DRAFT

TECHNICAL BASE FOR DESIGNATION OF HAZARDOUS SUBSTANCES AND ASSIGNMENT OF REPORTABLE QUANTITIES

A Report to the
Emergency Response Division
Office of Emergency and Remedial Response
United States Environmental Protection Agency

Prepared by

Rockwell International Corporation
Environmental Monitoring & Services Center
2421 West Hillcrest Drive
Newbury Park, California 91320

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FOREWORD

This draft report was prepared to provide the U.S. Environmental Protection Agency Emergency Response Division with technical assistance for issuing regulations pursuant to Sections 102 and 103 (a,b) of the Comprehensive Emergency Response and Liability Act. Principal authors were F. C. Gunderloy, Jr., M. Kirsch, G. R. Ricci, P. Scofield, and R. S. Smith.

The guidance of P. Holtzclaw, Dr. K. J. Kooyoomjian, and John Riley is gratefully acknowledged. A preliminary draft was also reviewed by J. Lounsbury, D. Patrick, and J. Cross, whose comments have been incorporated into this revision. Leo McCarthy of the Oil and Hazardous Materials Spills Branch, MERL, Edison, New Jersey, served as Project Officer and provided invaluable advice in the preparation of this document.

"If a better system is thine, impart it, else make use of mine."

Homer

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SECTION 1

INTRODUCTION AND SUMMARY

Under Section 102 of CERCLA, or Superfund (PL 96-510), the Administrator of the United States Environmental Protection Agency is authorized to designate as hazardous substances any chemicals deemed appropriate in addition to those so defined in Section 101(14) of the Act. This section also permits the assignment of a Reportable Quantity for the designated hazardous substances. To quote from the appropriate sections of the Act:

> Sec. 102.(a) The Administrator shall promulgate and revise as may be appropriate, regulations designating as hazardous substances, in addition to those referred to in section 101(14) of this title, such elements, compounds, mixtures, solutions, and substances which, when released into the environment may present substantial danger to the public health or welfare or the environment, and shall promulgate regulations establishing that quantity of any hazardous substance the release of which shall be reported pursuant to section 103 of this title. The Administrator may determine that one single quantity shall be the reportable quantity for any hazardous substance, regardless of the medium into which the hazardous substance is released.
>
> (b) Unless and until superseded by regulations establishing a reportable quantity under subsection (a) of this section for any hazardous substance as defined in section 101(14) of this title, (1) a quantity of one pound, or (2) for those hazardous substances for which reportable quantities have been established pursuant to section 311(b)(4) of the Federal Water Pollution Control Act, such reportable quantity, shall be deemed that quantity, the release of which requires notification pursuant to section 103(a) or (b) of this title.
>
> Sec. 101(14) "hazardous substance" means (A) any substance designated pursuant to section 311(b)(2)(A) of the Federal Water Pollution Control Act, (B) any element, compound, mixture, solution, or substance designated pursuant to section 102 of this Act, (C) any hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress), (D) any toxic pollutant listed under section 307(a) of the Federal Water Pollution Control Act, (E) any hazardous air pollutant listed under section 112 of the Clean Air Act, and (F) any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to section 7 of the Toxic Substances Act. The term does not include petroleum, including crude oil or any

fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

The above definition clearly includes as hazardous substances those promulgated in 40CFR116 under section 311 of the Clean Water Act for which reportable quantities, RQs, have been established under 40CFR117, and many substances under section 307(a) of this Act and under several other acts for which no RQ has been established except the one pound specified in section 102(b)(1) of Superfund.

The primary motivation for passage of CERCLA was concern for the danger to human health presented by the many dump sites (such as Love Canal) scattered throughout the country from which improperly disposed of chemicals are entering the environment and endangering the public health and welfare and the environment. One major purpose of CERCLA is to provide a mechanism for cleaning up the "orphan" dump sites. In addition, to prevent further occurrences, the Act also requires that releases of the designated hazardous substances above the assigned reportable quantity (with some allowable specified exemptions) be reported to the National Response Center. This early reporting requirement is designed to permit an emergency response, when appropriate, to prevent escalation of the hazard created by the release.

INTENT OF CONGRESS

The Senate Report No. 96-848 to accompany S.1480 (the Superfund bill) provides considerable insight into the intent of the Senate. "The range of problems explored by the Committee went beyond waste disposal. Senator Stafford addressed these in his opening remarks at the first hearing on March 18, 1979.

Mr. Chairman, it is important to emphasize, I think, at the outset that these hearings deal with more than just the problem of abandoned hazardous waste sites. The orphaned site problem is important, and it is justly receiving a great deal of attention. Not only are water supplies being contaminated, but untold number of innocent persons are exposed to extremely toxic and hazardous chemicals. Some places, such as Love Canal, have become environmental ghettos. But these hearings are to inquire into the universal problems caused by the release of toxics into the environment.

If these hearings were to deal only with the Love Canal or Toone, Tenn., we would be neglecting the radium sites in Denver. And if we were to deal with the Denver sites as well, we would still be neglecting PCBs in the Hudson River and PBBs in Michigan." (p.10)

These opening comments clarify the breadth of problems that the Senate intended to solve. In addition to purely chemical hazards, the radium sites in Denver are mentioned, implying that the intention is to address the hazards associated with radionuclides.

The Senate Committee Report contains an extensive discussion of the definition of hazardous substance and of reportable quantity (pp. 24-30). This discussion points out "two basic mechanisms for substances to be designated as hazardous ... The first under section 2(b)(13)(A) through (E) is through the operation of the statute itself" [This section became section 101(14)(A) through (F) in the statute]. The discussion goes on to list all the 297 hazardous substances promulgated under section 311 of the Clean Water Act and names the six hazardous air pollutants under section 112 of the Clean Air Act (arsenic was designated a hazardous air pollutant on June 5, 1980 in 45FR37886). With respect to hazardous wastes, the Committee Report states:

Any material which is listed as a hazardous waste under section 3001 (including listed process wastes) or identified as a hazardous waste pursuant to the characteristics published under section 3001 is a hazardous substance under S. 1480.

At the present time the Environmental Protection Agency has promulgated rules providing for the identification and listing of hazardous waste at 40 CFR Part 261 (45 FR 33119, May 19, 1980). These regulations must be referred to to determine the hazardous wastes and their constituents which are hazardous substances for purposes of S. 1480. Any material

> listed as a hazardous waste or hazardous constituent is a hazardous substance for the purpose of S. 1480 regardless of whether it is a waste.

This last sentence appears to require that all hazardous wastes and hazardous constituents (Appendix VIII) listed in 40CFR261 be designated as hazardous substances whether or not they are wastes. The Senate committee report goes on:

> The second basic mechanism for designating hazardous substances ... is the addition of substances just for the purposes of this bill ... [Section 102] authorizes the President to designate as hazardous substances those compounds, elements, mixtures, and solutions which may present substantial danger to public health and welfare and the environment. This provision essentially authorizes the President to augment the existing lists of hazardous substances derived from existing statutes. The language of this provision has a lower threshold for designation than that currently in place in section 311(b)(2) of the Clean Water Act. This is intended to afford the President broad discretion in designating substances which may adversely affect public health or the environment.

Executive Order 12316 has delegated to the Administrator of the EPA the Presidential authority mentioned in the paragraph above.

In connection with the reportable quantities, the Senate Committee Report comments that [Section 102]

> also authorizes the President to establish for each additional hazardous substance so designated a single quantity which, if released, discharged, or disposed of, must be reported ... This does not in any way imply or require that such quantities be determined for any other hazardous substances.

The intention is to permit, but not necessarily to require, that the second mechanism for designation actually be invoked or that new reportable quantities be assigned.

SUMMARY

The primary objective of this study is to provide the decision-makers with the technical information upon which to base a choice among possible alternatives, including ways of maximizing the net social benefit as required by Executive Order 12291. The regulatory impact analysis is addressed in a companion report to be submitted by ICF, Incorporated.

The major thrust of the study on development of a candidate list for designation and hazardous substances and on strategies for RQ assignment appears in sections 5 and 6, respectively. A detailed description of those radionuclides to be included in Superfund, a possible mechanism for notification of radionuclide releases and of various strategies for RQ assignment appear in Section 7.

An important historical item in this review is the recognition that aquatic toxicity, used to develop the RQs that appear in 40CFR117, refers not to human toxicity, but fresh- and salt-water animal toxicity such as the fathead minnow and brine shrimp. Accordingly, aquatic toxicity is considered as a public welfare factor rather than a public health factor when used in the rating and ranking systems discussed in Sections 5 and 6.

Possible approaches to the designation of hazardous substances are considered along with advantages and disadvantages of each. Using the EPA Chemical Activities Status Report as one major starting point, a number of screening steps are taken to reduce the 4100 compounds to 1085 compounds that are candidates for designation, since they are already regulated pursuant to other statutes. Along the way, the Department of Transportation Hazardous Materials List (49CFR172.101 and .102) and the International Agency for Research on Cancer List of Carcinogens are also incorporated into the screening procedure. The final candidate list consists of 917 substances (including the specific and nonspecific F and K wastes from RCRA) and appears in Appendix B, where the legislative authority for each compound regulated is indicated explicitly.

The history of developing RQs for hazardous substances pursuant to the

Clean Water Act includes many steps in which the quantity was linked to the degree of harm it could cause because the language in the Act (until amended on October 14, 1978) required this link. Because of this history, it is felt that any further designation of hazardous substances and/or assignment of RQs will be greatly strengthened by building upon the earlier experience. Accordingly, although Superfund permits assigning RQs based primarily on administrative convenience and practicality (i.e., by considering only the information necessary to ensure that the appropriate response powers pursuant to CERCLA Section 104 could be activated in a manageable fashion), other alternative approaches to assigning RQs are also considered. For each approach, advantages and disadvantages are examined. The approach developed in most detail is that referred to as Hazard Index, a technique for calculating a single numerical value from a variety of criteria. The Hazard Index was applied to a typical set of already designated 27 hazardous substances. Various ways of combining the hazard criteria in the Hazard Index resulted in different numerical values, and they, in turn, produced different rankings of the representative hazardous substances. The particular rankings selected for RQ development may be based on toxicity alone, or may include environmental factors. A comparison of the rankings is an important result reported herein.

Radionuclides and facilities that appear to come under Superfund jurisdiction are described. A possible notification-of-release procedure that employs the in-place mechanisms to a large extent is described. A method for assignment of RQs for radionuclides is developed. It should be noted that because of their characteristics the expected RQ for many (if not all) radionuclides (in radioactivity units) may have a weight much smaller than one pound.

The Chemical Information System, CIS, data base was used to generate information on many of the compounds of interest and to assist in the screening process during the preparation of the candidate hazardous substance list. It is also expected that the CIS will be useful to provide a retrievable computerized storage for the CERCLA-specific information being generated under this program.

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SECTION 2

ISSUES

ISSUES IN THE DESIGNATION PROCESS

The strategy for designation described in this report raises several issues which need addressing.

1. The first issue is the designation of the hazardous waste which when tested according to procedures listed in 40CFR261, Subpart C, for Ignitability, Corrosivity, Reactivity, and Toxicity fall into the classification of hazard, the so-called ICRT wastes, or those which are identified as the D series. These wastes are not identified with any specific manufacturing process and if when tested have one or more of the charcteristics of ICRT fall under the RCRA regulations. This category of hazardous wastes contains essentially an unlimited number of hazardous substances which cannot be identified for designation. It might be possible to include in the designation a category of hazardous substances which includes all wastes which are positive to one or more of the ICRT tests. If this is done then a reportable quantity for that category must be established (see Section 6). Alternatively, it might be practical not to designate these wastes, and rely upon the wastes as "pollutants and contaminants." By this strategy, the Government could respond if they knew that a release could occur. This has the advantage that an RQ need not be established for any of the ICRT wastes, but has the disadvantage that a release of the waste need not be reported. An economic evaluation of the benefits of designating or not designating the ICRT wastes should be determined before a final recommendation is made.

2. We have used as a gate an LD_{50} or LD_{lo} for oral toxicity of 500 mg/kg. This is the "one-swallow" lethal dose for a 15 kg (33 lb) child. All substances having this toxicity or greater (i.e., an LD_{50} value of 500 mg/kg or lower) were retained on the list.* One can argue that this is too restrictive a toxicity limit, and should be lowered to 50 mg/kg which is the DOT limit for "Poison, Class B." We have elected to follow a worst case scenario because if there were a release the probability of a child ingesting the released substance is more likely than a mature adult doing so, since the child would have less concern for poisons than an adult. We would, of course, be pleased to consider other criteria in establishing an oral toxicity limit.

3. We included on the regulated list all the substances listed pursuant to the Safe Drinking Water Act (SDWA) and the Federal Insecticide Fungicide and Rodenticide Act (FIFRA), even though these acts are not specifically mentioned in CERCLA Section 101(14). The reason these were included is that we view the regulations resulting from CERCLA to be the comprehensive definition of hazardous materials, regardless of environmental medium. It would seem to be technically contradictory to have a substance listed as hazardous in an EPA regulation pursuant to SDWA and FIFRA, and not a hazardous substance pursuant to CERCLA. We further would recommend that as the regulations of SDWA and FIFRA are amended to include other substances, that the designation of substances in the regulations of CERCLA be

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* Note: The <u>lower</u> the numerical LD_{50} value, the <u>greater</u> the toxicity, i.e., the smaller the amount needed to produce a toxic effect, the more poisonous it is considered to be.

amended accordingly, notwithstanding the fact that lists in SDWA and FIFRA are regulated for entirely different reasons than the list of CERCLA.

However, it can also be argued that FIFRA and SDWA were excluded from CERCLA Section 101(14) by intent. The issue is one of whether CERCLA, if it is indeed to be the inclusive act for all substances regardless of medium, is also to encompass the materials regulated in all prior acts, whether specifically mentioned in Section 101(14) or not.

4. We have used annual production to establish lists of varying priority. However, it must be remembered that in the regulation promulgated pursuant to 311 of CWA (40CFR116) production level was one of the criteria used to decide whether materials were listed or not. The 311 regulation did not apply to multimedia as the CERCLA regulation, but it can still be argued that a production level criterion should be applied as a measure of risk of exposure. We welcome a dialog on this issue since the use of the 10,000,000 lb. production quantity would eliminate all but 275 additional substances from the listings. Perhaps all materials given in Appendices C and D should be subjected to the HI (Hazard Index) test and the rankings of those substances compared with those of legislated substances. By this procedure it would be possible to at least compare the degree of hazard.

ISSUES IN THE RQ ASSIGNMENT PROCESS

1. Achieving consensus among the various interested groups on a mutually acceptable approach to RQ assignment will require considerable compromise. Some groups may favor a rationale that emphasizes potential hazards and tends to produce low RQs, while others may prefer a rationale that tends in the opposite direction.
2. After acceptance of a particular rationale is achieved, details of the method for assigning RQs will need to be worked out. For example, if the Hazard Index (HI) is chosen as the preferred rationale, the details of the factors to be considered, the rating scales and the weighting factors will have to be established, and finally the preferred relation between HI and RQ will need to be selected. (Some of the possible alternatives are described in this report.)

The statutory text of CERCLA allows, but does not require, the determination of a single RQ without regard to the medium into which the hazardous substance may be released. Upon analysis of the legislative history, however, it seems reasonably clear that Congress intended that the RQ be a single, multimedia value determined without regard to the circumstances surrounding the release. As stated in the legislative history documented in the Senate Report of the Committee on Environment and Public Works that accompanied S 1480:

> ...A single quantity is to be determined for each hazardous substance, and this single quantity requires notification upon release into any environmental medium. It would virtually be impossible to determine a single quantity applicable to al' media while at the same time linking such quantity to any subjective concept of harm. (Emphasis added.)

The legislative history further states that:

> ...It is essential that such quantities be relatively simple for those subject to notification requirements to understand and comply with...and that Administrative feasibility and practicality should be primary factors.

In light of Congressional intent and in the spirit of the present Administration's regulatory relief philosophy, reportable quantities which vary depending on environmental medium are not necessary and should not be assigned.

ISSUES WITH RESPECT TO RADIONUCLIDES

1. Since radionuclides are regulated under other Acts than CERCLA and by other agencies than the EPA, coordination will be essential both to avoid duplication of effort and prevent the absence of response when release occurs.
2. The Nuclear Regulatory Commission noted important deficiencies in existing emergency response plans for fuel fabrication facilities. For example, the plans failed to describe adequately the means for measurement and assessment of accidental releases of radioactive materials and arrangements for prompt notification of Federal, State, and local Government agencies (46 FR 29712). This illustrates the existence of problems in the detection and assessment of accidental releases of radionulcides even for professionals.
3. The responsibility for reporting the release of a quantity of a designated hazardous substance in excess of its RQ implies that the "operator" must have knowledge that such a release has occurred. The circumstances under which it is believed that such knowledge exists may not always be clear. For example, when it is known that radionuclides are released, but the particular radionuclide released is not known, the quantity released is not easily determined.

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SECTION 3

RECOMMENDATIONS

The next major steps to be taken to provide the technical basis for issuing regulations under Superfund Sections 102 and 103 (a and b) are:

1. Provide a "quick-fix" basis for adjusting RQs of the CERCLA Section 101(14) materials (both upward and downward) to emphasize the importance of human toxicity, including the specific and nonspecific wastes (F and K lists) and the ICRT wastes.
2. Devise multimedia strategies for RQs of all hazardous substances.
3. Complete the basis for designation and RQ assignment for radionuclides.
4. When agreement on rationale is reached, calculate (or assign) RQs to all designated hazardous substances.

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SECTION 4

HISTORY OF DESIGNATION AND RQ ASSIGNMENT

Since the starting point for designation of hazardous substances and for the assignment of reportable quantities under Superfund is the analogous development under Section 311 of the Clean Water Act, that development is reviewed in this section.

DEVELOPMENT OF 40CFR116 AND 117

Legislative authority for these regulations resided originally in Section 311(b)(4) of the FWPCA Amendments of 1972 (PL 92-500) which states:

> (4) The President shall by regulation to be issued as soon as possible after the date of enactment of this paragraph, determine for the purposes of this section those quantities of oil and any hazardous substance the discharge of which, at such times, locations, circumstances, and conditions, will be harmful to the public health or welfare of the United States including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches except that in the case of the discharge of oil into or upon the waters of the contiguous zone, only those discharges which threaten the fishery resources of the contiguous zone or threaten to pollute or contribute to the pollution of the territory or the territorial sea of the United States may be determined to be harmful.

On August 3, 1973, Executive Order 11735 delegated the authority of the President under Section 311(b)(4) to the Administrator of the EPA.

An ANPRM was published on August 22, 1974 (39FR30466-71) for the designation of hazardous substances and the determination of their removability. When the NPRM was issued, on December 30, 1975 (40FR59960-60017), 59 candidate substances were deleted from the earlier list because of low spill potential. The remaining substances proposed for designation as hazardous were so listed because of the criteria quoted below:

> In summary, the proposed selection criteria for hazardous substances are as follows: any element, compound, or mixture thereof, possesses

sufficient danger potential to be designated as a hazardous substance, if it is lethal to:

(a) One-half of a test population of aquatic animals in 96 hours or less at a concentration of 500 milligrams per liter (mg/l) or less; or

(b) One-half of a test population of animals in 14 days or less when administered as a single oral dose equal to or less than 50 milligrams per kilogram (mg/kg) of body weight; or

(c) One-half of a test population of animals in 14 days or less when dermally exposed to an amount equal to or less than 200 mg/kg of body weight for 24 hours; or

(d) One-half of a test population of animals in 14 days or less when exposed to a vapor concentration equal to or less than 20 cubic centimeters per cubic meter (volume/volume) in air for 1 hour; or

(e) Aquatic flora as measured by a 50% decrease in cell count, biomass, or photosynthetic ability in 14 days or less at concentrations equal to or less than 100 milligrams per liter (mg/l).

In addition to meeting one or more of the above acute lethality criteria, a candidate substance must have a reasonable potential for being discharged. Factors considered in making this evaluation include (1) past spill history, (2) production quantity, (3) use and distribution patterns, and (4) value of the substance.

Substances were proposed for designation as hazardous on the basis of the following toxicological properties:

1. Aquatic animal toxicity

2. Oral mammalian toxicity

3. Dermal mammalian toxicity

4. Inhalation mammalian toxicity

5. Phytotoxicity

The method proposed for determining harmful quantities was based on a modification of the hazardous material classification system developed by the Intergovernmental Maritime Consultative Organization (IMCO) in conjunction with acute toxicity data. Substances were divided into four categories on the basis of relative hazard to the environment and the smallest common commercial container size (one pound/454 grams) was defined as the harmful quantity for all members of the most highly toxic categories (other categories were thereafter assigned harmful quantities on a proportional basis). The EPA chose to use this methodology after detailed consideration of alternative methods suggested by Battelle Northwest (EPA 440/9-75-005) were rejected because of "excessive complexity; incomplete or conflicting data; difficulty visualized in implementation." (40 FR 59985) In determining harmful quantities, the designated hazardous substances were classified into four categories depending on its LC_{50} toward the aquatic test animals in a 96-hour test. These categories are tabulated below (40FR59989).

EPA CATEGORIES FOR HARMFUL QUANTITY DETERMINATION

Category	Representative Range	Harmful Quantity lb (kg)
A	LC50* < 1 ppm	1.0 (0.454)
B	1 ppm ≤ LC50 <10 ppm	10 (4.54)
C	10 ppm ≤ LC50 < 100 ppm)	100 (45.4)
D**	100 ppm<≤ LC50 ≤ 500 ppm	500 (227)

* LC50 means that concentration of material which is lethal to one-half of the test population of aquatic animals upon continuous exposure for 96 hours or less.

** The basic IMCO criterion for Category D aquatic toxicity is 96-hr. LC50 values of 100-1000 ppm. The selection criteria for materials proposed in 40 CFR Part 116 eliminated any material with a 96-hr. LC50 in excess of 500 ppm. Thus, the representative toxicity range for Category D proposed here has been changed to 100-500 ppm.

The representative range means that substances in Category A have LC50 values of less than 1 ppm, Category B substances have LC50 values of 1 ppm or greater up to 10 ppm, Category C substances have LC50 values of 10 ppm or greater up to 100 ppm, and Category D substances have LC50 vvalues of 100 ppm up to and including 500 ppm.

On March 13, 1978, EPA promulgated Part 116 as a modification of an international categorization system (43FR10474-10488). The toxicological properties were modified to consider only the aquatic toxicity of the substances. The effect of this modification on the final designation is that toxicological effects other than aquatic are not considered in the priority list of hazardous substances. This decision was based upon the problems in the initial system, which required "subjective judgments that could lead to alternative decisions." (43 FR 10475)

Toxicological data for individual substances used in determining harmful quantities were derived from the compendium of information fact sheets entitled Hazardous Substances Fact Sheets, 1977, which are available from the Environmental Protection Agency. In addition, other primary sources of data were: Water Quality Criteria Federal Water Pollution Control Administration, 1968, Water Quality Criteria 1972, EPA, March 1973, and Quality Criteria for Water, EPA 440/9-76-023, July 1976.

Some thirty-odd substances that appeared on the proposed list were not included on the list as promulgated for various reasons. CAS registry numbers were included in the promulgated list of Part 116.

Harmful quantity categories (40CFR118) were modified to adjust the inequity of the factor of 10 difference between Categories D and C, C and B, and B and A, while permitting Category A to range over more than three orders of magnitude. Therefore, another category was added, X, to encompass substances with LC_{50} values of less than 0.1 mg/l and designated the basic unit of 1 pound as the harmful quantity. The designated harmful quantities for Categories A, B, C, and D were changed to 10, 100, 1000, and 5000 pounds, respectively. The modified table is shown below (with obvious typographical errors corrected).

Category	Toxicity Range	Harmful Quantity lb (kg)
X	LC50 <0.1 mg/l	1.0 (0.454)
A	0.1 mg/l <LC50 <1 mg/l	10 (4.54)
B	1 mg/l <LC50 <10 mg/l	100 (45.4)
C	10 mg/l <LC50 <100 mg/l	1000 (454)
D	100 mg/l <LC50 <500 mg/l	5000 (2270)

Before the effective date of these promulgated regulations, their validity was challenged in several lawsuits and Part 118 was declared invalid on the grounds of being contrary to the statutory mandate and because it was arbitrary and capricious. Section 311 of the CWA was amended by PL 95-576 on November 2, 1978, to eliminate the earlier requirement for determination of removability or units of measurement for computing penalties. Accordingly, Parts 117, 118, and 119 were reworked on February 16, 1979 (44FR10266-10284) and a new, simplified Part 117 was re-proposed which listed the reportable quantities of hazardous substances.

The Part 116 list was expanded to include episodic discharges of substances that bioaccumulate to cause subsequent damage to an organism or its predator, or substances that have been shown to be carcinogenic, mutagenic, or teratogenic. These substances were added since they may present an imminent and substantial danger to the public health for reasons other than acute aquatic toxicity.

The basis for determining reportable quantities, formerly termed harmful quantities, was greatly simplified. The determination does not require an assessment of actual harm. Rather, it is based upon the chemical and toxic properties of the substance itself, not the circumstances surrounding its release. Reportable quantities are a rational, generalized prediction of those quantities that may be harmful. Thus, the duty to notify authorities of a discharge is not dependent on a show of actual harm; the degree of harm and other relevant factors are instead examined in assessing civil penalties. The final rule was published August 29, 1979, and took effect a month later with essentially the same RQs as in the re-proposed Part 117.

SECTION 5

DESIGNATION OF HAZARDOUS SUBSTANCES

INTRODUCTION

The ultimate objective of this task is to provide a candidate list of hazardous substances which, when issued as part of the final promulgated regulation, will provide the basis for a notification system with benefits outweighing costs.

This section covers the needs for developing a list of hazardous substances to be designated, the strategies for developing the list, the source of the starting list, and finally the list itself.

RATIONALE FOR A LIST

CERCLA Section 102(a) states:

> The Administrator shall promulgate and revise as may be appropriate, regulations designating as hazardous substances, in addition to those referred to in Section 101(14) of this title, such elements, compounds, mixtures, solutions, and substances which, when released into the environment, may present substantial danger to the public health or welfare or the environment ...

The operative language clearly permits, but does not require, that substances be designated as hazardous beyond those defined in Section 101(14). Once a substance has been designated, the release of some minimum quantity to the environment will trigger notification of the National Response Center (NRC), and if response is necessary, the affected state or Federal agency can react to assure protection of human health and welfare by requiring the releaser to clean up. If the releaser does not clean up, and the substance is on the list and has been released in quantities above the designated quantity, the appropriate agency is then authorized to clean it up with funds through CERCLA, Section 104 or via the mechanism of Section 311 of the Clean Water Act. However, that same section authorizes the President to clean up (or react to a threat) any "pollutant or contaminant which presents imminent and substantial danger to the public health or welfare." The releaser, however, is not required to report a release of a pollutant or contaminant not on the list of hazardous substances. Accordingly, the list must include all materials that constitute a substantial hazard when released, or the government may not become aware of incidents and problems with releases of such materials in a timely manner.

The purpose, therefore, for having a list, is to provide both the government and the regulated community with guidelines for the identification of such hazardous substances which will require a report to the National Response Center upon their release.

STRATEGIES FOR DESIGNATION

Although CERCLA provides EPA broad discretionary authority for designation of hazardous substances, logic dictates that the list must be balanced. On one hand, a complete list of all substances likely to be manufactured or transported would compromise the value of the system because the National Response Center (NRC) would need to divert resources to processing an excessive number of reports, most of which would not require response action. On the other hand, an inadequate list might result in failure of the appropriate agency to respond when necessary. Thus a need exists for developing balanced and meaningful criteria for those substances to be designated.

The designation of a substance as hazardous depends primarily upon the effect of the properties of the substance on human health and welfare and on the environment. However, these effects should be such that they present a danger sufficient enough to require a response action. That is, some limiting value must be placed on any deleterious property that is used as a solution criterion.

With these concepts in mind, a number of strategies for preparing the list of candidates for designation can be considered, as given below.

Strategy 1. Retain only those substances listed pursuant to the Regulations from the Acts listed in Section 101(14).

If this is used, no further designation is necessary. These substances are those appearing in the forthcoming Interpretative Notice. The advantages of this strategy are obvious: (a) no further action in the designation process is required, (b) the regulated community need not change any of its present procedures, since they are already responsive under current regulations, and (c) the list would keep pace with the changes in the regulations pursuant to the CERCLA Section 101(14) Acts, since any change in those regulations automatically triggers the same change in the CERCLA regulations, and (d) such a list meets the minimum requirement of the Act.

The disadvantages are: (a) many hazardous substances are not present on any of the lists, since the largest list (40CFR116 pursuant to Section 311 of the Clean Water Act) was derived based on aquatic toxicity (not human toxicity) and omits many carcinogenic, flammable, explosive, corrosive, and reactive materials, (b) the legislated list does not consider hazardous substances considered from all other Acts, for instance, regulations pursuant to the Safe Drinking Water Act, the Federal Insecticide, Fungicide, and Rodenticide Act, (c) the list does not include all the materials the Department of Transportation has designated as hazardous (pursuant to the Hazardous Materials Transportation Act), nor all the known or suspected carcinogens.

Strategy 2. Use a comprehensive list such as that of the 55,000 chemicals listed in the Toxic Substances Control Act Chemical Substance inventory

The advantages are: (a) essentially everything that is hazardous would be included, (b) the list is in existence and no further evaluation need be made, (c) the list meets the requirement of CERCLA. The disadvantages are obvious: (a) the list is intended to be used as an inventory, and the degree of hazard of many of the listed materials is either nil or so low as to be essentially non-existent, (b) a severe economic impact would be placed on the regulated community since this would present a substantial change in their current practices, and (c) the National Response Center would be flooded with telephone calls, compromising the intent and effectiveness of the system.

Strategy 3. Assign a Blue Ribbon Committee to select the new substances to be designated

The advantages are: (a) a select group of experts would judge what goes on the list, and thus each substance would then have been considered by an expert impartial committee, making the validity of the list incontrovertible, (b) a multiplicity of technical and, perhaps, sociological views would have been aired in arriving at a list. The disadvantages are: (a) reaching on agreement of a list by independent experts may require an extensive period of time, (b) technical criteria should be provided to the committee in order to arrive at a common jumping off point and these criteria might be difficult for the committee to agree upon.

Strategy 4. Establish a Hazard Index Rating and rank all candidate hazardous substances by its degree of harm.

A hazard index (HI) is a method to quantify value judgments about a substance's relative environmental impact or potential for causing harm. It provides a direct way to consider basic data clearly related to hazard, and allows a rank assessment based on degree of hazard. An in-depth discussion of the HI is given in Section 6. The HI discussion is in the section on strategies for Reportable Quantities since its use, it turns out, is more applicable to reportable quantities requirements than to designations. However, there are some advantages to the use of HI for designations, such as: (a) it provides a quantitative measure of the hazard of a substance, (b) it takes advantage of all available basic data, and (c) it provides a ranking, thus enabling a cutoff point to satisfy a selected definition of hazard. There are also many disadvantages for its use in designation: (a) data gaps exist which could lead to omission of hazardous substances, (b) HI (as developed) does not consider economic factors, and (c) it may be difficult to have HI accepted by the interested community as the sole criterion for designation.

Strategy 5. Establish a set of "gates" based upon criteria related to hazard, and apply these to a master list or list of substances.

This strategy contemplates starting off with a major list of substances, and adding or deleting substances depending upon the effects on human health or the environment. The advantages of this strategy are: (a) it allows for all technical considerations to be given to a substance, (b) it permits other considerations as well, such as economics, quantity of production, likelihood of release, etc., and (c) it is flexible by permitting a larger or smaller list depending on the limits placed on the criteria. The disadvantages are: (a) the lower or upper criteria of hazard must be established and all interested parties may not agree on the value selected.

Selection of Strategy

Based on the above discussion, it turns out that no one strategy is 100% perfect, and that a combination of strategies gets us to the major goal of providing a list of designated hazardous substances which when promulgated will provide more benefits than they will cost. Accordingly, for the purposes of developing a candidate list, we have relied on Strategy 5, recognizing, of course, that CERCLA provides the Administrator the use of broad discretion in revising such lists. At a later date we will include the use of HI as a check and balance of the final candidate list, when the fact sheets (as described in Section 8) have been completed. We have selected this combined strategy since it provides the best compromise of all the listed strategies by using available technical data, clearly identified criteria, and consideration of all other Acts not listed in Section 101(14). This strategy also provides a technical baseline from which any other interested party could perform a further screening for deletion or addition to the final candidate list.

STEPS IN THE DESIGNATION PROCESS

The following steps are necessary to arrive at a final candidate list.

1. Select listing categories.

   An initial restriction is applied to limit the designation process to individual chemical compounds and to wastes. In particular, radionuclides are addressed separately (see Section 7).

2. Establish a Master List

   This master list must have all the substances which should be considered for designation. We have selected as the master list the EPA's Chemical Activity Status Report, EPA 560/13-80-040, because it provides the listing of all substances which have already been designated under various Acts and also those which are being considered for further regulation.

3. Establish first-level screening criteria

   These criteria are the "gates" which will be used for the first screening.

4. Perform the first-level screening based on the criteria.

5. Add to the list materials from the DOT tables of Hazardous Materials and from the International Agency for Research on Cancer list of known or suspected carcinogens.

6. Cross-check with the original regulation listings to ensure that all legislated substances as required by CERCLA Section 101(14) are still on the list, and that no materials not so legislated have been inadvertently identified as such.

7. Split the list into two parts: one including all the materials that are currently regulated by the EPA under various acts (the regulated list), the other including all materials not so regulated (the supplemental list).

8. Complete the regulated list by adding the specific and non-specific RCRA wastes (the F and K lists).

9. Prioritize the supplemental list according to annual production quantities.

This procedure is shown graphically in Figure 5-1.

Future steps to be taken include reviewing the list with the interested community and considering their comments. The economic impact of the list on the regulated community will also be evaluated. Benefits derived from adding or deleting newly designated substances will be considered.

The following discussion provides details of the steps in the designation process.

Step 1. Select the Listing Categories

The primary decision was that of electing to address radionuclides as a totally separate and distinct subject area. The technical and regulatory basis for this decision is covered in detail in Section 7.

Step 2 - Establish a Master List

The EPA's Office of Pesticides and Toxic Substances has been compiling information on all the chemicals in which several program offices within the EPA have an interest. They recently issued the Chemical Activities Status Report (second edition), EPA 560/13-80-040 a & b, which lists all the chemicals in this data base and provides such information as the technical basis for listing, legislative mandate, or nonlegislative reason for listing. In addition, the information on each chemical is also accessible through a machine-searchable data base, EPACASR-2.

Using the EPACASR as the starting point for the comprehensive list assures that we are consistent with all of the EPA's interests. The introduction to this report describes the sources of the listings as follows:

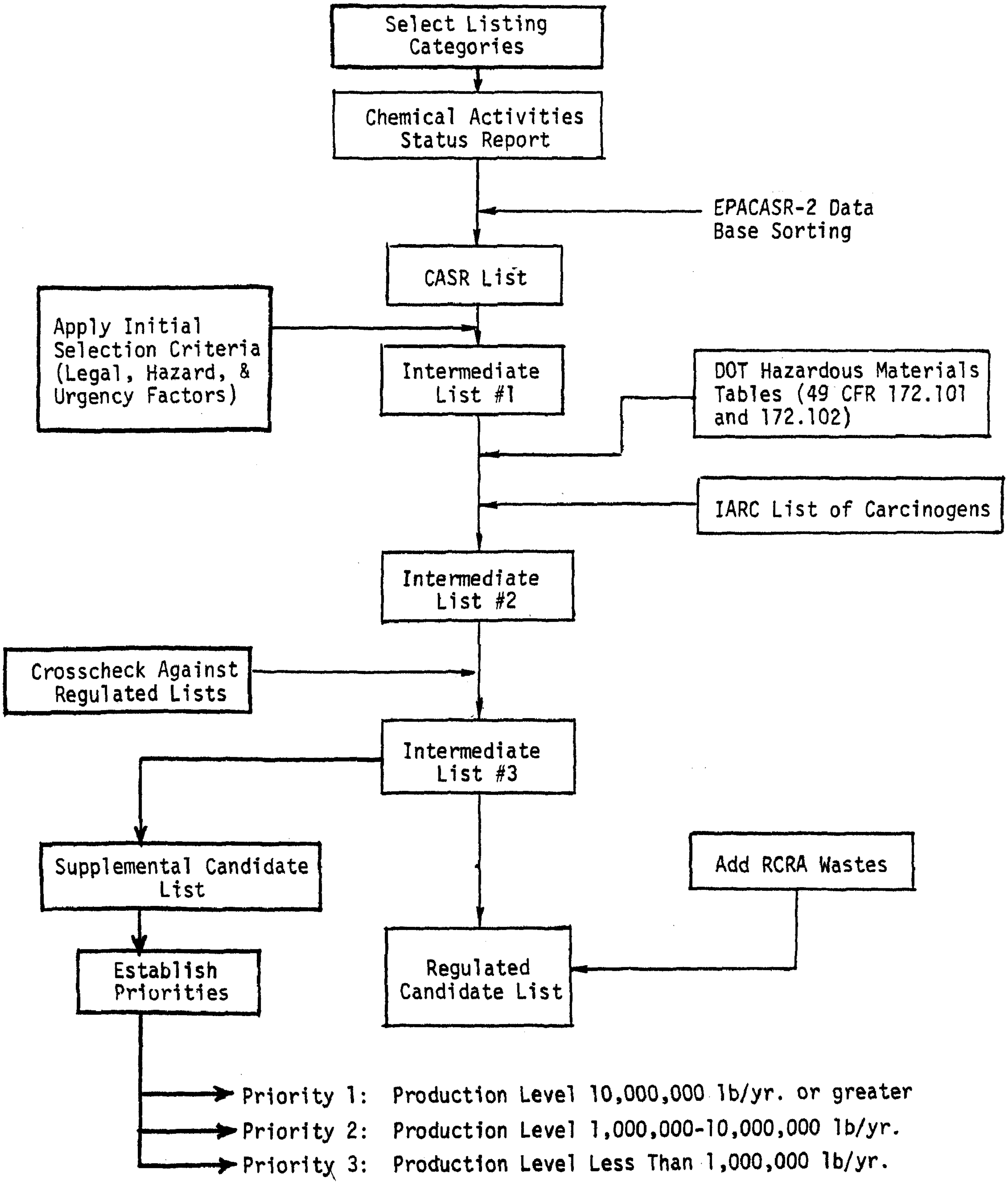

Figure 5-1. Development of Comprehensive Hazardous Substances Candidate List

Clean Air Act

- o Criteria Pollutants designated under Section 109 of the Act (40CFR50).
- o Chemicals addressed under new source performance standards (Section 111) (40CFR60)
- o National Emission Standards for Hazardous Air Pollutants (Section 112) (40CFR61)
- o Assessments in Progress, obtained from the Office of the DAA, Air Quality Planning and Standards

Clean Water Act

- o OHM-TADS (Oil and Hazardous Materials Technical Assistance Data), obtained from Oil and Special Materials Control Division; kept under authority of Section 311, and used to support the National Contingency Plan (spill response)
- o Hazardous Spill Regulations. Promulgated or proposed under Section 311 of the Act, 40CFR116.
- o Toxic Substance Effluent Regulations proposed and promulgated under Section 307(a) of the Act, and obtained from 40CFR129, and the Criteria and Standards Division.
- o Water Quality Criteria proposed under Section 304 of the Act. Included in consent decree, and obtained from the FR Notices of March 18, July 28, and October 1, 1979.

Note: Effluent Guidelines were not included because they are not chemical-specific; however, controlling certain gross parameters will afford an unspecified degree of reduction in certain toxic chemicals.

Federal Insecticide, Fungicide, and Rodenticide Act

- o Major cancellations and suspensions, obtained from a compilation prepared by the Pesticide Enforcement Branch. This includes partial as well as total cancellation (e.g., the most hazardous uses may be cancelled, and other uses permitted with or without restrictions.
- o Rebuttable Presumption Against Registration (RPAR) issued under the reregistration authorities of Section 6 is the normal first step toward cancelling or modifying pesticide registrations, although RPAR may not result in such action.
- o Preregulatory assessments address those substances being considered for RPAR.
- o Restricted use pesticides are those that must be applied only by certified applicators.

Resource Conservation and Recovery Act

- o Chemicals designated as hazardous under Section 3001, obtained from 40CFR261.

Safe Drinking Water Act

- o Interim Primary Drinking Water Regulations promulgated under 40CFR141.
- o Interim Secondary Drinking Water Regulations, obtained from the FR Notice of March 31, 1977.
- o Indicators of Industrial Pollution used to determine need to treat water supplies, from the FR Notice of February 9, 1978.
- o Chemicals under review for possible regulation, from ODW.

Toxic Substances Control Act

- o Testing recommendations by the Interagency Testing Committee (ITC), under Section 4(e) authority. (FR Notices)

- Preregulatory Assessments: Chemical Hazard Identification Profiles (CHIPs) and Phase I reviews, as obtained from the Office of Toxic Substances (CHIPs are summary reviews of readily available literature which present information characterization, uses, and effects of chemicals. Phase I reviews involve detailed study of secondary information sources).
- Chemicals regulated under Section 6, and proposed for reporting rules under Section 8(a).

Other

- Office of Research and Development/Carcinogen Assessment Group reviews to support assessment under the foregoing statutes. Listing supplied by CAG.
- ORD projects, from a search of the Office of Research and Development Information System and communications with project officers.

Details of the CASR List

The CASR list is a computer print-out of each of the materials covered in the Chemical Activities Status Report, with each material listed only once and using the chemical nomenclature as given in the 9th Cumulative Index of the Chemical Abstracts Service. It contains approximately 4100 entires, and was provided by Eleanor Merrick of the EPA's Toxic Integration Staff, who is in charge of the CASR project.* In addition, Ms. Merrick also provided printouts showing which entries on the list were there because they were already covered in promulgated regulations, which were there because they were being listed in proposed or in-development regulations, and which were merely "of interest."

*It should be noted that the alphabetical index published in the hard copy of Chemical Activities Status Report was not a satisfactory starting list for our purposes because it contains synonyms as well as the primary name, and is approximately 13,000 entries in length.

The CASR list is not absolutely alphabetical, since the data base management program used in machine sorting the lists employs a combination of alphabetical and numerical fields to generate its final listings. The program first assembles everything within a given alphabetical field, then sorts numerically within that field, printing out low-numbered items first, and finally printing unnumbered items in alphabetical sequence. Thus the materials

Benzene

Benzene, bromo-

Benzene, 1,3-dichloro-

Benzene, 1,2-diethyl-

are listed by the CASR program in the following order:

Benzene, 1,2-diethyl-

Benzene, 1,3-dichloro-

Benzene

Benzene, bromo-

Despite this peculiarity, the CASR list proved to be easy to use, and served as an excellent starting point in developing the final candidate list.

