes. Manufacturing and processing operations are reviewed to determine potential releases in the work place, such as fugitive vapors from open vats, that could reach workers as well as those that leave the facility and enter the environment.

We have a number of tools which allow us to gather information about the environment into which the pollutant is being discharged, and to estimate the resulting concentrations there. These tools range from mathematical equations for simple dilution in a work room, to complex computer models which can trace a pollutant's path through the environment over time. These computer models are capable of accounting for the pollutant's decay as it travels through the environment, as well as estimating overlapping concentrations resulting from many nearby sources.

Exposures

The last step in an exposure assessment is the estimate of the populations working or living near a pollutant discharge, and the potential doses to which they may be exposed. To estimate potential dose, we evaluate the level of contact an individual is likely to have with the pollutant by each possible route. To do this, we consider those human activities such as inhaling air or drinking water contaminated with the pollutant that would affect the amount of contact with the pollutant.

Often we calculate potential doses using established assumptions like a typical breathing rate of twenty cubic meters per day, and a typical drinking water consumption of two liters per day. Finally, we estimate the number of people potentially exposed to these doses using either general estimates of the number of employees involved in an industrial process or the number of nearby people using a population database like the Census data.

For more information, contact: Tom Murray, (202) 260-1876
Internet: murray.thomas@epamail.epa.gov

Estimating Exposure: The Graphical Exposure Modeling System (GEMS)

Thomas Murray, Chief, *Exposure Assessment Branch, Economics, Exposure, and Technology Division*

The Graphical Exposure Modeling System (GEMS) supports exposure and risk assessments by providing easy access to a number of tools routinely used to estimate pollutant exposures. These exposure estimates include estimated concentrations in the environment and the populations potentially exposed to these concentrations. There is also a stand-alone version of GEMS for the PC called PCGEMS; it contains many, but not all, of the features of GEMS.

GEMS contains a number of computer models which use mathematical algorithms to calculate an estimate of pollutant concentration based on a number of environmental factors. These models include media-specific capabilities for modeling pollutant releases to the atmosphere, surface water, soil, and ground water. There are also several screening-level models to predict chemical partitioning, the separation of components of a chemical mixture, among the environmental media.

To support the models, GEMS contains several databases of information needed to perform an exposure assessment. There are data available on sources of pollutant release to the environment, including a link with the Toxics Release Inventory System (TRIS) to retrieve environmental release estimates submitted to EPA under the Emergency Planning and Community-Right-to-Know Act of 1986 (EPCRA). There are nationwide environmental data, including weather data and stream characteristics, that are used to more realistically model the way the pollutant will spread through the environment.

Finally, in order to determine the number and location of people potentially exposed to a pollutant, GEMS has access to the 1990 Census population data, as well as information on drinking water facilities and the size of the population they serve.

Public Hotlines and Clearinghouses referred to in this issue

EPA Programs

Emergency Planning and Community Right-to-Know Act Hotline, (800) 535-0202; in the Washington, D.C., metropolitan area, (703) 920-9877

Integrated Risk Information System (IRIS) Information Hotline, (513) 569-7254

National Center for Environmental Publications and Information (NCEPI), FAX (513) 489-8695

Pollution Prevention Information Clearinghouse (PPIC), (202) 260-1023

Toxic Substances Control Act Assistance Information Service (TSCA Hotline), (202) 554-1404

TRI User Support, (202) 260-1531

Other numbers

National Library of Medicine, IRIS Representative, (301) 496-6531

National Technical Information Service (NTIS), (703) 487-4650

For an overview of the GEMS program or to request a copy of the GEMS User's Guide, contact Cathy Turner at (202) 260-3929. For further information, contact Lynn Delpire, (202) 260-3928, or Patricia Harrigan, (202) 260-8479.

TRI Environmental Indicators

Nicolaas W. Bouwes, *Economics, Exposure, and Technology Division*

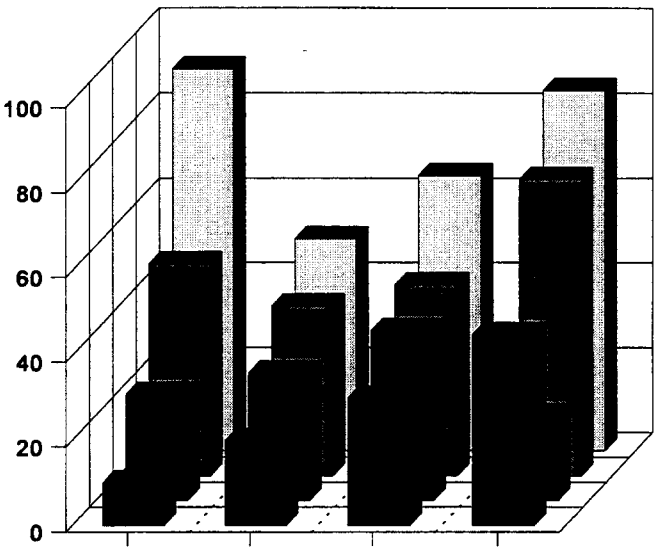
The Office of Pollution Prevention and Toxics (OPPT) has developed a new way to track the potential impacts of Toxics Release Inventory (TRI) chemical emissions over time. OPPT is planning to develop four indicators of potential acute and chronic health and ecological impacts.

The model, a Microsoft Windows-based computer application, uses chemical data submitted by manufacturers to EPA's TRI. The model combines these data with weighting factors representing toxicity, exposure characteristics, and potentially affected populations or receptor populations to generate relative ranking numbers. Numeric values or "indicator elements" are calculated for each combination of facility, chemical, and environmental medium (for example, air, water, land). The total of these indicator elements forms a TRI Environmental Indicator.

Each year's indicator will provide one perspective on how the potential impact of TRI emissions is changing. An indicator can also provide information broken down by medium, chemical, region, state, type of industry or Standard Industrial Classification (SIC) Code, or a combination of these. The model produces four alternative outputs: pounds of release, pounds weighted by toxicity, pounds weighted by toxicity and population size, and the full model which includes pounds, toxicity, surrogate exposure and receptor population size. Comparing these allows analysts to identify patterns of relative contribution to the full indicator.

Potential uses include examining trends and ranking of chemicals for other possible projects. Since the model results are exportable in a dBase format, they can be used for further analysis in other software applications.

The Indicators have been under development since 1991, with the planned methodology widely distributed for comment in 1992 at a public meeting. The "chronic health indicators" model is now being tested, with plans for sensitivity and uncertainty analyses in FY96. The indicators' input data, relative toxicity scores, and updated methodology are scheduled to be circulated for EPA review in early fiscal year (FY96). We hope to have



the first version of the computer model available for distribution within EPA by the end of FY96. The revised/updated version of the methodology should be available in about three months.

For more information contact Nicolaas Bouwes at: (202)260-1622; bouwes.nick@epamail.epa.gov

Emergency Planning and Community Right to Know Act (EPCRA): Release Information Required by Section 313

Under Section 313 of EPCRA, certain manufacturing facilities are required to submit a "Form R," in which they report releases of over 300 different toxic chemicals into the environment and other information about the companies to EPA. This information collected by EPA makes up what is called the Toxics Release Inventory (TRI). To find out how to access TRI data submitted by industries, call TRI User Support at (202) 260-1531. To obtain information on EPCRA Section 313 reporting requirements, call the EPCRA/Superfund Hotline at (800) 535-0202, or (703) 920-9877 in the Washington, D.C., metropolitan area.

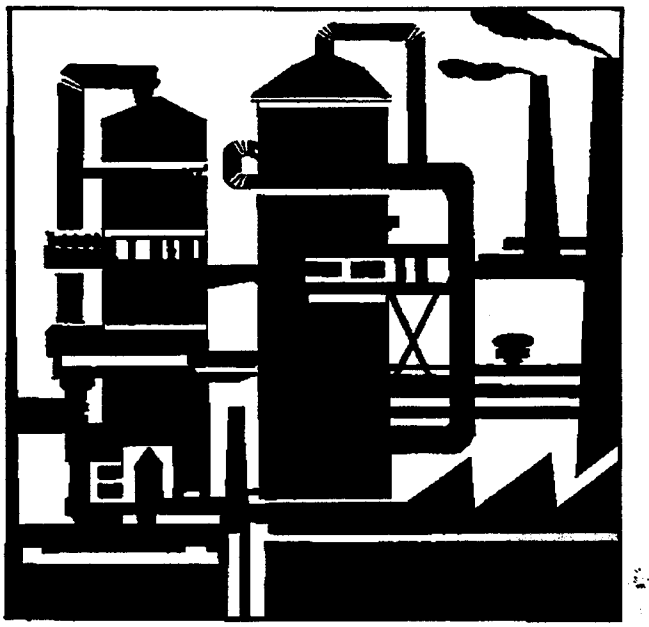
Using "Generic Scenarios" to Estimate Exposure