Step 3 - Establish and Apply First-Level Screening Criteria

The 4100 chemicals on the CASR list fall into three categories:

CAT 1: Those already listed in promulgated regulations (under CAA, CWA, SDWA, TSCA, FIFRA, and RCRA)

CAT 2: Those listed in proposed or in-development regulations (primarily under TSCA)

CAT 3: "Of Interest." That is, there is some associated EPA concern or activity, but there is no urgent need for regulatory action.

A set of "gates" was developed and applied as the first-level screening of the CASR list. Gates are of two types: entry or retention gates, which either keep things on the list or allow new substances to be added, and exit gates which allow substances to drop off the list.

Retention Gates

1. All substances from the regulations pursuant to the Clean Air Act, the Clean Water Act, Toxic Substance Control Act, and the Resource Conservation and Recovery Act including the Hazardous Constituents (Appendix VIII)

2. All substances from the regulations pursuant to the Safe Drinking Water Act and the Federal Insecticide, Fungicide, and Rodenticide Act

Thus all CAT 1 are retained.

3. Known or suspected carcinogens, as identified in the CASR listing or in the Registry of the Toxic Effects of Chemical Substances (RTECS)*

4. Materials hazardous to the health, for any of the following reasons:

   a. An oral toxicity value (LD_{50} or LD_{1o}) of less than 500 milligrams per kilogram of body weight or lower. This value is derived from work on another Rockwell program, using a scenario in which it is presumed that a small child (a "toddler") is exposed to a toxic material under circumstances that would allow him to take on good swallow of such a material.
   This scenario was first discussed with personnel at Children's Hospital in Los Angeles, California, who subsequently referred

* The Registry is a compendium maintained and published by the U.S. Department of Health and Human Services. The latest hardcopy was issued in 1979. The data is also accessible via the Chemical Information System, and this format includes updated material updated in 1980-1981 (see Section 8, p. 8-6).

us to one of the nation's foremost authorities on problems of poisoning children, Dr. Howard Mossensen at the Nassau County Medical Center in Long Island, New York. Dr. Mossensen agreed that this scenario would be a reasonable one, and conservative enough to provide a high degree of protection in the event of such an exposure.

A good swallow by a small child amounts to about 4 to 4.5 cubic centimeters. For a toddler weighing 15 kilograms, this works out to a dose of 300 milligrams per kilogram of body weight, assuming an ingested material of unit density. To provide for a safety margin (allowing for lower body weights and/or higher density materials), a limiting toxicity value of 500 milligrams per kilogram of body weight* was chosen. For reference purposes, aspirin, a notorious toxicant for children, has a recorded low lethal dose of 81 milligrams per kilogram, sodium chloride (common salt), a recorded low lethal dose of 500 milligrams per kilogram.

It is of interest to note that applying this same series of calculations to the "standard man" (70 kilogram body weight, swallow volume of 21 cubic centimeters) also yields a value of 500 milligrams per kilogram of body weight for the limiting toxicity value. However, adults are much less likely to ingest foreign materials than are children.

Data for assessing toxicity were taken from RTECS for the most part, with occasional reference to The Merck Index, 9th Edition. Whenever available, the low lethal dose (LD_{lo}) for humans was used to make the decision on a particular compound.

* Note: The higher this toxicity value, the less toxic is the material.

If this was not available, the LD_{50} for any mammalian species was used. It is recognized, of course, that data from other mammals, while it affords a reasonable approximation of human response, is not an absolute. However, it must also be understood that human toxicity data is derived largely from isolated cases of accidental poisoning, and statistically valid results from toxicity studies on larger human populations are available in very, very, few cases indeed.

b. Other health effects: teratogenicity, mutagenicity, irritant effect on the eyes, skin, or lungs, and evidence for bioaccumulation. Again, RTECS was used as the primary source of data, and evidence for one of the effects in any mammalian species was considered sufficient reason for retaining a chemical on the list.

5. Corrosives, as identified in the CASR list or in RTECS. Corrosive is taken not only to mean the capability for attacking metal (e.g., RCRA regulation 40CFR261.22) but also in the health hazard sense of "causing ulceration or necrosis to flash" (DOT definition).

6. Flammables, using either the DOT criteria as listed in the Hazardous Materials Tables (49CFR171.101 and 171.102) and/or the National Fire Protection Association (NFPA) ratings in their publication Fire Protection Guide on Hazardous Materials.

   In the DOT's tables, the distinction between flammability and combustibility was generally related to the chain length of the material. This is particularly true of aliphatic compounds. For instance, amyl acetate (pentyl acetate, 7 carbon atoms) is listed as a flammable liquid, while ethyl butyl acetate (hexylacetate, 8 carbon atoms) is listed as a combustible liquid. Thus, without having to try and find numerical data on flash points, one can quickly decide whether any compound in this class should be classed as flammable or not simply by knowing its chain length.

The NFPA uses 5 categories to assess "susceptibility to burning" as follows:

4 Very flammable gases or very volatile flammable liquids. Shut off flow and keep cooling water streams on exposed tanks or containers.

3 Materials which can be ignited under almost all normal temperature conditions. Water may be ineffective because of low flash point.

2 Materials which must be moderately heated before ignition will occur. Water spray may be used to extinguish the fire because the material can be cooled below its flash point.

1 Materials that must be preheated before ignition can occur. Water may cause frothing if it gets below the surface of the liquid and turns to steam. However, water fog gently applied to the surface will cause a frothing which will extinguish the fire.

0 Materials that will not burn

Falling into either Category 3 or 4 above was considered sufficient reason for retaining a material on the list.

7. Oxidizers and explosives

Exit Gates

1. Petroleum, petroleum fractions, and natural gas (methane) as mandated by CERLCA.

2. Aliphatic species (hydrocarbons, esters, alcohols, amines, acids, etc.), _if_:

   (a) They were rated combustible, but not flammable, by DOT or the National Fire Protection Association. As noted above, flammability and combustibility can be related to chain length. Thus, as in the example used above, any simple ester with a chain length of eight carbon atoms or more would drop off the list at this point. With respect to the NFPA rating system, items on the 0-2 categories would drop off.

   (b) They were nontoxic and noncorrosive

3. High Polymers. This term is an abbreviated form of "High Molecular Weight Polymers," and is meant to designate those polymeric macromolecular species that are both solid and without detectable vapor pressure at ambient temperature.

4. Sugars, polyols, glycols, and esters and ethers thereof. [1,2-Propanediol was originally identified as an "Acute Hazardous Waste" under the RCRA regulations (45FR33125, 19 May 1980), but was later deleted (45FR78533, 25 November 1980)].

5. Nonregulated freons

6. Low-toxicity natural products (amino acids, etc.)

7. Medicinals

Step 4 - Complete the First-Level Screening

As a final step in the first-level screening, we applied what may be called an "Urgency" factor. That is, we reviewed all CAT 3 chemicals (i.e., of interest), and unless they had been tagged with a specific hazard during the prior technical review, they were eliminated from further consideration at this point.

This procedure eliminated many chemicals with relatively innocuous properties, such as benzenemethanol (benzyl alcohol), sodium acetate, and borax. However, it also eliminated a number of materials that are closely related to others that remain on the list either because of prior regulatory action or because the retention gates kept them there. For instance, 1,1-dibromoethane drops off, and the reason is that the compound is a rarity (no commercial production or use) and what little toxicity data are available on the material do not indicate that it is hazardous.

During all of this procedure we relied heavily on the Chemical Information System to check nomenclature, to identify additional sources of information, and in particular, to provide data on carcinogenicity and toxicity from the RTECS (Registry of the Toxic Effects of Chemical Substances) data base.

At the end of this overall application of selection criteria, Intermediate List #1 contained about 2600 entries.

Step 5 Addition of DOT and IARC Listings

The Department of Transporation publishes two lists, the Hazardous materials Table (49CFR172.101) and Optional Hazardous Materials Table (49CFR172.102). These tables show the restrictions, packaging standards, and labelling requirements for about 2000 chemicals, with the "optional" table more closely following the international conventions in such areas. From this list were selected another 430 chemicals, on the following basis:

1. They were not already on the original CASR list.
2. They required the following labels:
   Flammable (liquid or solid)
   Oxidizer
   Peroxide
   Poison B
   Corrosive
   Dangerous When Wet
   Spontaneously Combustible

The International Agency for Research on Cancer has published a summary list of 142 chemicals from its monographs 1-20 of those compounds that have "sufficient evidence of carcinogenicity in experimental animals." Review of these showed that 20 of them were not already on the original CASR list.

In reviewing these two lists and comparing them with the CASR listings, the Chemical Information System was again our major tool, using the SANSS (Structure and Nomenclature Search System) to obtain the CAS numbers, the 9th Collective Index nomenclature, or simply to cross-check identities.

With these two additions, the result became Intermediate List #2, which contained approximately 3100 entries.

Step 6 - Perform Listing Cross-Check

Up to this point, we had relied entirely on the CASR generated listings to identify materials from the various regulations. However, as a safeguard we now cross-checked each entry against the actual regulation itself, to be sure that no material designated in the regulations had been inadvertently omitted, or that no material had been mistakenly identified as regulated when it was not. At the same time, we reviewed and added to the list the various isomers where the regulations spelled out "all isomers" and made sure that if an isomer were identified by both a specific CAS number and a general CAS number that both were entered.

Also, certain regulated substances, because they are not specific, require that more than one entry be made on the list to be sure that all possible variations of the compound be covered. For instance "Pyrethrins" generates two entries and "Aflatoxins" generates twelve.

One material on the list, "Ferric Cyanide," from the RCRA Hazardous Constituents list, remains somewhat of an enigma. Technically, there is no such compound as ferric cyanide if we take the strict approach that this should be the name for a compound formulated as $Fe(CN)_3$. However, checking with the Chemical Abstract Service, we were told that "Iron Cyanide" is a synonym for ferric ferricyanide, $Fe[Fe((CN)_6]$, and have accordingly identified "Ferric Cyanide" by the equivalent CAS registry number.

Intermediate List #3, after this cross check and after adding all appropriate isomers, contained about 3200 entries.

Step 7--Split the List

At this point, the list was separated into two parts: the regulated list and the supplemental candidate list. The regulated list consists of 833 entries (including 25 PCB's listed by CAS registry number alone), all of which are currently subject to specific regulations under one of the environmental acts: FIFRA, RCRA, SDWA, CAA, CWA, and TSCA. Of these, 53 are not mandated by CERCLA Section 101(14), since they derive from either FIFRA or Appendix VIII of RCRA, and are not covered under any other act. These are as follows:

FIFRA Only:

51317	Benzoic acid, 2,3,6-trichloro-
58366	10H-Phenoxarsine, 10,10- oxybis
72560	Benzene, 1,1'(2,2-dichloroethylidene)bis(4-ethyl)
78342	Phosphorodithioic acid, S,S'-1,4-dioxane-2,3-diyl 0,0,0',0'-tetraethyl ester
97187	Phenol, 2,2'-thiobis (4,6-dichloro)
115902	Phosphorothioic acid, 0,0-diethyl 0-[4-(methyl-sulfinyl) phenyl] ester
118752	2,5-Cyclohexadiene-1,4-dione, 2,3,5,6-tetrachloro
150685	Urea, N'-(4-chlorophenyl)-N,N-dimethyl

470906	Phosphoric acid, 2-chloro-1-(2,4-dichlorophenyl-ethenyl diethyl ester
578949	Phenarsazine, 10-chloro-5,10 dihydro
944229	Phosphonodithioic acid, ethyl-, O-ethyl, S-phenyl ester
1918021	2-Pyridinecarboxylic acid, 4-amino-3,5,6-trichloro-
2385855	1,3,4-Methano-1H-cyclobuta[c,d]pentalene, 1,1a,2,2,3,3a, 4,5,5,5a,6-dodecachloro-octahydro-
3861765	1H-Benzimidazole-1-ethanamine, 2-[(4-chloro-phenyl)methyl] -N,N-diethyl5-nitro-
4685147	4,4'-Bipyridinium, 1,1'-dimethyl
6923224	Phosphoric acid, dimethyl 1-methyl-2-(methyl-amino)-3-oxo-1-propenyl ester
8001501	Strobane
8065483	Phosphorothioic acid, 0,0-diethyl 0-[2-(ethyl-thio)ethyl] ester, mixt with 0,0-diethyl S-[2-(ethylthio)ethyl] phosphorothioate
10103614	Arsenic acid (H3As04), copper salt
13171216	Phosphoric acid, 2-chloro-3-(diethylamino)-1-methyl-3-oxo-1-propenyl dimethyl ester
22224926	Phosphoramidic acid, (1-methylethyl), ethyl 3-methyl-4-(methylthio) phenyl ester
23135220	Ethanimidothioic acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo, methyl ester
33089611	Methanimidamide, N'-(2,4-dimethylphenyl)-N-[[(2,4-Dimetnylphenyl)imino]methyl]-N-methyl-
61788338	Terpheynyl, chlorinated

RCRA Appendix VIII Only:

1162658	Aflatoxin B1
1165395	Aflatoxin G1
1402682	Aflatoxin
6795239	Aflatoxin M1
688570	Aflatoxin M2

7220817	Aflatoxin B2
7241987	Aflatoxin G2
17878545	Aflatoxin B2a
20421107	Aflatoxin G2a
29611038	Aflatoxin RO
32215024	Aflatoxin P1
52819962	Aflatoxin Q1
98055	Arsonic acid, phenyl
205823	Benzo(j)fluoranthene
92671	(1,1'-Biphenyl)-4-amine
226368	Dibenz(a, h)acridine
224420	Dibenz(a,j)acridine
194592	7H Dibenzo(c,g)carbazole
51752	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl
55867	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl, hydrochloride
126852	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl, N-oxide
302705	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl, N-oxide, hydrochloride
66275	Methanesulfonic acid, methyl ester
16543558	Nornicotine, N-nitroso
7530054	Oxirane, 2-chloromethyl-3-methyl
126681	Phosphorothioic acid, 0,0,0-triethyl ester
108601	Propane, 2,2'-oxybis(1-chloro
56575	Quinoline, 4-nitro, 1-oxide
95498	Benzene, 1-chloro-2-methyl-
106434	Benzene, 1-chloro-4-methyl
96184	Propane, 1,2,3-trichloro
52244	Aziridine, 1,1',1"-phosphinothioylidynetris

14901087	beta-D-Glucopyranoside, (methyl-ONN-azoxy)methyl
13256229	Glycine, N-methyl-N-nitroso-
6358538	2-Naphthalenol, 1-[(2,5-dimethyoxyphenyl)azo]
51525	4(1H)-Pyrimidinone, 2,3-dihydro-6-propyl-2-thioxo-
59892	Morpholine, 4-nitroso

FIFRA and RCRA Appendix VIII only

85687	1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester
140578	Sulfurous acid, 2 chloroethyl 2-(4-(1,1-dimethylethyl) phenoxyl)-1-methylethyl ester

Step 8 Complete the Regulated List

To complete the list of regulated materials, the RCRA specific and nonspecific wastes, as listed in 40CFR261.31 and 261.32, have been added. These lists are sometimes called the F and K lists, and bring the total number of entries on the regulated list up to 917.

The regulated list is given as Appendix B. The act under which the material has been regulated is also shown, and in the case of RCRA, the specific list within the regulation is also indicated.

It should be noted that since this list derives from the CASR list, it still retains the mixed numberical/alphabetical order that results from the EPACASR2 sorting procedure. Prior to publication in a regulation, the following is recommended:

1. That the list be resorted in true alphabetical fashion, ignoring numerical fields
2. That two other companion lists be generated:
    a. A list sorted by CAS number
    b. An alphabetical list using common names and synonyms taken from the original regulation wherever possible.

Step 9--Prioritize the Supplemental List

As a final step, the supplemental list of chemicals was divided into three sections:

Priority 1 - These materials produced in annual quantities of 10,000,000 pounds or more.

Priority 2 - Those materials produced in annual quantities of 1,000,000 to 10,000,000 pounds.

Priority 3 - Those produced in annual quantities of less than 1,000,000 pounds.

Production quantity was used in developing regulations under the Clean Water Act, Section 311 as a measure of risk, since there is generally more chance of spill an contamination of waterways in cases of materials produced in large quanity. In those regulations, production at greater than 10,000,000 lb/yr was one of the necessary designation criteria. However, since CERCLA covers many more circumstances than spills into waterways, it may not be appropriate to apply the same criteria here. Accordingly, we have used production level only as a measure of importance. Note that regulation of a high-volume material is likely to have a greater economic impact than regulating a low-volume one, and the level of production will be of concern in later cost-benefit studies.

The data for these evaluations again came from the Chemical Information System, using TSCAPP (The Toxic Substances Control Act Plant and Production Data). According to the information displayed in the introduction to this data base, the latest update of this material was in August 1981, but this is in reference only to new materials added to the data base. The bulk of the information was gathered in 1977. However, four years is really a very short time in terms of the chemical industry, and these data are believed to be still valid.

The three lists generated by this process contain 275 Priority 1 materials, 509 Priority 2 materials, and approximately 1600 Priority 3 materials. The Priority 1 and 2 materials are given in Appendices C and D respectively. The Priority 3 list has been relegated to the Rockwell files for the time being, but can be provided whenever needed.

Each item on thse two lists is accompanied by a code designating a primary reason for it being considered hazardous, as follows:

Co	=	Corrosive
F	=	Flammable
Fs	=	Flammable Solid
H	=	Health Hazard (Includes carcinogenicity, toxicity, and all other health hazards)
H/W	=	Hazardous When Wet
X	=	Oxidizer or Explosive
Py	=	Pyrophoric

Only one primary reason is given for each material, but this does <u>not</u> exclude the material from being equally hazardous for one or more additional reasons.

As with the regulated materials lists, these two lists still retain the peculiar sorting characteristics of the original CASR list, and should be alphabetized and supplemented with numerically-ordered and synonym lists before final publication.

Of those compounds added from DOT and IARC tables in preparing Intermediate List #2, only nine remain on the Priority 1 List. These are (listed by increasing CAS number):

75194	Cyclopropane
79414	2-Propenoic acid, 2-methyl
115106	Methane, oxybis

116143	Ethene, tetrafluoro-
563473	1-Propane, 3-chloro-2-methyl
7681381	Sulfuric acid, monosodium salt
7757791	Nitric acid, potassium salt
8049170	Ferrosilicon
26545733	Propanol, dichloro

An additional six such compounds are found in the Priority 2 List, as follows:

98124	Silane, trichlorocyclohexyl
4098719	Cyclohexane, 5isocyanatol(isocyanatomethyl)-1,3,3-trimethyl
7778747	Perchloric acid, potassium salt
9007130	Calcium resinate
9010699	Resin acid, zinc salt
9056386	Starch, nitrate

Issues in the Designation Process

The use of the strategy for designation raises several issues which need addressing.

1. The first issue is the designation of the hazardous waste which when tested according to procedures listed in Part 261 for Ignitability, Corrosivity, Reactivity, and Toxicity fall into the classification of hazard, the so-called ICRT wastes, or those which are identified as the D series. These wastes are not identified with any specific manufacturing process and if when tested have one or more of the charcteristics of ICRT fall under the RCRA regulations. This category of hazardous wastes contains essentially an unlimited number of hazardous substances which cannot be identified for designation. It might be possible to

include in the designation of a category of hazardous substances which includes all wastes which are positive to one or more of the ICRT tests. If this is done then a reportable quantity for that category must be established (see Section 6). Alternatively, it might be practical not to designate these wastes, and rely upon the wastes as "pollutants and contaminants." By this strategy, the Government could respond if they knew that a release could occur. This has the advantage that an RQ need not be established for any of the ICRT wastes, but has the disadvantage that a release of the waste need not be reported. An economic evaluation of the benefits of designating or not designating the ICRT wastes should be determined before a final recommendation is made.

2. We have used as a gate an LD_{50} or LD_{lo} for oral toxicity of 500 mg/kg. This is the "one-swallow" lethal dose for a 15 kg (33 lb) child. All substances having this toxicity or greater (i.e., a value of 500 mg/kg or lower) were retained on the list.* One can argue that this is too restrictive a toxicity limit, and should be lowered to 50 mg/kg which is the DOT limit for "Poison, Class B." We have elected to follow a worst case scenario because if there were a release the probability of a child ingesting the released substance is more likely than a mature adult doing so, since the child would have less concern for poisons than an adult. We of course would be pleased to consider other criteria in establishing an oral toxicity limit.

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* Note: The <u>lower</u> the numerical value, the <u>greater</u> the toxicity, i.e., the smaller the amount needed to produce a toxic effect, the more poisonous it is considered to be.

in establishing an oral toxicity limit.

3. We included on the regulated list all the substances listed pursuant to the SDWA and FIFRA, even though these acts are not specifically mentioned in CERCLA Section 101(14). The reason these were included is that we view the regulations resulting from CERCLA to be the comprehensive definition of hazardous materials, regardless of environmental medium. It would seem to be technically contradictory to have a substance listed as hazardous in an EPA regulation pursuant to SDWA and FIFRA, and not a hazardous substance pursuant to CERCLA. We further would recommend that as the regulations of SDWA and FIFRA are amended to include other substances, that the designation of substances in the regulations of CERCLA be amended accordingly, notwithstanding the fact that lists in SDWA and FIFRA are regulated for entirely different reasons than the list of CERCLA.

   However, it can also be argued that FIFRA and SDWA were excluded from CERCLA Section 101(14) by intent. The issue is one of whether CERCLA, if it is indeed to be the inclusive act for all substances regardless of medium, is also to encompass the materials regulated in all prior acts, whether specifically mentioned in Section 101(14) or not.

4. We have used annual production to establish lists of varying priority. However, it must be remembered that in the regulation promulgated pursuant to 311 of CWA (40CFR116) production level was one of the criteria used to decide whether materials were listed or not. The 311 regulation did not apply to multimedia as the CERCLA regulation but it can still be argued that a production level criterion should be applied as a measure of risk of

exposure. We welcome a dialog on this issue since the use of the 10,000,000 lb. production quantity would eliminate all but 275 additional substances from the listings. Perhaps all materials given in Appendices C and D should be subjected to the HI test and the rankings of those substances compared with those of legislated substances. By this procedure it would be possible to at least compare the degree of hazard.

5. Radionuclides were not addressed in this designation process. They are treated separately (Section 7).

DRAFT

SECTION 6

REPORTABLE QUANTITIES

This section describes the various approaches investigated to determine the method of assignment of reportable quantities (RQ's) to CERCLA designated hazardous substances specified in Section 101(14) and 102 of the Act. The legislative basis of the RQ concept is discussed as well as the pros and cons of the various strategies of RQ assignment.

THE CONCEPT OF REPORTABLE QUANTITIES

As stated in the legislative history and the language of the statute itself, a CERCLA reportable quantity (RQ) provides the triggering mechanism by which notification of releases into the environment of hazardous substances are reported to the National Response Center under Section 103(a). Although Section 102 establishes a link between "hazardous substance" and a concept of harm or hazard by the phrase, "...may present substantial danger to the public health or welfare or the environment ...", it is important to note that the language of the Act makes no reference to such a link between the RQ and a concept of harm or hazard. The legislative history documented in the Senate Report of the Committee on Environment and Public Works that accompanied the Senate version of CERCLA, S1480, states the rationale:

> The provision intentionally omits from the requirement to determine "reporting" quantities any reference to harm or hazard. A single quantity is to be determined for each hazardous substance, and this single quantity requires notification upon release into any environmental medium. <u>It would be virtually impossible to determine a single quantity applicable to all media while at the same time linking such quantity to any subjective concept of harm</u>.
>
> It is essential that such quantities be relatively <u>simple</u> for those subject to notification requirements to understand and comply with. Since releases in such quantities trigger notification requirements, but do not, in and of themselves, give rise to other liabilities under this Act, the Presidents' (sic) broad discretion to select quantities will not unfairly burden those persons subject to the Act.

> In determining reportable quantities under this paragraph [Section 3(a)(2)], the President may consider any factors deemed relevant to administering the reporting requirement or the President's other responsibilities under this Act. Administrative feasibility and practicality should be primary factors. In addition, the President may revise such regulations from time to time if under-reporting or over-reporting is occurring under existing regulations. (Emphasis added.)(Senate Report, p. 29).

Congress designed CERCLA to be a legislative "umbrella" under which the problems outlined in Section 1 of this report could be addressed comprehensively. The Senate Report states:

> The bill (S.1480) is not intended to replace other laws which aim to correct a variety of toxic chemical concerns. The Clean Air Act, the Clean Water Act, the Toxic Substances Control Act, the Solid Waste Disposal Act, and other statutes are only beginning to build regulatory foundations to address the wide range of toxic contamination incidents. The reported bill, S.1480, is structured to complement these laws. (Senate Report, p. 12).

Because of this, the legislative text specifies no hazardous substance designation criteria for those substances not covered under Section 101(14) except that a "hazardous substance" under Section 102 must be one that may present substantial danger to the public health, welfare or the environment. In reference to the earlier Senate version of Section 102, the Senate Report for S.1480 states:

> Section 3(a)(2) authorizes the President to designate as hazardous substances those compounds, elements, mixtures, and solutions which may present substantial danger to public health and welfare and the environment. This provision essentially authorizes the President to augment the existing lists of hazardous substances derived from existing statutes (see Section 2(b)(13)(A), (B), (C), (D), and (E)). The language of this provision has a lower threshold for designation than that currently in place in Section 311(b)(2) of the Clean Water Act. This is intended to afford the President broad discretion in designating substances which may adversely affect public health or the environment. (Emphasis added.) (Senate Report, p. 28).

In combination, the process of hazardous substance designation and the assignment of RQ's comprise one of the Act's major mechanisms to protect the public health and environment.

Hazardous substance designation defines what is to be regulated and the assignment of RQ's defines to what extent releases will be reported for possible federal response pursuant to Section 104. The appropriate RQ should therefore reflect not only current Federal priorities, but should be responsive to changing conditions that govern the use and disposal of hazardous substances in the United States. Regulatory realities may make these objectives difficult to achieve.

Prior to the enactment of CERCLA, the provisions of the Federal Water Pollution Control Act (Clean Water Act (CWA)) required the determination of what was originally referred to as "harmful quantities." Section 311(b)(4) of the Federal Water Pollution Control Act Ammendments of 1972 (PL 92-500) stated:

> The President shall by regulation to be issued as soon as possible after the date of enactment of this paragraph, determine for the purposes of this section those quantities of oil and any hazardous substance the discharge of which, at such times, locations, circumstances, and conditions will be harmful to the public health or welfare of the United States including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches except that in the case of the discharge of oil into or upon the waters of the contiguous zone, only those discharges which threaten the fishery resources of the contiguous zone or threaten to pollute or contribute to the pollution of the territory or the territorial sea of the United States may be determined to be harmful. (Emphasis added.)

As the result of a law suit initiated by the Manufacturing Chemists Association in 1978, Congress revised the CWA by statutory amendment (PL 95-576) and changed the "harmful quantities" (first proposed in 40CFR118, December 30, 1975) which trigger the provisions of Section 311, to quantities which "may be harmful", and by deleting the reference to specific circumstances and conditions surrounding a discharge. The revised language states:

> The President shall by regulation determine for the purposes of this section those quantities of oil and any hazardous substances the discharge of which may be harmful to the public health or welfare of the United States, including but not limited to fish, shellfish, wildlife, and public and private property, shorelines, and beaches. (Emphasis added.) (Section 311(b)(4)).

According to the preamble of the proposed rulemaking of 40 CFR Part 117 (44FR10271) dated February 16, 1979, Congress intended that the determination of quantities "which may be harmful" would not require an assessment of actual harm in the variety of circumstances in which hazardous substances might be discharged. The deletion of all language specifying times, locations, circumstances, and conditions from the applicable parts of Section 311 illustrates this point. The preamble goes on to state, "Congress intended that the determination be based on the chemical and toxic properties of the substance itself, not the circumstances surrounding its release." Pursuant to this philosophy, the regulatory term "harmful quantity" was changed to "reportable quantity." Reportable quantities now "...need only be a rational generalized prediction of those quantities which may be harmful." Thus the duty to notify authorities under Section 311 is predicated on the degree of harm and other relevant factors instead of a verification of actual harm. Determination of the degree of harm vs. actual harm allows the use of intrinsic and generic criteria in establishing what quantities of hazardous substances "may be harmful," which is more in line with the present ability to predict the fate and effects of hazardous substances in the environment.

Even though the regulatory mechanisms established under CERCLA are modeled after the CWA with respect to the designation of hazardous substances and assignment of RQs, distinct differences in the statutory language of the two acts result in two different RQ concepts. To the extent that the CWA will act as a precedent in developing the technical and legal basis for RQ assignment pursuant to CERCLA, the differences in the conceptual framework of RQ assignment under each act should be understood.

Most significant is that the statutory language of CERCLA allows the Administrator (EPA) to assign RQs without necessarily linking the specific RQ to a concept of harm or degree of harm. RQ assignments pursuant to the CWA have all been determined by a method that, in contrast, considers the degree of harm posed by the toxicological properties of designated hazardous substances in relation to the aquatic medium. In addition, the statutory text of CERCLA allows, <u>but does not require</u>, the determination of a single RQ without regard to the medium into which the hazardous substance may be released, even though the legislative history presents valid reasons for a single RQ (Senate Report, p. 29). The CWA is concerned with the restoration and maintenance of the nation's navigable waters with respect to their biological, physical, and chemical integrity, and therefore does not consider releases to other media in assigning RQs.

Regardless of the language of the Act and legislative history that allows the Administrator to assign CERCLA RQ's on the basis of administrative feasibility and practicality, from its inception, this study has emphasized the development of strategies that tie RQ assignment to a concept of hazard based on appropriate and factual criteria. It was felt that such an orientation will provide the best assurance to EPA that the forthcoming regulations will be based on sound, objective, and technically justifiable considerations.

APPROACHES TO ASSIGNMENT OF RQs

Several alternative strategies have been considered for the assignment of RQs for CERCLA designated hazardous substances. In keeping with the requirements of the Act, EPA policy, and administrative considerations, the various strategies were formulated to be flexible, simple, logical, defensible, and to reflect the state-of-the-art within the strictures of what could conceivably be implemented. To date, six major approaches appear to be viable options. They are:

1. Administrative Feasibility and Practicality

This strategy is founded on the intent of Congress which suggests that RQ assignment be primarily based on "administrative feasibility and practicality" (Senate Report, p. 29). The criteria used to constitute such a strategy should allow the Administrator to implement a system of reporting that would insure that all releases that have the potential for <u>serious</u> environmental and human health consequences be reported to the National Response Center (NRC). This strategy makes no attempt to link the assigned RQ to an assessment of a hazardous substance's potential for causing harm.

2. Scenarios

This alternative employs part fact and part assumption to predict an appropriate RQ based on the hazardous substance's potential for causing harm via multimedia pathways. Generic assumptions are used to characterize the environmental media as well as the fate and effects of the specific hazardous substance. RQ's are calculated directly by the use of a general formula representative of the facts and assumptions governing the scenarios.

3. Fate and Effects Research

This strategy involves the sponsoring of research programs designed to resolve the outstanding issues concerning the fate and effects of hazardous substances in the environment. RQ's would then be assigned on the basis of specific knowledge of a hazardous substance's multimedia behavior and potential for harm.

4. Hazard Indices

   This strategy employs the use of scientific criteria in specified combinations for the purpose of rating the hazard potential of various hazardous substances. RQ assignments are then made on the basis of the ranking hierarchy.

5. Combined Approach--Hazard Index Combined with Administrative Feasibility

   This strategy entails the use of a hazard index rating scheme to rank the relative hazard potential of all designated hazardous substances. The RQ's assigned to the various ranges of hazard rank are then adjusted up or down based on considerations of administrative feasibility and practicality. This "fine tuning" can use both scientific and "real world" considerations for the final assignment of the RQ value.

6. Selective Criteria Processing

   In this strategy RQ assignments are based on a series of individual and/or a combination of criteria that allow segregation of designated hazardous substances into separate categories. Each category reflects proven or suspected environmental hazards based on scientific information, and RQ's are then assigned to each category based on assessments of the reporting necessary to respond to or evaluate the need to respond to specific release incidents.

Each strategy was evaluated in detail, and those that showed least promise of fulfilling the program's objectives received appropriately less attention. The strategies cited above provide many options within the six major alternatives by the consideration of various permutations and combinations of their basic elements. Each alternative strategy, its pros and cons, and permutations is addressed below. Also discussed is the strategy proposed by the Chemical Manufacturers Association (CMA) to the EPA for revising the one-pound RQs specified by Congress for all legislated hazardous substances other than those listed under Section 311 of the CWA.

Administrative Feasibility and Practicality

As mentioned previously, the legislative history and language of the Act empowers the Administrator (EPA) to exercise broad discretion in both designation and the assignment of RQs to hazardous substances designated pursuant to CERCLA Section 102(a) and (b). Consistent with the Act's intent and purpose, RQs are not necessarily required to be linked to a concept of harm or hazard. The operative language in Section 102(a), "The Administrator shall promulgate and revise as may be appropriate regulations designating as hazardous substances...such substances which, when released into the environment may present substantial danger to the public health or welfare or the environment, ..." implies that the link to harm or hazard must be established during the designation step. This means, according to the above interpretation, that once a substance has been designated as hazardous for the purposes of the statute, it has the potential of causing substantial danger to the public health, welfare, or the environment without regard to specific amounts released or the media pathway involved.

In expressing the need for a comprehensive bill (S.1480) to address all releases of hazardous substances, Senator Stafford (Rep-VT) reasoned:

> For 3 years, the Senate has worked on a bill that would respond to emergencies caused by chemical poisons, and to seek to discourage the release of those chemicals into the environment. In many ways, the Senate bill is analogous to the natural disaster assistance programs we have enacted into law. When those natural disaster assistance laws were enacted, no one suggested that we should respond to floods, but not to earthquakes. It makes no more sense to make that kind of distinction when dealing with chemical emergencies than it does when dealing with natural emergencies.
>
> ...There is simply no good reason for us to respond to one type of release of a poison but not another. The test should not be whether poison was released into river water rather than into well water, or by toxic waste buried in the ground rather than toxic waste discharged to the ground. The test should be whether the poison was released. I assure you that the victim does not care to make those distinctions, nor should the Congress. (Congressional Record, p. S.14967).

As illustrated by this passage, the intent of Congress was to establish a comprehensive response capability regardless of the type of release or the media involved. Furthermore, the definition of a hazardous substance was made intentionaly broad so as to allow regulation of such substances before they could substantiate their harmfulness by their release into the environment. The text on Page 29 of the Senate Report explains:

> This generic definition (of a hazardous substance originally defined in S.1480) is included because hazardous substances characteristically are not included on a governmental list until after they have demonstrated their danger by killing or injuring people or causing significant environmental damages. The actual listing of a substance lags behind release and exposure by years and sometimes decades. This happens even though the persons responsible for manufacturing or handling the substances usually know, either through experience or scientific studies, the substance's dangerous propensities.
>
> ...Some substances have not been included on one of the relevant lists even after they have, in fact, caused grievous injuries.

In reference to the role that RQ's would have in activating such a comprehensive notification and response mechanism, Senator Randolph (Dem. W.VA) explained in the following text how earlier versions of S.1480 reflected the sponsor's concern that all hazardous substance releases be reported for possible Federal response.

> Another change in Government notification from that in S.1480 involves the establishment and use of reportable quantities of hazardous substances under Section 102. The earlier Senate proposals authorized regulations establishing reportable quantities for hazardous substances, but required reporting of all releases of a hazardous substance.
>
> Authority to designate additional hazardous substances and to establish reportable quantities for all hazardous substances is retained, but reporting of releases is now limited to those involving such reportable quantities. To assure that reporting commenses immediately upon enactment, Section 102(b) establishes a reportable quantity of one pound for all hazardous substances (except those already designated under the Clean Water Act) unless and until superseded by any regulations issued after the act's passage. (Emphasis added.)(Congressional Record, p. S.14965).

It seems clear from the above that Congress wanted to know about all releases of hazardous substances regardless of type or specific amount, and considered RQ's only as a way to provide a logical administrative tool for notification. Thus, the method for establishing RQs should be determined by considering only the information necessary to ensure that the appropriate response powers pursuant to CERCLA Section 104 can be activated in a manageable fashion.

Consistent with present EPA policy, the Federal Government wishes to confine NRC notification to releases that present true emergency situations requiring immediate response in order to prevent or ameliorate dangerous consequences to public health, welfare, or environment. Since RQs must be assigned *a priori* to the specific circumstances surrounding the actual release of any designated hazardous substance, RQs could conceivably be based on an assessment of release potential and/or magnitude. Even though one person adversely affected by a release of a hazardous substance is one too many, true emergencies warranting federal response are typically incidents that affect tens, hundreds, and thousands of people at a time. Factors that relate to release potential and magnitude not connected directly to the intrinsic properties of hazardous substances themselves are: (1) production volume, (2) transportation modes, (3) distribution data, (4) containerization, (5) size of typical bulk shipments, and (6) spill histories and/or accident frequencies of applicable transportation modes and stationary sources. The data base containing this information can be accessed through use of the CIS system, DOT regulations, and other computer data bases compiled by EPA and DOT. Specific data bases that may provide this information are:

- Pollution Incident Reporting System (PIRS)
- Hazardous Materials Information System (HMIS)

- o Spill Prevention Control and Countermeasures (SPCC)
- o Hazardous Materials Incidents Reported to U.S. EPA Regional Offices for October 1977 through September 1979
- o Chemicals in Commerce Information System (CCIS)

"Hand searches" for other data related to release incidents may be possible through records provided by trade organizations and insurance companies.

Any one of the above criteria, or combination thereof, could be used to classify hazardous substances with respect to a specific RQ. Similar to the classification system developed under Section 311 of the CWA, RQ categories could be established as 1, 10, 100, 1000, and 5000 lb. reflecting appropriate categories of the selected criteria. As appropriate, RQ categories different from those established pursuant to the CWA could be set to more nearly reflect production volume, containerization, and bulk shipment size instead of assessments of potential harm or hazard.

For instance, if the containerization, bulk shipment size, and production volume were chosen as the RQ assignment criteria, materials shipped in the largest containers and produced in the largest amounts should have an appropriately small RQ, since the probabilities of releases potentially resulting in large spills would be highest. This would ensure that early notification would be made for these potentially disastrous situations. Of course, special categories of substances, such as carcinogens, could be assigned specific RQs regardless of the above criteria, since these pose special risks to the public health.

Using a hypothetical example, Substance X is manufactured in quantities of 10 million lb. per year and is shipped in containers of 100, 1000, and 5000 lb. Following the entries in the table below, it is evident that 67% of the bulk shipments per year contain 10,000 lb. of substance X in containers of 1000 lb.

and 100 lb. sizes in a ratio of approximately 1.7:1 respectively. Thirty-three percent of the bulk shipments contain 5,000 lb. of Substance X in containers of equivalent size. The RQ in this example would be most logically set somewhere between 100 lb. and 5000 lb. If the RQ was set at 5000 lb. then a value of the entire contents of a barge in an accident would have to occur in order for notification to be triggered. If the RQ was set at 100 lb., an accidental breakage of just one container in handling would require notification. However, if the RQ was set at 1000 lb., 67% of the bulk shipments would be required to report if 10% of their containers were ruptured, 10 containers in the case of truck transport, and one container in the case of rail transport. This RQ would not require reporting for accidental handling incidents involving one or two 100 lb. containers and would require the reporting of incidents that would potentially involve the release of the total 5000 lb. of the chemical in a barge accident. Catastrophic releases involving rail shipments usually occur as the result of multiple car derailments. Hence, incidents of this kind would not likely rupture more than one tank, and hence, would require reporting. Examination of spill histories and accident frequencies of various transportation modes would supply qualifying data that would either confirm or deny the logic of the RQ based on generalizations about typical accidental releases.

% of Production Vol. Transported	Container Size	# of Containers per Shipment	Bulk Shipment Size	Shipments/Yr. (% of Total)
Truck (30%)	100 lb.	100 (Boxes)	10,000 lb.	300 (25%)
Barge (20%)	5,000 lb.	1 (Tank)	5,000 lb.	400 (33%)
Rail (50%)	1,000 lb.	10 (Cars)	10,000 lb.	500 (42%)

The obvious benefit of adopting this strategy is that it is extremely flexible. Substances could be assigned an RQ based on "special considerations" not necessarily tied to one set of invariant criteria. In addition, if different sets of multiple or single criteria were used to assign RQ's to specific groups of hazardous substances, different RQ ranges could be used to best ensure notification of the incidents most likely to require Federal assistance. The data base for measures of release potential and/or magnitude is relatively good (with respect to other data concerning the fate and effects of substances in the environment), and could be used to essentially avoid scientific controversy as to what specific amounts are "of concern" for purposes of notification. If, on the other hand, EPA chose not to establish a range of RQs and simply assigned all designated hazardous substances a 1-lb. RQ, then the statutory language of CERCLA itself would provide the firmest and most justifiable basis upon which to establish such a quantity.

There are several major disadvantages to adopting the administrative feasibility and practicality approach. Regardless of the statutory mandate allowing broad discretion in assigning RQs, this approach risks being criticised as arbitrary and capricious, since considerable disagreement may exist on the use and significance of the chosen criteria. This approach does not firmly link RQs to harm or hazard as in the case of RQs assigned under Section 311 of the CWA. Accordingly, the contrast between the two approaches may not provide the interested community with the impression that EPA is following a consistent policy toward hazardous substances. Depending upon the specifics, classifications that assign only one or two categories of RQs (e.g., 1 lb and 1,000 lb) may be too costly to the regulated community, in consideration of monitoring and reporting requirements, and too broad so as to cause administrative paralysis due to "over-reporting."

In sum, this strategy appears to be viable for use by itself or in combination with a more rigorous strategy for RQ assignment. If used in combination with another strategy, consideration of administrative feasibility and practicality would allow "special cases" to be handled by appropriate "fine tuning" of specific RQ's. In either case, the legislative history and the language of the statute presents ample justification for the use of such a strategy for RQ assignment.

Scenarios

The use of scenarios in providing a basis for regulation is well established and is perpetuated by the regulatory apparatus itself. For instance, scenarios are maintained by the regulations that govern the preparation of Environmental Impact Statements. The requirements are found in 40CFR1502.22 in the heart of regulations resulting from the National Environmental Policy Act (NEPA). They state: "If the agency proceeds ... (to evaluate an action that has adverse impacts important to a decision that cannot be evaluated or is based on data too expensive to obtain), ... it shall include a worst-case analysis and an indication of the probability or improbability of its occurrence." From the regulatory standpoint, scenarios are attempts to define the phenomena and consequences of an event lacking the data necessary to describe it purely on an empirical basis. For the purposes under discussion, "scenario development" is defined as "the art of selection and compilation of a specific set of circumstances conceived to describe a projected course of events."

Scenarios are considered a viable alternative for assignment of RQs in cases where the state-of-the art will not support detailed evaluations of the fate and effects of substances in the environment (assuming that RQs will be assessed by their relative hazard potential in the media). Scenarios can be developed for any purpose using part fact and part assumption to "model" the behavior of substances released into various media pathways. Incomplete data can be assembled, for instance, to describe what would happen if a release to the soil led to contamination of groundwater that was eventually ingested. Such a scenario was developed during the early phases of the program and resulted in the determination that scenarios which "model" fate and effects of hazardous substances in a comprehensive manner are by their nature complex and subject to controversy. Scenarios that define simpler systems, such as transportation, accidents, etc., would logically be more justifiable since the phenomena are far less complex, and hence, less controversial. What follows is an example of a scenario used to calculate RQs on the basis of scientific knowledge concerning the fate and effects of a substance in the groundwater environment. It will serve to illustrate some of the pros and cons of scenarios, in general, as a strategy for RQ assignment.

RQ Assignment for Chloroform--An Example

A recent paper by Dacre, et al. (1980) develops the concept of relating an acceptable daily dose of a toxic substance (D_T) to safe concentrations of the substance in various media, specifically water and soil. This concept is not new since Dacre's work essentially adapts earlier, more comprehensive studies by Cleland, et al. (1977) in the development of the Multimedia Environmental Goals Project sponsored by EPA. Other methods of calculating the minimum safe exposure doses of environmental pollutants are more rigorous (Walsh, et al., 1979), but these generally have limited application and require specialized data resources to complete the equations. Dacre's procedure was adapted for purposes of illustration because of its general applicability, its relative simplicity, and because this method is representative of most that propose to calculate safe exposure doses of toxic substances.

Adaptation of the methodology proposed by Dacre, et al., (1980), permits the calculation of the maximum quantity of a hazardous substance that will be equal to the "threshold" above which human health effects are evident in the case of chronic exposure. The method is linked to a scenario with the following assumptions:

1. The dose-response relationship for humans indicates that there is some finite exposure dose below which the rates of the biological protective processes of detoxification, excretion and injury-repair keep pace with or exceed the rates of exposure, absorption, and injury production. In short, the threshold dose concept applies.
2. The environment, in this example, neither mitigates nor enhances the toxic potency of a released chemical.
3. The pollutant pathway is soil-groundwater-man.
4. The lifetime average daily dose (LADD) for one individual is equal to the acceptable daily dose of a toxic substance (D_T).
5. The hazardous substance is completely mixed in water.
6. Carcinogenic potential is not considered a criterion for RQ assignment.

Consider the scenario of a release of an amount (N_R) of the hazardous substance, chloroform, into the soil. Chloroform has an oral-rat LD_{50} toxicity of 800 mg/kg. The substance is assumed to percolate through the soil and enter an aquifer pumped by a single well used for household consumption. If all of the substance eventually enters the well water and the average daily use per individual is assumed to be 400 liters, of which 2 liters (0.5%) is ingested, then the lifetime average daily dose (LADD) for one individual weighing 70 kg and living 70 years is:

$$\text{LADD} = \frac{.005 \times N_R}{70 \text{ kg} \times 25{,}500 \text{ days} \times 1 \text{ person}} = 2.8 \times 10^{-9}\ N_R \text{ kg}^{-1} \text{ day}^{-1} \qquad (1)$$

Since the most likely toxicity value to be found in the literature is an ingestion LD_{50}, usually for rats and mice, Dacre et al. (1980) equated the acceptable daily dose (D_T) in terms of the LD_{50} for a given toxic substance.

This was done, because there is seldom enough information to permit extrapolation of LD_{50} data to a dosage which kills only a very small fraction (e.g., 1%) of the animals, or to determine an acceptable risk level.

Based on experimental studies, Handy and Schindler (1976) assumed a safe limit for the continuous human intake of a toxic substance to be approximately 5×10^{-4} times its LD_{50} value. They also assumed a biological half-life of 30 days, which implies a disappearance rate of 2.31% per day. If the daily intake of the toxic substance is made equal to the daily disappearance rate at the safe concentration limit, then that safe concentration is maintained:

$$DT = 2.31 \times 10^{-2} \times 5 \times 10^{-4} \times LD_{50} = 1.2 \times 10^{-5} \times LD_{50} \text{ mg kg}^{-1} \text{ day}^{-1} \qquad (2)$$

Assumption #4 gives us the relationship:

$$D_T = \text{LADD, or}$$

$$[1.2 \times 10^{-5} \text{ day}^{-1}][LD_{50} \text{ mg kg}^{-1}] = [2.8 \times 10^{-9} \text{ kg}^{-1} \text{ day}^{-1}] \text{ NR} \qquad (3)$$

Making the conversion from mg to lb yields:

$$\frac{[1.2 \times 10^{-5} \text{ day}^{-1}][LD_{50} \text{ mg kg}^{-1}][2.205 \times 10^{-6} \text{ lb mg}^{-1}]}{2.8 \times 10^{-9} \text{ kg}^{-1} \text{ day}^{-1}} = N_R$$

or

$$[9.1 \times 10^{-3} \text{ lb mg}^{-1} \text{ kg}][LD_{50} \text{ mg kg}^{-1}] = N_R \qquad (4)$$

For Chloroform, substituting 800 mg/kg for the LD_{50} value into Equation (4) gives:

$$[9.1 \times 10^{-3} \text{ lb mg}^{-1} \text{ kg}][800 \text{ mg kg}^{-1}] = N_R = 7.3 \text{ lb}$$

In this scenario, the form of Equation (4) can be reduced to $k \times LD_{50} = N_R$ where k, in the units specified, is a constant representative of the assumptions cited.

Taking this scenario further, partition coefficients that represent the relative manner in which N_R is passed through this media pathway can be incorporated into the calculation. Recent studies have indicated that there appears to be a linear relationship between the n-octanol/water partition coefficient for a given organic chemical and the tendency for it to be sorbed into the soil matrix (Kanaga and Goring, 1978; and Karickoff, et al., 1978).

Based on this general relationship, the N_R value can be modified to account for chloroform's hydrophobic properties. In addition to the six basic assumptions provided earlier, two more are needed to support the scenario.

1. The n-octanol/water partition coefficient $\left(K_{ow}\right)$, defined as the ratio of the equilibrium concentration of a chemical in n-octanol $\left(C_o\right)$, to the concentration of a chemical in water $\left(C_w\right)$ is an accurate measure of soil sorption.

$$K_{ow} = \frac{C_o}{C_w}$$

2. The ratio (K_{sw}) of the equilibrium concentration <u>or</u> amount of an organic chemical in water (C_w or N_w) to the concentration <u>or</u> amount in <u>any</u> soil matrix (C_s or N_s) is equal to the n-octanol/water partition coefficient, i.e.,

$$K_{sw} = K_{ow} = \frac{C_s}{C_w} \text{ or } \frac{N_s}{N_w}$$

Considering the same release scenario as before, the addition of the partitioning effect in the environment takes into account that the soil matrix sorbs a chemical proportional to K_{sw} and the remainder enters the groundwater. The n-octanol/water partition coefficient for chloroform is 93.325 (Leo, A., et al., 1971), and thus if all the substance enters the soil, only one part in 93.325 is left unsorbed by the soil matrix. Therefore the percentage of N_R that reaches the groundwater is equal to 1.07%. Assuming the same conditions as before, with the average daily household use per individual equal to 400 liters, 2 liters of which are ingested (0.5%), the average daily dose (LADD) for one individual weighing 70 kg and living 70 years is:

$$\text{LADD} = \frac{.005 \times .0107 \times N_R}{70 \text{ kg} \times 25{,}500 \text{ days} \times 1 \text{ person}} = 3.0 \times 10^{-11}\ N_R \text{ kg}^{-1}\text{day}^{-1} \qquad (5)$$

Using the same logical sequence of steps defined by Equations (2) through (4) yields:

$$[0.85 \text{ lb mg}^{-1} \text{ kg}][LD_{50} \text{ mg kg}^{-1}] = N_R \qquad (6)$$

which can be reduced to the form

$$k \times LD_{50} \times K_{ow} = N_R \quad \text{(Where k is equal to } 9.1 \times 10^{-3} \text{ lb mg}^{-1}\text{kg)} \qquad (7)$$

Solving Equation (6) or (7) yields an N_R value of 679.8 lb. This means that to receive an LADD equal to the D_T for chloroform, 679.8 lb will have to be released into the environment, of which 7.3 lb will actually be ingested during a lifetime.

On the basis of a chemical's K_{ow}, adaptation of this partitioning technique could, in theory, be used to adjust the N_R value commensurate with a substance's sorption potential within a selected pathway. In the above example, the RQ for chloroform would be 680 lbs (RQ = 1000 lb) or 7 lb (RQ = 10 lb), depending on which version of the scenario is selected for use.

The above method is similar to that used in EPA's proposed amendment to 40CFR Part 117 (45 FR 46097-46099, July 9, 1980) for the assignment of reportable quantities for hazardous substances on the basis of carcinogenicity. In that proposed amendment, the RQ equation takes the form N = 9.85/B which calculates the number of pounds of a substance, N, having a carcinogenic potency, B, that would result in a lifetime cancer risk of 10^{-6} The "B" factor for each compound is equal to the slope of the dose-response line derived from linear extrapolations of dose-response data (incidence of tumors in animals). The constant, 9.85, was derived using specific units and a set of assumptions incorporated into a scenario similar to the one described above. Both scenarios are directly related to one basic data element, the LD_{50} toxicity and the "B" factor, carcinogenic potency.

$$N_R = k \times LD_{50} \qquad N = 9.85 \times 1/B$$

The value of the constants in the two equations represent the character of the contrived scenario in the specified units. As of October 1981, the proposed amendment remains unimplemented.

Analysis--

Close examination of this and similar methodologies show how scenarios allow the direct calculation of RQs, a valuable feature, but are also vulnerable to criticism as being arbitrary. Regardless of the particulars of the scenario, examination of the equations shows that, in essence, the N_R value (in this case the RQ) is directly related to the basic data element, a measurement of toxicity. From this perspective, the entire scenario can be potentially viewed as nothing more than "playing with numbers".

The choice and value of the parameters in equations (1) and (2) could be changed without necessarily violating accepted scientific principles. Any such change would result in RQs being either higher or lower than the one calculated above. In this way, scenarios can be manipulated to "justify" a set of high RQs or low RQs for a group of substances that can be viewed as either a "blessing or a curse" from the regulatory standpoint. The carcinogen scenario developed in 45 FR 46097-46099 is another example of this phenomenon where the basic determination of an RQ value rests with the"B" factor as a measure of a substance's carcinogenic potency.

From the standpoint of a "devil's advocate", since the basic assumptions cited in the groundwater scenario are simplistic and, in the strictest sense, subject to controversy, the scenario can be seen as serving no purpose other than to obfuscate any apparent link between toxicity and an appropriate RQ. This fact may provide ample grounds for arguing the inappropriateness of the entire methodology as a strategy for regulatory management. The scenario route to an RQ, in this case, appears to be simply a convoluted way of indexing substances on the basis of toxicity. Typically, scenarios in this application are similar in concept to the ones discussed, in that they are based on some basic data elements that act as an index of the quantity to be assessed as opposed to its actual measurement.

Scenarios can be useful for the purposes at hand, if they are kept simple and do not involve highly complex phenomena that may be subject to considerable controversy. Often simple scenarios are universally "accepted" by the scientific community when consistent lack of data or knowledge forces generalizations about natural phenomena. The fact that certain ones are standardized allows some procedural uniformity and comparison of results. In the field of toxicology, some of the most familiar ones involve standardized assumptions about absorption factors, transfer coefficients, dose/ concentration relationships, dietary intake, life expectancy, reference volumes, and the like.

Scenarios may be useful in defining RQs on the basis of release or exposure potential. Spill incident scenarios could be designed using data related to the most common mode of transport, the most common container type, size and bulk shipment, production volume, accident frequency, and related spill history. Other than CIS, data bases that could supply this information are:

- Pollution Incident Reporting System (PIRS)
- Hazardous Materials Information System (HMIS)
- Spill Prevention Control and Countermeasures (SPCC)
- Hazardous Materials Incidents Reported to U.S. EPA Regional Offices for October 1977 through September 1979
- Chemicals in Commerce Information System (CCIS)

This information could be accessed in addition to that obtained by "hand searches" to provide data useful in defining what type and size of spills are most representative for a given substance. Reportable Quantities could then be based on a scale representing the probable magnitude and likelihood of a release. The smallest RQs would be reserved for substances that have the highest production volume and are shipped in the largest containers (or bulk shipments). A spill incident, in the "worst case", would most likely be equal to the release of the entire contents of the vehicle load or container. Such an incident, in the case of a railroad tank car, would involve thousands of gallons of hazardous substances, certainly a reportable event. Hazardous substances of low production volume shipped predominantly in the smallest containers and the smallest bulk shipments, would have RQs higher than the largest single vehicle load. Such an RQ would assure that multi-vehicle accidental releases would be reported, an event more likely to require federal assistance.

In sum, scenarios are useful ways to relate basic data to a set of assumed conditions, events, and circumstances. Data gaps can be "filled" by reasonable assumptions or data extrapolations to provide a useful description for the purpose of regulation. These advantages are magnified when "real-world" considerations are used in simple form and in noncontroversial areas.

The disadvantages in the use of scenarios for regulatory purposes are that any assumptions used to complete a scenario may be viewed as arbitrary by the interested community. Also, in the case of transportation accident scenarios, any RQ assigned using this approach will not directly link the RQ to a concept of harm or hazard. However, if that link to harm is firmly established during the designation step, then RQs could be assigned by transportation-related scenarios and still be consistent with the legislative mandate (see the discussion on the Concept of Reportable Quantities).

Fate and Effects Research

Establishing RQs by hazard assessment using sound and detailed knowledge of the principal factors governing the fate and effects of hazardous substances in the environment would be, from the standpoint of rigor and defendability, an ideal strategy for a regulatory program under CERCLA that links RQs to a concept of harm. Unfortunately, at this time, data limitations and the state-of-the-art will not support the broad and uniform application of such an approach. In a recent report by the Institute of Medicine, National Academy of Science (1981), the state of knowledge in fate and effects research was addressed:

> There seldom is a simple relationship between environmental hazards and health effects. The contribution of a given environmental factor can vary, depending on the conditions under which it is encountered, the presence of other factors in the environment that may modify its effects, and the susceptibility of the population exposed. A given substance can lead to multiple health problems, and people are exposed to a variety of

> potentially hazardous substances in their surroundings. It is extremely difficult to determine causes of health problems that result from relatively low levels of exposure, especially if the resulting health problems occur after a long latent period and have no features specifically identifying them as environmentally caused. The need for new kinds of data is, therefore, great.

The report went on to conclude that, "At present there is not a good theoretical basis for extrapolating results of animal studies to estimate human risk." Even in this light, the numerous difficulties in extrapolating toxicological data from laboratory animals to man are small compared with those of evaluating the toxicological hazards of chemicals to the whole environmental biospectrum. Review of acute toxicity data of some pesticides, for example, in a large number of species suggest that the variance of interspecies response in nonmammalian organisms is probably even larger than the factor of 10 to 12 estimated in susceptibility differences between mice and men (Murphy, 1978). Clearly, hazard assessment of substances in the environment suffers from a universal lack of integrated data related to dose-response, bioaccumulation, persistence, and transport phenomena within the environmental media.

The scientific literature has just recently been concerned with the quantification of the fate and effects of chemicals in the environment, and work to date that could be classified as "model development" has been oriented toward well-defined, limited systems of carefully controlled variables. Application of these scientific developments to the task at hand can only be made in a generic sense.

The uncertainty in the state-of-the-art is well illustrated by the opposite conclusions reached in two recent publications dealing with the causes of cancer. In one (Reif, 1981), cancer is said to be caused mostly by environmental factors. Studies are cited supporting the view that the workplace, radiation, diet, and water and air pollution may all contribute to the development of cancer. On the other hand, in a study commissioned by the Congressional Office of Technology Assessment, Doll and Peto (1981) claim that the only new cancer-producing hazard introduced in recent decades is cigarette smoking. Such major differences of opinion demonstrate clearly that fate and effects phenomena are extremely complicated, and that much remains to be done to resolve the ambiguities. Since it would require a wealth of information to adequately describe the fate and effects of all substances under all the possible environmental circumstances of interest, the purely scientific approach, at this time, seems to have only limited applicability for RQ assignment considering the apparent and immediate need for regulatory relief. In the instance where a 1-lb. RQ is mandated by the statute itself (CERCLA Section 102), the need for regulatory relief is particulary urgent.

However, in a generic sense, research and development could play an important role in assigning RQs, given a sufficient amount of time. The wide range of data scattered among many different sources needs to be integrated in a comprehensive fashion, and where major data gaps exist, they need to be filled by appropriate research. Research, with time and adequate funding, could resolve discrepancies or ambiguites that now exist. Such a long-range program would delay implementation of the needed regulations, however, and would be very resource-intensive. Further, the legislative history of CERCLA clearly recognized these pit-falls and provided language allowing broad administrative discretion in the absence of data.

With respect to hazardous substances, assessments of the basic phenomena governing the following subject areas should receive a high priority in any such research effort.

1. Determination of absorption factors and transfer coefficients
2. Mammalian, human, and interspecies toxicosis correlations
3. Toxic substance degradation rates within the media
4. Synergism
5. Determination of ambient background levels
6. Determination of media transfer coefficients
7. Comprehensive synthesis of existing data
8. Structure/activity correlations
9. Determination of factors controlling bioaccumulation
10. Adsorption coefficient for soils and sediments
11. Standardization bioassoy methodologies

Advancing the state-of-the-art in these major areas would substantially aid in the defendability of RQs assigned pursuant to CERCLA on the basis of their propensity to cause harm.

Hazard Index

If the concept of hazard is to be considered in setting reportable quantities, an alternative strategy which accomplishes this is utilization of a hazard index. The hazard index is an objective scoring system designed to assess the relative potential threat to human health and to the environment of chemical substances released to the air, water (both surface waters and groundwater) and soil. The system consists of various rating factors used to examine the types of hazards that may result and, to the extent possible, the potential degree of hazard. Each rating factor has a defined rating scale by which substances receive numerical scores based on known data. The rating factors are combined in an equation to arrive at a single unitless number that is used to rank a chemical relative to other chemicals processed through the same equation.

Under this strategy, the hazard index rating values would serve as a basis for RQ assignment. The hazard index rating value would be grouped and tied to specific categories of RQs based on "best engineering judgment" in a manner similar to and consistent with the judicially approved list pursuant to Section 311 of the Clean Water Act (CWA). Generally, the higher the HI value, the lower will be the corresponding RQ, as shown in Table 6-1. The HI values presented in this table are used only for the purpose of example and are not associated with any specific rating system. The actual link between HI and RQ can only be established after a particular equation is chosen.

While this strategy is not necessarily the most implementable and justifiable, it offers the following advantages: (1) the hazard index can relate to all media; (2) it can include a wide range of criteria that link a substance to a concept of hazard; (3) it can provide an impartial, objective, and uniform rating mechanism which can be applied to a wide variety of hazardous substances; (4) it is a simple and direct way to evaluate a large data base with respect to intrinsic properties; (5) it relies on what is known about a substance and therefore, it presumes a substance to be "innocent until proven guilty"; and finally, (6) the HI system of rating hazardous substances will allow administrative discretion to adjust RQ values on a caseby-case basis, depending upon production volume, geographical distribution, or other considerations.

The primary disadvantage of the hazard index approach is that there is no single, absolute, and scientifically acceptable hazard index which can be applied. The rating of hazardous substances can be accomplished in a number of ways, and by the use of any number of criteria. Hazard rating

TABLE 6-1

ASSIGNMENT OF RQs TO HAZARD INDEX RATINGS

HI	RQ	
50	X	1 lb.
40	A	10 lb.
30	B	100 lb.
20	C	1000 lb.
10	D	5000 lb.

values, and consequently relative rankings, can vary widely since different equations proceed from different definitions of hazard. For this reason, the hazard index introduces elements of subjectivity and decisions may result from personal preference, creating disagreement at various levels of review. Other disadvantages of the hazard index approach are: (1) the hazard index must rely on judgemental considerations to link the HI ratings to RQ assignments; (2) in cases where the data base is limited and data are missing, the hazard index does not measure degree of potential hazard; (3) rating values are on a nonlinear scale; (4) because of limitations in the available data base, the hazard index does not measure chronic toxicity; and (5) the hazard index does not measure difficulty of cleanup, the public perception of hazard, exposure and distribution, or other considerations that may be pertinent in specific spill or exposure situations.

Four alternative equations which have been derived in this study for rating hazardous substances are shown in Table 6-2 and are discussed in greater detail in Appendix E. These alternatives differ in logic and in the number of potential health and environmental effects rating factors considered. The rating factors which have been considered in the development of each equation are also shown below each equation in Table 6-2.

The approach taken during this study was to select criteria for evaluation of hazardous substances in such a way that the most important health and environmental effects were included for consideration. The criteria which have been considered to a greater or lesser extent in development of each of the four alternative equations fall into four general categories as outlined below:

TABLE 6-2. ALTERNATIVE HAZARD INDEX EQUATIONS AND RATING FACTORS

EQUATION 1

HI = (Carcinogenicity) + (Mutagenicity) + (Teratogenicity) + (Human Toxicity) + (Mammalian Toxicity)

EQUATION 2

HI = (Health Effects) + (Welfare Effects) + (Aggravating Effects) - (Mitigating Effects)

(Health Effects)	(Welfare Effects)	(Aggravating Effects)	(Mitigating Effects)
. Carcinogenicity	. Flammability	. Persistence	. Innocuous Transformation Products
. Mutagenicity	. Explosivity	. Bioaccumulation	. Evaporation Potential
. Teratogenicity	. Corrosivity	. Toxic Combustion Products	
. Human Toxicity	. Reactivity		
. Mammalian Toxicity			

EQUATION 3

HI = [(Health Effects) x (Aggravating Health Factors) + (Welfare Effects)] x (Aggravating/Mitigating Transformation Products)

(Health Effects)	(Aggravating Health Factors)	(Welfare Effects)	(Aggravating/Mitigating Transformation Products)
. Carcinogenicity	. Bioaccumulation	. Flammability	. Mitigating (Innocuous Products)
. Human Toxicity	. Persistence	. Explosivity	. Aggravating (Hazardous Products)
. Mammalian Toxicity		. Corrosivity	
		. Reactivity	

EQUATION 4

HI = (Health Effects) + (Welfare Effects) + (Environmental Mobility) + (Aggravating Characteristics)

(Health Effects)	(Welfare Effects)	(Environmental Mobility)	(Aggravating Characteristics)
. Carcinogenicity	. Ignitability	. Volatility	. Bioaccumulation
. Mutagenicity	. Reactivity	. Solubility	. Persistence
. Teratogenicity	. Aquatic Toxicity		
. Toxicity - Inhalation - Ingestion - Dermal			

A. Health Effects
- o Carcinogenicity
- o Mutagenicity
- o Teratogenicity
- o Toxicity (Human and Mammalian)

B. Human Welfare Effects
- o Flammability
- o Explosivity
- o Corrosivity
- o Reactivity
- o Aquatic Toxicity

C. Aggravating Characteristics
- o Persistence
- o Bioaccumulation
- o Toxic Combustion Products

D. Physical and Biological Transformation Characteristics
- o Hydrolysis
- o Photolysis
- o Oxidation
- o Biolysis

E. Environmental Mobility
- o Volatility
- o Solubility

Basically, five steps were followed in developing the HI:

1. Determine the technical criteria
2. Derive alternative equations
3. Establish appropriate rating scales for the rating factors
4. Test each equation on a selected list of 27 substances
5. Provide a final ranking list

Table 6-3 presents for each of the 27 test substances (arranged alphabetically) the HI values calculated using each of the alternative equations. Column I lists the values obtained from the first equation. Column IIa lists the values obtained from the second, without using weighting factors, and Column IIb lists the values obtained from the second using various weighting factors. Columns III and IV list the HI values obtained from the third and fourth alternative equations respectively. The larger the HI value, the more hazardous a substance is.

For the purpose of comparison, Figure 6-1 presents graphically the range and the variance in the relative rankings for each hazardous substance. The equation from which each data point was taken is denoted. The range of differences in the relative rankings obtained by the various alternative equations can be quite large. However, in several cases, the relative rankings fall fairly close together (i.e., acrolein, benzene, carbon disulfide, carbon tetrachloride, chloroform, nitric acid, and PCB's). It is clear from this figure that the relative ranking of chemicals depends very much on the number of selected criteria and the emphasis placed on these criteria in each equation. The relative rankings of the 27 hazardous substances are summarized in Table E-21 of Appendix E according to the alternative equations.

Combined Approach

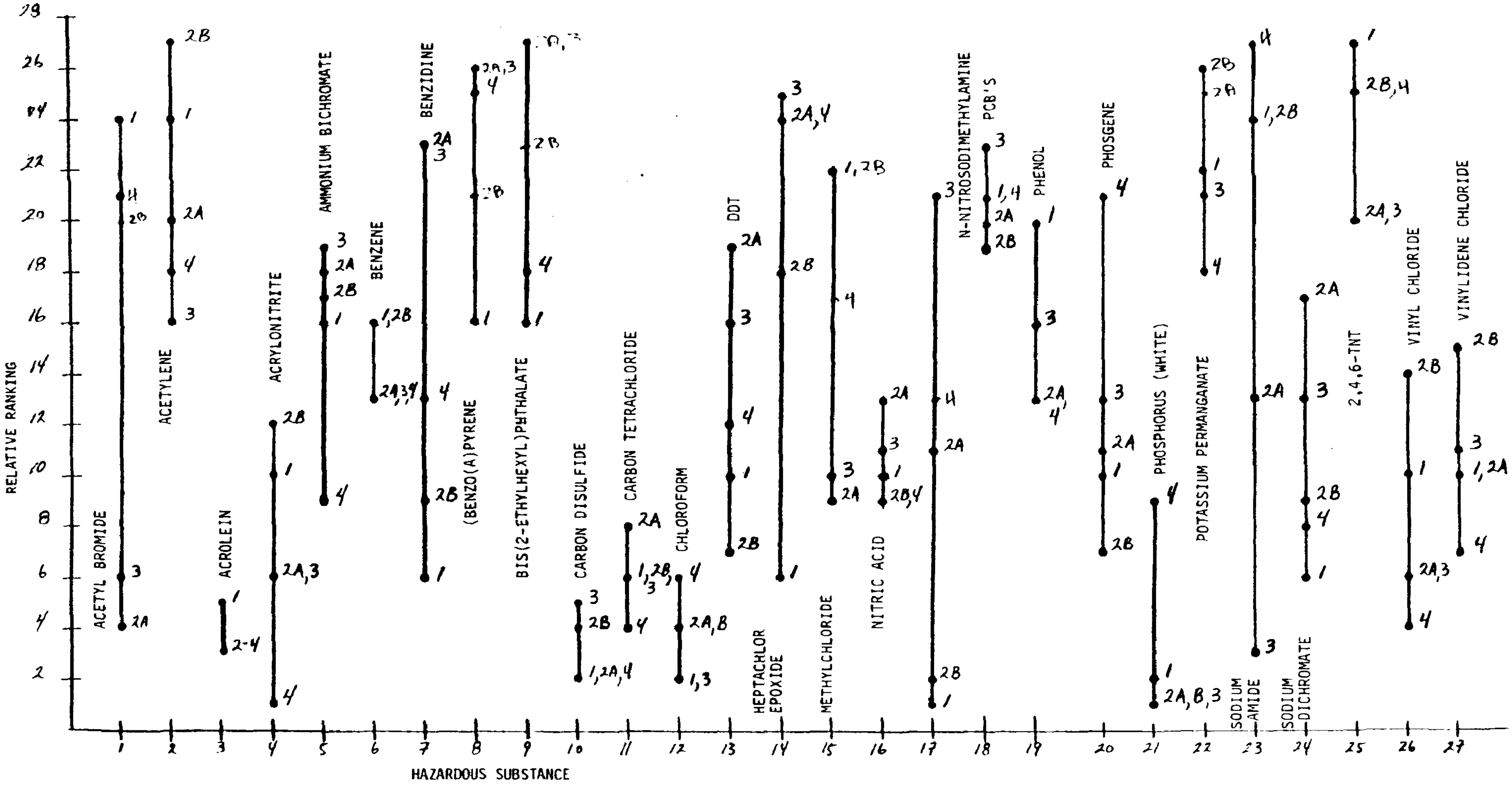
To assign RQs based on a hazard index and to "fine tune" the rankings on a case-by-case basis using programmatic options designed to incorporate administrative feasibility and practicality into the decision-making process is a viable strategy for meeting the regulatory objectives. This "combined" approach could be employed in the following manner.

TABLE 6-3

HAZARD INDEX SCORES DETERMINED FROM THE ALTERNTIVE EQUATIONS

	I	IIa	IIb	III	IV
Acetyl Bromide	3	24	49	26	14
Acetylene	3	14	29	18	16
Acrolein	10	25	109	28	27
Acrylonitrile	8	23	69	26	30
Ammonium Bichromate	7	16	61	17	20
Benzene	7	18	63	20	18
Benzidine	9	13	74	10	18
Benzo(a)pyrene	7	9	48	3	12
Bis(2-ethylhexyl)phthalate	7	8	44	2	16
Carbon Disulfide	11	26	105	27	29
Carbon Tetrachloride	9	22	93	26	26
Chloroform	11	24	105	29	24
DDT	8	15	79	18	19
Heptachlor Epoxide	9	11	60	6	13
Methyl Chloride	4	21	47	24	17
Nitric Acid	8	18	74	21	20
N-Nitrosodimethylamine	12	19	121	12	18
PCB's	5	14	58	10	14
Phenol	6	18	68	18	18
Phosgene	8	19	79	20	14
Phosphorus (White)	11	31	122	41	20
Potassium Permanganate	4	10	30	12	16
Sodium Amide	3	18	35	28	19
Sodium Dichromate	9	17	74	20	22
2,4,6-TNT	2	14	32	15	12
Vinyl Chloride	8	23	67	26	26
Vinylidene Chloride	8	20	66	21	23
RANGE OF VALUES					
Low	2	8	29	2	9
High	12	31	122	41	30

FIGURE 6-1. VARIANCE IN THE RELATIVE RANKINGS OF SELECTED HAZARDOUS SUBSTANCES



First, substances could be screened for the purposes of designation, and those qualified hazardous substances could be uniformly rated by use of a multicriteria hazard index designed to establish potential degrees of hazard (see discussion on Hazard Indices above.) As with any rating scheme, data gaps and the choice of the selection criteria will allow certain substances to be rated imprecisely relative to their "absolute" hazard potential. However, the hazard index will provide a uniform and basic rating methodology that can be augmented by case-by-case consideration of other criteria. Using data that define the practical or "real world" considerations pertaining to a substance's use, distribution, and general "profile", etc., would allow RQ ranks to be adjusted up or down based on the exercise of the broad discretionary powers allowed the Administrator under the Act. Such case-by-case assessment could be related to (1) extent of a substance's geographic distribution, (2) production volume, (3) most probable mode of transport, (4) type and volume of containerization, (5) amount of typical bulk shipments, (6) spill history, (7) special scientific considerations, e.g., extreme carcinogenicity, and (8) other considerations that reflect a substance's <u>perceived</u> hazard with respect to the interested community.

The choice of criteria for this "fine-tuning" are related primarily to the assessment of a substance's exposure potential or spill risk, the size or amount of typical release, and perceived hazard that is suspected, but not conclusively proved with respect to the public and the scientific community. Case-by-case assessment of these types of considerations would allow the Administrator to exercise broad flexibility and discretion and, at the same time, be responsive to a hazard indexing scheme that allows an evaluation of what is actually <u>known</u> about a substance's potential hazard. In short, there appears to be "something for everybody" in this approach.

Another way of applying this strategy would be to employ the basic criteria selected for use in the hazard index in the designation phase as a series of "on-the-list," "off-the-list" decisions. Once the list has been compiled, case-by-case assessment of RQs using the Administrator's best judgment as to what RQ rank should be set, using the previously mentioned criteria, could also be a viable option (see Strategy 6 below).

The advantage of the "combined" approach is that it allows a rational method of blending available data related to hazard potential with other criteria related to a substance's "real world" use. As the final assignment of RQs is a process of "fine tuning" on the basis of "real world" considerations related to administrative feasibility, flexibility is maintained even though known data related to a substance's propensity for harm is assessed in a uniform and consistent manner by means of a rating scheme. This flexibility, justified under the guise of the broad discretion afforded the Administrator to assign RQs, has as its base a rating scheme that considers only what is known about a substance's hazard potential. It presumes a substance to be "innocent until proven guilty" and does so in a verifiably consistent and well precedented manner.

The disadvantage is that the nature or lack of available data related to hazard potential may result in inadequate resolution between substances that may indeed have vast differences in their relative potential for causing harm. In addition, RQ assignments will be made practically on arbitrary considerations of concepts not directly related to hazard potential.

Selective Criteria Processing

An alternative approach to the hazard index and linking the HI to an RQ would be to base RQ assignments on either individual criteria or a combination of criteria that allow segregation of substances into separate categories. This could be done in one of three ways.

In the first, the RQ assignments could be based primarily on a single health effect criterion such as mammalian toxicity. Specific categories of RQs (say, 1, 10, 100, 1000, 5000 lb) could be established for specific ranges of mammalian toxicity (i.e., oral rat LD_{50} data) as was similarly done under Section 311 of the Clean Water Act which used aquatic toxicity exclusively.

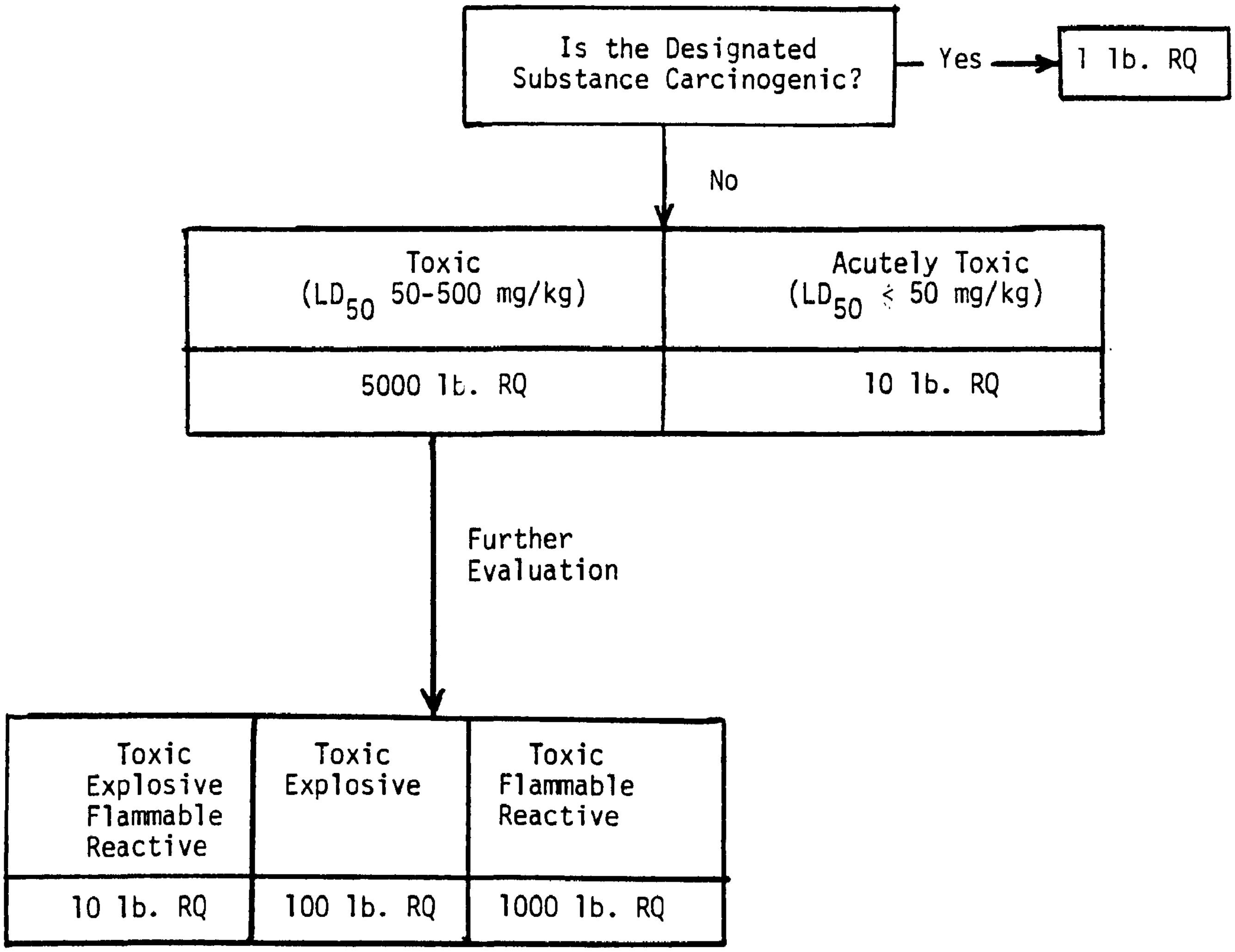
The advantages of this approach are: (1) it is simple and less complicated than the HI system; (2) it relates to some subjective link to potential harm to human health; and (3) it allows for broad administrative feasibility and practicality considerations to be incorporated in the assignment of the RQ categories. The major disadvantage of this approach, however, is its reliance on a single criterion which is subject to the limitations and validity of the available data base. Also the implied extrapolation from experimental animal data to human effects is fraught with uncertainties. Finally, it ignores potential hazards to other ecological populations as well as hazards that are not related to toxicity.

In the second option, a selected set of hazard criteria (i.e., carcinogenicity, mammalian toxicity, ignitability, reactivity, and aquatic toxicity) could be associated individually with categories of RQs following the RQ framework established under Section 311 of the CWA. For example, specific categories of RQs (say 1, 10, 100, 1000, 5000 lb) would be established for specific ranges of mammalian and aquatic toxicity, specific flammability ratings, specific reactivity ratings, etc. The RQ category assignments are based on "best technical judgment" and assessment of the reporting levels necessary for the Federal government to respond to. The final RQ for each designated substance could then be determined either from the arithmetic average or a weighted average of the individual RQs assigned by each criterion.

The third option involves a limited set of hazard criteria which are prioritized in a sequential "gating" mechanism as shown in Figure 6-2. The criteria are prioritized as follows: carcinogenicity > toxicity > explosivity > flammability reactivity. The toxicity component is subdivided into two categories: (1) acutely toxic (LD_{50} <50 mg/kg), and (2) toxic (LD_{50} - 50-500 mg/kg). To use this approach, the first question asked is: "Is the designated substance carcinogenic?" If the data indicate the substance to be a positive carcinogen or it is reasonably suspected based on scientific evidence, then the RQ assignment would be automatically made into a low category (e.g., 1 lb) and the other criteria need not be considered. The rationale for this first step is that carcinogens are a special category of hazardous substances with no known threshold levels. The concern of the interested community is such that carcinogens should be regulated in a more stringent manner than substances which are hazardous for other reasons. If the substance was determined not to be carcinogenic, then it must be classified as to whether it was toxic (LD_{50} 50-500 mg/kg) or acutely toxic (LD_{50} < 50 mg/kg). If it proved to be acutely toxic, then the RQ assignment would again automatically be made into a generally low RQ category (e.g., 10 lb). For such acutely toxic substances it would not be necessary to consider the remaining criteria (explosivity, flammabilty, reactivity). Finally, if the substance was not carcinogenic but its toxicity was of reasonable concern, an initially high RQ would be assigned (e.g., 5000 lb) and this RQ could then be adjusted after evaluation of its explosive potential, flammability, potential, and reactivity. That is, if the substance was only toxic, its RQ might be assigned in the 5000 lb category. If it was toxic and also explosive, flammable, and highly reactive, the 5000 lb RQ could be lowered, say to 10 lb. If it was toxic and explosive, its RQ might be adjusted say to 100 lb. If it was toxic, flammable, and reactive, its RQ could be assigned to the category of say, 1000 lb.

FIGURE 6-2

EXAMPLE DIAGRAM OF CRITERIA PRIORITIZATION



Chemical Manufacturers Association (CMA) Strategy

The strategy proposed by the Chemical Manufacturers Association (CMA) to the EPA on May 28, 1981, for revising the 1-lb. RQs is based upon the existing RQ framework established under Section 311 of the Clean Water Act (40CFR117) which is based solely on aquatic toxicity. It begins by grouping hazardous substances regulated by other laws, particularly the Resource Conservation and Recovery Act (RCRA), into categories, and then analyses the substances in these same categories which have RQs established under Section 311 of the CWA. Using this generic approach, an RQ is established for the particular hazardous substance category.

The following categories of hazardous substances or wastes were analyzed for purposes of revising the 1 lb. RQ.

- The P-List (acute hazardous wastes) of RCRA (Section 261.33(e)).
- The U-List (toxic wastes) of RCRA (Section 261.33(f)).
- The four characteristics established by RCRA for identifying hazardous wastes that are not listed wastes:
    - Ignitability (Section 261.21)
    - Corrosivity (Section 261.22)
    - Reactivity (Section 261.23)
    - EP Toxicity (Section 261.24)
- The F- and K- Lists of RCRA (Section 261.31 and Section 261.32).
- Toxic water pollutants listed under authority of Section 307 of the Clean Water Act which are not identified as hazardous substances under 311-CWA or hazardous wastes under Section 261 of RCRA.

For the elements listed as toxic pollutants, CMA utilizes 311-CWA RQs for compounds containing those elements, as technical guides for deriving the RQs for those elements. The use of elemental compounds as guides can result in serious underestimation of the toxicity of the hazardous substance involved.

The proposed revisions for the P-List and U-List of RCRA were based on further categorization for those compounds as pesticides and non-pesticides. Weighted average RQs for such categories were calculated for the 311-CWA substances and assigned for the non-311-CWA substances on the P- and U-Lists. A similar approach using other pertinent characteristics was used to derive revised RQs for the other categories of hazardous substances.

Although the rationale of the CMA strategy is clearly stated and the RQ adjustments are logically made for the assumptions given, such an approach is not entirely justifiable since the 311 RQs are based entirely on aquatic toxicity (i.e., on tests on species such as fathead minnow and brine shrimp) which bears no known relation to human toxicity. Also, aquatic toxicity is not the most relevant concern for a spill on permeable soil overlying an important aquifer near a human population. The assignment of RQs should be more directly related to a health component to reflect congressional intent.

Besides relying too heavily on aquatic toxicity, the CMA approach is scientifically inaccurate. As is pointed out in the Environmental Defense Fund's evaluation of this strategy (EDF, July 17, 1981):

> ...the approach used by CMA is predicated on the assumption that a separation of pesticides and non-pesticides is scientifically valid and that a weighted average for these two artificially created groups accurately reflects the distribution of RQs within each group...there is substantial overlap between 311-CWA RQs for pesticides and non-pesticides on the "P" and "U" lists. Thus the separation of the "P" and "U" lists into two classifications is arbitrary and has no reasonable relationship to the toxicity of particular substances. In addition, the RQs for both pesticides and non-pesticides in the 311 list vary widely and do not fall into a normal distribution. Thus, a weighted average is an inappropriate representation of either class.