Nhan Nguyen, *Economics, Exposure, and Technology Division*

Ideally, occupational and environmental release assessments should be based on monitoring data. However, for many chemicals being assessed in the Office of Pollution Prevention and Toxics risk screening programs, monitoring data are very limited or are not available. New chemicals do not usually have exposure and release information during processing and use. The chemical engineers in the OPPT Chemical Engineering Branch (CEB), in the absence of such data, use various data sources and modeling techniques to estimate exposures and releases.

One of the data sources that CEB engineers use to estimate exposures and releases of chemicals are "generic scenarios." These scenarios are based on information from past chemical cases, technical references, industry contacts and other EPA reports.

Each generic scenario provides information on a specific process or commercial use. It contains generic information and assumptions on how chemicals are handled or used in a process, the unit operations involved, chemical usage rates, number of workers and their activities, formulation composition or method of arrangement, potential points of release, cleanup and disposal practices, and sometimes exposure and release monitoring data. For example, a generic scenario on textile dyeing is often used to estimate the population of workers potentially exposed, the exposure dose rates, duration of exposure, and releases for a new chemical that will be used as a reactive dye in fabric.



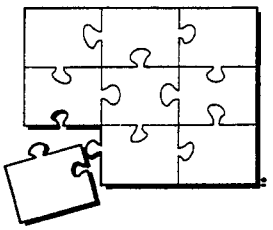
The estimates of the population potentially exposed, the exposure dose rates and releases are based on assumptions such as percent exhaustion or percent deletion rates for acid dyes, quantity of fabric used per batch, number of batches handled per day, and concentration of dyes in the dye bath. The assumptions for this scenario were developed based on information from a comprehensive joint EPA/industry study on textile dyes.

Development of generic scenarios is an ongoing effort in CEB. There are now over 50 generic scenarios. Additional generic scenarios will be developed during 1996 to help OPPT in estimating exposure and releases to chemicals in a variety of industries. The generic scenarios have been developed for internal use; they have not been peer-reviewed and are considered to be in draft form.

For additional information about the generic scenarios, contact Nhan Nguyen at (202) 260-3741, FAX (202) 260-0981 (Internet: nguyen.nhan@epamail.epa.gov).

Risk Characterization

Lois Dicker, *Chemical Screening and Risk Assessment Division (Chair, OPPT Risk Assessment Work Group)*



OPPT has been an active participant in the Agency's new program for improving risk characterization since March 1995 when Carol Browner issued new risk characterization policy and guidance. She has called on each Program Office to develop specific policies and procedures for risk characterization suited to their own risk assessment/risk management needs. The emphasis is on being "CLEAR, CONSISTENT, TRANSPARENT, and REASONABLE."

Within OPPT we have taken the activity of risk assessment and risk characterization seriously. Beginning in 1993 we formed a Quality Action Team to examine problems in our risk assessment process. As an outcome of the QAT we have a standing interdivisional work group (the Risk Assessment Work Group) which explores risk assessment issues and problems. We have compiled a large collection of "Information Tools" (procedures, guidance, and supplemental documents) for risk assessment/risk characterization.

The work group is currently completing a draft, "OPPT Risk Characterization Statement," which will act as the Office specific operating plan for how we perform risk characterizations. In addition, the group will be preparing an "Appendix" to the Statement giving more in depth information on preparing hazard, exposure, dose-response and risk assessments, and risk characterizations. These two documents will serve as updates to OPPT's current compilation of Information Tools for Risk Assessment/Risk Characterization.