If this type of approach were to be used, however, other characteristics which reflect a human health component (i.e., carcinogenicity, human or mammalian toxicity, etc.) should be included in the analysis.

ISSUES RAISED BY RQ STRATEGIES

1. How can a consensus be established that will allow the forthcoming regulation to be founded on an RQ linked to a hazard index?

There are no certain answers to questions of this nature. However, adequate precedent for linking RQs to an indexing system has already been established pursuant to Section 311 of the Clean Water Act. At the core of the system, RQ ranks are assigned on the basis of a hierarchy of aquatic toxicity ratings for CWA designated hazardous substances. In this case, the link that established the equivalence between an RQ category and a toxicity category was the philosophy that discharges of the most toxic substances should require reporting based on quantities equivalent to the smallest amounts commercially packaged (one pound). Since toxicity is assumed to increase logarithmically, establishment of the other RQ categories followed in kind. Regulations established under Section 311 of the CWA have been successfully implemented and provide some reassurance that a CERCLA regulation founded on the same basic principles will have similar success.

Although CERCLA is different from the CWA in many respects, the underlying concepts with regard to RQs are essentially the same. The differences are manifest mainly in the latitude and discretion afforded the Administrator to assign an RQ based on criteria not directly linked to a substance's potential for causing harm. With this legislative foundation, linking a hazard index category to a RQ category based on a similar philosophy established under Section 311 of the CWA is decidedly a viable option.

2. Should Reportable Quantities vary depending on Environmental Medium?

The statutory text of CERCLA allows, <u>but does not require</u>, the determination of a single RQ without regard to the medium into which the hazardous substance may be released. Upon analysis of the legislative history, however, it seems reasonably clear that Congress <u>intended</u> that the CERCLA reportable quantity (RQ) be a single, multimedia RQ determined without regard to the circumstances surrounding the release. As stated in the legislative history documented in the Senate Report of the Committee on Enviornment and Public Works that accompanied the Senate version of CERCLA, S 1480:

> ...A single quantity is to be determined for each hazardous substance, and this single quantity requires notification upon release into <u>any</u> environmental medium. It would virtually be impossible to determine a single quantity applicable to all media while at the same time linking such quantity to any subjective concept of harm. (Emphasis added.)

The legislative history further states that:

> ...It is essential that such quantities be relatively simple for those subject to notification requirements to understand and comply with...and that Administrative feasibility and practicality should be primary factors.

In light of Congressional intent and in the spirit of the present Administration's regulatory relief philosophy, reportable quantities which vary depending on environmental medium are not necessary and should not be assigned. Beyond these considerations, such an approach would be even more difficult from a technical veiwpoint because it requires a further resolution in the causative link to harm, which is not supported by the available data base on fate and effect of hazardous substances.

3. What about the economic effects of assigning various RQs for designated substances?

The exact economic effects of assigning various RQs for designated substances cannot be stated at the present time without performing a sensitivity analysis on the economic impact. ICF, Inc. is actively working toward a resolution of this issue. However, it would be reasonable to assume that such a regulatory strategy may be too costly to implement and could result in a great deal of confusion or opposing points of view.

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SECTION 7

RADIONUCLIDES

INTRODUCTION

The legislative history makes it clear that the inclusion of radionuclides as hazardous substances under Superfund (CERCLA) did not occur by happenstance. Although radionuclides are included in the definition of hazardous substance in Section 101(14)e because they constitute one of the materials named as a hazardous air pollutant pursuant to Section 112 of the Clean Air Act, radioactive materials were discussed explicitly early in the legislative development. Mention of the Atomic Energy Act of 1954 in connection with the definition of "release" in Section 101(22) further supports the conclusion that the legislative intent was to include radionuclides under Superfund, at least under some circumstances.

The authority to designate radionuclides as hazardous substances and, therefore, assignment of RQs arises from including in Section 101(14)e of Superfund "any hazardous air pollutant listed under Section 112 of the Clean Air Act."

The response authority of CERCLA expressly excludes two types of radioactive releases that are subject to financial protection or remedial action directives under prior law (Entwisle, 1981):

- o Release of any source, by-product, or special nuclear material from a nuclear incident "subject to" financial protection requirements established under S170 of the Atomic Energy Act (AEA).
- o Release of any source, by-product or special nuclear material from a site designated under the Uranium Mill Tailings Radiation Control Act of 1978.

This section is divided into three parts. The first part pertains to EPA's legislative jurisdiction for inclusion of radionuclides into Superfund. The legislative analysis was primarily developed by the Environmental Law Institute (Entwisle, 1981) under contract to Rockwell International. Also included in this part is a draft list of designated radionuclides. The second part presents a discussion of existing regulatory responsibilities and notification mechanisms for emergency response activities. A suggested notification approach for Nuclear Regulatory Commission (NRC) or agreement state licensees is through an interagency or intergovernmental system rather than direct notification from the responsible party to the National Response Center (NRC-II)*. However, for materials such as naturally occurring and accelerator-produced materials (NARM), direct notification would be required due to the nonuniformity of regulatory controls. The third part is devoted to the development of Reportable Quantities (RQs) for radionuclides. This part is subdivided into three main topics: (1) Development of an emergency response notification level, (2) methodology establishment for RQs, and (3) issues concerning radionuclides and Superfund.

LEGISLATIVE JURISDICTION

Inclusion/Exclusion of Radionuclides in Superfund

Section 101(14) defines "hazardous substances" covered by Superfund as "...any hazardous air pollutant listed under Section 112 of the Clean Air Act..."

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* In this section, NRC means the Nuclear Regulatory Commission. The National Response Center is abbreviated NRC-II.

Section 112 of the Clean Air Act defines a "hazardous air pollutant" as "an air pollutant to which no ambient air quality standard is applicable and which in the judgment of the Administrator causes or contributes to, air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness."

Section 122(a) of the Clean Air Act directed EPA to study radioactive pollutants (including source materials, special nuclear material, and by-product material), cadmium, arsenic and polycyclic organic matter and their effects, "...in ambient air to determine whether they cause or contribute to air pollution which may reasonably be anticipated to endanger public health." Therefore, Section 112 and 122 of the Clean Air Act allowed for the inclusion of radionuclides, generally, into coverage by Superfund.

Federally permitted releases are exempt from Superfund's notification and penalty mandate as stated in Section 103(a). Section (101)(10) defines "federally permitted release" as..."(k) any release of source, special nuclear, or by product material, as those terms are defined in the Atomic Energy Act of 1954, in compliance with a legally enforceable license, permit, regulations or order issued pursuant to the Atomic Energy Act of 1954."

In Section 101(22), Superfund defines releases as "any spilling, injecting, escaping, leaching, dumping, or disposing into the environment, but excludes ...(c) release of source, by-product, or special nuclear material from a nuclear incident, as those terms are defined in the Atomic Energy Act of 1954, if such release is <u>subject</u> (author's emphasis added) to requirements with respect to financial protection established by the Nuclear Regulatory Commission under Section 170 of such Act, or for the purposes of Section 104 of this Title or any other response action, any release of source, by-product or special nuclear material from any processing site designated under Section 102(a)(1) or 302(a) of the Uranium Mill Tailings Radiation Control Act of 1978,..."

Radioactive releases that are not specifically excluded under these provisions could be subject to CERCLA's response authority.

Excluded Radioactive Releases

Two major sources of radioactive releases are exempt from CERCLA's response authority: (1) releases of source, by-product or special nuclear material that result from a "nuclear incident" which is "subject to" financial protection under S170 of the AEA otherwise known as the Price Anderson Act, or (2) releases from any processing site designated under S102(a)(1) or 302(a) of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA).

Atomic Energy Act - Section 170

Section 170 of the Atomic Energy Act (AEA), otherwise known as the Price Anderson Act, established a system of Government indemnity and license conditions requiring certain licensees to have financial protection for damages caused by nuclear incidents (42 FR 46).

Nuclear incident is defined in S11(a) of the AEA as:

> ...any occurrance, including an extraordinary nuclear occurrence, within or outside the United States, causing bodily injury, sickness, disease, or death, or loss of or damage to property, or loss of use of property, arising out of or resulting from the radioactlve, toxic, explosive, or other hazardous properties of source, special nuclear, or by-product material.

It appears from this definition that to constitute a "nuclear incident," a release of source, special nuclear, or by-product material must at a minimum cause bodily injury or damage to property. Releases which damage only certain natural resources would not necessarily be considered nuclear incidents since such resources may not be viewed as "property" in the traditional sense of "ownership," legal title, or the exclusive right of possession and enjoyment. Thus, only those releases of source, by-product, or special nuclear material which cause bodily harm or property damage may be excluded from CERCLA, because these could be considered nuclear incidents (Entwisle, 1981).

In addition, to be excluded from CERCLA's definition of a release under S101(22)(c), a nuclear incident must be "subject to" financial requirements under S170 of the AEA.

Section 170(a) states that each license issued under Section 103, which is concerned with production and utilization facilities (nuclear reactors); Section 104, that pertains to utilization facilities for use in medical therapy, and utilization and production facilities useful for research and development activities; and Section 185, that affects licenses to construct or modify production or utilization facilities, shall maintain financial protection to cover public liability claims.

Therefore, releases of source, by-product, or special nuclear material from these licensees and fuel reprocessing plants (S170(c)) are beyond CERCLA's response authority.

All other phases in the fuel cycle under NRC's jurisdiction are regulated by materials licenses for source, special nuclear material (SNM) and by-product material. These licensees are not statutorily required to have financial protection as a license condition

It has been the NRC's policy to require financial protection under S170 of the AEA as a condition of materials licenses for plutonium processing and plutonium fuel fabrication facilities with inventories equal to or above designated quantities (42 FR 46). There are currently five such facilities in existence (Entwisle, 1981).

There are two possible interpretations of CERCLA's coverage of such releases: (1) CERCLA's response authority excludes only releases from materials licensees that, in fact, must maintain financial protection under the AEA, or (2) CERCLA excludes all source, by-product, or special nuclear releases from materials licensees since the NRC may require any material licensee to maintain financial protection. Under this latter interpretation, all releases of such radioactive substances from material and facilities licensees would be excluded from CERCLA's response authority provisions (Entwisle, 1981).

The legislative history of Section 101(22) of CERCLA explains the exclusion and suggests that CERCLA include radioactive releases that may maintain financial protection but do not in fact do so. Successive drafts of the Senate bill enlarged the exclusion of nuclear releases from CERCLA's response authority. The earliest printed version of the bill contained no exclusions from the definition of release (S1480a). A subsequent draft excluded from "release" those releases that "result in liability under Section 170 of the (AEA) under a waiver of defenses specified in Subsection n of such section (S1480b)." This amounted to excluding from CERCLA's response authority only those releases from extraordinary nuclear occurrences (ENOs) (the most severe type of nuclear incident under the AEA). An even later draft excluded from CERCLA a nuclear release, "to the extent such release is covered by financial protection required...under Section 170 of (the AEA)." (emphasis added) (S1480c). This language excluded releases from any nuclear incident (not just an ENO) "to the extent" it was covered by financial protection. In addition, the language of this later draft suggested that only those releases that were, in fact, covered by financial protection would be excluded (at least partially) from CERCLA (Entwisle, 1981).

The current statute excludes releases from nuclear incidents if they are "subject to" financial protection requirements under the AEA. Therefore, the key modification requiring elucidation occurred in the last two drafts of the bill, where the definition of excluded release changed from those "covered by" financial protection requirements to those "subject to" such requirements (Entwisle, 1981).

Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA)

The second exclusion in S101(22)(c) of CERCLA, pertains to radioactive releases from mill tailings sites. The provision states:

> ...release...excludes...(c)...for purposes of Section 104 of this title or any other response action, any release of source, by-product or special nuclear material from any processing site designated under Section 102(a)(1) or 302(a) of the Uranium Mill Tailings Radiation Control Act of 1978.

This phrase states that the sites identified in UMTRCA are excluded from remedial/removal activities but not from the notification requirements.

S102(a)(1) of UMTRCA lists approximately 20 locations at which the Secretary of Energy must designate processing sites for remedial action. It also gives the Secretary the discretion to designate additional sites for such action. Furthermore, S302(a) of UMTRCA gives the Secretary of Energy the discretion, if the NRC determines that the public health, safety, and environment cannot otherwise be protected, to designate two specific processing sites for remedial action.

Pursuant to the authority granted in UMTRCA, the Secretary of Energy in 1979 designated 25 inactive uranium processing sites. Releases of source, by-product or special nuclear material from any of these 25 processing sites are excluded from CERCLA's response authority (DOE, 1979).

<u>Naturally Occurring and Accelerator Produced Materials (NARM)</u>

It should be noted with respect to both the AEA and UMTRCA exclusions, that source, by-product, and special nuclear material do not include all radioactive substances. Some "naturally occurring" radioactive materials (e.g., radium, radon, and daughters) and man-made radioactive materials (e.g., produced in accelerators or cyclotrons) are not included in the definition of source, by-product, or special nuclear material. Thus, they would not be excluded from the definition of release under S101(22) of CERCLA, and EPA would not be precluded from exercising response authority over such substances (Entwisle, 1981).

Conflicts Between CERCLA and Price Anderson

The financial protection schemes of the two Acts seem to have different purposes: CERCLA's scheme is set up to remove from the environment substances that are hazardous to the public health and welfare and to restore the environment to its previous condition, whereas, S170 of the AEA was enacted to cover liability claims (tort claims for bodily injury, property damage, etc.). Thus, even if CERCLA's response authority exists for every radioactive release not indemnified under the AEA, it is not certain that tort victims will be able to recover damages (Entwisle, 1981).

Designation of Radionuclides Under Superfund

There are a number of facilities that use radioactive material but are not production and utilization facilities and so are not required by regulation to maintain financial protection for public liability. Since these facilities and associated materials are excluded from Price Anderson, they could be covered by Superfund. The other exclusions in Section 101(22)(c) of Superfund are those 25 processing sites included in the Uranium Mill Tailings Radiation Control Act (UMTRCA), Section 102(a)(1) and 302(a). These are the only exclusion comments for radionuclides in Superfund. Therefore, naturally occurring and accelerator-produced radioactive material (NARM) is also covered by Superfund, as mentioned above. Table 7-1 identifies the major types of facilities and materials that could be covered by Superfund. Table 7-2 illustrates by use of a matrix the materials that are associated with the facilities identified in Table 7-1. These materials are further detailed in a list of designated radionuclides for Superfund in Table 7-3.

The list in Table 7-3 was developed based on the following criteria:

1. The radionuclides are used, generated, or stored in conjunction with the facilities shown in Tables 7-1 and 7-2.
2. The radionuclides have a half-life greater than or equal to 7 days; however, there are a few exceptions, e.g., Rn-222 and Mo99/Tc-99m.
3. The radionuclides are commercially available isotopes and decay products that meet the half-life criteria of number 2, above.
4. They are naturally occurring radionuclides and decay products that meet the half-life criterion of number 2, above.

The 7-day half-life criterion was chosen to designate radionuclides that could require possible Superfund response, since the need for response activities would be limited for radionuclides with shorter half-lives (approximately 99% of a radioactive material decays within 7 half-lives).

Those radionuclides with a half-life less than 7 days that are on the list are either widely used commercially, e.g., Mo-99/Tc-99m, or are readily dispersed and have long-lived parents, such as Rn-222.

The mode of formation and/or use of the designated radionuclides is depicted in Table 7-3.

TABLE 7-1

FACILITIES COVERED BY SUPERFUND

Uranium Conversion Facilities
Low Level Waste Disposal Sites
Fuel Fabrication Facilities (Non-Plutonium)
Radioisotope Processing Facilities - Accelerator Produced
Spent Fuel Facilities/High Level Waste Disposal Sites (may be covered by Section 170 at a later date)
Active Uranium Mills and Mines (except those facilities exempt from Section 104 by Section 102(a)(1) and 302(a) UMTRCA)
Phosphate Industry

MATERIALS COVERED BY SUPERFUND

Source, by-product, Special Nuclear Material - (associated with the above facilities)
Naturally Occurring and Accelerator-Produced Radioactive Materials (NARM)

TABLE 7-2

MATRIX OF MATERIALS TO FACILITIES COVERED BY SUPERFUND

Facilities	Materials				
	Accelerator	Natural	SNM	By-Product	Source
Waste Disposal Sites	X	X	X	X	X
U-Conversion Facilities			X		X
U-Fabrication			X		X
Radiopharmaceutical Accelerator	X				
Active Uranium Mills		X			X
Active Uranium Mines		X			X
Phosphate Industry		X			

TABLE 7-3

RADIONUCLIDES SUBJECT TO DESIGNATION UNDER SUPERFUND

Radionuclides	Mode of Formation *	Radionuclides	Mode of Formation *
Ac-225	(N)	Cm-245	(B)
Ac-227	(N)	Cm-246	(B)
Am-241	(B)	Cm-247	(B)
Am-242	(B)	Cm-248	(B)
Am-243	(B)	Er-169	(B)
Sb-124**	(B)	Eu-152	(B)
Sb-125	(B)	Eu-154**	(B)
Ar-37	(A)	Eu-155	(B)
As-73	(A)(B)	Fe-55	(A)(B)
As-74	(A)(B)	Fe-59	(B)
Ba-131	(B)	Gd-153	(B)
Ba-133**	(B)	Ge-68	(A)
Ba-140**	(B)	Ge-71	(B)
Bk-249	(B)	Au-195	(A)
Be-7	(A)(N)(B)	Hf-175	(A)
Bi-206	(A)(B)	Hf-181	(B)
Bi-207	(A)	Ho-166m	(B)
Cd-109	(A)(B)	Hg-203	(B)
Cd-115m	(B)	H-3	(N)(B)
Ca-45	(B)	In-114m	(B)
Ca-47	(B)	In-115	(N)(B)
Cf-249	(B)	I-125	(A)(B)
Cf-250	(B)	I-129	(B)
Cf-251	(B)	I-131	(B)
Cf-252	(B)	Ir-190	(A)(B)
C-14	(N)(B)	Ir-192**	(B)
Ce-139	(A)	Kr-85	(B)
Ce-141	(B)	La-138	(N)
Ce-142	(N)	Pb-210	(N)
Ce-144	(B)	K-40	(N)
Cs-131	(A)(B)	Lu-177	(B)
Cs-135	(B)	Lu-176	(N)
Cs-136	(B)	Mn-54	(A)(B)
Cs-137**	(B)	Hg-203	(B)
Cl-36	(B)	Nd-144	(B)(N)
Cr-51	(A)(B)	Nd-147	(B)
Co-56	(A)	Np-237	(B)
Co-57	(A)(B)	Mo-99	(B)
Co-58	(A)(B)	Ni-59	(B)
Co-60**	(B)	Ni-63	(B)
Cm-242	(B)	Nb-93m	(B)
Cm-243	(B)	Nb-95	(B)
Cm-244	(B)	Os-185	(B)

TABLE 7-3 (Continued)

Radionuclides	Mode of Formation*	Radionuclides	Mode of Formation*
Os-191	(B)	S-35	(N)(B)
Pd-103	(A)(B)	Ta-182	(B)
P-32	(N)(B)	Tc-96	(B)
Pt-190	(N)	Tc-97m	(A)(B)
Pt-192	(N)	Tc-97	(B)
Pu-238	(SNM)	Tc-99m	(B)(A)
Pu-239	(SNM)	Tc-99	(B)
Pu-240	(SNM)	Te-125m	(B)
Pu-241	(SNM)	Te-127m	(B)
Pu-242	(SNM)	Te-129m	(B)
Pu-244	(SNM)	Te-131m	(B)
Pa-231	(N)	Tb-160	(B)
Pa-233	(N)	Tl-200	(B)
Po-208	(A)	Tl-201	(B)
Po-210	(N)(B)	Tl-202	(A)(B)
Pr-143	(B)	Tl-204	(B)
Pm-147	(B)	Th-227	(N)
Pa-231	(N)	Th-228	(N)
Ra-223	(N)	Th-230	(N)
Ra-226**	(N)	Th-232	(N)
Ra-228	(N)	Th-nat	(N)(S)
Rn-222	(N)	Th-234	(N)
Re-183	(B)	Tm-170	(B)
Rh-102m	(A)	Tm-171	(B)
Rb-84	(A)	Sn-113	(A)(B)
Rb-86	(B)	W-181	(B)
Rb-87	(N)(B)	W-185	(B)
Ru-103	(B)	U-232	(B)
Ru-106	(B)	U-233	(SNM)
Sm-147	(B)(N)	U-234	(N)
Sm-151	(B)	U-235	(SNM)
Sc-46	(B)	U-236	(B)
Se-75	(B)	U-238	(N)
Ag-105	(A)(B)	U-nat &/or	(S)(N)
Ag-110m	(B)	U-depleted	(S)
Ag-111	(B)	V-48	(A)(B)
Na-22**	(A)(N)	Yb-169**	(B)(A)
Sr-85	(B)	Zn-65	(B)
Sr-89	(B)	Zr-93	(B)
Sr-90	(B)	Zr-95	(B)

*Mode of formation or use:

N - Natural
B - Byproduct
A - Accelerator
SNM - Special Nuclear Material
S - Source

**Strong gamma emitters

EXISTING REGULATORY CRITERIA FOR EMERGENCY ACTIVITIES

Introduction

Discussed herein are existing emergency response, notification, responsibilities, and cost recovery mechanisms for the nuclear industry. The Nuclear Regulatory Commission (NRC) requires immediate or 24-hour notification of the conditions from an incident as outlined in 10 CFR 20.403(a) and (b). The NRC recently required that certain licensees prepare on-site contingency plans for actions to be taken in the event of an accident to limit off-site releases of radioactive materials, among other purposes. The development of the plan requires characterization of several classes of emergency situations and then relates them to response levels.

The Environmental Protection Agency (EPA) developed protective action guides (PAG's) to provide guidance to State, local, and other officials on criteria to use in planning protective actions for radiological emergencies that could present a hazard to the public.

The Federal Emergency Management Agency (FEMA) has developed the "Master Plan" for incidents at nuclear power plants. This "Plan" includes agency responsibilities, notification, and Federal response management mechanisms. FEMA plans to begin development of similar types of "plans" for other nuclear facilities within the next year. Basic emergency response mechanisms developed for the nuclear power plants are discussed herein, for it is possible that the basic notification mechanism for emergency response could be similar. The notification, responsibilities of the involved parties, and cost recovery mechanisms for transportation accidents are discussed. Finally, there is a discussion of the possibility of including the Superfund notification scheme within those that already exist or are about to be developed.

Emergency Response--Types of Situations

The general types of situations that would require possible emergency response activities and notification can be categorized into accidents and incidents. An accident is defined as an unintentional and undesirable occurrence. An incident is defined as an occurrence of seemingly minor importance that can lead to serious consequences. The major difference between the definitions is that the incident could have been an intentional occurrence initially, but the consequences or results of the occurrence were undesirable.

Chapter 0502 of the U.S. Nuclear Regulatory Commission NRC Manual, "NRC Incident Response Program," (NRC, 1978) defines incident as:

> Any occurrence which, by itself or its consequences, poses an actual or potential hazard to public health and safety, property, or the environment; or an actual or potential threat to the safeguards of licensed facilities or materials...

Existing Criteria

10 CFR 20 Standards for Protection Against Radiation

Each licensee is required to immediately, or within 24 hours, notify the NRC of any incident that caused or threatens to cause exposures, elevated concentrations, loss of worktime, and damage to property in excess of the criteria established in 10 CFR 20.403(a) and (b), respectively, as shown in Figure 7-1.

FIGURE 7-1

§ 20.403 Notifications of incidents.

(a) *Immediate notification.* Each licensee shall immediately notify by telephone and telegraph, mailgram, or facsimile, the Director of the appropriate NRC Regional Office listed in Appendix D of any incident involving byproduct, source, or special nuclear material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual of 150 rems or more or radiation; or exposure of the feet, ankles, hands or forearms of any individual to 375 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Appendix B, Table II; or

(3) A loss of one working week or more of the operation of any facilities affected; or

(4) Damage to property in excess of $200,000.

(b) *Twenty-four hour notification.* Each licensee shall within 24 hours notify by telephone and telegraph, mailgram, or facsimile, the Director of the appropriate NRC Regional Office listed in Appendix D of any incident involving licensed material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in Appendix B, Table II; or

(3) A loss of one day or more of the operation of any facilities affected; or

(4) Damage to property in excess of $2,000.

Proposed Rulemaking Emergency Preparedness--Contingency Plans

The Three Mile Island nuclear reactor accident precipitated the need for improvements in emergency preparedness planning and coordination for some NRC-licensed activities. Emergency planning requirements were strengthened for nuclear power reactors (10 CFR 50.47 and Appendix E, 10 CFR 50) and the NRC prepared orders that other licensed activities--fuel processing and fabrication, uranium conversion facilities, and radioisotope installations--were required to develop comprehensive on-site contingency plans.

The NRC plans to extend these requirements to uranium mills and other source materials licensees (46 FR 29712). The NRC determined that previously submitted plans for fuel fabrication plants disclosed important deficiencies. The plans did not adequately describe (1) the means for measurement and assessment of accidental releases of radioactive materials, (2) the arrangements for prompt notification of Federal, State, and Local Government agencies, and (3) plans for recovery actions that would restore safe conditions following an accident.

Development of the plan requires characterization of classes of credible emergencies that might occur and description of radiological contingency measures for each class of emergency. A NRC-recommended classification scheme, classifying emergency situations into four categories, is shown in Figure 7-2. Each recommended category of emergency situations includes in the licensee actions prompt notification of state and local off-site authorities.

Protective Action Guides (PAG's)

The protective action guides (PAG's) were developed by Environmental Protection Agency, Office of Radiation Programs. The PAG's were developed by the EPA in conformance with a Federal Register Notice of Interagency

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FIGURE 7-2

RECOMMENDED CLASSIFICATION SCHEME

Class	Class Description
Notification of Unusual Event	Unusual events are in process or have occurred which indicate a potential degradation of the level of safety of the plant. No releases of radioactive material requiring off-site response or monitoring are expected unless further degradation of safety systems occurs.
Alert	Events are in process or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.
Site Area Emergency	Events are in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public. Off-site releases are not expected to exceed EPA Protective Actuion Guideline exposure levels except near site boundary.
General Emergency	Events are in process or have occurred which involve actual or imminent loss of confinement integrity. Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels off-site for more than the immediate site area.

Responsibilities for nuclear incident response planning dated January 17, 1973. The PAG's were prepared to provide guidance to state, local, and other officials on criteria to use in planning protective actions for radiological emergencies that could present a hazard to the public. The States have the primary responsibility of protection of public health.

The PAG's provide for three broad pathways of radiation:

1. Exposure from airborne radioactive releases
2. Exposure through the food chain
3. Exposure from radioactive materials deposited on the ground

Different PAG's are developed for each pathway of exposure since different criteria of risk, loss, and benefit are involved.

PAG's have been developed for exposure from airborne radioactive releases for the general population as shown in Table 7-4. PAG's are in the draft form for food and animal feeds. The draft PAG's for food and animal feeds are shown in Table 7-5.

Federal Emergency Management Agency

On December 7, 1979, the President directed the Federal Emergency Management Agency (FEMA) to head all activities associated with the off-site planning and response to all Federal off-site nuclear emergency planning and response. FEMA was also delegated the authority for the development and promulgation of the National Radiological Emergency Preparedness/Response Plan for Commercial Nuclear Power Plant Accidents, otherwise known as the Master Plan (45 FR 84910).

According to recent information, similar plans will be developed for other types of nuclear facilities such as those of concern to Superfund (Sanders, 1981). Developments of these plans could most likely involve similar

TABLE 7-4

PROTECTIVE ACTION GUIDES FOR EXPOSURE TO

AIRBORNE RADIOACTIVE MATERIAL

	Projected Dose (rem)
General Population whole body	1-5
Thyroid	5-25

TABLE 7-5

DRAFT PROTECTIVE ACTION GUIDES FOR
FOOD AND ANIMAL FEEDS

	Projected Dose (rem)
Preventive PAG	
Whole body, major portion of body including active marrow	0.5
Thyroid	1.5
Emergency PAG	
Whole body	5
Thyroid	15

types of mechanisms as those developed for nuclear power plants. These plans are expected to be developed within the next year. The plan provides a network for management of the Federal off-site responses to radiological accidents. It includes notification procedures and description for the interaction between the Federal response and that of the states. Prior to notifying the Federal Government of an accident and pursuant to NRC regulations, the licensee would be required to classify the accident, based on its estimated severity. Each category initiates a specific notification scheme which in each case includes the NRC as shown in Figure 7-3. State and Local agencies are to be notified by the licensee as well as by the NRC.

Cost Recovery. According to the Master Plan, FEMA has the responsibility to develop procedures for reimbursement of Federal agencies for resources expended in responding to a radiological accident. If the accident is declared an emergency, monies for response activities are readily available (Sanders, 1981). On the other hand, if the accident is not declared an emergency, reimbursement for response activities could be difficult, if the responsible party did not have adequate funds.

Radiological Transportation Incident/Accident Response Mechanisms

The Department of Transportation (DOT) defines any material in which the radioactivity exceeds 0.002 microcurie per gram as radioactive material (49 CFR Parts 170-179). They include by-product, source, and special nuclear material as defined in Section II of the Atomic Energy Act of 1954 and in the regulations of the Nuclear Regulatory Commission and naturally occurring and accelerator-produced radioactive materials (NARM) as defined in the Suggested State Regulations for Control of Radiation (NRC 1977).

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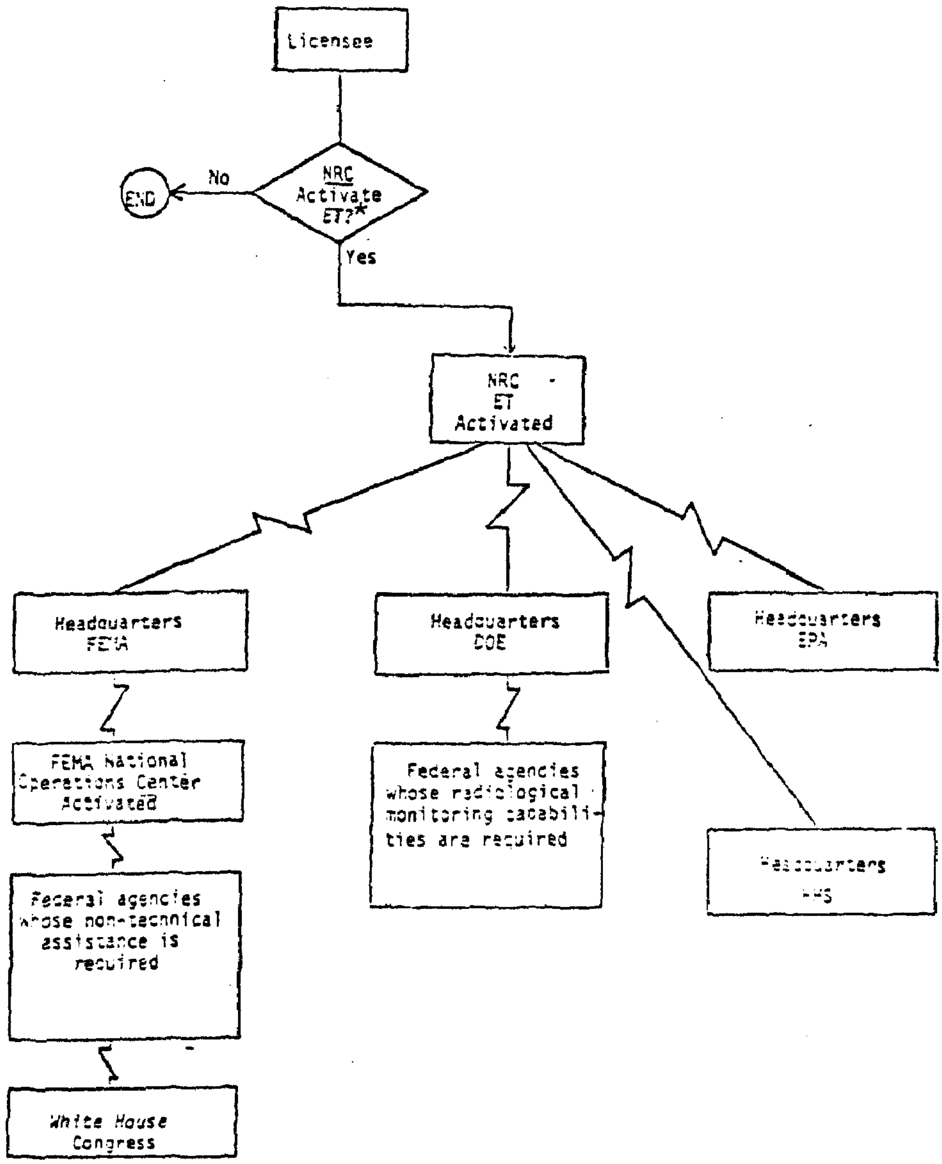
FIGURE 7-3

FEDERAL NOTIFICATION SCHEME



* ET = Executive Team

The carrier has the primary responsibility to notify DOT, State, Local authorities, the shipper and the driver's management as soon as the accident has occurred. Immediate notification of DOT is required if fire, leakage, spillage, or suspected radioactive contamination occurs involving shipment of radioactive material as stated in the Code of Federal Regulations, Title 49, Section 171.15(a)(4).

According to the Memorandum of Understanding (MOU) for transportation of radioactive materials (44 FR 38691), DOT will promptly notify the NRC of accidents, incidents, and instances of actual or suspected leakage involving radioactive material package if such an event occurs in transit. Figure 7-4 illustrates the regulatory agency notification scheme for transportation accidents. Also, the NRC will encourage the Agreement States and the DOT will encourage the non-Agreement states to impose incident reporting requirement on shippers and receivers subject to the State's jurisdiction (44 FR 38691).

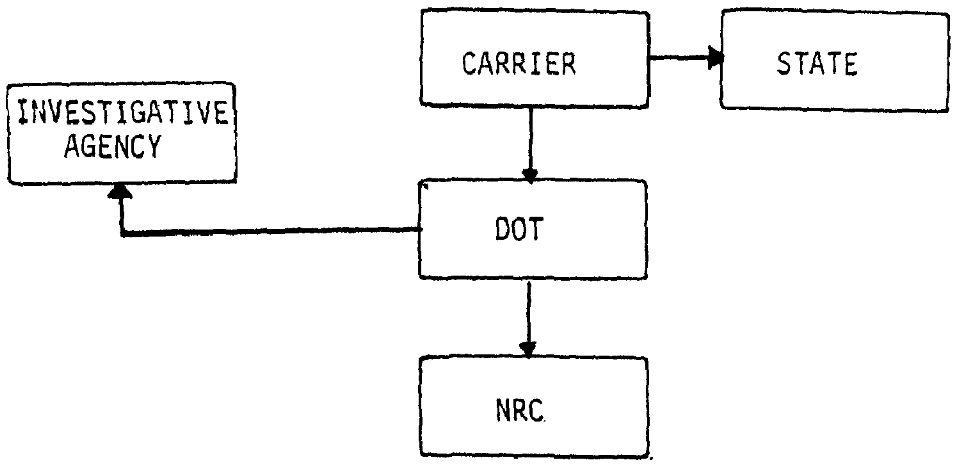
Cost Recovery. The cost of cleanup and any liability for damages to life or property resulting from the incident are borne, in most cases, initially by the carrier. In most cases, the fixing of such costs and the real responsibility for them will be determined in the courts. In some cases, indemnity coverage would be provided under private insurance or under Price Anderson Liability Coverage (NRC, 1977).

Notification/Response Management Schemes Involving the National Response Center

The discussions above included description of existing or planned notification and cost recovery mechanisms. It is considered important to utilize existing mechanisms if possible to avoid dual authority and notification conflicts.

FIGURE 7-4

REGULATORY AGENCY NOTIFICATION MECHANISM FOR TRANSPORTATION ACCIDENTS/INCIDENTS



CERCLA Section 103(a) states:

> Any person in charge of a vessel or an off-shore or on-shore facility, shall, as soon as he has knowledge of any release (other than a federally permitted release) of a hazardous substance from such vessel or facility in quantities equal to or greater than those determined pursuant to Section 102 of this title, immediately notify the National Response Center...

However, the RQ levels that Superfund would consider for possible emergency response activity, would, in most cases, be reported to the responsible regulatory agency, e.g., 10 CFR 20.403 and licensee action for actual or threatened on-site emergency situations, pursuant to contingency plans and 49 CFR 171.15(a)(4). Therefore, for emergency response activities a possible approach for notification of the National Response Center (NRC-II) would be through an intergovernmental (State to NRC-II) or interagency (NRC to NRC-II) network. This approach would be primarily applicable for NRC or agreement state licensees.

For materials such as NARM that are not uniformly regulated throughout the United States, the person in charge of the facility would be required to notify the National Response Center. This approach could eliminate possible dual notification requirements for licensees but would require direct notification from facilities that possessed materials (NARM) not uniformly regulated in the United States.

DEVELOPMENT RQ'S FOR RADIONUCLIDES

Three basic steps are required to develop reportable quantities for radionuclides: (1) Establish a notification level, (2) Develop a methodology for RQ assignment, and (3) Categorize the designated radionuclides as required. Within each of these steps are other mechanisms required to achieve the final goal, which are RQs for radionuclides.

Emergency Response Notification Levels

Basic assumptions must be made to determine what levels should trigger the emergency reponse mechanism, and therefore help to develop a notification level.

1. An emergency situation results from abnormal conditions.
2. Those abnormal conditions that require emergency action may vary in duration.
3. A notification level should be set below levels that would impact the general public significantly.
4. The notification level should be set such that the steps taken and the magnitude of action may be minimal so that emergency response activities may be cost effective.

It should be noted that for remedial purposes a second notification level may be useful. However, this possibility is not considered further herein.

Determination of an Emergency Response Notification Level

The whole body dose equivalent of 0.5 rem was selected as the recommended emergency response notification level. However, the process of determining numerical limits for radiation standards is one of risk assessment. This process, in which risk considerations are an important factor in the decision making, consists of two elements: determination of "acceptable risk" and determination of the probability that an event will occur (BRH, 1981).

The emergency response notification level assumes that a release has occurred or there is a substantial threat of a release. The estimation of the probabilities that an accident/incident will occur is not considered in this report.

Currently, there are two processes in use for determining "acceptable risk" for radiation exposures. The first process is the application of the life table method developed by Bunger, Cook, and Barrick (Bunger, 1981) for examining the risk of death from exposure of workers to low level ionizing radiation. This method provides estimates of the expectation of premature death and the resultant life shortening. The methodology facilitates the analysis of changes in assumed dose-response relationships, dose levels, and age ranges at times of exposure. In this article, the radiation exposure risks were then compared to national statistics for the risk of death from on-the-job accidents not related to radiation. This methodology could be adapted to estimate risks from low level ionizing radiation exposure to any population or sub-group of the population for which the life table would be available or can be constructed.

However, this methodology has been limited to occupational hazards and has not been used in examining risk for the general population, or for critical groups within the population.

The second process for determining risk is used in a draft document prepared by the Bureau of Radiological Health (BRH, 1981). This document compares the risk from natural disasters and the variation in "natural radiation background" to the radiation risk associated with the dose-equivalent limit of 0.5 rem whole body and major organs and 1.5 rem thyroid. This analysis is referenced (BRH, 1981) and can be used to support the recommended notification level for Superfund.

The suggested dose-equivalent level (0.5 rem whole body) is in conformity with current U.S. radiation protection practice and is the level recommended by the National Council on Radiation Protection and Measurement (NCRP, 1971), and International Commission on Radiation Protection (ICRP, 1959)(ICRP, 1977). The basis for utilizing the 0.5 rem dose commitment limit rather than the 1-5 rem as recommended in the emergency PAG's is also discussed in the draft document (BRH, 1981). Excerpts from the document follow:

> The Preventive PAG dose commitment limit may be viewed as equivalent to the average projected radiation dose which could be avoided by initiating protective actions. Situations under which Emergency PAG limits are applicable are those in which maximum radiation exposures might be anticipated and in which a smaller number of individuals might be exposed. Hence, the relationship between the Preventive PAG's and the Emergency PAG's is analogous to the relationship between anticipated average doses to the population and maximum doses to an individual.
>
> The intent, however, is to take action at the Preventive PAG, and thus avoid levels approaching the Emergency PAG. The Emergency PAG is thus an upper limit which is most applicable to the maximally exposed individual.

Two approaches that one could consider in the assignment of Reportable Quantities (RQ's) for radionuclides, are as follows:

1. The RQ for radionuclides would be the recommended whole body dose-equivalent level of 0.5 rem.
2. Utilization of the recommended dose-equivalent notification level as a basis for calculations to develop RQs.

The first approach would have the following apparent advantages:

1. The RQ assignment for all radionuclides would be the same. This would yield a "multimedia" designation. This would be the dose to an individual regardless of the medium that would require notification.
2. Utilization of the dose for the RQ would reduce the assumptions made in calculating reportable quantities, e.g., if the RQ were in activity or weight units of measure.

However, calculating the potential dose received by the general public may be difficult and time-consuming.

The second approach would have the following advantages:

1. The designations could be based on generally worst-case situations that would take into account critical pathways, critical groups, etc.

2. This designation would strictly adhere to the criteria established in Section 102(a) that a single "quantity" shall be the reportable quantity for any hazardous substance, regardless of medium. Dose is not a "quantity" designation.

A disadvantage of the second approach is that the establishment of a notification level based on dose-equivalent is required regardless of RQ assignment, and assumptions would be necessary to develop the RQ's in activity units of measure.

Units of Measure

Section 102(a) of CERCLA, specifies that a single quantity may be the reportable quantity for any hazardous substance, regardless of medium.

Quantity for radionuclides is defined as activity levels which describe the amount of radioactivity. The basic event that characterizes a radioactive nuclide is the transformation of its nucleus into the nucleus of another species. This transformation is known as decay, and there may be several modes of decay for a given nuclide. The number of nuclear transformations occurring per unit of time is called the activity. The activity of radioactive material is generally expressed in terms of the curie or fraction of a curie which is 3.7×10^{10} atom disintegrations per second. The SI unit for activity is the becquerel, which is equal to 1 disintegration per second.

The other hazardous substances being considered under Superfund will be utilizing weight in units of pounds (lb). This unit of measure would not be particularly applicable to radionuclides due to the small quantities of certain radioactive materials that could cause harm to a human being. Activity levels are more applicable to RQ assignments. The actual weight of the RQ of many radionuclides will likely be much less than one pound.