Within OPPT there are three major types of risk assessments performed based on level of effort — screening level assessments (for example, as in the New Chemicals Program), intermediate level assessments (such as the RM1 and RM2 assessments in the Existing Chemicals Program), and comprehensive assessments (special, more in-depth assessments for existing chemicals). OPPT requires each risk assessment to contain a risk characterization at the level of detail appropriate for the type of assessment.

A characterization for a new chemical may be a single paragraph, while one for an in-depth assessment could be many pages. Every risk characterization should cover the following points:

(1) The scope of the assessment,
(2) A statement of the bottom line of the risk conclusions,
(3) A summary of the key issues,
(4) Methods used in the assessment,
(5) Summary of overall strengths and uncertainties of the assessment,
(6) Putting the risk assessment into context with other similar risks, and
(7) Highlighting other important information bearing on the assessment.

It is felt that to "characterize" risk is not just to restate what has been said in the hazard, exposure, and dose/response assessments; but to truly integrate the information to give the risk manager a clear picture of risk conclusions and the train of thought which supports those conclusions. The Agency has recognized that this is not an easy task, and has scheduled a series of colloquia and round tables to grapple with how to write a good risk characterization.

Currently, OPPT uses a variety of resources to assure adequate risk characterization. It relies on use of its collection of Risk Information Tools, adherence to the Agency's 1995 risk characterization policy and guidance, and also its own internal review procedures which include review by management, technical work groups, technical staff peer review, and regularly scheduled decision meetings. For comprehensive risk assessments additional review such as outside peer review, consultation with other EPA experts, or Science Advisory Board review are utilized.

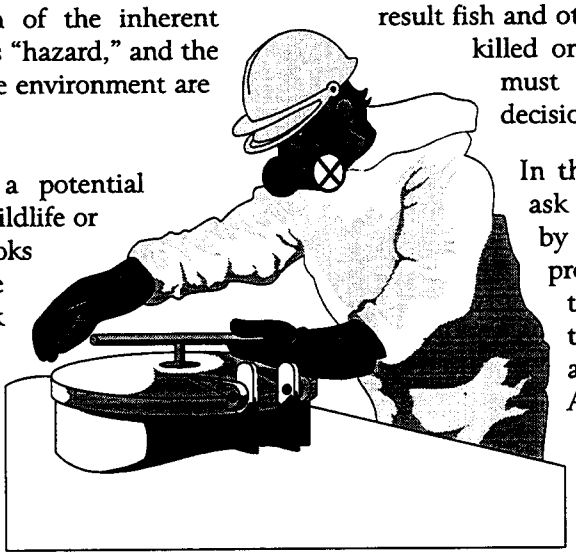
OPPT will be among the featured Offices at the next EPA Risk Characterization Colloquium. The focus will be on the "Risk Characterization Statement" and whether it is helping risk assessors develop good risk characterizations. We are looking forward to discussions with other parts of the Agency, and to further improving how we do risk characterizations within OPPT.

For more information on risk characterization, call Lois Dicker, (202) 260-3387.

Risk Management: Keeping Risks Within Reason

David Di Fiore, *Chemical Control Division*

To understand "risk management," one must first understand the concept of risk as used in the field of human health and environmental protection. Risk is a function of the inherent harmfulness of a compound, or its "hazard," and the extent to which individuals or the environment are exposed to that compound.



When analysis indicates that a potential serious risk exists — to people, wildlife or the environment — the Agency looks for ways to control or limit the risk; this process is called "risk management." Deciding what risks need to be managed and what is the most effective and efficient way to accomplish risk reduction is a complicated endeavor, with a great many variables and uncertainties.

Under its Toxic Substances Control Act authority, the Agency seeks to control those risks where the potential for harm are significant and where good reason would indicate that the risk ought to be controlled. To make this determination, the Agency relies on the best available information concerning risk and related matters, and on the knowledge and experience of its scientific, technical and regulatory staff.

The Agency has a wide array of tools at its disposal to accomplish risk management—for example, rule making, voluntary agreements, and programs that inform individuals about risks and how to protect themselves and the environment. EPA tries to use the appropriate tool for a given risk situation. For example, if in the process of manufacturing a new chemical, a company intends to release its waste water to a stream and as a result fish and other aquatic organisms might be killed or seriously harmed, the Agency must make a risk management decision.