Assumptions - RQ Methodology

The operative language of CERCLA leads to choosing a quantity or quantities rather than a dose for RQ's for radionuclides. There cannot be a single quantity for all radionuclides. They must be evaluated either individually or in groups. For the purposes of this Section, the methodology should be based on: (1) critical pathways, e.g., inhalation, ingestion, external radiation exposure, and (2) effects to the sensitive segment of the population.

Methodology Alternatives

Two methodologies will be discussed for establishing RQ designations. One method involves use of the Annual Limits on Intake (ALI) that are being developed for workers (ICRP, 1979), and involves development of factors to extrapolate the ALI for the worker to the general public.

The other methodology involves the use and modification of the Limiting Possession Limits (LPL) developed by Nuclear Regulatory Commission (NRC, 1981). Licensees that possessed quantities of radionuclides as derived by the LPL formula that could cause exposures to the general public at emergency PAG levels, are required to develop an emergency contingency plan.

The methodologies for calculating dose are currently being revised. The International Commission on Radiological Protection (ICRP, 1977) revised its recommendations on internal exposure by derived weighting factors which represent the proportion of risk resulting from a given tissue to the total cancer risk when the whole body is irradiated uniformly. The weighting factors are based on the best estimates of the risk of production of cancer from single-organ exposure, compared to the risk of malignancy from whole-body exposure (Shapiro, 1981).

It appears that the regulatory agencies are in a transition period because the methodologies for calculating dose are being revised. The "new" methodology was used in the development of the ALI's. It is recommended that this methodology be used in the development of RQ's based on the Limited Possession Limits (LPL's), if this approach is selected.

Annual Limit on Intake Methodology. The approach of the International Commission on Radiological Protection (ICRP, 1979) is to specify limits for the total intake in a year. Designated as the Annual Limit on Intake (ALI), this is the radioactivity taken into the body (by ingestion or inhalation) that will impart a dose equivalent equal to the basic annual occupational limit of 5 rem (50 mSv) of uniform whole-body irradiation. For almost all radionuclides, the dose imparted results from irradiation over the lifetime of the radioactivity in the body. In the case of the few radionuclides which have very long effective half-lives in the body, the limit on intake for one year is the activity that will impart a dose of 5 rem in the next 50 years. For application to the general public, age-specific ALI's must be developed.

As it may be noted, the ALI's have been developed for occupational exposure, which means its calculations are based on an adult. The critical group for exposure to ionizing radiation in the general public is typically children. ALI's have not been developed for the general public basically due to the lack of information of the effects of radiation damage and risk on other age groups than the standard man.

As stated (ICRP, 1979):

> The Commission does not recommend the use of the data and the models described in this report to estimate committed dose equivalent to members of the population, for example from radionuclides in the environment, by adjustment solely on the basis of differences in mass of organs or magnitude of intake. While some insight into population exposure may be obtained from the data, they were not collected with this purpose in mind.

Regulatory exposure limits for the general public are one-tenth of the occupational exposure limits. The development of Maximum Permissible Concentrations (MPC's) for the general public were based on Maximum Permissible Body Burdens (MPBB's) to the critical organ which were 1/10th of occupational MPC's. The MPC's also assume that the exposure time is 3 times as great per year for the general public as for an occupational worker.

Since the reportable quantities developed would serve as guidelines based on a dose notification level, it is conceivable to modify the occupational ALI's to reflect possible effects to the general public.

ALI's may be adjusted in two steps: (1) by dividing by a factor of 10 to convert the occupational dose equivalent limit of 5 rem to 0.5 rem for the general public, and (2) by dividing by a factor that would take account of the sensitive group(s) in the population.

Advantages/Disadvantages. The advantages to utilizing this approach or facsimile is as follows:

1. ALI's have been calculated for occupational exposures utilizing the current method for dose calculations (ICRP, 1977).
2. The modification of the ALI is based on a divisor for the critical group, which takes into account a number of effects that are complex and yield a more comprehensive way of evaluating the effects of radiation to an individual than basing it solely on a critical organ.

The disadvantages of this approach are as follows:

1. The divisor that would be chosen could over- or underestimate effects to the sensitive group.
2. The data used in ALI's calculation are not meant to be used for the general public.

Limiting Possession Limits (NRC, 1981). The Limiting Possession Limits (LPL's) were developed by the Nuclear Regulatory Commission. They were developed to upgrade radiological contingency planning for those licensed fuel cycle and major materials facilities which have the potential for accidents that could result in off-site doses exceeding 1 rem to the whole body, 5 rem to the thyroid, or 3 rem to the other critical organs. The radiation doses of 1 rem whole body, and 5 rem to the thyroid were the lower limits of the PAG's derived for airborne radiological releases.

Figure 7-5 shows the formula the NRC used to calculate the LPL's. Inhalation was considered the critical pathway except for those radionuclides in which submersion in an airborne cloud was the acute exposure pathway. The ingestion pathway was not considered likely to cause prompt acute exposures to individuals, and therefore, was not considered limiting enough for the analysis.

Estimates of release fractions, the portions of inventories of radioactive materials that could be airborne in an accident, were based on experience and generic physical and chemical forms of the radionuclide involved since there was insufficient data available to make an analysis. The release fraction ranges from zero for encapsulated materials and "special form" materials to one for volatile and/or combustible radionuclides.

A fraction of the materials released, called the "intercept fraction," would be inhaled and therefore contribute to radiation dose. An intercept fraction of 10^{-6} for off-site exposures (Brodsky, 1980)(Brodsky, 1965) corresponds to a breathing rate of 20 m^3/day and an atmospheric relative concentration value X/Q of 4×10^{-3} sec/m^3, when the receptor is present throughout the entire release event. An atmospheric relative concentration value of

FIGURE 7-5

Estimates of quantities of materials, which could lead to significant off-site doses and to overexposures of workers from accidents, that require protective actions have been based upon the relationship:

$$Q = \frac{D_n}{DCF_n \quad RI}$$

Where Q = Limiting possession limit, i.e., the quantity of radionuclide authorized to be possessed and assumed subject to an accidental release

D_n = Doses requiring protective actions, rem

DCF_n = The inhalation dose conversion factor for the limiting body organ

R = Release fraction likely to be dispersed in a severe real accident

I = Intercept fraction that could be inhaled by an individual

4×10^{-3} was used and considered a typical value for fuel cycle and materials licensee installations. This value corresponds to the ground level relative concentration experienced 150 meters from a ground level release under stable meteorological conditions.

Modification of the LPL's Equation for Superfund. The doses used in the LPL's correspond to the emergency PAG's developed for airborne releases. The suggested whole body dose equivalent for a Superfund notification is 0.5 rem therefore, the numerical value for the dose used in the LPL could be changed. The intercept fraction would also be modified to take into account differences in distance from the release. Accidents involving the facilities specified in the LPL's derived by the NRC, generally have a fixed boundary at a distance from the receptor on the order of 150 meters; however, in a transportation accident the distance between the receptor and the released materials could be much less. The suggested distance from a release to the receptor would be 15 meters. This could take into account the "worst case" distance, where the receptor was present throughout the entire release. The formula to calculate RQ's for Superfund is shown in Figure 7-6. This formula was modified to meet the conditions specified in (ICRP, 1977). The LPL's calculated by the NRC are for radionuclides commonly associated with the fuel cycle and licensed materials facilities. Superfund is also concerned with the radionuclides associated with other types of facilities and materials, e.g., low level waste disposal sites and naturally occurring and accelerator produced radioactive materials (NARM). Therefore, the release fractions may need to be determined for the additional radionuclides. If there is insufficient information on the release fraction of a particular radionuclide, one (1.0) would be used to calculate the RQ.

FIGURE 7-6

MODIFICATION OF THE LPL FORMULA FOR RQ DETERMINATION

$$Q = \frac{D_n}{R \cdot I \, [DCF_{WB_s} + \Sigma \, w_t \; DCF_t]}$$

Q = Reportable Quantity

D_n = Dose required for Notification Level

R = Release Factor

I = Intercept fraction

DCF_{WB_s} = Dose conversion factor for whole body, e.g., submersion in contaminated air

w_t = Weighting factor for tissue (t)

DCF_t = Dose conversation factor for tissue (t)

Advantages/Disadvantages. The main advantage of utilizing this approach is that it takes into account "real" events that could surround a release from a facility and/or transportation accident/incident.

The main disadvantage of utilizing this approach is that the RQ could be overly conservative, especially for a fixed facility.

Direct Gamma Radiation Effects

For some radionuclides, exposure to external gamma radiation could be the critical pathway. For example, a sealed radiographic source lost or spilled in a transportation accident, could present a substantial direct gamma radiation exposure hazard. Examples of gamma emitters are depicted in Table 7-3. The formula used to calculate gamma radiation exposure rates is shown in Figure 7-8.

Two methods of incorporating direct gamma radiation effects to RQs would be (1) develop RQs for those radionuclides that exhibit direct gamma radiation effects as the critical pathway; or (2) establish an external gamma radiation exposure rate, regardless of specific radionuclide, that would require notification.

Establishment of a direct gamma radiation exposure rate would be required for both methods. As stated earlier, the operative language of CERCLA leads to choosing a quantity or quantities rather than dose or exposure rate for RQs for radionuclides. Therefore, the first method would be recommended. The RQ derived from the formula in Figure 7-8, if more restrictive, would supersede the RQ based on intake of the radionuclide into the body, as the critical pathway.

Categorization

As stated in Part 2 of this section, if the dose notification level were to be used for the reportable quantities (RQ) determination, the term "radionuclides" would be the only designation. If the other methodologies for RQ

FIGURE 7-8

FORMULA FOR EXTERNAL GAMMA RADIATION

$$X = \frac{\Gamma C}{r^2} \quad ; \qquad C = \frac{X\, r^2}{\Gamma}$$

where

Γ	=	Specific exposure rate constant ($\frac{R}{hr\text{-}Ci}$ @ 1 m)
C	=	Number of curies
r	=	Distance from the source in meters (m)
X	=	Exposure rate, R/hr (roentgen/hr)

determination were utilized, the radionuclides would need to be individually listed as shown in Table 7-3, or categorized, which could reduce the number of designations for radionuclides. This part discusses two possible approaches for categorization of radionuclides:

1. The toxicity classification of radionuclides developed by the International Atomic Energy Agency (IAEA, 1963)
2. Eight groups developed by Allen Brodsky that correspond to the relative magnitudes of the radionuclides maximum radiotoxicities (Brodsky, (a)1980).

Both approaches group the radionuclides according to the risk of biological injury when they are incorporated into the human body. Those radionuclides for which direct gamma radiation may be the limiting factor would be evaluated on a case-by-case basis and placed in the group whose limiting activity levels based on potential health effects would be similar.

Toxicity Classification--(IAEA, 1963)

The International Atomic Energy Agency developed a toxicity classification for radionuclides. The purpose of this classification was to make a toxicity grading of the radionuclides according to the risk of biological injury which they may cause when they become incorporated in the human body. Due to the wide range of toxicities in this classification, three main groups were distinguished. However, it was recognized that the group of medium toxicity nuclides may cover too wide a range of toxicity and therefore, four groups also were derived.

There are three ways in which radionuclides normally enter the body; by absorption through the skin, by ingestion, and by inhalation. Inhalation was the mode used in the basic toxicity classification. A further consideration in making the toxicity grading is the rate at which the radioactivity is inhaled--continuous intake or an intake of short duration. The latter case would be applicable to those only likely to be in contact with radioactivity once in a lifetime--for example, members of the public who inhale radioactive material after an accidental release to the environment. The classification is based on the ICRP values for maximum permissible concentrations in air (MPC) for continuous inhalation, however, the classification is also applicable to a single intake.

The calculations used for development of this toxicity classification were based on the doses delivered to the critical organ. However, for our purposes, the method used for the toxicity grading would not vary greatly if the method for dose calculations was updated (ICRP, 1977); therefore, the groupings as they exist (IAEA, 1963) would remain basically unchanged. Table 7-6 shows radionuclides arranged in the order of their most restrictive (MPC) value as determined (IAEA, 1963).

Brodsky's Eight Groups--(Brodsky (a), 1980)

In the article, "Determining Industrial Hygiene Requirements for Installations Using Radioactive Materials," a set of guidelines was proposed as an aid in determining the specific facilities, equipment, and procedures required for operations involving radioactive materials. The guidelines were illustrated by the development of a table that groups commonly used radionuclides in eight groups that correspond to the relative magnitudes of their maximum radiotoxicities. The eight groups were chosen to correspond to the eight orders of magnitude over which the maximum doses per curie range when radioactive material is delivered in a single intake by inhalation.

As mentioned in the (IAEA, 1963) toxicity classification, the use of single intakes by inhalation may seem to apply only to accidental situations, however, the same ordering of radionuclides would occur if the groups were selected on the basis of permissable concentrations for continuous intake.

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TABLE 7-6

RADIONUCLIDES ARRANGED IN ORDER OF THEIR MOST RESTRICTIVE $(MPC)_a$ VALUE

HIGH TOXICITY

Pa^{231}, Cf^{249}, Th-Nat, Pu^{239}, Pu^{240}, Pu^{242}, Th^{232}, Pu^{238}, Ac^{227}, Th^{230}, Np^{237}, Th^{228}, Am^{241}, Am^{243}, Cm^{243}, Cm^{245}, Cm^{246}, Cf^{250}, Cf^{252}, Cm^{244}, U^{232}, Ra^{226}, Ra^{228}, Sm^{147}, U-Nat, Nd^{144}, U^{238}, Pu^{241}, Pb^{210}, U^{230}, U^{233}, U^{234}, U^{235}, U^{236}, Cm^{242}, Th^{227}, Po^{210}, Ra^{223}, Sr^{90},

MEDIUM TOXICITY

Upper Sub-Group A

Ra^{224}, Pa^{230}, Bk^{249}, I^{129}, Eu^{154}, Ru^{106}, Ce^{144}, Bi^{210}, At^{211}, Na^{22}, Co^{60}, Ag^{110m}, I^{126}, I^{131}, Cs^{134}, $Eu^{152(13yr)}$, Cs^{137}, Bi^{207}, Pb^{212}, Ac^{228}, In^{114m}, Sb^{124}, Ta^{182}, Cl^{36}, Sc^{46}, Sb^{125}, Ir^{192}, Tl^{204}, Ca^{45}, Mn^{54}, Y^{91}, Zr^{95}, Sr^{89}, Cd^{115m}, In^{115}, Te^{127m}, Te^{129m}, I^{133}, Ba^{140}, Tb^{160}, Tm^{170}, Hf^{181}, Th^{234},

Lower Sub-Group B

P^{32}, V^{48}, Fe^{59}, Co^{58}, Ni^{63}, Zn^{65}, Rb^{86}, Rb^{87}, Tc^{99}, Cd^{109}, Sn^{113}, Pm^{147}, Sm^{151}, Os^{185}, Hg^{203}, As^{76}, Y^{90}, Zr^{97}, Nb^{95}, Ru^{103}, Ag^{105}, Sn^{125}, Cs^{135}, Eu^{155}, Gd^{153}, Bi^{212}, K^{42}, As^{74}, Se^{75}, Sr^{85}, Nb^{93m}, Zr^{93}, Te^{125m}, Te^{132}, I^{135}, La^{140}, Tm^{171}, W^{181}, W^{185}, Na^{24}, Sc^{48}, Mn^{52}, Y^{93}, Tc^{97m}, Sb^{122}, Ce^{141}, Pr^{142}, Re^{183}, Ir^{194}, Bi^{206}, Ca^{47}, Co^{57}, Ga^{72}, Br^{82}, Cd^{115}, Te^{131m}, Cs^{136}, Pr^{143}, Ho^{166}, Re^{188}, Pa^{233}, Mo^{99}, Ce^{143}, Dy^{166}, Tc^{96}, Ag^{111}, I^{132}, Nd^{147}, Pm^{149}, Re^{186}, Au^{198}, Tl^{202}, S^{35}, Sr^{91}, Os^{143}, Zn^{69m}, As^{73}, As^{77}, Sr^{92}, Y^{92}, Tc^{97}, Pd^{109}, Ba^{131}, Sm^{153}, $Eu^{152(4.2h)}$, Gd^{159}, Er^{169}, W^{187}, Os^{191}, Ir^{190}, Pt^{193}, Rn^{220}, Rn^{222}, * Sc^{47}, Mn^{56}, Ni^{59}, Ni^{65}, Kr^{87}, Ru^{105}, Rh^{105}, I^{134}, Er^{171}, Yb^{175}, Lu^{177}, Re^{187}, Pt^{191}, Pt^{197}, Au^{196}, Np^{239}, Si^{31}, Fe^{55}, Pd^{103}, Te^{127}, Au^{199}, Hg^{197m}, Tl^{200}, Tl^{201}, Be^{7}, A^{41}, Cu^{64}, Hg^{197}, Th^{231}, Nd^{149}, Ru^{97}, In^{115m}, Pb^{203}, Cl^{38}, Dy^{165}, Cr^{51}, F^{18}, C^{14}, Kr^{85m}, Te^{129}, Xe^{135}, Cs^{131},

LOW TOXICITY

H^{3}, Zn^{69}, Ge^{71}, Nb^{97}, In^{113m}, Cs^{134m}, Pt^{193m}, Pt^{197m}, Tc^{99m}, Co^{58m}, Kr^{85}, Xe^{133}, Os^{191m}, Xe^{131m}, Y^{91m}, Sr^{85m}, Tc^{96m}, Rh^{103m}, A^{37}.

As pointed out in the article (Brodsky (a), 1980), the calculations were based on inhalation; however, the relative group of radionuclides would also be consistent within one order of magnitude if based on relative ingestion toxicity.

It was also pointed out the maximum dose per curie inhaled varies over about nine orders of magnitude or more. It was found that the use of only three groups may result in applying similar safeguards to two radionuclides that could differ by a factor of approximately 1,000 in relative toxicity. Therefore, a grouping of 3 or 4 could lead to over-estimates of relative toxicity by a factor of 1,000. This could also affect the quantities that would be derived for Superfund.

The radionuclides were arranged in order of dose per curie as shown in Table 7-7. Based on the assumption that the relative ordering of the maximum dose per curie inhaled, the radioncul ides are arranged in groups each of which covers a factor of 10 in relative radiotoxicity.

This methodology and grouping was developed for occupational exposure. However, the categorization methodology could be used for RQ assignment because the groups would not greatly vary. The use of only 3 or 4 groups could lead to over-estimates of relative toxicity by a factor of 1000 (Brodsky(a), 1980) within each group. If categorization is to be used for RQ designation for radionuclides, the Brodsky approach would be preferred.

TABLE 7-7

TYPICAL RADIONUCLIDES WITHIN THE EIGHT GROUPS BASED ON RELATIVE TOXICITY

Group	Radionuclide
I	H-3
	C-14
II	Cr-51
	Fe-55
III	Ce-141
	Sr-85
	Fe-59
IV	Hf-181
	Cl-36
	Tm-170
V	I-129
	Tc-99m
VI	Ra-223
	Sr-90
	U-235 (+ 1% U-234)
VII	Ra-226
	Cm-244
VIII	Am-243
	Th-230
	Pu-239

Issues Concerning Radionuclides and Superfund

Some issues were not fully developed in this section that concern the inclusion of radionuclides into Superfund. An administrative issue is that radionuclides are regulated under other Acts than Superfund and by other agencies than the EPA. It would be desirable to coordinate activities between the responsible agencies to reduce duplication of notification and response activities.

Technical issues include the following:

1. The NRC noted important deficiencies in existing emergency response plans for fuel fabrication facilities. For example, the plans failed to describe adequately the means for measurement and assessment of accidental releases of radioactive materials and arrangements for prompt notification of Federal, State, and local Government agencies (46 FR 29712). This illustrates that there are problems involved in detection and assessment of accidental releases of radionuclides even for professionals. Also illustrated was that there are existing notification inconsistencies for uniformly regulated materials. It appears evident that these problems would exist and perhaps be magnified for materials not uniformly regulated by the States, e.g., NARM.
2. The difference between the definition of removal and remedial activities denotes two types of effort. Therefore, the notification level associated with remedial activities especially concerning "non-beneficial" facilities or sites, e.g., orphan disposal sites, could be established at a lower level than required for possible emergency response activities.

Conclusion

Superfund is a comprehensive act that will be able to deliver assistance to State and Local and Federal agencies if a release occurs of a hazardous substance, pollutant or contaminants to protect public health and welfare and the environment.

As pointed out in Part 1 of this section, radionuclides are considered a hazardous substance because they are named as a hazardous air pollutant by Section 112 of the Clean Air Act. Releases of radionuclides, in certain instances as defined by Section 101(22)(c), will be required to be reported if a given "quantity" has been exceeded except for those facilities covered by Section 170 of the Atomic Energy Act (AEA). Removal and remedial activities could be provided for radiological releases, except for the facilities and materials covered by Section 170 of the AEA, the sites delineated in Sections 102(a)(1) or 302(a) of the Uranium Mill Tailings Radiation Control Act (UMTRCA), and releases at federally owned facilities, as indicated in Section 111(d)(3) of Superfund.

Radiological materials and facilities are, for the most part, tightly regulated and the regulations are tightly enforced. There are existing notification mechanisms that Superfund could perhaps tap. This approach would lessen the number of notifications required by a licensee of the Nuclear Regulatory Commission (NRC) or Agreement State. Notification by the state and/or responsible federal agency to the National Response Center is a suggested approach. Direct notification would be required from facilities that possessed materials, such as NARM, not uniformly regulated.

The suggested emergency response notification level for Superfund whole body dose-equivalent is 0.5 rem. This exposure is generally considered the upper limit for the general public exposure. This level is sufficiently low to prevent significant harm to the general public. Thus, it allows for possible planning activities and response activities that could be cost effective.

According to Section 102(b)(2) of Superfund, a single quantity is desired for any hazardous substance regardless of the medium. The designation of one pound is not appropriate for radionuclides. There are two possible approaches: (1) utilization of a dose, or (2) utilization of a "quantity" for RQ's. The advantages of using a dose designation is that it is a multimedia designation but it is not a "quantity." Activity is the "quantity" unit of measure for radionuclides. To obtain a "quantity" designation, two approaches were discussed: (1) the use of the Annual Limit on Intake (ALI) modified to generally reflect possible general public intake values, and (2) modification of the formula used to establish the Limiting Possession Limits (LPL's) that were derived by the Nuclear Regulatory Commission (NRC, 1981). Modification of the LPL formula appears to be the best method for deriving RQ's.

The "reportable quantity" will be based on a dose. The dose is the important element in the development of RQ's. Once the RQ's are developed by the prescribed method for the designated radionuclides, the two approaches for actual RQ designation would be: (1) list the RQ for each designated radionuclide, or (2) categorize the radionuclides in some manner into groups according to relative toxicity and assign the same RQ to all members of the same group. If categorization is the chosen approach, the methodology and groupings derived by A. Brodsky in "Determining Industrial Hygiene Requirements for Installations using Radioactive Materials," would be recommended.

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SECTION 8

DATA MANAGEMENT SYSTEM

THE NIH/EPA CHEMICAL INFORMATION SYSTEM (CIS)

Fein-Marquart Associates, Inc., of Baltimore, Maryland, conducts a program to design, develop, implement, install, and maintain the CIS for the U.S. Environmental Protection Agency, the National Institute of Health, and the National Bureau of Standards. The CIS is a collection of computerized data storage and retrieval modules for chemical information. Each of these modules is essentially a "stand-alone" system dealing with a particular aspect of chemistry. However, they are all prepared according to a standard set of CIS guidelines so that they can share the same utility software and communicate among each other. In this way, it is relatively easy to conduct composite searches dealing with these various aspects of chemistry, and similarly to display, in association with retrieved compounds, information stored in the data bases associated with the various modules.

The modules (components) of the CIS are listed below, and the structure of the CIS is depicted in Figure 8-1.

SANSS	Structure and Nomenclature Search System
MSSS	Mass Spectral Search System
CRYST	X-Ray Crystallographic Search System
CNMR	Carbon 13 NMR Search System
MLAB	Mathematical Modeling Laboratory
CLAB	Cluster Analysis Laboratory
RTECS	Registry of Toxic Effects of Chemical Substances
CAMSEQ-II	Conformational Analysis Programs
OHM/TADS	Oil and Haz. Materials/Tech. Assist. Data System
PDSM	JCPDS Powder Diffraction Search Match
FRSS	Federal Register Search System
XTAL	Single Crystal Reduction and Search System
WDROP	Water Distribution Register of Organic Pollutants
NMRLIT	NMR Literature Search System
CTCP	Clinical Tox. of Commercial Products Search System
TSCAPP	Toxic Substance Control Act Plant & Production Data
MAIL	MAIL System

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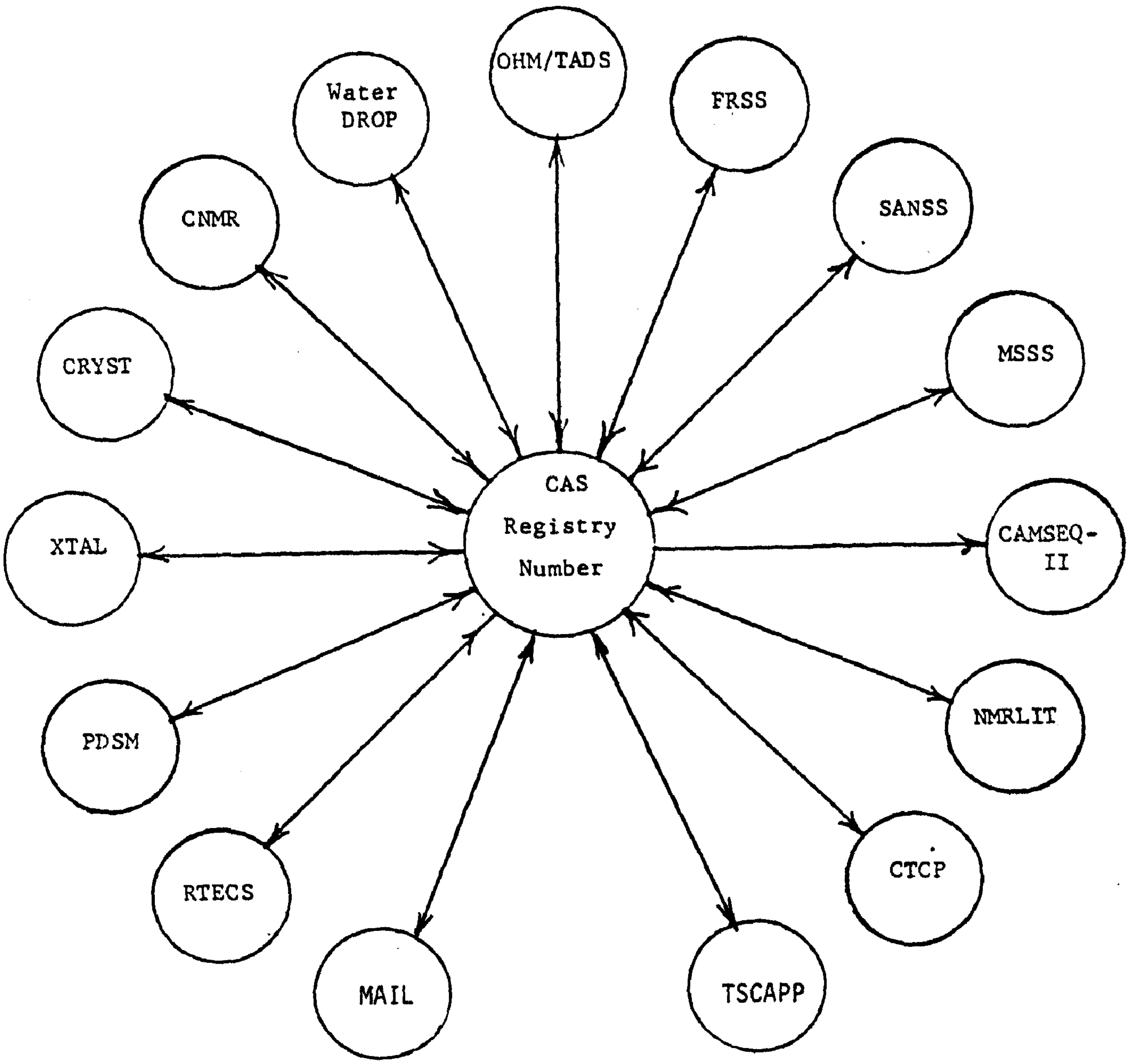

Figure 8-1. Structure of the CIS.

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The modules of the CIS communicate among themselves by stored lists of Registry Numbers, for the most part supplied by Chemical Abstracts Service. In the case of some modules, for example CTCP, WaterDROP, and Federal Register Search System, the retrievals are, more exactly, represented internally by "Citations," where each citation contains a specific reference to a compound (represented by its Registry Number). A given list of citations is automatically converted to a list of the pure Registry Numbers of all the compounds referenced in that list when it was generated. In some modules, where more than one "entry" for a Registry Number is possible, a subidentifier is appended to the Registry Number. As an example, there are cases when more than one crystalline form for a compound exists, and, therefore, more than one entry for a compound might be found in a list of one or more Registry Numbers being generated and stored. For instance, within the Structure and Nomenclature Search System (SANSS) one might ask for all compounds containing a particular structural fragment, or with a name or synonym containing a certain name fragment, or having a molecular formula satisfying certain broad criteria. The answer to each such query is a stored file containing a list of the Registry Numbers for those compounds satisfying the criteria specified.

For essentially all the compounds in the CIS the following information is available:

- o CAS Registry Number
- o Structure
- o The chemical name and molecular formula in accordance with the introductory sections of the Toxic Substances Control Act, Chemical Substances Inventory, Volume 1, May 1979

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- CAS Index Name(s)
- A list of sources of further information
- Other names and synonyms by which the substances are commonly known in commerce and manufacturing

In addition, as described in the following sections, much additional information, e.g., mass spectrum, toxicity data, regulation, is also available for many of the compounds.

The following sections will discuss briefly the features of each of the CIS components that are most useful to the Reportable Quantities program.

Oil and Hazardous Materials/Technical Assistance Data System (OHM/TADS)

OHM/TADS is a collection of interactive computer programs which allow searching of the Environmental Protection Agency's Oil and Hazardous Materials/Technical Assistance Data System (OHM/TADS). This data system provides necessary technical support for the assessment of potential or actual dangers encountered as a result of the discharge of oil or hazardous substances. OHM/TADS contains data for any material which has been designated an oil or hazardous material by the EPA. Currently there is information in the system for about 1,100 substances. While the primary function of this data base is to provide emergency information to spill response team personnel, it can also be regarded as a general source of diverse information on hazardous substances. OHM/TADS data has been gathered from the open literature.

OHM/TADS searches are based on the 126 subjects into which all information in the data base has been categorized. These subjects are generally referred to as "fields." For example, the MAT field contains the material name, and the DRK field contains the recommended drinking water limits. Every material in the data base has information in the MAT field, but information may not be available on every subject for the material of interest. Perhaps the necessary measurement has not been made; for example, the boiling point (BLP field) may not be known. One can list all of the information available for a particular chemical or restrict the listing to only the fields of interest.

OHM/TADS allows a search for materials with certain values of specified properties (for example, the specific gravity or vapor pressure) or ranges of those properties. OHM/TADS also provides recommended methods for disposing of spilled materials (the DIS field), and for notifying proper authorities (DSN field).

Structure and Nomenclature Search System (SANSS)

The SANSS module data base is designed to contain an entry for each compound included in the data bases associated with the other individual CIS components. Each such entry includes, as available: CAS Registry Number; systematic name (8th CI and/or 9th CI); synonyms and trade names; molecular formula; connection table, and references to other sources of information. Currently there are approximately 200,000 substances in the data base. One can query this system for compounds having a wide variety of characteristics. For example, one can search for all compounds having a specific structural fragment contained within it. To accomplish this the user described the two-dimensional structural fragment by means of simple typed commands. The system can also be searched on the basis of name (either complete, or partial); ring system; specific functional groups; molecular formula (complete, partial, or ranged); molecular weight, and atom count.

Acute Toxicity Data from the NIOSH Registry of Toxic Effects of Chemical Substances (RTECS)

The search and retrieval system for the NIOSH Registry of Toxic Effects of Chemical Substances (RTECS) is based on the NIOSH publication of the same name. Each quarter, a completely updated magnetic tape copy of the RTECS publication is processed, and the data base for the interactive search and retrieval system is replaced. Currently there is information in the system for 40,861 compounds.

The direct search allows the user to display, for a given list of compounds, the CAS Registry Number, the RTECS Registry Number, and the details of each published toxicity measurement for each compound, including literature references.

Alternatively, the user may ask for all entries relating to specific end effects (e.g., eye irritation) on specific classes of animals (e.g., rabbits) for specific means of application, having dosage within a given range. The result of such a query is a list of Registry Numbers which can then be used to display RTECS data or to obtain information from other modules of the CIS.

Federal Register Search System (FRSS)

The FRSS was established to accumulate regulations, rules, standards, and guidelines involving chemical substances, and to provide a means of access to up-to-date information regarding the status of such regulations and standards. In this system, a "citation" consists of the mention in the FR of a chemical, substance, material, or product. If the cited substance is a mixture, each of its components (if mentioned in the article) are themselves the objects of other citations, with full cross-referencing information in all of the citations. Each citation includes: the substance name(s) and CAS Registry Number, if any; the FR volume and page number; the type of FR article (Notice,

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Proposed Rule, Final Rule); the agency and/or office; the CFR sections, if any, affected; references to prior FR articles; a descriptive string of "Keywords" and ordinary English words that, when expanded for presentation to the user, form an abstract of the intent of the article; specific dates upon which certain actions will take place (effective date, public hearings, etc.); and annotated cross-references to citations for other, related substances. Guidelines, proposed guidelines, standards, and any non-regulatory but recommended criteria for dealing with a particular substance are also entered.

The primary FR citation is, of course, to the article in which the substance appears; this gives the user immediate access to the article. As touched on above, subsequent CFR and FR citations give the user a whole background of specific information, as well as providing access to the actual CFR and FR documents themselves. A significant implication of this compilation of information is that the system can assist the user in gaining not merely facts, but an understanding of the regulatory history of the substance, and potentially a projection of its regulatory future.

It is important to note that the abstract contained in this system tells the user what the article is about--not what it actually says. It was deemed critical to the design of the data analysis process that there should be no temptation for the user to reference to the content of this system as the "legal" authority for his actions. This system is a method of locating and identifying Federal Register articles of interest to specific users; it is deliberately <u>not</u> an alternative to the Federal Register itself.

The FRSS contains data beginning with the issue of January 1, 1978, and is updated at least weekly; currently (as of March 26, 1981) there are 78,032 citations in the system.

Clinical Toxicology of Commercial Products (CTCP)

CTCP is an on-line interactive data base based on the book of the same title by Drs. Gosselin, Hodge, Smith, and Gleason. In it is contained information about approximately 20,000 commercial products, consisting of their manufacturer, uses, and composition. For the chemicals comprising a product the CAS Registry Number, concentration, and indication of toxicity (if applicable) are given. As any consumer knows, the composition of a product is subject to significant change from time to time, even if the trade name under which it is marketed remains the same. However, it is often critical to know the composition of earlier versions of a specific product--for example, in the case where a child may have ingested the contents of an old bottle. Thus, prior formulations are retained whenever possible.

The data base may be searched against essentially all of its fields. For example, one might inquire about all compounds containing phosphoric acid which are used as fertilizers.

Toxic Substances Control Act Plant & Production Data (TSCAPP)

The TSCAPP data base is the production and plant site information associated with the Toxic Substances Control Act (TSCA) Chemical Substance Inventory: Initial Inventory. This information was originally contained in two tape files in the CICIS - Chemical Production Information Tape, which is documented in NTIS Computer Products Data Sheet - Accession No. PB80-155153, EPA Report No. EPA/DE-80/005.

The TSCAPP data base contains two separate sets of entries: one of production information concerning the production of a single substance in a plant; another set of entries containing information about plants. These two

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sets of entries are accessed by different commands, but can be combined in various ways for display. For example, searches performed by CAS number will allow assessment of the total annual production of a given compound, and the manufacturing sites can be identified.

THE CERCLA REPORTABLE QUANTITIES FILE

Several steps have been taken to develop the RQ public record file. The first of these is the establishment of a "hard copy" catalog of items to be included in the file. The second is the establishment of appropriate links with the EPA computer system that will allow generating part of the file from information already in data bases available to the EPA, and also setting up an ADP index to the file that will allow machine-searching. Each of these operations is discussed in more detail below.

Cataloging System

The "hard copy" catalog of items to be entered in the CERCLA Reportable Quantities file is being developed initially from documents currently held and considered relevant by the Rockwell EMSC staff. After one iteration the list of filing categories and subclasses currently in use is shown in Table 8-1. Categories have been included to accommodate items under development by other subcontracts (i.e., the "Comment Letters" Category No. VII.

Each document's nature is being recorded on an indexing sheet, as shown by the sample in Table 8-1. This information will eventually be uncoded and become the basis for the ADP index. As noted, the "CONTENTS" section is used to record a few key descriptor words, and if the title of the item already has enough such descriptors, the entry made is simply "See Title."

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TABLE 8-1

FILING CATEGORIES AND SUBCLASSES

CERCLA REPORTABLE QUANTITIES FILE

I. Law and Legislation

a. CERCLA
b. Legislative Review
c. Congressional Reports
d. Related Law/Legislative Review

II. Regulations

a. Drafts/Typewritten Versions
b. Federal Register Reprints/Copies
c. Related/Reference Regulations
d. Procedural Items

III. Chemicals - Non-Radioactive

a. Data Sheets
b. Data Base Information
c. Lists
d. General References
(Note 1) e. Specific References
f. General References
g. Selection Criteria

IV. Radionuclides

a. Lists
b. Background Information
c. Hazards/Effects
d. Laws/Regulations
e. Hazard/Risk Analysis
f. General References
g. Media-Specific Information (Air/Land/Water)
h. Spill/Release Information

V. Reportable Quantities

a. Scenarios/Strategies/Models
b. Supporting Development
c. Calculations/Determinations
d. Hazard Indices

VI. Comment Letters

a. Chemical
(Note 2) b. Classification Methods

(continued)

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TABLE 8-1 (Continued)

VII. Experts/Centers of Excellence

a. Identification
b. Qualifications
c. Support Provided

VIII. Media-Specific Information

a. Land
b. Air
c. Water

IX. Contractor Reports

a. Bi-Monthly/Monthly/Semi-Monthly/Weekly
b. Interim/Drafts
c. Final
d. Work Statements
e. Formats

X. Spill/Release Information

(Note 1) a. Specific References
b. Summary Reports
c. Data Base Information

XI. Economic Effects/Factors

(Note 3) a. General Refrences
b. Summary Reports
c. Use/Application

XII. Memoranda of Record

a. Meetings
b. Trip Reports
c. Symposia Notes
d. Letters
e. Notes

XIII. Background/General Information

a. Books
b. Handbooks
c. Guides
d. Reports
e. Articles

Note 1. "Specific Reference" means reference to a specific chemical material or a specific waste by name.

Note 2. Additional subclasses to be developed when comment letters become available. Will accommodate classification method used by VIAR.

Note 3. To be expanded and/or revised to accommodate ICF input.

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Table 8-2
Sample Indexing Sheet

I. <u>LAW & LEGISLATION</u>

<u>SUBCLASS</u>:

<u>DATE</u>:

<u>TITLE</u>:

<u>ORIGIN</u>:

<u>CONTENTS</u>:

(Note: if the title is self-explanatory and contains sufficient descriptive key words, the entry here is "SEE TITLE")

<u>CROSS REFERENCE</u>:

(Other pertinent categories and subclasses under which the document should also be listed are given here)

<u>AVAILABILITY</u>:

(Three choices: 1) File [a copy will be actually kept in the file]
2) Available EPA Library
3) Any Technical Library)

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Document availability will be indicated in the final index as follows:

FILE - A hard copy of the document will be placed in the file. This includes all reports from sources other than the EPA.

AVAILABLE EPA LIBRARY - This entry is being used primarily for EPA reports that are available in the EPA headquarters library in Washington, DC. Arrangements have been made with Mrs. Sami Klein, the EPA head librarian, to check on all documents so listed and assure that they are indeed available.

However, if a document is judged to be particulary pertinent, a hard copy will be placed in the file as well.

ANY TECHNICAL LIBRARY This entry is being used for standard reference works, handbooks, and textbooks. Again, if a document is judged particularly pertinent, a hard copy is obtained for the file. A good example of this is the 1979 two-volume Registry of Toxic Effects of Chemical Substances (RTECS), which is certainly a key reference, and a copy of this has been purchased to go into file.

Once the ADP index system is developed and in place, it will be possible to search for any document in the file at least in the following ways:

1. By any category of subclass
2. By keywords of contents or title entries
3. By date or origin

Additional search and ranking modes for data on fact sheets will also be developed as these items are incorporated into the files.

Computerization Tasks--

Two computerization tasks have been defined:

Task 1 Computerization of chemical fact sheets

Task 2 Computerization of the Reportable Quantities File

To elaborate on these:

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Task 1 - The need to computerize chemical fact sheets. The computerization should include the following capabilities:

a) Fact Sheet Entry

b) Fact Sheet Updating and/or Modification

c) Fact Sheet Retrieval by Any of Several as Yet Undefined Keys. Retrieval Includes Printing of the Sheet.

Task 2 - The Reportable Quantities requires the same capabilities as the fact sheet, however, the number of keys (categories) for storage/retrieval probably will be larger.

After consultation with the Project Officer, and several meetings between her and appropriate EPA personnel, it was decided that the EPA computer system in Washington would be used. Mr. Steve Heller of EPA-Washington has been our contact.

Opening a New File in CIS for CERCLA

Opening a special file within CIS to contain the CERCLA data, consisting of candidate and designated substances and RQs as well as the document record appears to be highly desirable. As indicated in the excerpt of a trip report made by the Rockwell Manager of Computer Applications, reproduced below, clarification of the role of Fein-Manquart is setting up this data file is essential before proceeding.

> "The original intent of this trip, based on information from Dr. Al Fein of Fein-Marquart and Steve Heller of the EPA, was to acquire the knowledge necessary to install the two new data bases (Fact Sheets and Legal File) into the existing CIS data base.
>
> The initial discussions, on Wednesday, July 29, 1981, were centered around the purpose of the trip. Dr. Fein was under the impression that the first day was to be spent in training in the use of the ICS, while I was under the impression that all the time (2 days) was to be spent in training in the installation of our data bases. At that point, Dr. Fein explained that the installation of new data bases into CIS was quite

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complicated and they (Fein-Marquart) would most likely have to do the major portion of the work.

In addition, since the CIS system has limited formatting (display) capabilities, Dr. Fein felt that a custom display module would be necessary in order to provide a display which would suit our needs for both the Fact Sheets and the Legal File data. This module would also have to be written by Fein-Marquart.

The remainder of the day, Wednesday, was spent in setting up the actual mnemonic definitions which will be used by the system for the Fact Sheets. This process involves choosing codes (1-6 characters), field numbers, search method and field definitions for each data field to be used.

A document called TDRS a Textual Document Retrieval System, by Joe R. McDaniel, Staff Member, Fein-Marquart Associates, was given to me.

This document, a slightly revised version of a document given to us by Rudy Potenzone of the EPA, represents the only written documentation of the installation process presented to me, and this document is not complete. There were sections which Mr. McDaniel had which he did not give me with the explanation that they were still under development and not ready for distribution.

The contents of this document, though somewhat helpful, are far from complete. It is quite obvious that very little, if any written documentation exists for the actual CIS software. There may be some documentation within the code itself; however, I do not have copies of the code at this time, although Dr. Fein agreed to send copies of that data to me.

Thursday, July 30, 1981, was spent in defining the requirements for our custom display modules and the anticipated needs for further consulting during the installation phase.

Although Fein-Marquart was quite cooperative, and they seem extremely competent, it is quite clear that they intend to guard against outside intervention into their system. By this I mean that they have not intent of letting other firms make software modification to the system such as would be required to add our data base. They will happy, for a fee, to make such modifications for us, but do not seem willing to actually show us how to do it ourselves.

This is quite understandable from their point of view, since CIS represents a major portion of their business base; however, it will make it quite awkward from our standpoint, since we will be dependent upon them for whatever modification need to be made.

Additionally, there seems to be very little, if any documentation on the software itself, although there are decent users' manuals for system operation.

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SECTION 9

COMMENTS AND EXPERTS

When the program was begun in February 1981, it was expected that the interpretive notice on Sections 102, 103(a,b) would shortly appear in the Federal Register. Since public comments were invited in that notice for up to 60 days after publication, plans were also made to respond to those comments. These plans included ways of classifying, organizing, and responding to such comments. The following discussion presents an overall approach for dealing with these comments. A system for classifying the comments is also proposed. Finally, a list of topics that commentators are likely to address and necessary professional disciplines to assist comment responses is provided. A start was also made at compiling a specific list of available experts and centers of excellence for the necessary professional disciplines. This list is short, since the effort was interrupted when it became clear that publication of the notice was being delayed.

COMMENTS HANDLING APPROACH

The summary comments handling approach is presented in Table 9-1. A proposed comment classification system and a comment topics/experts matrix are being provided herewith.

As comments are received, they will be classified and organized according to the above system. Then, the comments will be distributed to appropriate EMSC staff/experts/centers of excellence for preparation of technical responses. It was planned to integrate the total comments and their responses into a Response to Comments Report. This Response to Comments Report would then form a basis for symposia, public meetings and other dialogue with

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TABLE 9-1. SUMMARY COMMENTS HANDLING APPROACH

Accomplishment/Deliverable
Proposed Comment Classification System
Proposed Topics/Experts Matrix
Final Comment Classification System
Subcontract for Administrative Handling
List of Available Experts/Centers of Excellence
Classified and Organized Comments
Response to Comments Report

industrial groups, public interest and environmental groups, and federal/state agencies in Phase II.

Comments Classification System

A proposed classification system is presented in Table 9-2. The classification objective is to first assemble public comments by rational technical categories for use in response preparation, and second, evaluate total comments by summary tabulations.

Of course, the potential list of issues or topics of comments reflect the entire activity of designated adjustments to reportable quantities. The basic issues deal with the following:

- What is a hazardous substance?
- What constitutes a release?
- Is the reportable quantity appropriate?

These questions form the framework for comments classification.

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TABLE 9-2. COMMENTS CLASSIFICATION SYSTEM FORMAT

<u>Identification</u>

Comment Number

Organization/Individual Name

Organization/Individual Category

    Industry, Public Interest/Environmental, Government Agency, Other

    SIC

Geographic Location

    State

<u>Issue/Topic</u>

Medium

    Air, Water, Land, Groundwater

Substance

    Each Designated Hazardous Substance

Persons Subject to the Notification Requirement

Hazardous Substance Designation Process

Release Potential/Mechanism

Reportable Quantity Level

Exemptions

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Anticipated Comment Topics/Necessary Experts

Table 9-3 presents a topics/experts matrix identifying in greater detail potential issues or topics that commentators may address, scientific or technical knowledge necessary to respond to respective comments, and professional disciplines normally associated with each field.

EXPERTS

A short list of experts fulfilling the needs of the expected comments appears below. As mentioned earlier, this list is incomplete, because this task was interrupted shortly after it was begun due to unexpected delays in the publication of the interpretive notice.

Martin Alexander
Laboratory of Soil Microbiology
Department of Agronomy
Cornell University
Ithaca, NY 14853
Biodegradation in water and soil

Bruce N. Ames
Professor of Biochemistry
University of Califronia
Berkeley, CA
Carcinogenicity testing

Henry T. Appleton
Syracuse Research Corporation
Merrill Lane
Syracuse, NY 13210
Fate and effects of toxic chemicals in water

Etcyl H. Blair
The Dow Chemical Company
Midland, MI 48640
Transport and fate studies

David R. Brown
Associate Professor and Director, Toxicology Program
Northeastern University
Boston, MA
Industrial toxicology, safety evaluation

James L. Burchfiel
Children's Hospital Medical Center
Boston, MA
Neurophysiology effects of toxicants

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TABLE 9-3. COMMENT TOPICS/EXPERTS MATRIX

Issue or Topic	Required Scientific/Technical Knowledge	Professional Discipline
Hazardous Substance Designation		
Concept of selection criteria	Toxicity	Toxicologists
Criteria themselves	Carcinogenicity	Occupational safety/health specialists
Effects basis	Mutagenicity	Aquatic ecologists
Acute vs chronic effects	Teratogenicity	Terrestrial ecologists
Synergism and antagonism between substances	Aquatic ecological effects	Biostatisticians
Human, animal, plant subject selection	Terrestrial ecological effects	Epidemiologists
Concentration level setting	Bioaccumulation	Explosive/fire specialists
Testing period	Ignitability	
Identification specificity	Corrosivity	
	Reactivity	
Hazardous Substance Release Potential		
Form of use	Production processes	Manufacturing chemists/engineers
Production rate	Packaging	Transportation officers
Substance handling	Distribution	Health/safety officers
Modes of distribution/shipping	Product transportation	
Value consideration		
Spill history		

(continued)

TABLE 9-3 (Continued)

Issue or Topic	Required Scientific/Technical Knowledge	Professional Discipline
Hazardous Substance Release Mechanism		
Ways substances enter environment	Physical/chemical characteristics of releases	Manufacturing chemists/ engineers
		Health/safety officers
	Dispersion, transport, persistence, transformation, accumulation of substances	Hydrologists
		Meteorologists
		Environmental scientists
Reportable Quantity Determination		
Basis for level	Overall environmental impact	Health, safety officers
Relationship to hazardous level	Environmental sampling and analysis	Occupational health, safety specialists
Multimedia treatment		Environmental sampling/analytical specialists
Accidental/episodic vs routine continuous/ intermittent releases		
Release time period		
Measurement capability		
Information availability		
Cost impact to comply with notification		

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Wendell L. Dilling
Environmental Sciences Research Laboratory
The Dow Chemical Company
Midland, MI 48640
Photochemical decomposition of organic compounds

Frank H. Duffy
Children's Hospital Medical Center
Boston, MA
Neuorophysiology effects of toxicants

Walter J. Farmer
Department of Soil and Environmental Sciences
University of California
Riverside, CA 92521
Behavior of toxic organic chemicals in the vapor phase

J. G. Fox
Division of Laboratory Animal Medicine
Massachusetts Institute of Technology
Cambridge, MA 02139
N-nitroso compounds

James J. Geraghty
Geraghty & Miller Inc.
6800 Jericho Turnpike
Syosset, NY 11791
Groundwater

Ray Harbison
University of Arkansas
Little Rock, AR
Toxicology

Fred C. Hart
Fred C. Hart Associates
New York, NY
General strategies

L. H. Keith
Radian Corporation
Austin, TX 78766
Chemical analysis of toxic chemicals

Richard A. Kimerle
Monsanto Company
St. Louis, MO 63166
Hazard evaluation

M.A.Q. Khan
Department of Biological Sciences
University of Illinois at Chicago Circle
Chicago, IL 60680
Chlorinated hydrocarbon pesticides

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William Lijinsky
Chemical Carcinogenesis Program
Frederick Cavero Research Center
Frederick, MD 21701
Carcinogenicity

Kenneth J. Macek
EG&G
Bionomics Aquatic Toxicology Laboratory
Wareham, MA 02571
Bioconcentration and elimination

Donald Mackay
Department of Chemical Engineering and Applied Chemistry
University of Toronto
Toronto, Ontario M5S1A4
Dispersion of contaminants into water and air

Theodore Mill
SRI International
Menlo Park, CA 94025
Fate of chemicals

Sheldon D. Murphy
Division of Toxicology
Department of Pharmacology
University of Texas Medical School at Houston
Houston, TX 77025
Toxicology

Randy Mott
Zuchert, Scoutt & Rosenberger
Washington, DC
Benefit/cost analysis

Efraim Racher
Cornell University
Ithaca, NY 14853
Carcinogenicity

Arnold E. Reif
Research Professor of Pathology
Boston University School of Medicine
Boston City Hospital
Boston, MA 02118
Causes of cancer

APPENDIX A

DEFINITIONS

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) was designed to complement previously existing regulatory programs under the Clean Air Act (CAA), Clean Water Act (CWA), Toxic Substances Control Act (TSCA), and the Resource Conservation and Recovery Act (RCRA). As an "umbrella" act, CERCLA's operative language and definitions has the potential to be in conflict with the language of acts that are directly affected by its provisions. To provide assurance that any inconsistencies in the definitions of the above acts do not pose a threat to the intended functioning of the statute, all the definitions of the CAA, CWA, TSCA, and RCRA were reviewed for potential conflicts and/or inconcistencies with CERCLA.

The definitions for all terms cited in the acts and compiled below were screened for inconsistencies. Where inconsistencies were found, the records were searched to uncover the basis and rationale for the discrepancies. The only definitions that were found to be inconsistent enough to warrant comment consistent with the purpose of this task are as follows:

"Onshore facility" - CERCLA vs CWA

"Owner or operator" - CERCLA vs CWA vs CAA

"Person" - CERCLA vs CWA vs RCRA

"Pollutant" - CERCLA vs CWA

"Remove or removal" - CERCLA vs CWA

"Vessel" - CERCLA vs CWA

It should be kept in mind that the purpose of this analysis was to ensure that the language of the various definitions, as it relates to CERCLA, is consistent and clear enough to facilitate enactment of the applicable sections of CERCLA pertaining to the designation of hazardous substances and the determination of their reportable quantities. The analysis of definition inconsistencies therefore was restricted to the terms' legal implications regarding the provisions of Sections 102 and 103.

Although several definitions were found to be materially inconsistent, the nature of the inconsistencies was primarily related to the broad scope of CERCLA in contrast to the more restricted scopes of the other Acts. The inconsistencies between the various definitions identified above appear to present no problem to either the interpretation or the enforceability of the applicable sections of CERCLA.

In addition to the above analysis, the text of CERCLA was reviewed in light of current EPA policy and the Act's legislative history for terms that might require definition over and above the meaning established by their common English usage.

TERM INCONSISTENCES

"ONSHORE FACILITY"

- o [CERCLA - Sec. 101(18)] means any facility (including, but not limited to, motor vehicles and rolling stock) of any kind located in, on, or under any land or non-navigable waters within the United States.
- o [CWA - Sec. 311(a)(1), section specific 3] means any facility (including, but not limited to, motor vehicles and rolling stock) of any kind located in, on, or under any land within the United States other than submerged land.

"Onshore facility" is essentially defined the same in the two acts except that the CERCLA definition includes "non-navigable waters" as a specification as to where an onshore facility is to be located, and the CWA definition excludes "submerged lands" from its specification of facility location.

The inclusion of "non-navigable waters" within the CERCLA definition appears to be related to the scope of the Act's provisions pursuant to Sections 102(a) and 103(a) in that releases to the environment denote all media pathways. Since the term "offshore facility" under CERCLA is defined with respect to "navigable waters" only (which is identical to the CWA definition), the inclusion of "non-navigable waters" within the CERCLA definition is consistent with the intent and scope of the Act. The differences noted above should not present any conflict with respect to the provisions of Section 103(a). More importantly, Section 304(c) of CERCLA provides that any conflicts between CERCLA and Section 311 of the CWA will be resolved in CERCLA's favor.

"OWNER or OPERATOR"

- o [CERCLA - Sec. 101(20)] means (A)(i) in the case of a vessel, any person owning, oeprating, or chartering by demise, such vessel, (ii) in the case of an onshore facility or an offshore facility, any person owning or operating such facility, and (iii) in the case of any abandoned facility, any person who owned, operated, or otherwise controlled activities at such facility immediately prior to such abandonment. Such term does not include a person who, without participating in the management of a vessel or facility, holds indicia of ownership primarily to protect his security interest in the vessel or facility.

  (B) in the case of a hazardous substance which has been accepted for transportation by a common or contract carrier and except as provided in Section 107(a)(3) or (4) of this Act, (i) the term "owner or operator" shall mean such common carrier or other bona fide for-hire carrier acting as an independent contractor during such transportation, (ii) the shipper of such hazardous substance shall not be considered to have caused or contributed to any release during such transportation which resulted solely from circumstances or conditions beyond his control;

  (C) in the case of a hazardous substance which has been delivered by a common or contract carrier to a disposal or treatment facility and except as provided in Section 107(a)(3) or (4) (i) the term "owner or operator" shall not include such common or contract carrier, and (ii) such common or contract carrier shall not be considered to have caused or contributed to any release at such disposal or treatment facility resulting from circumstances or conditions beyond its control.

- [CWA - Sec. 311(a)(6), section specific 311] means (A) in the case of a vessel, any person owning, operating, or chartering by demise, such vessel, and (B) in the case of an onshore facility, and an offshore facility, any person owning or operating such onshore facility or offshore facility, and (C) in the case of any abandoned offshore facility, the person who owned or operated such facility immediately prior to such abandonment.

- [CAA - Sec. 112(a)(3), section specific 112] shall have the same meaning as such terms have under section 111(a). (Section 111(a)(5) of the CAA defines "owner or operator" as "any person who owns, leases, operates, controls, or supervises a stationary source.")

The meaning of the term "owner or operator" as defined by the above three acts differ significantly. The CWA definition restricts its language in the case of abandoned facilities to offshore facilities and is silent with respect to the CERCLA definition in clarifying who is an "owner or operator" in the case of hazardous substances that are accepted and/or delivered by a common or contract carrier. The CAA definition relates the term in question to a "stationary source" that includes under Section 111(a)(3) "any building, structure, facility, or installation which emits or may emit any air pollutant."

The scope of CERCLA's legislative mandate requires that the term "owner or operator" be extended to establish legal responsibility for virtually all the ways a release can enter the environment. As such, the Act defines the term with respect to transportation of hazardous substances as well as making no distinction between an "offshore facility" or an "onshore facility" in the case of an abandoned facility. The CWA is limited in scope to include navigable waters only and therefore is restricted in its language to the "offshore" environment with respect to abandoned facilities. In any event, the provisions for conflict resolution under Section 304(c) of CERCLA apply.

The CAA's reference to a "stationary source" in its definition of the term "owner or operator" can be related to the same concept of facility as covered by the other two acts in consideration of the definition of "stationary source" under Section 112(a)(3) of the CAA. The CAA specifies that "any building, structure, facility, or installation which emits or may emit any air pollutant" is considered a "stationary source" under its definition. Consequently the language of the CAA does allow releases of air pollutants from a facility to be tied to the language of establishing legal responsibility under the Act.

"PERSON"

- [CERCLA - Sec. 101(21)] means an individual, firm, corporation, association, partnership, consortium, joint venture, commercial entity, United States Government, State, municipality, commission, political subdivision of a State, or any interstate body.

- [CWA - Sec. 311(a)(7), section specific 311] includes an individual, firm, corporation, association, and a partnership.

- [RCRA - Sec. 1004(15)] means an individual, trust, firm, joint stock company, corporation (including a government corporation), partnership, association, State, municipality, commission, political subdivision of a State, or any interstate body.

Under CERCLA, CWA, RCRA, and CAA there are seven separate definitions of "person." Of the definitions cited above that relate to applicable sections of the various acts, each includes individual, firm, corporation, association, and partnership in their specification of "person." Both CERCLA and RCRA also include state, municipality, commission, political subdivision, and interstate body in their definitions. The CERCLA definition is the only definition to include consortium, joint venture, commercial entity, and U.S. Government in its language.

The definition under CERCLA is more broad, in keeping with the scope and provisions of the Act. The term's broad scope should not present a conflict with the provisions of the other acts.

"POLLUTANT" (or "CONTAMINANT" - CERCLA)

- [CERCLA - Sec. 104(a)(2), section specific 104] shall include, but not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

The term does not include petroleum, including crude oil and any fraction thereof which is not otherwise specifically listed or designated as hazardous substances under Section 101(14)(A) through (F) of this title, nor does it include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).

o [CWA - Sec. 502(6), except as provided] means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.

This term does not mean (A) "sewage from vessels" within the meaning of Section 312 of this Act; or (B) water, gas, or other material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil or gas production and disposed of in a well, if the well used either to facilitate production or for disposal purposes is approved by authority of the State in which the well is located, and if such State determines that such injection or disposal will not result in the degradation of ground or surface water resources.

The term under CERCLA is broadly defined to include essentially every sort of substance, including "disease-causing agents," that can be released into the environment and shows a link to death, disease, etc. exclusive of petroleum or natural gas. The term under CWA is narrowly defined to include specific substances, including heat, that are discharged into water, exclusive of "sewage from vessels" or other material injected into wells to facilitate oil and gas production. In addition, water derived from a State-approved production well that is reinjected or disposed of is also exempt from the definition.

Since CERCLA contains a broad mandate to provide authority to respond to all releases into the environment, the definition of "pollutant" contains no restrictions as to specific media pathways. No apparent conflict exists between response authorities of the two acts as a result of the differences in their respective definitions. If conflicts were present, the provisions of Section 304(c) would apply.

"REMOVE or REMOVAL"

- [CERCLA - Sec. 101(23)] means the cleanup or removal of released hazardous substances from the environment, such actions as may be necessary taken in the event of the threat of release of hazardous substances into the environment, such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances, the disposal of removed material, or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release.

  The term includes, in addition, without being limited to, security fencing or other measures to limit access, provision of alternative water supplies, temporary evacuation and housing of threatened individuals not otherwise provided for, action taken under Section 104(b) of this Act, and any emergency assistance which may be provided under the Disaster Relief Act of 1974.

- [CWA - Sec. 311(a)(8), section specific 311] refers to removal of the oil or hazardous substances from the water and shorelines or the taking of such other actions as may be necessary to minimize or mitigate damage to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches.

The definition in the CWA refers to removal of oil and hazardous substances from waters and shorelines, as well as "other actions that may be necessary to minimize or mitigate damage." The CERCLA definition is more comprehensive as it specifies actions for removal and cleanup of hazardous substances from the environment with no specification of media pathways. CERCLA also includes actions that are authorized to monitor and assess releases or threats of release. Since the term "Hazardous Substance" as defined in CERCLA specifically excludes petroleum, the actions under the definition of "remove or removal" pursuant to CERCLA does not extend to petroleum releases. The implications are that authority for removing petroleum from the environment falls outside the authority of CERCLA and comes under the provisions of Section 311(c)(1) of the CWA.

"VESSEL"

- o [CERCLA - Sec. 101(28)] means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water.
- o [CWA - Sec. 311(a)(3), section specific 311] means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water other than a public vessel.

The only difference in the definition of terms under the two acts is the exclusion of "public vessel" from the definition under the CWA. The implication is that CERCLA pertains to all types of vessels under its provisions, which is entirely consistent with its legislative mandate.

NEW DEFINITIONS

"REPORTABLE QUANTITY" [Section 102(b)]

means a quantity of a hazardous substance as set forth in subsection 1, the release of which requires notice as set forth in subsection 2. Blank subsections refer to forthcoming regulations pursuant to Sections 102(b) and 103(a) that list RQs and prescribe notification instructions, respectively.

"MIXTURE" [Section 102(a)]

means any combination of two or more substances in varying proportions that retain their own individual properties.

"PUBLIC WELFARE" [Section 102(a)]

includes, but is not limited to, private and public property, economic and aesthetic values, weather, visibility, animals, crops, man-made materials, and personal comfort and well-being.

"AFFECTED STATE" [Section 103(a)]

means that state or states within which a release occurs, or that state or states that may be materially influenced by such a release originating beyond its borders.

"WORKPLACE" [Section 101(22)(A)]

means a facility that is totally enclosed such that a release of a hazardous substance within its confines cannot enter the environment.

"SUBSTANTIAL THREAT OF RELEASE" [Section 104(a)(1)(A)]

means an imminent event that requires an immediate response in accordance with subsection 1 in order to prevent such a release. (The blank subsection refers to forthcoming regulations describing the type of responses authorized by the Act in Sections 104, and the National Contingency Plan.)

"IN CHARGE" [Section 103(b)]

means, in the case of a vessel or facility, exercising control of operations or custody at the time of a release of a hazardous substance equal to or greater than its reportable quantity as set forth in subsection 1. (The blank subsection refers to forthcoming regulations that list RQs for designated hazardous substances.)

"STABLE IN QUANTITY AND RATE" [Section 103(f)(2)]

in the case of routine continuous or anticipated intermittent releases means within normal limits characteristic of the circumstances of the release.

"CONSUMER PRODUCT IN CONSUMER USE" [Section 101(9)(B)]

means any article sold to a consumer for that person's use, consumption, or enjoyment in or around a household, residence, school, in recreation or otherwise.

"NUCLEAR INCIDENT, SOURCE, BYPRODUCT, SPECIAL NUCLEAR MATERIAL" [Section 101(22)(c)]

means the same as those terms as defined in the Atomic Energy Act of 1954.

"NORMAL APPLICATION OF FERTILIZER" [Section 101(22)]

means application in accordance with label instructions and consistent with the product's customary uses.

"PUBLIC RECORD" [Section 101(10)]

means the NPDES permit application or the NPDES permit itself and the "record for final permit" as defined in 40 CFR Part 124.122.

"TOXIC POLLUTANT" [Section 101(14)(D)]

means the same as those listed under Section 307(a)(1) of the Federal Water Pollution Control Act.

"HAZARDOUS AIR POLLUTANT" [Section 101(14)(E)]

means the same as those listed under Section 112 of the Clean Air Act.

"IMMINENTLY HAZARDOUS CHEMICAL SUBSTANCE OR MIXTURE" [Section 306(a)]

means the same as those that are subject to action by the Administrator pursuant to Section 7 of the Toxic Substances Control Act.

"HAZARDOUS MATERIAL" [Section 306(a)]

means the same as that defined under 49 CFR Part 171 pursuant to the Hazardous Material Transportation Act.

"PUBLIC HEALTH" [Section 102(a)]

means human health and well-being of the population of the United States.

"STATISTICALLY SIGNIFICANT INCREASE" [Section 103(f)(2)]

means, in the case of routine, continuous, or anticipated intermittent releases, a statistical increase as measured by the student's t-test at a level of significance set forth in subsection 1. (Blank subsection refers to forthcoming regulations that will explain, in detail, the procedures for obtaining the appropriate statistical measures.)

COMPILATION OF TERMS

The compilation of terms from the several related acts follows in alphabetical order.

DEFINITIONS

This is an alphabetized compilation of all defined terms cited in the following acts:

1. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980. (CERCLA)
2. The Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (Commonly Referred to as the Clean Water Act) (CWA).
3. The Toxic Substances Control Act (TSCA)
4. The Clean Air Act (CAA)
5. The Resource Conservation and Recovery Act of 1976 (RCRA)

Reference Citations Format:

(Act - Text location, part of act to which definition applies): Example - (CWA - Sec. 112(a), SS 109-112) Term applies to the entire act, except as noted. Underlined words in definitions and, as appropriate, paragraph spacing are for editorial emphasis only.

SS means Section Specific
TS means Title Specific

PS means Paragraph Specific

CS means Chapter Specific

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"ACADEMIC YEAR"

1. means an academic year or its equivalent, as determined by the Administrator.

   (CWA - Sec. 112(a), SS 109-112)

"ACT OF GOD"

1. means an unanticipated grave natural disaster or other natural phenomenon of an exceptional, inevitable, and irresistible character, the effects of which could not have been prevented or avoided by the exercise of due care or foresight.

   (CERCLA - Sec. 101(1))

2. means an act occasioned by an unanticipated grave natural disaster.

   (CWA - Sec. 311(a)(12), SS 311)

"ADMINISTRATOR"

1. means the Administrator of the United States Environmental Protection Agency.

   (CERCLA - Sec. 101(2))

2. means the Administrator of the Environmental Protection Agency.

   (TSCA - Sec. 3(1))

3. means the Administrator of the Environmental Protection Agency.

   (CAA - Sec. 302(a))

4. means the Administrator of the Environmental Protection Agency

   (RCRA - Sec. 1004(1))

"AIR POLLUTANT"

1. means any air pollution agent or combination of such agents, including a physical, chemical, biological, radioactive (including source material, special nuclear material, and by-product material) substance or matter which is emitted into or otherwise enters the ambient air.

(CAA - Sec. 302(g))

"AIR POLLUTION CONTROL AGENCY"

1. means any of the following:

(A)A single State agency designated by the Governor of that State as the official State air pollution control agency for purposes of this Act.

(B) An agency established by two or more States and having substantial powers or duties pertaining to the prevention and control of air pollution.

(C) A city, county, or other local government health authority, or, in case of any city, county, or other local government in which is an agency other than the health authority charged with responsibility for enforcing ordinances or laws relating to the prevention and control of air pollution, such other agency.

(D) An agency of two or more municipalities located in the same State or in different States and having substantial powers or duties pertaining to the prevention and control of air pollution.

(CAA - Sec. 302(b))

"AS EXPEDITIOUSLY AS PRACTICABLE"

1. means as expeditiously as practicable but in no event later than five years after the date of approval of a plan revision under this section (or the date of promulgation of such a plan revision in the case of action by the Administrator under section 110(c) for purpose of this section.)

   (CAA - Sec. 169A(g)(4), SS 169A)

"BARREL"

1. means forty-two United States gallons at sixty degrees Fahrenheit.

   (CERCLA - Sec. 101(3))

2. means 42 United States gallons.

   (CERCLA -Title II, Subtitle A, Chapter 38,Subchapter A, Sec. 4612(a)(8), CS 38A)

3. means 42 United States gallons at 60 degrees Fahrenheit.

   (CWA - Sec. 311(a)(13), SS 311)

"BASELINE CONCENTRATION"

1. means, with respect to a pollutant, the ambient concentration levels which exist at the time of the first application for a permit in an area subject to this part, based on air quality data available in the Environmental Protection Agency or a State air pollution control agency and on such monitoring data as the permit applicant is required to submit. Such ambient concentration levels shall take into account all projected emissions in, or which may affect, such area from any major emitting facility on which construction commenced prior to January 6, 1975, but which has not begun operation by the date of the baseline air quality concentration determination. Emissions of sulfur oxides and particulate matter from any major emitting facility on which construction commenced after January 6, 1975, shall not be included in the baseline and shall be counted against the maximum allowable increases in pollutant concentrations established under this part.

   (CAA - Sec. 169(4), PSC)

"BASELINE MODEL YEAR"

1. means, with respect to any pollutant emitted from any vehicle or engine, or class or category thereof, the model year immediately preceding the model year in which Federal standards applicable to such vehicle or engine, or class or category thereof, first applied with respect to such pollutant.

(CAA - Sec. 202(a)(3)(A)(v), PS 202(a)(3)(A)(v))

"BASIN"

1. includes, but is not limited to, rivers and their tributaries, streams, coastal waters, sounds, estuaries, bays, lakes, and portions thereof, as well as the lands drained thereby.

(CWA - SS 102(c)(3),SS 102(c))

"BEST AVAILABLE CONTROL TECHNOLOGY"

1. means an emission limitation based on the maximum degree of reduction of each pollutant subject to regulation under this Act emitted from or which results from any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production, processes and available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of each such pollutant. In no event shall application of 'best available control technology' result in emissions of any pollutants which will exceed the emissions allowed by any applicable standard established pursuant to section 111 or 112 of this Act.

(CAA - Sec. 169(3), PSC)

"BIOLOGICAL MONITORING"

1. shall mean the determiniation of the effects on aquatic life, including accumulation of pollutants in tissue, in receiving waters due to the discharge of pollutants (A) by techniques and procedures, including sampling of organisms representative of appropriate levels of the food chain appropriate to the volume and the physical, chemical, and biological characteristics of the effluent, and (B) at appropriate frequencies and locations.

(CWA - Sec. 502(15)), Except as provided

"BOARD"

1. means the Low-Emission Vehicle Certification Board.

(CAA - Sec. 212(a)(1), SS 212)

"CATEGORY OF CHEMICAL SUBSTANCES"

1. means a group of chemical substances the members of which are similar in molecular structure, in physical, chemical, or biological properties, in use, or in mode of entrance into the human body or into the environment, or the members of which are in some other way suitable for classification as such for purposes of this Act, except that such term does not mean a group of chemical substances which are grouped together solely on the basis of their being new chemical substances.

(TSCA - Sec. 26(b)(2)(A), SS 26(b)(1))

"CATEGORY OF MIXTURES"

1. means a group of mixtures the members of which are similar in molecular structure, in physical, chemical, or biological properties, in use, or in the mode of entrance into the human body or into the environment, or the members of which are in some other way suitable for classification as such for purposes of this Act.

(TSCA - Sec. 26(b)(2)(B), SS 26(b)(1))

"CHEMICAL SUBSTANCE"

1. means (A) any organic or inorganic substance of a particular molecular identity, including (i) any combination of such substances occurring in whole or in part as a result of a chemical reaction or occurring in nature, and (ii) any element or uncombined radical.

   (B) Such term does not include (i) any mixture, (ii) any pesticide (as defined in the Federal Insecticide, Fungicide, and Rodenticide Act) when manufactured, processed, or distributed in commerce for use as a pesticide, (iii) tobacco or any tobacco product, (iv) any source material, special material, or by product material (as such terms are defined in the Atomic Energy Act of 1954 and regulations issued under such Act), (v) any article the sale of which is subject to the tax imposed by section 4181 or 4221 or any other provision of such Code), and (vi) any food, food additive, drug, cosmetic, or device (as such terms are defined in section 201 of the Federal Food, Drug, and Cosmetic Act) when manufactured, processed or distributed in commerce for use as a food, food additive, drug, cosmetic, or device. (Except as provided in subparagraph (B) of Sec. 3.)

   (TSCA - Sec. 3(2)(A))

"CITIZEN"

1. means a person or persons having an interest which is or may be adversely affected.

   (CWA - Sec. 505(g), SS 505)

"CLAIM"

1. means a demand in writing for a sum certain.

   (CERCLA - Sec. 101(4))

"CLAIMANT"

1. means any person who presents a claim for compensation under this Act.

   (CERCLA - Sec. 101(5))

"COMMENCED"

1. as applied to construction of a major emitting facility means that the owner or operator has obtained all necessary preconstruction approvals or permits required by Federal, State, or local air pollution emissions and air quality laws or regulations and either has (i) begun, or caused to begin, a continuous program of physical on-site construction of the facility of (ii) entered into binding agreements or contractual obligations, which cannot be canceled or modified without substantial loss to the owner or operator, to undertake a program of construction of the facility to be completed within a reasonable time.

(CAA - Sec. 169(2)(A), PSC)

"COMMERCE"

1. means trade, traffic, transportation, or other commerce (A) between a place in a State and any place outside of such State, or (B) which affects trade, traffic, transportation, or commerce described in clause (A).

(TSCA - Sec. 3(3))

2. means (A) commerce between any place in any State and any place outside thereof; and (B) commerce wholly within the District of Columbia.

(CAA - Sec. 216(6), TS II)

"COMMERCIAL VESSELS"

1. means those vessels used in the business of transporting property for compensation or hire, or in transporting property in the business of the owner, lessee, or operator of the vessel.

(CWA - Sec. 312(a)(10), SS 312)

"COMPREHENSIVE PLANNING"

1. include planning or management respecting resource recovery and resource conservation.

(RCRA - Sec. 1004(30))

"CONSTRUCTION"

1. means any one or more of the following: preliminary planning to determine the feasibility of treatment works, engineering, architectural, legal, fiscal, or economic investigations or studies, surveys, designs, plans, working drawings, specifications, procedures, or other necessary actions, erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works, or the inspection or supervision of any of the foregoing items.

   (CWA - Sec. 212(1), TS II)

2. means any placement, assembly, or installation of facilities or equipment (including contractual obligations to purchase such facilities or equipment) at the premises where such equipment will be used, including preparation work at such premises.

   (CWA - Sec. 306(a)(5), SS 306)

3. when used in connection with any source of facility, includes the modification (as defined in section 111(a)) of any source or facility.

   (CAA - Sec. 169(2)(C), PSC)

4. with respect to any project of construction under this Act, means (A) the erection or building of new structures and acquisition of lands or interests therein, or the acquisition, replacement, expansion, remodeling,. alteration, modernization, or extension of existing structures, and

   (B) the acquisition and installation of initial equipment of, or required in connection with, new or newly acquired structures or the expanded, remodeled, altered, modernized or extended part of existing structures (including trucks and other motor vehicles, and tractors, cranes, and other machinery) necessary for the proper utilization and operation of the facility after completion of the project; and includes preliminary planning to determine the economic and engineering feasibility and the public health and safety aspects of the project, the engineering, architectural, legal, fiscal, and economic investigations and studies, and any surveys, designs, plans, working drawings, specifications, and other action necessary for the carrying out of the project, and

   (C) the inspection and supervision of the process of carrying out the project to completion.

   (RCRA - Sec. 1004(2))

"CONTAMINANT"

1. shall include, but not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

   The term does not include petroleum, including crude oil and any fraction thereof which is not otherwise specifically listed or designated as hazardous substances under section 101(14)(A) through (F) of this title, nor does it include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (of mixtures of natural gas and such synthetic gas).

   (CERCLA - SEC. 104(a)(2), SS 104)

"CONTIGUOUS ZONE"

1. shall have the meaning provided in section 502 of the Federal Water Pollution Control Act.

   (CERCLA - Sec. 101(30))

2. means the entire zone established or to be established by the United States under article 24 of the Convention on the Territorial Sea and the Contiguous Zone.

   (CWA - Sec. 311(a)(9), SS 311)

3. means the entire zone established or to be established by the United States under article 24 of the Convention of the Territorial Sea and the Contiguous Zone.

   (CWA - Sec. 502(9)), Except as provided

"CONTROL"

1. of a corporation means ownership of more than 50 percent of its stock.

(CAA - Sec. 325(c)(2), SS 325)

"CRUDE OIL"

1. includes crude oil condensates and natural gasoline.

(CERCLA -Title II, Subtitle A, Chapter 38, Subchapter A, Sec. 4612(a)(1), CS 38A)

"DAMAGES"

1. means damages for injury or loss of natural resources as set forth in section 107(a) or 111(b) of this Act.

(CERCLA - Sec. 101(6))

"DEALER"

1. means any person who is engaged in the sale or the distribution of new motor vehicles or new motor vehicle engines to the ultimate purchaser.

(CAA - Sec. 216(4), TS II)

"DELAYED COMPLIANCE ORDER"

1. means an order issued by the State or by the Administrator to an existing stationary source, postponing the date required under an applicable implementation plan for compliance by such source with any requirement of such plan.

(CAA - Sec. 302(o))

"DEMONSTRATION"

1. means the initial exhibition of a new technology process or practice or a significantly new combination or use of technologies, processes or practices, subsequent to the development stage, for the purpose of proving technological feasibility and cost effectiveness.

(RCRA - Sec. 1004(2A))

"DESIGNED FOR EMISSION CONTROL"

1. as used in the preceding sentence means a catalytic converter, thermal reactor, or other component installed on or in a vehicle for the sole or primary purpose of reducing vehicle emissions (not including those vehicle components which were in general use prior to model year 1968 and the primary function of which is not related to emission control).

(CAA - Sec. 207(a)(3),, Sentence Specific, Sec. 207(a)(3) 1st Sentence)

"DISCHARGE"

1. includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping, but excludes (A) discharges in compliance with a permit under section 402 of this Act,

(B) discharges resulting from circumstances identified and reviewed and made a part of the public record with respect to a permit issued or modified under section 402 of this Act, and subject to a condition in such permit, and

(C) continuous or anticipated intermittent discharges from a point source, identified in a permit or permit application under section 402 of this Act, which are caused by events occuring within the scope of relevant operating or treatment systems.

(CWA - Sec. 311(a)(2), SS 311)

2. includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping.

(CWA - Sec. 312(a)(9), SS 312)

3. when used without qualification includes a discharge of a pollutant, and a discharge of pollutants.

(CWA - Sec. 502(16)),Except as provided

"DISCHARGE OF A POLLUTANT" or "DISCHARGE OF POLLUTANTS"

1. each means (A) any addition of any pollutant to navigable waters from any point source, (B) any addition of any pollutant to the water of the contiguous zone or the ocean from any point source other than a vessel or other floating craft.

(CWA - Sec. 502(12)),Except as provided

"DISPERSION TECHNIQUE"

1. includes any intermittent or supplemental control of air pollutants varying with atmospheric conditions.

(CAA - Sec. 123(b), SS 123)

"DISPOSAL"

1. shall have the meaning provided in section 1004 of the Solid Waste Disposal Act.

(CERCLA - Sec. 101(29))

2. means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous wastes into or on any land or water so that such solid waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters.

(RCRA - Sec. 1004(3))

"DISTRIBUTE IN COMMERCE" and "DISTRIBUTION IN COMMERCE"

1. when used to describe an action taken with respect to a chemical substance or mixture or article containing a substance or mixture mean to sell, or the sale of, the substance, mixture, or article in commerce; to introduce or deliver for introduction into commerce, or the introduction or delivery for introduction into commerce of, the substance, mixture, or article; or to hold, or the holding of, the substance, mixture, or article after its introduction into commerce.

(TSCA -Title II, Subtitle A, Chapter 38, Subchapter A, Sec. 3(4))

"DOMESTIC CRUDE OIL"

1. means any crude oil produced from a well located in the United States.

(CERCLA - Sec. 4612(a)(2), CS 38A)

"DRINKING WATER SUPPLY"

1. means any raw or finished water source that is or may be used by a public water system (as defined in the Safe Drinking Water Act) or as drinking water by one or more individuals.

(CERCLA - Sec. 101(7))

"EFFECTS ON WELFARE"

1. includes, but is not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being.

(CAA - Sec. 302(h))

"EFFLUENT LIMITATIONS"

1. means any restriction established by a State or the Administration on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean, including schedules of compliance.

(CWA - Sec. 502(11)), Except as provided

"EFFLUENT STANDARD OR LIMITATION UNDER THIS ACT"

1. means (1) effective July 1, 1973, an unlawful act under subsection (a) of section 301 of this Act;

(2) an effluent limitation or other limitation under section 301 or 302 of this Act;

(3) standard of performance under section 306 of this Act;

(4) prohibition, effluent standard or pretreatment standards under section 307 of this Act;

(5) certification under section 401 of this Act; or

(6) a permit or condition thereof issued under section 402 of this Act, which is in effect under this Act (including a requirement applicable by reason of section 313 of this Act).

(CWA - Sec. 505(f), SS 505)

"ELIGIBLE TREATMENT WORKS"

1. means those treatment works in each State which meet the requirements of section 201(g)(5) of this Act and which can be fully funded from funds available for such purpose in such State in the fiscal years ending September 30, 1979, September 30, 1980, and September 30, 1981. Such term does not include collector sewers, interceptors, storm or sanitary sewers or the separation thereof, or major sewer rehabilitation.

(CWA - Sec. 202(a)(4), SS 202)

"EMISSION STANDARD OR LIMITATION"

1. means (1) a schedule or timetable of compliance, emission limitation, standard of performance or emission standard.

   (2) a control or prohibition respecting a motor vehicle fuel or fuel additive, which is in effect under this Act (including a requirement applicable by reason of section 118) or under an applicable implementation plan, or

   (3) any condition or requirement of a permit and part C of title I (relating to nonattainment), any condition or requirement of section 113(d) (relating to certain enforcement orders), 119 (relating to primary nonferrous smelter orders), any condition or requirement under an applicable implementation plan relating to transportation control measures, air quality maintenance plans, vehicle inspection and maintenance programs, or vapor recovery requirements, section 211(e) and (f) (relating to fuels and fuel additives), section 169A (relating to visibility protection), any condition or requirement under part B of title I (relating to ozone protection), or any requirement under section 111 or 112 without regard to whether such requirement is expressed as an emission standard or otherwise.

   (CAA - Sec. 304(f), SS 304)

2. "EMISSION LIMITATION" —means a requirement established by the State or the Administrator which limits the quantity, rate, or concentration of emissions of air pollutants on a continuous basis including any requirement relating to the operation or maintenance of a source to assure continuous emission reduction.

   (CAA - Sec. 302(k))

3. "EMISSION STANDARD" --- means a requirement established by the State or the Administrator which limits the quantity, rate, or conentration of emissions of air pollutants on a continuous basis including any requirement relating to the operation or maintenance of a source to assure continuous emission reduction.

(CAA - Sec. 302(k))

"ENVIRONMENT"

1. means (A) the navigable waters, the waters of the contiguous zone, and the ocean waters of which the natural resources are under the exclusive management authority of the United States under the Fishery Conservation and Management Act of 1976, and (B) any other surface water, ground water, drinking water supply, land surface or subsurface strata, or ambient air within the United States or under the jurisdiction of the United States.

(CERCLA - Sec. 101(8))

2. includes water, air, and land and the interrelationship which exists among and between water, air, and land and all living things.

(TSCA - Sec. 3(5))

"EVIDENCE"

1. as used in clause (i) the term means any matter in the rulemaking record.

(TSCA - Sec. 19(c)(1)(B)(iii), SS 19(c)(1)(B)(i))

"EXISTING SOURCE"

1. means any stationary source other than a new source.

(CAA - Sec. 111(a)(6), SS 111)

2. shall have the same meaning as such terms have under section 111(a).

(CAA - Sec. 112(a)(3), SS 112)

"EXISTING VESSEL"

1. includes every description of watercraft or other artifical contrivance used, or capable of being used, as a means of transportation on the navigable waters, the construction of which is initiated before promulgation of standards and regulations under this section.

(CWA - Sec. 312(a)(2), SS 312)

"FACILITY"

1. means (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any vessel.

(CERCLA - Sec. 101(9))

"FEDERAL AGENCY"

1. means any department, agency, or other instrumentality of the Federal Government, any independent agency or establishment of the Federal Government including any Government corporation, and the Government Printing Office.

(RCRA - Sec. 1004(4))

"FEDERAL GOVERNMENT"

1. includes the legislative, executive, and judicial branches of the Government of the United States, and the government of the District of Columbia.