In this situation, the Agency might ask the company to restrict releases by adopting a manufacturing process that avoids water release or through the use of recycling, treatment technology or alternative disposal methods. Any one of these steps could eliminate the risk or reduce it to an acceptable level. Typically, the Agency would ensure that this risk reduction takes place by entering into an agreement in which the manufacturer promises not to release the new chemical to water or to release only up to certain amounts. This agreement, a common approach to risk management in the New Chemicals Program, is called a "consent order" and is legally binding and enforceable.

The Agency employs many voluntary approaches to risk management as well, as discussed elsewhere in this publication. Additionally, EPA employs voluntary approaches to risk management prior to making its final risk management decisions.

For more information contact David Di Fiore at (202) 260-3374.

The Existing Chemicals Program's Risk Management Procedures

Deborah Williams, *Chemical Control Division*

HOW DOES THE EXISTING CHEMICAL PROGRAM PROTECT HEALTH AND THE ENVIRONMENT?

Risk Management Initiatives

The Existing Chemicals Program develops and evaluates strategies for preventing pollution and reducing the risks associated with chemicals currently in production or use. Risk Management 1 (RM1) is the first step in the process leading to the development of options to reduce or eliminate risk and is about six months in length. This step is designed to initially *screen* and *select*, from among the subset of approximately 15,000 commercial chemicals, those chemicals that appear to be of greatest concern to human health and the environment.

Risk Management 2 (RM2) is the next step in the process and is approximately 12 to 24 months in length. In RM2, RM1 chemicals that appear to pose a problem are further *investigated* and *analyzed*, and options are developed for addressing any concerns identified. Not all RM1 cases reach RM2.

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In Post Risk Management 2 (Post-RM2), the Program *implements* one or more of the options recommended in RM2 to reduce or eliminate the risks (negotiation of voluntary agreements, rules development, etc.). Post-RM2 can range between three months and two years. Some RM2 cases do not need a formal Post-RM2 phase.

WHEN IS TESTING REQUIRED?

When specific chemical concerns are found in RM activities, but important data needs remain in order to adequately assess potential risk, the chemical is referred for development of appropriate testing action and placed on the "Master Testing List" (MTL). This consolidated listing of the testing priorities under the Toxic Substances Control Act (TSCA) establishes an agenda for development of testing actions which are implemented by formal TSCA Section 4 Test Rules, TSCA Section 4 Enforceable Consent Agreements (ECAs), or Voluntary Testing Agreements. In addition, the MTL contains the priority industrial chemical testing needs of other parts of EPA as well as other Federal agencies. In some cases, voluntary exposure/risk reduction actions can be combined with testing actions and result in Product Stewardship agreements.

HOW DOES THE PROGRAM USE THE TESTING DATA?

All new data submitted as a result of Existing Chemicals Program testing actions are promptly evaluated. The new data is then reviewed together with other available information on the chemical in the RM1 component of the Program or the RM2/post-RM2 component from which the testing need originated. In cases where another "client," such as the Consumer Product Safety Commission, originated the testing need/action, copies of the new data are provided for their use promptly upon EPA's receipt.

WHAT KINDS OF CASES ARE PART OF THE RISK MANAGEMENT AGENDA?

The program uses three case types — chemical, use, and facility. *Chemical specific* cases examine the life cycle of *one* chemical to see what risks it might present, and what risk management, if any, is necessary. *Use cluster* cases examine one use of chemicals (such as aerosol spray paints) and examines ***all*** the chemicals that might be used for that purpose. The primary goal is to find safer chemical substitutes for that use. *Facility specific* cases look at individual chemical or manufacturing facilities in the United States to see if some may present health or environmental concerns for nearby communities, based on one or more chemicals produced or used on site.

WHAT TOOLS ARE USED BY THE PROGRAM TO MANAGE CHEMICAL RISK?

Embracing creative and flexible approaches to managing cases in the Existing Chemicals Program has produced a number of successes that have made, and are making a difference in protecting health and the environment. These approaches have put the Program on the cutting edge of how EPA conducts its work in the 1990's.