(CAA - Sec. 212(a)(2), SS 212)

"FEDERAL LAND MANAGER"

1. means with respect to any lands in the United States the Secretary of the department with authority over such land.

(CAA - Sec. 302(i))

"FEDERALLY PERMITTED RELEASE"

1. means (A) discharges in compliance with a permit under section 402 of the Federal Water Pollution Control Act,

(B) discharges resulting from circumstances identified and reviewed and made part of the public record with respect to a permit issued or modified under section 402 of the Federal Water Pollution Control Act and subject to a condition of such permit,

(C) continuous or anticipated intermittent discharges from a point source, identified in a permit or permit application under section 402 of the Federal Water Pollution Control Act, which are caused by events occuring within the scope of relevant operating or treatment systems,

(D) discharges in compliance with a legally enforceable permit under section 404 of the Federal Water Pollution Control Act,

(E) releases in compliance with legally enforceable final permit issued pursuant to section 3005(a) through (d) of the Solid Waste Disposal Act from a hazardous waste treatment, storage, or disposal facility when such permit specifically identifies the hazardous substances and makes such substances subject to a standard of practice, control procedure or bioassay limitation or condition, or other control on the hazardous substances in such releases,

(F) any release in compliance with a legally enforceable permit issued under section 102 of section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972,

(G) any injection of fluids authorized under Federal undergound injection control programs or State programs submitted for Federal approval (an not disapproved by the administrator of the Envirormental Protection Agency) pursuant to part C of the Safe Drinking Water Act,

(H) any emission into the air subject to a permit or control regulation under section 111, section 112, title I part C, title I part D, or State implementation plans submitted in accordance with section 110 of the Clean Air Act (and not disapproved by the Administrator of the Environmental Protection Agency), including any schedule or waiver granted, promulgated, or approved under these sections,

(I) any injection of fluids or other materials authorized under applicable State law (i) for the purpose of stimulating or treating wells for the production of crude oil, natural gas, or water, (ii) for the purpose of secondary, tertiary, or other enhanced recovery of crude oil or natural gas, or (iii) which are brought to the surface in conjunction with the production of crude oil or natural gas and which are reinjected,

(J) the introduction of any pollutant into a publicly owned treatment works when such pollutant is specified in and in compliance with applicable pretreatment standards of section 307 (b) or (c) of the Clean Water Act and enforceable requirements in a pretreatment program submitted by a State or municipality for Federal approval under section 402 of such Act, and

(K) any release of source, special nuclear, or byproduct material, as those terms are defined in the Atomic Energy Act of 1954, in compliance with a legally enforceable license, permit, regulation, or order issued pursuant to the Atomic Energy Act of 1954.

(CERCLA - Sec. 101(10))

"FOOD"

1. as used in clause (vi) of this subparagraph includes poultry and poultry products (as devined in sections 4(e) and 4(f) of the Poultry Products Inspection Act), meat and meat food products (as defined in section 1(j) of the Federal Meat Inspection Act), and eggs and egg products (as defined in section 4 of the Egg Products Inspection Act).

(TSCA - Sec. 3(2)(A))

"FRACTIONAL PART OF BARREL"

1. In the case of a fraction of a barrel, the tax imposed by section 4611 shall be the same fraction of the amount of such tax imposed on a whole barrel.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter A, Sec. 4612(a)(9), CS 38A)

"FRACTIONAL PART OF TON"

1. In the case of a fraction of a ton, the tax imposed by section 4661 shall be the same fraction of the amount of such tax imposed on a whole ton.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter B, Sec. 4662(a)(5), CS 38B)

"FUEL ECONOMY IMPROVEMENT STANDARD"

1. means a requirement of a percentage increase in the number of miles of transportation provided by a manufacturer's entire annual production of new motor vehicles per unit of fuel consumed, as determined for each manufacturer in accordance with test procedures established by the Administrator pursuant to this Act. Such term shall not include any requirement for any design standard or any other requirement specifying or otherwise limiting the manufacturer's discretion in deciding how to comply with the fuel economy improvement standard by any lawful means.

(CAA - Sec. 213(a)(2), SS 213)

"FUND" or "TRUST FUND"

1. means the Hazardous Substance Response Fund established by section 221 of this Act or, in the case of a hazardous waste disposal facility for which liability has been transferred under section 107(k) of this Act, the Post-closure Liability Fund established by section 232 of this Act.

(CERCLA - Sec. 101(11))

"GASOLINE"

1. has the meaning provided under regulations of the Administrator promulgated under this section.

(CAA - Sec. 211(g)(1)(A), SS 211(g))

"GRAYWATER"

1. means galley, bath, and shower water.

(CWA - Sec. 312(a)(11), SS 312)

"GROUND WATER"

1. means water in a saturated zone or stratum beneath the surface of land or water.

(CERCLA - Sec. 101(12))

"GUARANTOR"

1. means any person, other than the owner or operator, who provides evidence of financial responsibility for an owner or operator under this Act.

(CERCLA - Sec. 101(13))

"HALOCARBON"

1. means the chemical compounds $CFCL_3$ and CF_2Cl_2 and such other halogenated compounds as the Administrator determines may reasonably be anticipated to contribute to reductions in the concentration of ozone in the stratosphere.

(CAA - Sec. 152(1), TS I(B))

"HAZARDOUS AIR POLLUTANT"

1. means an air pollutant to which no ambient air quality standard is applicable and which in the judgment of the Administrator causes, or contributes to, air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness.

(CAA - Sec. 112(a)(1), SS 112)

"HAZARDOUS SUBSTANCE"

1. means (A) any substance designated pursuant to section 311(b)(2)(A) of the Federal Water Pollution Control Act,

   (B) any element, compound, mixture, solution, or substance designated pursuant to section 102 of this Act,

   (C) any hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by the Act of Congress),

   (D) any toxic pollutant listed under section 307(a) of the Federal Water Pollution Control Act,

   (E) any hazardous air pollutant listed under section 112 of the Clean Air Act, and

   (F) any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to section 7 of the Toxic Substances Control Act.

   The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

   (CERCLA - Sec. 101(14))

2. means any substance designated pursuant to subsection (b)(2) of this section.

   (CWA - Sec. 311(a)(14), SS 311)

"HAZARDOUS WASTE"

1. shall have the meaning provided in section 1004 of the Solid Waste Disposal Act.

   (CERCLA - Sec. 101(29))

2. means any waste (A) having the characteristics identified under section 3001 of the Solid Waste Disposal Act, as in effect on the date of the enactment of this Act (other than waste the regulation of which under such Act has been suspended by the Act of Congress on that date), or (B) subject to the reporting or recordkeeping requirements of sections 3002 and 3004 of such Act, as so in effect.

   (CERCLA - Title II, Subtitle C, Chapter 38, Subchapter C, Sec. 4682(a)(1), CS 38C)

3. means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may—

   (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapaciting reversible, illness; or

   (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

   (RCRA - Sec. 1004(5))

"HAZARDOUS WASTE GENERATION"

1. means the act or process of producing hazardous waste.

   (RCRA - Sec. 1004(6))

"HAZARDOUS WASTE MANAGEMENT"

1. means the systematic control of the collection, source separation, storage, transportation, processing, treatment, recovery, and disposal of hazardous wastes.

(RCRA - Sec. 1004(7))

"HEALTH AND SAFETY STUDY"

1. means any study of any effect of a chemical substance or mixture on health or the environment or on both, including underlying data and epidemiological studies, studies of occupational exposure to a chemical substance or mixture, toxicological, clinical, and ecological studies of a chemical substance or mixture, and any test performed pursuant to this Act.

(TSCA - Sec. 3(6))

"HEAVY DUTY VEHICLE"

1. means a truck, bus, or other vehicle manufactured primarily for use on the public streets, roads, and highways (not including any vehicle operated exclusively on a rail or rails) which has a gross vehicle weight (as determined under regulations promulgated by the Adminstrator) in excess of six thousand pounds. Such term includes any such vehicle which has special features enabling off-street or off-highway operation and use.

(CAA - Sec. 202(b)(3)(C), PSD)

"HIGH TERRAIN AREA"

1. means with respect to any facility, any area having an elevation of 900 feet or more above the base of the stack of such facility.

(CAA - Sec. 165(d)(2)(D)(iv), SS 165(d)(2)(D)(iii))

"IMMINENTLY HAZARDOUS CHEMICAL SUBSTANCE OR MIXTURE"

1. means a chemical substance or mixture which presents an imminent and unreasonable risk of serious or widespread injury to health or the environment. Such a risk to health or the environment shall be considered imminent if it is shown that the manufacture, processing, distribution in commerce, use, or disposal of the chemical substance or mixture, or that any combination of such activities, is likely to result in such injury to health or the environment before a final rule under section 6 can protect against such risk.

(TSCA - Sec. 7(f), SS 7(b))

"IMPLEMENTATION"

1. does not include the acquisition, leasing, construction, or modification of facilities or equipment or the acquisition, leasing or improvement of land. (For purposes of Federal financial assistance other than rural communities assistance.)

(RCRA - Sec. 1004(8))

"IMPORTER"

1. means the person entering the taxable chemical for consumption, use, or warehousing.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter B, Sec. 4662(a)(3), CS 38B)

"INDIRECT SOURCE"

1. means a facility, building, structure, installation, real property, road, or highway which attracts, or may attract, mobile sources of pollution. Such term includes parking lots, parking garages, and other facilities subject to any measure for management of parking supply (within the meaning of section 110(c)(2)(D)(ii)), including regulation of existing off-street parking but such term does not include new or existing on-street parking. Direct emissions sources or facilities at, within, or associated with, any indirect source shall not be deemed indirect sources for the purpose of this paragraph.

(CAA - Sec. 5110(a)(5)(C), SS110(a)(5)(C))

"INDIRECT SOURCE REVIEW PROGRAM"

1. means the facility-by-facility review of indirect sources of air pollution, including such measures as are necessary to assure, or assist in assuring, that a new or modified indirect source will not attract mobile sources of air pollution, the emissions from which would cause or contribute to air pollution concentrations-(i) exceeding any national primary ambient air quality standard for a mobile source-related air pollutant after the primary standard attainment date, or (ii) preventing maintenance of any such standard after such date.

(CAA - Sec. 110(a)(5)(D), SS 110)

"INDUSTRIAL USER"

1. means those industries identified in the Standard Industrial Classification Manual, Bureau of the Budget, 1967, as amended and supplemented, under the category "Division D - Manufacturing" and such other classes of significant waste products as, by regulation, the Administrator deems appropriate.

(CWA - Sec. 502(18)), Except as provided

"INLAND OIL BARGE"

1. means a non-self-propelled vessel carrying oil in bulk as cargo and certificated to operate only in the inland waters of the United States, while operating in such waters.

(CWA - Sec. 311(a)(15), SS 311)

"INLAND WATERS OF THE UNITED STATES"

1. means those waters of the United States lying inside the baseline from which the territorial sea is measured and those waters outside such baseline which are a part of the Gulf Intracoastal Waterway.

(CWA - Sec. 311(a)(16), SS 311)

"INTERMUNICIPAL AGENCY"

1. means an agency established by two or more municipalities with responsibility for planning or administration of solid waste.

(RCRA - Sec. 1004(9))

"INSTITUTION OF HIGHER EDUCATION"

1. means an educational institution described in the first sentence of section 1201 of the Higher Education Act of 1965 (other than an institution of any agency of the United States) which is accredited by a nationally recognized accrediting agency of association approved by the Administrator for this purpose.

(CWA - Sec. 112(a), SS 109-112)

"INTERSTATE AGENCY"

1. means an agency of two or more states established by or pursuant to an agreement of compact approved by the Congress, or any other agency of two or more. States, having substantial powers or duties pertaining to the control of pollution as determined and approved by the Administrator.

(CWA - Sec. 502(2)), Except as provided

2. means an agency of two or more municipalities in different States, or an agency established by two or more States, with authority to provide for the management of solid wastes and serving two or more municipalities located in different States.

(RCRA - Sec. 1004(10))

"INTERSTATE AIR POLLUTION CONTROL AGENCY"

1. means (1) an air pollution control agency established by two or more States, or (2) an air pollution control agency of two or more municipalities located in different States.

(CAA - Sec.302(c))

"OTHERWISE SUBJECT TO THE JURISDICTION OF THE UNITED STATES"

1. means subject to the jurisdiction of the United States by virtue of United States citizenship, United states vessel documentation or numbering, or as provided by international agreement to which the United States is a party.

(CERCLA - Sec. 101(19))

2. means subject to the jurisdiction of the United States by virtue of United States citizenship, United States vessel documentation or numbering, or as provided for by international agreement to which the United States is a party.

(CWA - Sec. 311(a)(17), SS 311)

"LIABLE" OR "LIABILITY"

1. under this title shall be construed to be the standard of liability which obtains under section 311 of the Federal Water Pollution Control Act.

(CERCLA - Sec. 101(32))

"LIGHT DUTY VEHICLES AND ENGINES"

1. means new duty motor vehicles and new light duty motor vehicle engines, as determined under regulations of the Administrator.

(CAA - Sec. 202(b)(3)(B), PSD)

"LONG-TERM CONTRACT"

1. means, when used in relation to solid waste supply, a contract of sufficient duration to assure the viability of a resource recovery facility (to the extent that such viability depends upon solid waste supply).

(RCRA - Sec. 1004(11))

"LOW TERRAIN AREA"

1. means any area other than a high terrain area.

(CAA - Sec. 165(d)(2)(D)(iv), SS 165(d)(2)(D)(iii))

"LOW-EMISSION VEHICLE"

1. means any motor vehicle which (A) emits any air pollutant in amounts significantly below new motor vehicle standards applicable under section 202 at the time of procurement to that type of vehicle; and (B) with respect to all other air pollutants meets the new motor vehicle standards applicable under section 202 at the time of procurement to that type of vehicle.

(CAA - Sec. 212(a)(4), SS 212)

"LOWEST ACHIEVABLE EMISSION RATE"

1. means for any source that rate of emissions which reflects (A) the most stringent emission limitation which is contained in the implementtion plan of an State for such class or category of source, unless the owner or operator of the proposed source demonstrates that such limitations are not achievable, or

(B) the most stringent emission limitation which is achieved in practice by such class or category of source, whichever is more stringent. In no event shall the application of this term permit a proposed new or modified source to emit any pollutant in excess of the amount allowable under applicable new source standards of performance.

(CAA - 110(a)(2)(I)(3), Sec. 171(3), PS-D)

"LUBRICATING OIL"

1. means the fraction of crude oil which is sold for purposes of reducing friction in any industrial or mechanical device. Such term includes re-refined oil.

(RCRA - Sec. 1004(38))

"MAJOR EMITTING FACILITY"

1. means any of the following stationary sources of air pollutants which emit, or have the potential to emit, one hundred tons per year or more of any air pollutant from the following types of stationary sources: fossil-fuel fired steam electric plants of more than two hundred and fifty million British thermal units per hour heat input, coal cleaning plants (thermal dryers), kraft pulp mills, Portland Cement plants, primary zinc smelters, iron and steel mill plants, primary aluminum ore

reduction plants, primary copper smelters, municipal incinerators capable of charging more than two hundred and fifty tons of refuse per day, hydrofluoric, sulfuric, and nitric acid plants, petroleum refineries, lime plants, phosphate rock processing plants, coke oven batteries, sulfur recovery plants, carbon black plants (furnace process), primary lead smelters, fuel conversion plants, sintering plants, secondary metal production facilities, chemical process plants, fossil-fuel boilers of more than two hundred and fifty million British thermal units per hour heat input, petroleum storage and transfer facilities with a capacity exceeding three hundred thousand barrels, taconite ore processing facilities, glass fiber processing plants, charcoal production facilities. Such term also includes any other source with the potential to emit two hundred and fifty tons per year or more of any air pollutant. This term shall <u>not</u> include new or modified facilities which are nonprofit health or education institutions which have been exempted by the State.

(CAA - Sec. 169 (1), PSC)

2. means any stationary facility or source of air pollutants which directly emits, or has the potential to emit, one hundred tons per year or more of any air pollutant (including any major emitting facility or source of fugitive emissions of any such pollutant, as determined by rule by the Administrator).

(CAA - Sec. 302(j))

"MAJOR STATIONARY SOURCE"

1. means the following types of stationary sources with the potential to emit 250 tons or more of any pollutant; fossil-fuel fired steam electric plants of more then 250 million British thermal units per hour heat input, coal cleaning plants (thermal dryers), draft pulp mills, Portland Cement plants, primary zinc smelters, iron and steel mill plants, primary aluminum ore reduction plants, primary copper smelters, municipal incinerators capable of charging more than 250 tons of refuse per day, hydrofluoric, sulfuric, and nitric acid plants, petroleum refineries, lime plants, phosphate rock processing plants, coke oven batteries, sulfur recovery plants, carbon black plants (furnace process), primary lead smelters, fuel conversion plants, sintering plants, secondary metal production facilities, chemical process plants, fossil-fuel boilers of more than 250 million British thermal units per hour heat input, petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels, taconite ore processing facilities, glass fiber processing plants, charcoal production facilities.

(CAA - Sec. 169A(g)(7), SS 169A)

2. means any stationary facility or source of air pollutants which directly emits, or has the potential to emit, one hundred tons per year or more of any air pollutant (including any major emitting facility or source of fugitive emissions of any such pollutant, as determined by rule by the Administrator).

(CAA - Sec. 302(j))

"MANAGEMENT OF PARKING SUPPLY"

1. shall include any requirement providing that any new facility containing a given number of parking spaces shall receive a permit or other prior approval, issuance of which is to be conditioned on air quality considerations.

(CAA - Sec. 110(c)(1)(D)(ii), SS 110(c)(1)(D))

"MANDATORY CLASS I FEDERAL AREAS"

1. means Federal areas which may not be designated as other than class I under this part.

(CAA - Sec. 169A(g)(5), SS 169A)

"MANIFEST"

1. means the form used for identifying the quantity, composition, and the origin, routing, and destination of hazardous waste during its transportation from the point of generation to the point of disposal, treatment, or storage.

(RCRA - Sec. 1004(12))

"MANMADE AIR POLLUTION"

1. means air pollution which results directly or indirectly from human activities.

(CAA - Sec. 169A(g)(3), SS 169A)

"MANUFACTURE"

1. means any person engaged in the manufacturing, assembling, or importation of marine sanitation devices or of vessels subject to standards and regulations promulgated under this section.

   (CWA - Sec. 312(a)(7), SS 312)

2. means manufacturing or processing for commercial purposes.

   (TSCA - Sec. 5(i), SS 5)

"MANUFACTURER"

1. means to import into the customs territory of the United States (as defined in general headnote 2 of the Tariff Schedules of the United States), produce, or manufacture.

   (TSCA - Sec. 3(7))

2. as used in sections 202, 203, 206, 207, and 208 means any person engaged in the manufacturing or assembling of new motor vehicles or new motor vehicle engines, or importing such vehicles or engines for resale, or who acts for and is under the control of any such person in connection with the distribution of new motor vehicles or new motor vehicle engines, but shall not include any dealer with respect to new motor vehicles or new motor vehicle engines received by him in commerce.

   (CAA - Sec. 216(1), SS 202,203,206,207,208)

"MANUFACTURER PARTS"

1. means, with respect to a motor vehicle engine, parts produced or sold by the manufacturer of the motor vehicle or motor vehicle engine.

   (CAA - Sec. 203(a)(4)(D), Sentence Specific Sec. 203(a)(4)(D), 3rd Sentence)

"MARINE SANITATION DEVICE"

1. includes any equipment for installation on board a vessel which is designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage.

(CWA - Sec. 312(a)(5), SS 312)

"MEANS OF EMISSION LIMITATION"

1. means a system of continuous emission reduction (including the use of specific technology or fuels with specified pollution characteristics).

(CAA - Sec. 302(m))

"MIXTURE"

1. means any combination of two or more chemical substances if the combination does not occur in nature and is not, in whole or in part, the result of a chemical reaction; except that such term does include any combination which occurs, in whole or in part, as a result of a chemical reaction if none of the chemical substances comprising the combination is a new chemical substance and if the combination could have been manufactured for commercial purposes without a chemical reaction at the time the chemical substances comprising the combination were combined.

(TSCA - Sec. 3(8))

"MODEL YEAR"

1. with reference to any specific calendar year means the manufacturer's annual production period (as determined by the Administrator) which includes January 1 of such calendar year. If the manufacturer has no annual production period, the term 'model year' shall mean the calendar year.

(CAA - Sec. 202(b)(3)(A)(i), PSD)

"MODIFICATION"

1. means any physical change in, or change in the method of operation of, a stationary source which increases the amount of any air pollutant emitted by such source or which results in the emission of any air pollutant not previously emitted.

   (CAA - Sec. 111(a)(4), SS 111)

2. shall have the same meaning as such terms have under section 111(a).

   (CAA - Sec. 112(a)(3), SS 112)

3. means the same as the term 'modification' as used in section 111(a)(4) of this Act.

   (CAA - 110(a)(2)(I)(4), Sec. 171(4),PS-D)

"MODIFIED"

1. means the same as the term 'modification' as used in section 111(a)(4) of this Act.

   (CAA - 110(a)(2)(I)(4), Sec. 171(4),PS-D))

"MOTOR VEHICLE"

1. means any self-propelled vehicle designed for use in the United States on the highways, other than a vehicle designed or used for military field at training, combat, or tactical purposes.

   (CAA - Sec. 212(a)(3), SS 212)

2. means any self-propelled vehicle designed for transporting persons or property on a street or highway.

   (CAA - Sec. 216(2), TS II)

"MUNICIPALITY"

1. means a city, town, borough, county, parish, district, association, or other public body created by or pursuant to State law and having jurisdiction over disposal of sewage, industrial wastes, or other wastes, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of this Act.

(CWA - Sec. 502(4)), Except as provided

2. means a city, town, borough, county, parish, district, or other public body created by or pursuant to State law.

(CAA - Sec. 302(f))

3. (A) means a city, town, borough, county, parish, district, or other public body created by or pursuant to State law, with responsibility for the planning or administration of solid waste management, or an Indian tribe or authorized tribal organization or Alaska Native village or organization, and

(B) includes any rural community or unincorporated town or village or any other public entity for which an application for assistance is made by a State or politcal subdivision thereof.

(RCRA - Sec. 1004(13))

"NATIONAL CONTINGENCY PLAN"

1. means the national contingency plan published under section 311(c) of the Federal Water Pollution Control Act or revised pursuant to section 105 of this Act.

(CERCLA - Sec. 101(31))

"NATURAL RESOURCES"

1. means land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the fishery conservation zone established by the Fishery Conservation and Management Act of 1976), any State or local government, or any foreign government.

(CERCLA - Sec. 101(16))

"NAVIGABLE WATERS"

1. means the waters of the United States, including the territorial seas.

(CWA - Sec. 502(7)), Except as provided

2. Navigable Waters" or "Navigable Waters of the United States means the waters of the United States, including the territorial seas.

(CERCLA - Sec. 101(15))

"NECESSARY PRECONSTRUCTION APPROVALS OR PERMITS'

1. means those permits or approvals, required by the permitting authority as a precondition to undertaking any activity under clauses (i) or (ii) of subparagraph (A) of this paragraph.

(CAA - 169(2)(B), PSC)

"NEW CHEMICAL SUBSTANCE"

1. means any chemical substance which is not included in the chemical substance list compiled and published under section 8(b).

(TSCA - Sec. 3(9))

"NEW MOTOR VEHICLE"

1. means a motor vehicle the equitable or legal title to which has never been transferred to an ultimate purchaser.

(CAA - Sec. 216(2), TS II)

"NEW MOTOR VEHICLE ENGINE"

1. means an engine in a new motor vehicle or a motor vehicle engine the equitable or legal title to which has never been transferred to the ultimate purchaser; and with respect to imported vehicles or engines, such terms mean a motor vehicle and engine, respectively, manufactured after the effective date of a regulation issued under section 202 which is applicable to such vehicle or engine (or which would be applicable to such vehicle or engine had it been manufactured for importation into the United States).

(CAA - Sec. 216(3), TS II)

"NEW SOURCE"

1. means any source, the construction of which is commenced after the publication of proposed regulations prescribing a standard of performance under this section which will be applicable to such source, if such standard is thereafter promulgated in accordance with this section.

(CWA - Sec. 306(a)(2), SS 306)

2. means any stationary source, the construction or modification of which is commenced after the publication of regulations (or, is earlier, proposed regulations) prescribing a standard of performance under this section which will be applicable to such source.

(CAA - Sec. 111(a)(2), SS 111)

3. means a stationary source, the construction or modification of which is commenced after the Administrator proposes regulations under this section establishing an emission standard which will be applicable to such source.

(CAA - Sec. 112,(a)(2), SS 112)

"NEW VESSEL"

1. includes every description of watercraft or other artifical contrivance used, or capable of being used, as a means of transportation on the navigable waters, the construction of which is initiated after promulgation of standards and regulation under this section.

(CWA - Sec. 312(a)(1), SS 312)

"NONATTAINMENT AREA"

1. means for any air pollutant an area which is shown by monitored data or which is calculated by air quality modeling (or other methods determined by the Administrator to be reliable) to exceed any national ambinet air quality standard for such pollutant. Such term includes any area identified under paragraphs (A) through (C) of section 107(d)(1).

(CAA - 110(a)(2)(I)(2), Sec. 171(2), PS-D)

"NOT FEASIBLE TO PRESCRIBE OR ENFORCE AN EMISSION STANDARD"

1. means any situation in which the Administrator determines that (A) a hazardous pollutant or pollutants cannot be emitted through a conveyance designed and constructed to emit or capture such pollutant, or that any requirement for, or use of, such a conveyance would be inconsitent with any Federal, State, or local law, or

(B) the application of measurement methodology to a particular class of sources is not practicable due to technological or economic limitations.

(CAA - Sec. 112(e)(2), SS 112(e))

"NOT FEASIBLE TO PRESCRIBE OR ENFORCE A STANDARD OF PERFORMANCE"

1. means any situation in which the Administrator determines that (A) a pollutant or pollutants cannot be emitted through a conveyance designed and constructed to emit or capture such pollutant, or that any requirement for, or use of, such a conveyance would be inconsistent with any Federal, State, or local law, or

(B) the application of measurement methodology to a particular class of sources is not practicable due to technological or economic limitations.

(CAA - Sec. 111(b)(2), SS 111)

"OCEAN"

1. means any portion of the high seas beyond the contiguous zone.

(CWA - Sec. 502(10)), Except as provided

"OFFSHORE FACILITY"

1. means any facility of any kind located in, on, or under, any of the navigable waters of the United States, and any facility of any kind which is subject to the jurisdiction of the United States and is located in, on, or under any other waters, other than a vessel or a public vessel.

(CERCLA - Sec. 101(17))

2. means any facility of any kind located in, on, or under, any of the navigable waters of the United States, and any facility of any kind which is subject to the jurisdiction of the United States and is located in, on, or under any other waters, other than a vessel or a public vessel.

(CWA - Sec. 311(a)(11), SS 311)

"OIL"

1. means oil of any kind or in any form, including, but not limited to petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil.

(CWA - Sec. 311(a)(1), SS 311)

"ONSHORE FACILITY"

1. means any facility (including, but not limited to, motor vehicles and rolling stock) of any kind located in, on, or under, any land or nonnavigable waters within the United States.

(CERCLA - Sec. 101(18))

2. means any facility (including, but not limited to, motor vehicles and rolling stock) of any kind located in, on, or under, any land within the United States other than submerged land.

(CWA - Sec. 311(a)(10), SS 311)

"OPEN DUMP"

1. means any facility or site where solid waste is disposed of which is not a sanitary landfill which meets the criteria promulgated under section 4004 and which is not a facility for disposal of hazardous waste.

(RCRA - Sec. 1004(14))

"OPERATOR"

1. shall have the same meaning as such terms have under section 111(a).

(CAA - Sec. 112(a)(3), SS 112)

"ORGANIZATION"

1. means a legal entity other than a government, established or organized for any purpose, and such term includes a corporation, company, association, firm, partnership, joint stock company, foundation, institution, trust, society, union or any other association of persons.

(RCRA - Sec. 3008 (f)(5))

"OWNER"

1. shall have the same meaning as such terms have under section 111(a).

(CAA - Sec. 112(a)(3), SS 112)

"OWNER or OPERATOR"

1. means (A) (i) in the case of a vessel, any person owning, operating, or chartering by demise, such vessel, (ii) in the case of an onshore facility or an offshore facility, any person owning or operating such facility, and (iii) in the case of any abandoned facility, any person who owned, operated, or otherwise controlled activities at such facility immediately prior to such abandonment. Such term does not include a person, who, without participating in the management of a vessel or facility, holds indicia of ownership primarily to protect his security interest in the vessel or facility.

(B) in the case of a hazardous substance which has been accepted for transportation by a common or contract carrier and except as provided in section 107(a)(3) or (4) of this Act, (i) the term "owner or operator" shall mean such common carrier or other bona fide for hire carrier acting as an independent contractor during such transportation, (ii) the shipper of such hazardous substance shall not be considered to have caused or contributed to any release during such transportation which resulted solely from circumstances or conditions beyond his control;

(C) in the case of a hazardous substance which has been delivered by a common or contract carrier to a disposal or treatment facility and except as provided in section 107(a)(3) or (4) (i) the term "owner or operator" shall not include such common or contract carrier, and (ii) such common or contract carrier shall not be considered to have caused or contributed to any release at such disposal or treatment facility resulting from circumstances or conditions beyond its control.

(CERCLA - Sec. 101(20))

2. means any person who owns, leases, operates, controls, or supervises a source.

(CWA - Sec. 306(a)(4), SS 306)

3. means (A) in the case of a vessel, any person owning, operating, or chartering by demise, such vessel, and (B) in the case of an onshore facility, and an offshore facility, any person owning or operating such onshore facility or offshore facility, and (C) in the case of any abandoned offshore facility, the person who owned or operated such facility immediately prior to such abandonment.

(CWA - Sec. 311(a)(6), SS 311)

4. means any person who owns, leases, operates, controls, or supervises a stationary source.

(CAA - Sec. 111(a)(5), SS 111)

PARKING SURCHARGE REGULATION"

1. means a regulation imposing or requiring the imposition of any tax, surcharge, fee, or other charge on parking spaces, or any other area used for the temporary storage of motor vehicles.

   (CAA - Sec. 110(c)(1)(D)(i), SS 110(c)(1)(D))

"PERSON"

1. means an individual, firm, corporation, association, partnership, consortium, joint venture, commercial entity, United States Government, State, municipality, commission, political subdivision of a State, or any interstate body.

   (CERCLA - Sec. 101(21))

2. shall mean, in addition to the definition contained in section 502(5) of this Act, any responsible corporate officer.

   (CWA - Sec. 309(c)(3), SS 309(c))

3. includes an individual, firm, corporation, association, and a partnership.

   (CWA - Sec. 311(a)(7), SS 311)

4. means an individual, partnership, firm, corporation, or association, but does not include an individual on board a public vessel.

   (CWA - Sec. 312(a)(8), SS 312)

5. shall mean, in addition to the definition contained in section 502(5) of this Act, any responsible corporate officer.

   (CWA - Sec. 404(s)(4)(B), SS 404(s)(4)(A)

6. means an individual, corporation, partnership, association, State, municipality, commission, or political subdivision of a State, or any interstate body.

   (CWA - Sec. 502(5)), Except as provided

7. includes, in addition to the entities referred to in section 302(e), any responsible corporate officer.

(CAA - Sec. 113(c)(3), SS 113(c))

8. includes an individual, corporation, partnership, association, State, municipality, political subdivision of a State, and any agency, department, or instrumentality of the United State municipality, politcal subdivision of a State, and any agency, department, or instrumentality of the United States and any officer, agent, or employee thereof.

(CAA - Sec. 302(e))

9. means an individual, trust, firm, joint stock company, corporation (including a government corporation), partnership, association, State, municipality, commission, political subdivision of a State, or any interstate body.

(RCRA - Sec. 1004(15))

"PETROLEUM PRODUCT"

1. includes crude oil.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter A, Sec. 4612(a)(3), CS 38A)

"POINT SOURCE"

1. means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture.

(CWA - Sec. 502(14)), Except as provided

"POLLUTANT"

1. means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.

   This term does not mean (A) "sewage from vessels" within the meaning of section 312 of this Act; or (B) water, gas, or other material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil or gas production and disposed of in a well, if the well used either to facilitate production or for disposal purposes is approved by authority of the State in which the well is located, and if such State determines that such injection or disposal will not result in the degradation of ground or surface water resources.

   (CWA - Sec. 502(6)), Except as provided

2. shall include, but not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

   The term does not include petroleum, including crude oil and any fraction thereof which is not otherwise specifically listed or designated as hazardous substances under section 101(14)(A) through (F) of this title, nor does it include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).

   (CERCLA - Sec. 104(a)(2), SS 104)

"POLLUTION"

1. means the man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of water.

   (CWA - Sec. 502(19)), Except as provided

"PREFERENTIAL BUS/CARPOOL LANE"

1. shall include any requirement for the setting aside of one or more lanes of a street or highway on a permanent or temporary basis for the exclusive use of buses or carpools, or both.

(CAA - Sec. 110(A)(1)(D)(iii), SS 110(c)(1)(D))

"PREMISES"

1. has the same meaning as when used for purposes of determining gross income from the property under section 613.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter A, Sec. 4612(a)(7), CS 38A)

"PRIMARY STANDARD ATTAINMENT DATE"

1. means the date specified in the applicable implementation plan for the attainment of a national primary ambient air quality standard for any air pollutant.

(CAA - Sec. 302(n))

"PROCUREMENT"

1. means any device, good, substance, material, product, or other item whether real or personal property which is the subject of any purchase, barter, or other exchange made to procure such item.

(RCRA - Sec. 1004(16))

"PROCURING AGENCY"

1. means any Federal agency, or any State agency or agency of a political subdivision of a State which is using appropriated Federal funds for such procurement, or any person contracting with any such agency with respect to work performed under such contract.

(RCRA - Sec. 1004(17))

"PROCESS"

1. means the preparation of a chemical substance or mixture, after its manufacture, for distribution in commerce (A) in the same form or physical state as, or in a different form or physical state from, that in which it was received by the person so preparing such substance or mixture, or (B) as part of an article containing the chemical substance or mixture.

   (TSCA - Sec. 3(10))

2. means manufacturing or processing for commercial purposes.

   (TSCA - Sec. 5(i), SS 5)

"PROCESSOR"

1. means any person who processes a chemical substance or mixture.

   (TSCA - Sec. 3(11))

"PUBLIC VESSEL"

1. means a vessel owned or bareboat-chartered and operated by the United States, or by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce.

   (CWA - Sec. 311(a)(4), SS 311)

2. means a vessel owned or bareboat-chartered and operated by the United States, by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce.

   (CWA - Sec. 312(a)(3), SS 312)

"QUALIFIED HAZARDOUS WASTE DISPOSAL FACILITY"

1. means any facility which has received a permit or is accorded interim status under section 3005 of the Solid Waste Disposal Act.

   (CERCLA - Title II, Subtitle C,Chapter 38,Subchapter C,
   Sec. 4682(a)(2), CS 38C)

"QUALIFIED SUBSTANCE"

1. means any substance (i) used in a qualified use by the manufacturer, producer, or importer, (ii) sold for use by the purchaser in a qualified use, or (iii) sold for resale by the purchaser to a second purchaser for use by such second purchaser in a qualified use.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter B, Sec. 4662(b)(2)(B), SS 4662(b))

"QUALIFIED USE"

1. means any use in the manufacture or production of a fertilizer.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter B, Sec. 4662(b)(2)(C), SS 4662(b))

"REASONABLE FURTHER PROGRESS"

1. means annual incremental reductions in emissions of the applicable air pollutant (including substantial reductions in the early years following approval or promulgation of plan provisions under this part and section 110(a)(2)(I) and regular reductions thereafter) which are sufficient in the judgment of the Administrator, to provide for attainment of the applicable national ambient air quality standard by the date required in section 172(a).

(CAA - 110(a)(2)(I)(1), Sec. 171(1), PS-D)

"RECOVERABLE"

1. refers to the capability and likelihood of being recovered from solid waste for a commercial or industrial use.

(RCRA - Sec. 1004(18))

"RECOVERED MATERIAL"

1. means waste material and by products which have been recovered or diverted from solid waste, but such terms does not include those materials and byproducts generated from, and commonly reused within, an original manufacturing process.

(RCRA - Sec. 1004(19))

"RECOVERED RESOURCES"

1. means material or energy recovered from solid waste.

(RCRA - Sec. 1004(20))

"RECYCLED OIL"

1. means any used oil which is reused, following its original use, for any purpose (including the purpose for which the oil was originally used). Such term includes oil which is re-refined, reclaimed, burned, or reprocessed.

(RCRA - Sec. 1004(37))

"REFINER"

1. shall not include any refiner whose total refinery capacity (including the refinery capacity of any person who controls, is controlled by, or is under common control with, such refiner) does not exceed 65,000 barrels per day.

(CAA - Sec. 325(c)(2), SS 325)

"REFINERIES WHICH PRODUCE NATURAL GASOLINE"

1. In the case of the United States refinery which produces natural gasoline from natural gas, the gasoline so produced shall be treated as received at such refinery at the time so produced.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter A, Sec. 4612(a)(6), CS 38A)

"REFINERY"

1. has the meaning provided under regulations of the Administrator promulgated under this section.

(CAA - Sec. 211(g)(1)(A), SS 211(g))

"REGIONAL AUTHORITY"

1. means the authority established or designated under section 4006.

(RCRA - Sec. 1004(25))

"RELEASE"

1. means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment, but excludes (A) any release which results in exposure to persons solely within a workplace, with respect to a claim which such persons may assert against the employer of such persons,

(B) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine,

(C) release of source byproduct, or special nuclear material from a nuclear incident, as those terms are defined in the Atomic Energy Act of 1954, if such release is subject to requirements with respect to financial protection established by the Nuclear Regulatory Commission under section 170 of such Act, or, for the purposes of section 104 of this title or any other response action, any release of source byproduct, or special nuclear material from any processing site designated under section 102(a)(1) or 302(a) of the Uranium Mill Tailings Radiation Control Act of 1978, and

(D) the normal application of fertilizer.

(CERCLA - Sec. 101(22))

"REMEDY" or "REMEDIAL ACTION"

1. means those actions consistent with permanent remedy taken instead of or in addition to removal actions in the event of a release or threatened release of a hazardous substance into the environment, to prevent or minimize the release of hazardous substances so that they do no migrate to cause substantial danger to present or future public health or welfare or the environment.

The term includes, but is not limited to, such actions at the location of the release as storage, confinement, perimeter protection using dikes, trenches, or ditches, clay cover, neutralization, cleanup of released hazardous substances or contaminated materials, recycling or reuse, diversion, destruction segregation of reactive wastes, dredging or excavations, repair or replacement of leaking containers, collection of leachate and runoff, onsite treatment or incinceration, provision of alternative water supplies, and any monitoring reasonably required to assure that such actions protect the public health and welfare and the environment.

The term includes the costs of permanent relocation of residents and businesses and community facilities where the President determines that, alone or in combination with other measures, such relocation is more cost-effective than and environmentally preferable to the transportation, storage, treatment, destruction, or secure dispostion offsite of hazardous substances, or may otherwise by necessary to protect the public health or welfare.

The term does not include offsite transport of hazardous substances, or the storage, treatment, destruction, or secure disposition offsite of such hazardous substances or contaminated materials unless the President determines that such actions

(A) are more cost-effective than other remedial actions,

(B) will create new capacity to manage, in compliance with subtitle C of the Solid Waste Disposal Act, hazardous substances in addition to those located at the affected facility, or

(C) are necessary to protect public health or welfare or the environment from a present or potential risk which may be created by further exposure to the continued presence of such substances or materials.

(CERCLA - Sec. 101(24))

"REMOVE OR REMOVAL"

1. means the cleanup or removal or released hazardous substances from the environment, such actions as may be necesary taken in the event of the threat of release of hazardous substances into the environment, such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances, the disposal of removed material, or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release.

   The term includes, in addition, without being limited to, security fencing or other measures to limit access, provision of alternative water supplies, temporary evacuation and housing of threatened individuals not otherwise provided for, action taken under section 104(b) of this Act, and any emergency assistance which may be provided under the Disaster Relief Act of 1974.

   (CERCLA - Sec. 101(23))

2. refers to removal of the oil or hazardous substances from the water and shorelines or the taking of such other actions as may be necessary to minimize or mitigate damage to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches.

   (CWA - Sec. 311(a)(8), SS 311)

"REPLACEMENT"

1. means those expenditures for obtaining and installing equipment, accessories, or appurtenances during the useful life of the treatment works necessary to maintain the capacity and performance for which such works are designed and constructed.

(CWA - Sec. 212(3), TS II)

"RE-REFINED OIL"

1. means used oil from which the physical and chemical contaminants acquired through previous use have been removed through a refining process.

(RCRA Sec. 1004(43))

"RESOURCE CONSERVATION"

1. means reduction of the amounts of solid waste that are generated, reduction of overall resource consumption, and utilization of recovered sources.

(RCRA Sec. 1004(23))

"RESOURCE RECOVERY"

1. means the recovery of material or energy from solid waste.

(RCRA - Sec. 1004(22))

"RESOURCE RECOVERY SYSTEM"

1. means a solid waste management system which provides for collection, separation, recycling, and recovery of solid wastes, including disposal of nonrecoverable waste residues.

(RCRA - Sec. 1004(23))

"RESOURCE RECOVERY FACILITY"

1. means any facility at which solid waste is processed for the purpose of extracting, converting to energy, or otherwise separating and preparing solid waste for reuse.

(RCRA - Sec. 1004(24))

"RESPOND" or "RESPONSE"

1. means remove, removal, remedy, and remedial action.

(CERCLA - Sec. 101(25))

"RETAIL PRICE"

1. means (A) the maximum statutory price applicable to any class or model of motor vehicle; or (B) in any case where there is no applicable maximum statutory price, the most recent procurement price paid for any class or model of motor vehicle.

(CAA - Sec. 212(a)(5), SS 212)

"SANITARY LANDFILL"

1. means a facility for the disposal of solid waste which meets the criteria published under section 4004.

(RCRA - Sec. 1004(26))

"SANITATION SERVICES"

1. shall mean water supply, sewage disposal, solid waste disposal and other services necessary to maintain generally accepted standards of personal hygiene and public health.

(CWA -Sec. 113(g), SS 113)

"SCHEDULE AND TIMETABLE OF COMPLIANCE"

1. means a schedule of remedial measures including an enforceable sequence of actions or operations leading to compliance with an emission limitation, other limitation, prohibition, or standard.

(CAA - Sec. 302(p))

"SCHEDULE OF COMPLIANCE"

1. means a schedule of remedial measures including an enforceable sequence of actions or operations leading to compliance with an effluent limitation, other limitation, prohibition, or standard.