For more information about the program, please contact the TSCA Hotline at (202) 554-1404.

The Design for the Environment Program's Cleaner Technologies Substitutes Assessment

Jed Meline, *Economics, Exposure, and Technology Division*

The Design for The Environment (DfE) Program in the Office of Pollution Prevention and Toxics creates voluntary partnerships with specific industry sectors to evaluate the trade-offs among substitute products, processes or technologies. The assessment of trade-offs is only part of a DfE project. The project partners, which may include trade associations, universities, public interest groups, suppliers and individual businesses, work together to create outreach products and tools to convey the information necessary to help businesses incorporate environmental considerations into their decision-making process. Outreach products developed by the DfE Program have included case studies, brochures, videos, computer software, technology demonstrations, and training workshops.

The methodology created by the DfE Program to complete this evaluation is called a Cleaner Technology Substitutes Assessment or CTSA. Building upon the risk management process used by EPA's Existing Chemicals Program, the risk characterization involved in the CTSA utilizes the level of rigor necessary only to capture the differences between the substitutes.

In addition to the environmental and human health risk information, the CTSA also includes many other components necessary to inform business decision-making and promote behavior change toward cleaner alternatives. These components include field demonstrations of the substitutes to assess performance and cost, energy and natural resource considerations, pollution prevention opportunities, process safety concerns, Federal regulatory status, international trade issues, recycle and control opportunities and social benefits and costs.

The DfE Program is working with a number of industries including printing (lithography, flexography, and screen printing), dry cleaning, and electronics/printed wiring board. The first draft CTSA was the *Screen Printing-Screen Reclamation CTSA* released in October 1994. Many of the related outreach products conveying the human health and environmental risk trade-offs, pollution prevention opportunities and technology alternatives are available. Several more CTSAs are scheduled for release in 1996.

The DfE Program is also developing a *CTSA Methodology and Resource Guide* to explain the methodology and many of the resources available to complete substitutes assessment. This guide should be available early in 1996.

For information regarding the CTSA tools contact Jed Meline at (202) 260-0695 (Internet: meline.jed@epamail.epa.gov). For more information regarding the DfE Program contact Irina Vaysman at (202) 260-1312.

Copies of the draft Executive Summary are available from the Pollution Prevention Information Clearinghouse, (202) 260-1023. Request for copies of the full report can be faxed to the National Center for Environmental Publications and Information (NCEPI), (513) 489-8695. Ask for report number EPA 744/R-94/005A.

Communicating Environmental Risk

Susan Hazen, Director, *Environmental Assistance Division*

Communicating information about risks to human health is a complicated undertaking. Many different factors are involved, and these are often difficult to measure. These factors fall into the general categories of hazard and exposure, and require scientists to take into account, among other things, the type of hazard, the concentration of the chemical, duration of exposure, and the exposed population. The resulting rankings are not absolute and require assumptions and scientific judgements.

To add to this uncertainty, different groups will perceive risks differently. The regulated community, individuals living near the source, environmentalists, and elected officials may have very different views on the problem. In addition, each of us take different factors into account when we decide which risks we are willing to accept. For example, whether or not a risk is voluntary is important to us. We also take into account who controls the outcome of risky situations. Most of us have heard that, statistically, we risk our lives more by driving a car than by flying in an airplane. Yet how many of us feel the same nervousness behind the wheel of a car that we do as a passenger in a plane?

Because many different factors come together to determine how serious a risk is in the eyes of the public, EPA takes pains to ensure that we appropriately communicate risk. The Agency's seven cardinal rules of risk communication are listed in the sidebar.

Risk communication is not a one-way street. It is an interactive process where information and opinions are exchanged among individuals, groups, and institutions. EPA recognizes the need not only to inform the public, but also to provide the public with the opportunity to become involved in decision making. The purpose of risk communication is not to allay the public's concerns, but to empower the community to participate in the process and assist in reaching the right decision.

Risk communication objectives include: providing information to the public, motivating individuals to act, stimulating a response to emergencies, arriving at the best possible decision for those involved, helping the public determine what an appropriate reaction to a particular risk is, allowing all perspectives to be considered in each situation, and contributing to the resolution of conflict.

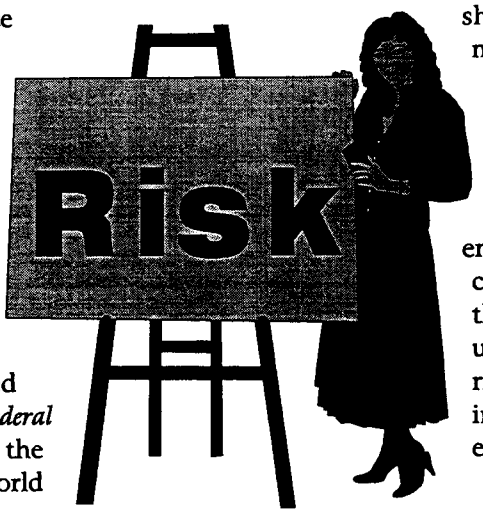
EPA uses different forums to communicate risk depending the specific situation, the nature of the risk, and the special needs of the community. Tools EPA can use to communicate risk include:

EPA's Seven Cardinal Rules of Risk Communication

1. Accept and involve the public as a legitimate partner.
2. Plan carefully and evaluate your performance.
3. Listen to the public's feelings.
4. Be honest, open and frank.
5. Coordinate and collaborate with other credible sources.
6. Meet the needs of the media.
7. Speak clearly and with compassion

From *The Seven Cardinal Rules of Risk Communication*, EPA, OPPE, May 1992. EPA Publication No.: EPA 230K92001. Available from EPA's National Center for Environmental Publications and Information (NCEPI), FAX: (513) 489-8695.

- public meetings
- citizen advisory groups
- advisory committees
- telephone hotlines
- press conferences
- information booths
- drop-in hours for citizens to ask questions
- informal meetings with interested organizations
- direct mailings
- advertising and public service announcements
- television or radio interviews
- newspaper or journal articles
- newsletters and other publications



When EPA intends to hold a public meeting, the time and place for the meeting are published in the *Federal Register*. EPA's *Federal Register* notices are posted on the Agency's homepage on the World Wide Web. People with Internet e-mail can actually subscribe to lists containing *Federal Register* rules and notices for EPA. (See page 20 for more information on accessing EPA *Federal Register* information via the Internet.)

There are many ways you can get involved in discussions about how the environmental risks you face in your life should be managed. One place to start might be your local library. Access the Toxics Release Inventory to find out about releases of toxic chemicals from manufacturing facilities in your area. Find out who is in charge of your local and state public health and environmental agencies and give them a call. Contact the EPA Regional Office that serves your area. When scientific understanding is combined with good risk communication and active public involvement, much better solutions to environmental problems emerge.

Federal Register Documents via the Internet

Within the "Rule, Regulations and Legislation" section of the EPA Gopher server (gopher.epa.gov) are twelve sections that contain documents extracted from the electronic daily issue of the *Federal Register*. These twelve general sections address various areas of environmental activity by U.S. Government entities. Not all documents available under these menus were originally issued by EPA, but they have been identified as having some environmental impact.

Documents available in these areas are also sent to an electronic mail listserver. You can subscribe to these listservs by sending e-mail to the address **listserver@unixmail.rtpnc.epa.gov** and including as the first non-blank line in the body of the message the command

SUBSCRIBE list-name First Name Last Name

where the list-name is taken from the list of listserves available from the EPA listserver. This list can be obtained by sending as the first non-blank line in the body of the message to the EPA listserver the command

LISTS

The following lists may be of particular interest to our readers.

Listserve Name	Description
EPA-TOX	Office of Pollution Prevention and Toxics documents excluding Community-Right-To-Know (Toxics Release Inventory) documents.
EPA-TRI	Community-Right-To-Know Toxics Release Inventory documents.
EPAFR-CONTENTS	The full-text of the table of contents with page number citations.
EPA-MEETINGS	All meeting notices including those for program-specific meetings.
EPA-SAB	Material relating to the Science Advisory Board.
EPA-PEST	All Office of Pesticide Programs documents.

EPA
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Environmental Protection
Agency
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