(CWA - Sec. 502(17)), Except as provided

"SECRETARY"

1. as used in this section means the Secretary of the Army, acting through the Chief of Engineers.

(CWA - Sec. 404(d), SS 404)

"SERIOUS BODILY INJURY"

1. means (A) bodily injury which involves a substantial risk of death;

   (B) unconsciousness;

   (C) extreme.physical pain;

   (D) protracted and obvious disfigurement; or

   (E) protracted loss or impairment of the function of a bodily member, organ, or mental faculty.

   (RCRA - Sec. 3008 (f)(6))

"SEWAGE"

1. means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes except that, with respect to commercial vessels on the Great Lakes such term shall include graywater.

(CWA - Sec. 312(a)(6), SS 312)

"SLUDGE"

1. means any solid, semisolid or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility or any other such waste having similar characteristics and effects.

(RCRA - Sec.1004(26A))

"SMALL REFINERY"

1. means a refinery or a portion of a refinery producing gasoline (i) the gasoline producing capacity of which was in operation or under construction at any time during the one-year period immediately preceding October 1, 1976, and (ii) which has a crude oil or bona fide feed stock capacity (as determined by the Administrator) of 50,000 barrels per day or less, and (iii) which is owned or controlled by a refiner with a total combined crude oil or bona fide feed stock capacity (as determined by the Administrator) of 137,500 barrels per day or less.

(CAA - Sec. 211(g)(1)(B), SS 211(g))

"SOLID WASTE"

1. means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

(RCRA - Sec.1004(27))

"SOLID WASTE MANAGEMENT"

1. means the systematic administration of activities which provide for the collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of solid waste.

(RCRA - Sec. 1004(28))

"SOLID WASTE MANAGEMENT FACILITY"

1. includes (A) any resource recovery system or component thereof,

   (B) any system, program, or facility for resource conservation, and

   (C) any facility for the collection, source separation, storage, transportation, transfer, processing, treatment of disposal of solid wastes including hazardous wastes, whether such facility is associated with facilities generating such wastes or otherwise.

   (RCRA - Sec. 1004(29))

"SOLID WASTE PLANNING"

1. include planning or management respecting resource recovery and resource conservation.

   (RCRA - Sec. 1004(30))

"SOLID WASTE MANAGEMENT"

1. include planning or management respecting resource recovery and resource conservation.

   (RCRA - Sec. 1004(30))

"SOURCE"

1. means any building, structure, facility, or installation from which there is or may be the discharge of pollutants.

   (CWA - Sec. 306(a)(3), SS 306)

"STANDARD OF PERFORMANCE"

1. means a standard for the control of the discharge of pollutants which reflects the greatest degree of effluent reduction which the Administrator determines to be achievable through application of the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.

   (CWA - Sec. 306(a)(1), SS 306)

2. means a requirement of continuous emission reduction, including any requirement relating to the operation or maintenance of a source to assure continuous emission reduction.

   (CAA - Sec. 302(1))

"STANDARDS FOR THE DEVELOPMENT OF TEST DATA"

1. means a prescription of (A) the (i) health and environmental effects, and (ii) information relating to toxicity, persistence, and other characteristics which affect health and the environment, for which test data for a chemical substance or mixture are to be developed and any analysis that is to be performed on such data, and

   (B) to the extent necessary to assure that data respecting such effects and characteristics are reliable and adequate (i) the manner in which such data are to be developed, (ii) the specification of any test protocol or methodology to be employed in the development of such data, and (iii) such other requirements as are necessary to provide such assurance.

   (TSCA - Sec. 3(12))

"STATE"

1. means any of the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

(RCRA - Sec. 1004(31))

2. means a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Trust Territory of the Pacific Islands.

(CWA - Sec. 502(3)), Except as provided

3. means any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, the Canal Zone, American Samoa, the Northern Mariana Islands, or any other territory or possession of the United States.

(TSCA - Sec. 3(13))

4. means a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, and American Samoa and includes the Commonwealth of the Northern Mariana Islands.

(CAA - Sec. 302(d)

"STATE AUTHORITY"

1. means the agency established or designated under section 4007.

(RCRA - Sec. 1004(32))

"STATE WATER POLLUTION CONTROL AGENCY"

1. means the State agency designated by the Governor having responsibility for enforcing State laws relating to the abatement of pollution.

(CWA - Sec. 502(1)), Except as provided

"STATIONARY SOURCE"

1. means any building, structure, facility, or installation which emits or may emit any air pollutant.

   (CAA - Sec. 111(a)(3), SS 111)

2. shall have the same meaning as such terms have under section 111(a).

   (CAA - Sec. 112(a)(3), SS 112)

"STORAGE"

1. when used in connection with hazardous waste, means the containment of hazardous waste, either on a temporary basis or for a period of years, in such a manner as not to constitute disposal of such hazardous waste.

   (RCRA - Sec. 1004(33))

"STRATOSPHERE"

1. means that part of the atmosphere above the tropopause.

   (CAA - Sec. 152(2), TS I(B))

"SUSTAINED-USE MOTOR VEHICLE"

1. means any diesel or gasoline fueled motor vehicle (whether light or heavy duty) which, as determined by the Administrator (in conjunction with the Secretary), is normally used and occupied for a sustained, continuous, or extensive period of time, including buses, taxicabs, and police vehicles.

   (CAA - Sec. 225(b), SS 226)

"TAXABLE CHEMICAL"

1. *means any substance (A) which is listed in the table under

   section 4661(b), and (B) which is manufactured or produced in the United States or entered into the United States for consumption, use, or warehousing.

   (CERCLA -Title II, Subtitle A, Chapter 38, Subchapter B, Sec. 4662(a)(1), CS 38B)

2. shall not include any substance to the extent derived from coal.

   (CERCLA -Title II, Subtitle A, Chapter 38, Subchapter B, Sec. 4662(b)(4), CS 38B)

"TECHNOLOGICAL SYSTEMS OF CONTINUOUS EMISSION REDUCTION"

1. means (A) a technological process for production or operation by any source which is inherently lowpolluting or nonpolluting, or

   (B) a technological system for continuous reduction of the pollution generated by a source before such pollution is emmitted into the ambient air, including precombustion cleaning or treatment of fuels.

   (CAA - Sec. 111(a)(7), SS 111)

"TERRITORIAL SEA"

1. shall have the meaning provided in section 502 of the Federal Water Pollution Control Act.

   (CERCLA - Sec. 101(30))

Except as provided in Sec. 4662(b).

TAX ON CERTAIN CHEMICALS
(Table referred to under section 4661(b).)

In the case of:	The tax is the following amount per ton
Acetylene	$4.87
Benzene	4.87
Butane	4.87
Butylene	4.87
Butadiene	4.87
Ethylene	4.87
Methane	3.44
Napthalene	4.87
Propylene	4.87
Toluene	4.87
Xylene	4.87
Ammonia	2.64
Antimony	4.45
Antimony trioxide	3.75
Arsenic	4.45
Arsenic trioxide	3.41
Barium sulfide	2.30
Bromine	4.45
Cadmium	4.45
Chlorine	2.70
Chromium	4.45
Chromite	1.52
Potassium dichromate	1.69
Sodium dichromate	1.87
Cobalt	4.45
Cupric sulfate	1.87
Cupric oxide	3.59
Cuprous oxide	3.97
Hydrochloric acid	0.29
Hydrogen fluoride	4.23
Lead oxide	4.14
Mercury	4.45
Nickel	4.45
Phosphorous	4.45
Stannous chloride	2.85
Stannic chloride	2.12
Zinc chloride	2.22
Zinc sulfate	1.90
Potassium hydroxide	0.22
Sodium hydroxide	0.28
Sulfuric acid	0.26
Nitric acid	0.24

"TERRITORIAL SEAS"

1. means the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles.

(CWA - Sec. 502(8)), Except as provided

"TON"

1. means 2,000 pounds. In the case of any taxable chemical which is a gas, the term 'ton' means the amount of such gas in cubic feet which is the equivalent of 2,000 pounds on a molecular weight basis.

(CERCLA -Title II, Subtitle A, Chapter 38, Subchapter B, Sec. 4662(a)(4), CS 38B)

"TOTALLY ENCLOSED MANNER"

1. means any manner which will ensure that any exposure of human beings or the environment to a polychlorinated biphenyl will be insignificant as determined by the Administrator by rule.

(TSCA - Sec. 6(e)(2)(C), SS 6(e)(2)(B))

"TOXIC POLLUTANT"

1. means those pollutants, or combinations of pollutants, including disease-causing agents, which after discharge and upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will, on the basis of information available to the Administrator, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological manfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

(CWA - Sec. 502(13)), Except as provided

"TRANSPORT" or "TRANSPORTATION"

1. means the movement of a hazardous substance by any mode, including pipeline (as defined in the Pipeline Safety Act), and in the case of a hazardous substance which has been accepted for transportation by a common or contract carrier, the term "transport" or "transportation" shall include any stoppage in transit which is temporary, incidental to the transportation movement, and at the ordinary operating convenience of a common or contract carrier, and any such stoppage shall be considered as a continuity of movement and not as the storage of a hazardous substance.

   (CERCLA - Sec. 101(26))

"TREATMENT"

1. shall have the meaning provided in section 1004 of the Solid Waste Disposal Act.

   (CERCLA - SEC. 101(29))

2. when used in connection with hazardous waste, means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste nonhazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume. Such term includes any activity or processing designed to change the physical form or chemical composition of hazardous waste so as to render it nonhazardous.

   (RCRA - Sec. 1004(34))

"TREATMENT WORKS"

1. means (A) any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature to implement section 201 of this act, or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, outfall sewers, sewage collection systems, pumping, power and other equipment, and their appurtenances; extensions, improvements, remodeling, additions, and alterations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities; and any works, including site acquisition of the land that will be an integral part of the treatment process (including land use for the storage of treated wastewater in land treatment systems prior to land application) or is used for ultimate disposal of residues resulting from such treatment.

   (CWA - Sec.212(2)(A), TS II)

2. means any other method or system for preventing, abating, reducing, storing, treating, separating, or disposing of municipal waste, including storm water runoff, or industrial waste, including waste in combined storm water and sanitary sewer systems. (In addition to meaning of definition cited on Sec. 212(2)(A).)

   (CWA - Sec. 212(2)(B),TS II)

"ULTIMATE PURCHASER"

1. means, with respect to any new motor vehicle or new motor vehicle engine, the first person who in good faith purchases such new motor vehicle or new engine for purposes other than resale.

   (CAA - Sec. 216(5), TS II)

"UNITED STATES"

1. include the several States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Commonwealth of the Northern Marianas, and any other territory or possession over which the United States has jurisdiction.

   (CERCLA - Sec. 101(27))

2. (A) means, in general, the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, any possession of the United States, the Commonwealth of the Northern Mariana Islands, and the Trust Territory of the Pacific Islands;

(B) United States includes continental shelf areas. The principles of section 638 shall apply for purposes of the term 'United States';

(C) United States includes foreign trade zones. The term 'United States' includes any foreign trade zone of the United States.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter A, Sec. 4612(a)(4), CS 38A)

3. has the meaning given such term by section 4612(a)(4).

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter B, Sec. 4662(a)(2), CS 38B)

4. means the States, the District of Columbia, the Commonwealth of Puerto Rico, the Canal Zone, Guam, American Samoa, the Virgin Islands, and the Trust Territory of the Pacific Islands.

(CWA - Sec. 311(a)(5), SS 311)

5. includes the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Canal Zone, and the Trust Territory of the Pacific Islands.

(CWA - Sec. 312(a)(4), SS 312)

6. when used in the geographic sense, means all of the States.

(TSCA - Sec. 3(14))

"UNITED STATES REFINERY"

1. means any facility in the United States at which crude oil is refined.

(CERCLA - Title II, Subtitle A, Chapter 38, Subchapter A, Sec. 4612(a)(5), CS 38A)

"USED OIL"

1. means any oil which has been --

   (A) refined from crude oil,

   (B) used, and

   (C) as a result of such use, contaminated by physical or chemical impurities.

   (RCRA - Sec. 1004(36))

"VESSEL"

1. means every description of watercraft or other artifical contrivance used, or capable of being used, as a means of transportation on water.

   (CERCLA - Sec. 101(28))

2. means every description of water craft or other artificial contrivance used, or capable of being used, as a means of transportation on water other than a public vessel.

   (CWA - Sec. 311(a)(3), SS 311)

"VILLAGE"

1. shall mean an incorporated or unincorporated community with a population of ten to six hundred people living within a two-mile radius.

   (CWA - Sec. 113(g), SS 113)

"VIRGIN MATERIAL"

1. means a raw material, including previously unused copper, aluminum, lead, zinc, iron, or other metal or metal ore, any undeveloped resource that is, or with new technology will become, a source of raw materials.

   (RCRA - Sec. 1004(35))

"VISIBILITY IMPAIRMENT" or "IMPAIRMENT OF VISIBILITY"

1. shall include reduction in visual range and atmospheric discoloration.

(CAA - Sec. 169A(g)(6), SS 169A)

APPENDIX B

LIST OF HAZARDOUS SUBSTANCES FROM PRIOR REGULATIONS

To show the act under which regulatory action has been taken, an "x" has been placed in the appropriate column(s) opposite the chemical name, except in the case of RCRA entries. Under RCRA, entries are coded to correspond to the original regulatory designation (40CFR261), as follows:

P = Acute hazardous waste

U = Toxic waste

8 = Hazardous constituent (Appendix VIII)

LIST OF HAZARDOUS SUBSTANCES FROM PRIOR REGULATIONS

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
208968	Acenaphthylene	x					
83329	Acenaphthylene, 1,2-dihydro	x					
75070	Acetaldehyde	x	U,8				
107200	Acetaldehyde, chloro		P,8				
75876	Acetaldehyde, trichloro		U				
640197	Acetamide, 2-fluoro		P,8	x			
62442	Acetamide, N-(4-ethoxyphenyl)		U,8				
591082	Acetamide, N-(aminothioxomethyl)		P,8				
53963	Acetamide, N-9H-fluoren-2-yl		U,8				
2545597	Acetic acid, (2,3,5-trichlorophenoxy)-, 2-butoxyethyl ester	x					
61792072	Acetic acid, (2,4,5-trichlorophenoxy)-, 1-methyl propyl ester	x					
1928478	Acetic acid, (2,4,5-trichlorophenoxy)-, 2-ethylhexyl ester	x					
93765	Acetic acid, (2,4,5-trichlorophenoxy)-	x	U,8	x			
93798	Acetic acid, (2,4,5-trichlorophenoxy)-, butyl ester	x					
1319728	Acetic acid, (2,4,5-trichlorophenoxy)- compd, with 1-amino-2-propanol (1:1)	x					
3813147	Acetic acid, (2,4,5-trichlorophenoxy)-, compd, with 2,2', 2''-nitrilotris (ethanol) (1:1)	x					
2008460	Acetic acid, (2,4,5-trichlorophenoxy)-, compd, with N,N-diethylethanamine (1:1)	x					
6369966	Acetic acid, (2,4,5-trichlorophenoxy)-, compd, with N,N-dimethylmethanamine (1:1)	x					
6369977	Acetic acid, (2,4,5-trichlorophenoxy)-, compd, with N-methylmethanamine (1:1)	x					
25168154	Acetic acid, (2,4,5-trichlorophenoxy)-, isooctyl ester	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
13560991	Acetic acid, (2,4,5-trichlorophenoxyl)-, sodium salt	x					
94111	Acetic acid, (2,4-dichlorophenoxy)-, 1-methylethyl ester	x					
1929733	Acetic acid, (2,4-dichloropheoxy)-, 2-butoxyethyl ester	x					
2971382	Acetic acid, (2,4-dichlorophenoxy)-, 4-chloro-2-butenyl ester	x					
94757	Acetic acid, (2,4-dichlorophenoxy)-	x	U,P,8		x		
94804	Acetic acid, (2,4-dichlorophenoxy)-, butyl ester	x					
1320189	Acetic acid, (2,4-dichlorophenoxy)-, ester with 1,2-propanediol monobutyl ether	x					
25168267	Acetic acid, (2,4-dichlorophenoxy)-, isooctyl ester	x					
1928387	Acetic acid, (2,4-dichlorophenoxy)-, methyl ester	x					
1928616	Acetic acid, (2,4-dichlorophenoxy)-, propyl ester	x					
94791	Acetic acid, (2,4-dichlorophenoxy)-, sec-butyl ester	x					
110190	Acetic acid, 2-methylpropyl ester	x					
64197	Acetic acid	x					
631618	Acetic acid, ammonium salt	x					
108247	Acetic acid, anhydride	x					
123864	Acetic acid, butyl ester	x					
543908	Acetic acid, cadmium salt	x					
1066304	Acetic acid, chromium (3+) salt	x					
142712	Acetic acid, copper (2+) salt	x					
108054	Acetic acid, ethenyl	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
141786	Acetic acid, ethyl ester		U				
62748	Acetic acid, fluoro-, sodium salt		P,8	x			
301042	Acetic acid, lead (2+) salt	x	U,8				
628637	Acetic acid, pentyl ester	x					
563688	Acetic acid, thallium (1+) salt		U,8				
557346	Acetic acid, zinc salt	x					
75058	Acetonitrile		U,8				
506967	Acetyl bromide	x					
75365	Acetyl chloride	x	U,8				
1162658	Aflatoxin B1		8				
1165395	Aflatoxin G1		8				
1402682	Aflatoxin		8				
6795239	Aflatoxin M1		8				
6885570	Aflatoxin M2		8				
7220817	Aflatoxin B2		8				
7241987	Aflatoxin G2		8				
17878545	Aflatoxin B2a		8				
20421107	Aflatoxin G2a		8				
29611038	Aflatoxin R0		8				
32215024	Aflatoxin P1		8				
52819962	Aflatoxin Q1		8				
20859738	Aluminum phosphide (AlP)		P,8	x			
7664417	Ammonia	x					
12125029	Ammonium chloride	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
12125018	Ammonium fluoride	x					
1341497	Ammonium fluoride ((NH4)(HF2))	x					
1336216	Ammonium hydroxide	x					
12135761	Ammonium sulfide ((NH4)2S)	x					
52628258	Ammonium zinc chloride	x					
120127	Anthracene	x					
28300745	Antimonate(2-), bis (mu-(2,3-dihydroxybutanedioato(4-) -O(1),O(2):O(3),O(4)) di-, dipotassium trihydrate, stereoisomer	x					
7440360	Antimony	x	8				
7647189	Antimony chloride (SbCl5)	x					
1309644	Antimony oxide (Sb2O3)	x					
506616	Argentate (1-), bis (cyano-C)-, potassium		P,8				
7784465	Arsenenous acid, sodium salt	x					
7440382	Arsenic		8		x	x	
7778394	Arsenic acid (H3AsO4)	x	P,8				
10103614	Arsenic acid (H3AsO4), copper salt			x			
7784410	Arsenic acid (H3AsO4), monopotassium salt	x					
7778441	Arsenic acid (H3AsO4), calcium salt (2:3)	x					
7784409	Arsenic acid (H3AsO4), lead (2+) salt (1:1)	x					
3687318	Arsenic acid (H3AsO4), lead (2+) salt (2:3)	x					
10102484	Arsenic acid (H3AsO4), lead (4+) salt (3:2)	x					
7645252	Arsenic acid (H3AsO4), lead salt	x					
7631892	Arsenic acid (H3AsO4), sodium salt	x					
1327533	Arsenic oxide (As2O3)	x	P,8	x			
1303282	Arsenic oxide (As2O5)	x	P,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
1303328	Arsenic sulfide (As2S2)	x					
7784341	Arsenous trichloride	x					
692422	Arsine, diethyl		P,8				
75605	Arsinic acid, dimethyl		U				
52740166	Arsonic acid, calcium salt (1:1)	x					
98055	Arsonic acid, phenyl		8				
10124502	Arsonic acid, potassium salt	x					
696286	Arsonous dichloride, phenyl		P,8				
1332214	Asbestos		U			x	
52244	Aziridine, 1,1',1''-phosphinothioylidynetris		8				
75558	Aziridine, 2-methyl		P,8				
151564	Aziridine		P,8				
50077	Azirino(2',3':3,4)pyrrolo(1,2-a)indole-4,7-dione, 6-amino-8-[(aminocarbonyl)oxy]methyl)-1,1A,2,8,8A, 8B-hexahydro-8A-methoxy-5-methyl-,[1AR-(1a alpha,8 beta,8a alpha,8b alpha)]		U,8				
7440393	Barium		8		x		
542621	Barium cyanide	x	P,8				
57976	Benz(a)anthracene, 7,12-dimethyl		U,8				
56553	Benz(a)anthracene		U,8				
56495	Benz(j)aceanthrylene, 1,2-dihydro-3-methyl		U,8				
23950585	Benzamide, 3,5-dichloro-n-(1,1-dimethyl-2-propynyl)-		U,8	x			
225514	Benz(c)acridine		U,8				
205992	Benz(e)acephenanthrylene	x	8				
99558	Benzenamine, 2-methyl-5-nitro		U,8				
636215	Benzenamine, 2-methyl-, hydrochloride		U,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
492808	Benzenamine, 4,4'-carbonimidoylbis(N,N-dimethyl		U,8				
101144	Benzenamine, 4,4'-methylenebis(2-chloro		U,8				
106478	Benzenamine, 4-chloro		P,8				
3165933	Benzenamine, 4-chloro-2-methyl-,hydrochloride		U				
100016	Benzenamine, 4-nitro		P,8				
62533	Benzenamine	x	U				
60117	Benzenamine, N,N-dimethyl-4-(phenylazo)		U,8				
86306	Benzenamine, N-nitroso-N-phenyl		P,8				
1300738	Benzenamine, AR, AR-dimethyl	x					
50293	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis (4-chloro)	x	U,8	x			
72435	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis (4-methoxy)	x	U		x		
72548	Benzene, 1,1'-(2,2-dichloroethylidene)bis(4-chloro)	x	U,8	x			
72560	Benzene, 1,1'-(2,2-dichloroethylidene)bis (4-ethyl)			x			
72559	Benzene, 1,1'-(dichloroethenylidene)bis(4-chloro)	x		x			
87616	Benzene, 1,2,3-trichloro	x					
95943	Benzene, 1,2,4,5-tetrachloro		U,8				
120821	Benzene, 1,2,4-trichloro	x	8				
95501	Benzene, 1,2-dichloro-	x	U,8				
95476	Benzene, 1,2-dimethyl	x	U,8				
528290	Benzene, 1,2-dinitro	x	8				
108703	Benzene, 1,3,5-trichloro	x					
108678	Benzene, 1,3,5-trinitro		U,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
541731	Benzene, 1,3-dichloro		U,8				
26471625	Benzene, 1,3-diisocyanatomethyl		U,8				
108383	Benzene, 1,3-dimethyl	x	U,8				
99650	Benzene, 1,3-dinitro	x	8				
106467	Benzene, 1,4-dichloro	x	U,8				
106423	Benzene, 1,4-dimethyl	x	U,8				
100254	Benzene, 1,4-dinitro	x					
101553	Benzene, 1-bromo-4-phenoxy		U,8				
95498	Benzene, 1-chloro-2-methyl		8				
106434	Benzene, 1-chloro-4-methyl		8				
7005723	Benzene, 1-chloro-4-phenoxy	x					
121142	Benzene, 1-methyl-2,4-dinitro	x	U				
88722	Benzene, 1-methyl-2-nitro	x					
99081	Benzene, 1-methyl-3-nitro	x					
99990	Benzene, 1-methyl-4-nitro	x					
98828	Benzene, (1-methylethyl)-		U				
606202	Benzene, 2-methyl-1,3-dinitro	x	U				
610390	Benzene, 4-methyl-1,2-dinitro	x					
71432	Benzene	x	U,8			x	
510156	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester		U	x			
305033	Benzenebutanoic acid, 4-(bis(2-chloroethyl) amino)		U,8				
108907	Benzene, chloro	x	U,8				
100447	Benzene, (chloromethyl)	x	P,8				
823405	1,3-Benzenediamine, 2-methyl		U,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
2687254	1,2-Benzenediamine, 3-methyl		U,8				
496720	1,2-Benzenediamine, 4-methyl		U,8				
95807	1,3-Benzenediamine, 4-methyl		U,8				
25376458	Benzenediamine, AR-methyl		U,8				
117817	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl)ester		U,8				
85687	1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester		8	x			
84742	1,2-Benzenedicarboxylic acid, dibutyl ester		U,8	x			
84662	1,2-Benzenedicarboxylic acid, diethyl ester	x	U,8				
131113	1,2-Benzenedicarboxylic acid, diethyl ester		U,8				
117840	1,2-Benzenedicarboxylic acid, dioctyl ester		U,8				
25321226	Benzene, dichloro	x	U,8				
98873	Benzene, (dichloromethyl)		U				
1330207	Benzene, dimethyl	x	U,8				
25154545	Benzene, dinitro	x					
51434	1,2-Benzenediol, 4-[1-hydroxy-2-(methyl-amino) ethyl]-, (R)-		P,8				
108463	1,3-Benzenediol		U,8				
122098	Benzenethanamine, alpha, alpha-dimethyl		P,8				
100425	Benzene, ethenyl	x					
100414	Benzene, ethyl-	x					
118741	Benzene, hexachloro		U,8				
115322	Benzene,ethanol, 4-chloro-alpha-(4-chlorophenyl)-alpha-(trichloromethyl)-	x					
108883	Benzene, methyl	x	U,8				
25321146	Benzene, methyldinitro	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
1321126	Benzene, methylnitro	x					
98953	Benzene, nitro	x	U,8				
608935	Benzene, pentachloro	x	U,8				
82688	Benzene, pentachloronitro		U,8				
127822	Benzensulfonic acid, 4-hydroxy-, zinc salt (2:1)	x					
27176870	Benzenesulfonic acid, dodecyl-	x					
68411325	Benzenesulfonic acid, dodecyl-, branched	x					
26264062	Benzenesulfonic acid, dodecyl-, calcium salt	x					
42504461	Benzenesulfonic acid, dodecyl-, compd, with 1-amino-2-propanol (1:1)	x					
27323417	Benzenesulfonic acid, dodecyl-, compd, with 2,2',2''-nitrilotris(ethanol) (1:1)	x					
25155300	Benzenesulfonic acid, dodecyl-, sodium salt	x					
98099	Benzenesulfonyl chloride		U				
108985	Benzenethiol		P,8				
98077	Benzene, (trichloromethyl)		U,8				
12002481	Benzene, trichloro-	x					
123024	Benzene, tridecyl	x					
3816765	1H-Benzimidazole-1-ethanamine,2-[(4-chlorophenyl) methyl]-N,N-diethyl-5-nitro			x			
81072	1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide		U,8				
50328	Benzo(a)pyrene		U,8				
120581	1,3-Benzodioxole, 5-(1-propenyl)		U,8				
94597	1,3-Benzodioxole, 5-(2-propenyl)-		U,8	x			
94586	1,3-Benzodioxole, 5-propyl		U,8				
1563662	7-Benzofuranol, 2,3-dihydro-2,3-dimethyl-, methylcarbamate	x		x			

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
191242	Benzo(ghi)perylene	x					
50317	Benzoic acid, 2,3,6-trichloro			x			
1918009	Benzoic acid, 3,6-dichloro-2-methoxy	x					
65850	Benzoic acid	x					
1863634	Benzoic acid, ammonium salt	x					
205823	Benzo(j)fluoroanthene		8				
207089	Benzo(k)fluorathene	x					
1194656	Benzonitrile, 2,6-dichloro	x					
100470	Benzonitrile	x					
81812	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)		P,8				
129066	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, sodium salt		P,8				
189559	Benzo(rst)pentaphene		U,8				
98884	Benzoyl chloride	x					
7440417	Beryllium	x	P,8			x	
7787475	Beryllium chloride	x					
7787497	Beryllium fluoride	x					
1464535	2,2'-Bioxirane		U,8				
298180	2,2'-Bioxirane, (R*,R*)-(+-)-		U,8				
564001	2,2'-Bioxirane, (R*,S*)-		U,8				
91941	(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dichloro	x	U,8				
84684	(1,1'-Biphenyl)-4,4'-diamine, 2,2'-dichloro	x					
1331471	(1,1'-Biphenyl)-4,4'-diamine, dichloro	x					
119904	(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dimethoxy		U,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
119937	(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dimethyl		U,8				
92875	(1,1'-Biphenyl)-4,4'-diamine		U,8				
92671	(1,1'-Biphenyl)-4-amine		8				
1336363	1,1'-Biphenyl, chloro-derivs, <u>(see footnote)</u>	x	8	x			x
4685147	4,4'-Bipyridinium, 1,1'-dimethyl			x			
13826830	Borate(1-), tetrafluoro-, ammonium	x					
13814965	Borate(1-), tetrafluoro-, lead(2+) (2:1)	x					

NOTE: This entry identifies the polychlorinated biphenyls (PCBs). However, while it is the sole entry on this list for this particular class of compounds, it is <u>not</u> meant to exclude other individual chlorinated biphenyls that can be identified by other unique CAS registry numbers. Such registry numbers may include:

2050671	13029088	34883437
2050682	16605917	37317412
2974927	25323686	37324235
11096825	25429292	37324246
11097691	26914330	37353632
11100144	27323188	53469219
11104282	34883391	
11120299	34883415	
11141165		
12672296		
12737870		

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
1332076	Boric acid, zinc salt	x					
87683	1,3-Butadiene, 1,1,2,3,4,4-hexachloro		U,8				
78795	1,3-Butadiene, 2-methyl	x					
109739	1-Butanamine	x					
13952846	2-Butanamine	x					
924163	1-Butanamine, N-butyl-N-nitroso		U,8				
513495	2-Butanamine, (S)	x					
14307438	Butanedioic acid, 2,3-dihydroxy- (R-R*,R*))-, ammonium salt	x					
815827	Butanedioic acid, 2,3-dihydroxy- (R-(R*,R*))-, copper(2+) salt (1:1)	x					
3164292	Butanedioic acid, 2,3-dihydroxy- (R-(R*,R*))-, diammonium salt	x					
121755	Butanedioic acid, ((dimethoxyphosphinothioyl)thio)-, diethyl ester	x					
107926	Butanoic acid	x					
624419	1-Butanol, 2-methyl-, acetate	x					
123922	1-Butanol, 3-methyl-, acetate	x					
71363	1-Butanol	x	U				
39196184	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl]oxime		P,8				
78933	2-Butanone		U,8				
1338234	2-Butanone, peroxide		U,P,8				
4170303	2-Butenal	x	U,8				
764410	2-Butene, 1,4-dichloro		U				
31423924	Butene, 1,4-dichloro		U				
110576	2-Butene, 1,4-dichloro-, (E)		U				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
1476115	2-Butene, 1,4-dichloro-,(Z)		U				
110178	2-Butenedioic acid (E)	x					
110167	2-Butenedioic acid (Z)	x					
303344	2-Butenoic acid, 2-methyl-,7-[[2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl] -2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-(1 alpha(Z), 7(2s*,3R*),7a alpha)]		U,8				
7786347	2-Butenoic acid, 3-((dimethoxyphosphinyl)oxy)-, methyl ester	x		x			
7440439	Cadmium		8		x		
7789426	Cadmium bromide	x					
10108642	Cadmium chloride	x					
75207	Calcium carbide (CaC2)	x					
592018	Calcium cyanide	x	P,8	x			
51796	Carbamic acid, ethyl ester		U,8				
615532	Carbamic acid, methylnitroso-, ethyl ester		U,8				
1111780	Carbamic acid, monoammonium salt	x					
79447	Carbamic chloride, dimethyl		U,8				
111546	Carbamodithioic acid, 1,2-ethanediylbis-		U,8				
2303164	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester		U,8				
75150	Carbon disulfide	x	P,8				
506876	Carbonic acid, diammonium salt	x					
6533739	Carbonic acid, dithallium(1+) salt	x	U,8				
1066337	Carbonic acid, monoammonium salt	x					
3486359	Carbonic acid, zinc salt (1:1)	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
75445	Carbonic dichloride	x	P,8				
353504	Carbonic difluoride		U				
630080	Carbon monoxide					x	
79221	Carbonochloridic acid, methyl ester		U				
12789036	Chlordane		U,8				
7782505	Chlorine	x					
7790945	Chlorosulfuric acid	x					
11115745	Chromic acid	x					
7789095	Chromic acid (H2Cr207), diammonium salt	x					
10588019	Chromic acid (H2Cr207), disodium salt	x					
13765190	Chromic acid (H2Cr04), calcium salt	x	U,8				
7788989	Chromic acid (H2Cr04), diammonium salt	x					
7789006	Chromic acid (H2Cr04), dipotassium salt	x					
7778509	Chromic acid (H2Cr207), dipotassium salt	x					
7738945	Chromic acid (H2Cr04)	x					
14307358	Chromic acid (H2Cr04), dilithium salt	x					
7775113	Chromic acid (H2Cr04), disodium salt	x					
7789062	Chromic acid (H2Cr04), strontium salt (1:1)	x					
7440473	Chromium		8		x		
10049055	Chromium chloride (CrCl2)	x					
218019	Chrysene		U,8				
7789437	Cobalt bromide (CoBr2)	x					
12002038	Color Index Pigment Green 21 (Cupric acetoarsenite)	x		x			
10380297	Copper(2+), tetraammine-, sulfate (1:1), monohydrate	x					
7440508	Copper	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
7447394	Copper chloride (CuCl2)	x					
544923	Copper cyanide		P,8				
8021394	Creosote		U,8				
57125	Cyanide	x	P,8				
506683	Cyanogen bromide		U,P,8				
506774	Cyanogen chloride	x	P,8				
118752	2,5-cyclohexadiene-1,4-dione, 2,3,5,6-tetrachloro-			x			
106514	2,5-Cyclohexadiene-1,4-dione		U				
608371	Cyclohexane, 1,2,3,4,5,6-hexachloro	x	U,8				
319857	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1alpha, 2beta,3alpha,4beta,5alpha,6beta)-	x	U,8				
319846	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1alpha, 2alpha,3beta,4alpha,5beta,6beta)	x	U,8				
58899	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1alpha, 2alpha,3beta,4alpha,5alpha,6beta)	x	U,8	x	x		
6108107	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1alpha, 2alpha,3alpha,4beta,5beta,6beta)	x	U,8	x			
319868	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1alpha, 2alpha,3alpha,4beta,5alpha,6beta)	x	U,8	x			
110827	Cyclohexane	x	U				
108941	Cyclohexanone		U				
77474	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro	x	U,8				
121211	Cyclopropanecarboxylic acid, 2,2-dimethyl-3-(2-methyl-1-propenyl)-, 2-methyl-4-oxo-3-(2,4-pentadienyl)-2-cyclopenten-1-yl ester (1alpha(1alpha(8*(Z)),3beta))	x					
121299	Cyclopropanecarboxylic acid, 3-(3-methoxy-3-methyl-3-oxo-1-propenyl)-2,2-dimethyl-,2-methyl-4-oxo-3-(2,4-pentadienyl)-2-cyclopenten-1-yl ester, (1R-(1alpha(8*(Z)),3beta(E)))-	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
226368	Dibenz(a,h)acridine		8				
53703	Dibenz(a,h)anthracene		U,8				
224420	Dibenz(a,j)acridine		8				
189640	Dibenzo(b,def)chrysene	x	8				
1746016	Dibenzo(b,e)(1,4)dioxin, 2,3,7,8-tetrachloro	x	8				
194592	7H-Dibenzo(c,g)carbazole		8				
72208	2,7:3,6-Dimethanonaphth(2,3-b)oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-,(1a alpha, 2 beta,2a beta, 3 alpha, 6 alpha, 6a beta, 7 beta, 7a alpha)	x	P,8	x	x		
60571	2,7:3,6-Dimethanonaphth(2,3-b)oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1a alpha, 2 beta, 2a alpha, 3 beta, 6 beta, 6a alpha, 7 beta, 7a alpha)	x	P,8	x	x		
465736	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-,(1 alpha, 4 alpha, 4a beta, 5 beta, 8 beta, 8a beta)		P,8				
309002	1,4:5,8-Dimethanonaphthalene, 12,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-,(1 alpha, 4 alpha, 4a beta, 5 alpha, 8 alpha, 8a beta)	x	P,8	x			
123911	1,4-Dioxane		U,8				
152169	Diphosphoramide, octamethyl		P,8	x			
107493	Diphosphoric acid, tetraethyl ester	x	P,8	x			
2764729	Dipyrido(1,2-a:2',1'-c)pyrazinediium, 6,7-dihydro-	x					
85007	Dipyrido(1,2-a:2',1'-c)pyrazinediium, 6,7-dihydro-, dibromide	x					
7779864	Dithionous acid, zinc salt (1:1)	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
51752	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl		8				
55867	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl, hydrochloride		8				
126852	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl, N-oxide		8				
302705	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl, N-oxide, hydrochloride		8				
75047	Ethanamine	x					
109897	Ethanamine, N-ethyl	x					
121448	Ethanamine, N,N-diethyl	x					
55185	Ethanamine, N-ethyl-N-nitroso		U,8				
10595456	Ethanamine, N-methyl, N-nitroso	x	8				
111911	Ethane, 1,1'-[methylenebis(oxy)]bis(2-chloro		U,8				
111444	Ethane, 1,1'-oxybis(2-chloro		U,8				
60297	Ethane, 1,1'-oxybis		U				
630206	Ethane, 1,1,1,2-tetrachloro		U,8				
71556	Ethane, 1,1,1-trichloro	x	U,8				
79345	Ethane, 1,1,2,2-tetrachloro		U,8				
79005	Ethane, 1,1,2-trichloro	x	U,8				
75343	Ethane, 1,1-dichloro		U,8				
106934	Ethane, 1,2-dibromo	x	U,8				
107062	Ethane, 1,2-dichloro	x	U,8				
75003	Ethane, chloro	x					
107153	1,2-Ethanediamine	x	P,8				
91805	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)		U,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
460195	Ethanedinitrile		P,8				
2944674	Ethanedioic acid, ammonium iron(3+) salt (3:3:1)	x					
55488874	Ethanedioic acid, ammonium iron salt	x					
14258492	Ethanedioic acid, ammonium salt	x					
5893663	Ethanedioic acid, copper(2+) salt (1:1) hemihydrate	x					
6009707	Ethanedioic acid, diammonium salt, monohydrate	x					
5972736	Ethanedioic acid, monoammonium salt, monohydrate	x					
67721	Ethane, hexachloro		U,8				
76017	Ethane, pentachloro		U,8				
25322207	Ethane, tetrachloro	x	8				
62555	Ethanethioamide		U,8				
25323891	Ethane, trichloro	x					
23135220	Ethanimidothioic acid, 2-(dimethylamino)-N-[[(methylamino)-carbonyl]oxy]-2-oxo-, methyl ester			x			
16752775	Ethanimidothioic acid, N-((methylamino)carbonyl)oxy)-, methyl ester		P,8	x			
1116547	Ethanol, 2,2'-(nitrosoimino)bis		U,8				
98862	Ethanone, 1-phenyl		U				
75354	Ethene, 1,1-dichloro	x	U,8				
156592	Ethene, 1,2-dichloro-, (Z)	x	8				
540590	Ethene, 1,2-dichloro	x	8				
156605	Ethene, 1,2-dichloro-, (E)	x	U				
110758	Ethene, (2-chloroethoxy)		U,8				
75014	Ethene, chloro	x	U,8	x		x	
127184	Ethene, tetrachloro		U,8				
79016	Ethene, trichloro	x	U,8				
14433933	Ferric cyanide (ferric ferrocyanide)		8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
206440	Fluoranthene		U,8				
86737	9H-Fluorene	x					
7782414	Fluorine		P,8				
50000	Formaldehyde	x	U,8				
64186	Formic acid	x	U				
544183	Formic acid, cobalt (2+) salt	x					
557415	Formic acid, zinc salt	x					
110009	Furan		U				
98011	2-Furancarboxaldehyde	x	U				
108316	2,5-Furandione	x	U,8				
109999	Furan, tetrahydro		U				
14901087	beta-D-Glucopyranoside, (methyl-ONN-azoxy)methyl		8				
18883664	D-Glucose, 2-deoxy-2[[methylnitrosoamino) carbonyl]amino]		U,8				
60004	Glycine, N,N'-1,2-ethanediylbis(N-carboxymethyl)	x					
13256229	Glycine, N-methyl-N-nitroso		8				
70257	Guanidine, N-methyl-N'-nitro-N-nitroso		U,8				
124049	Hexanedioic acid	x					
57147	Hydrazine, 1,1-dimethyl		U,8				
1615801	Hydrazine, 1,2-diethyl		U,8				
540738	Hydrazine, 1,2-dimethyl		U,8				
122667	Hydrazine, 1,2-diphenyl		U,8				
302012	Hydrazine		U,8				
79196	Hydrazinecarbothioamide		P,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
60344	Hydrazine, methyl		P,8				
7647010	Hydrochloric acid	x					
74908	Hydrocyanic acid	x	P,8	x			
7664393	Hydrofluoric acid	x	U				
7783064	Hydrogen sulfide (H2S)	x	U,8				
80159	Hydroperoxide, 1-methyl-1-phenylethyl		U				
7778543	Hypochlorous acid, calcium salt	x					
7681529	Hypochlorous acid, sodium salt	x					
10022705	Hypochlorous acid, sodium salt, pentahydrate	x					
96457	2-Imidazolidinethione		U,8				
193395	Indeno(1,2,3-cd)pyrene		U,8				
53861	1H-Indole-3-acetic acid, 1-(4-chlorobenzoyl)-5-methoxy-2-methyl		P,8				
7758943	Iron chloride (FeCl2)	x					
7705080	Iron chloride (FeCl3)	x					
10025771	Iron chloride (FeCl3), hexahydrate	x					
9004664	Iron dextran		U				
7783508	Iron fluoride (FeF3)	x					
85449	1,3-Isobenzofurandione		U,8				
133062	1H-Isoindole-1,3(2H)-dione, 3a,4,7,7a-tetrahydro-2-((trichloromethyl)thio)	x					
2763964	3(2H)-isoxazolone, 5-(aminomethyl)		P,8				
7439921	Lead		8		x	x	
1335326	Lead, bis(acetato-O)tetrahydroxytri		U,8				
7758954	Lead chloride (PbCl2)	x					
7783462	Lead fluoride (PbF2)	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
10101630	Lead iodide (PbI2)	x					
1314870	Lead sulfide (PbS)	x					
7439976	Mercury		U,8	x	x	x	
62384	Mercury,(acetato-o)phenyl-	x	P,8				
592041	Mercury cyanide (Hg(CN)2)	x					
628864	Mercury fulminate		x				
7785844	Metaphosphoric acid (H3P309), trisodium salt	x					
10124568	Metaphosphoric acid (H6P6018), hexasodium salt	x					
74895	Methanamine	x					
75503	Methanamine, N,N-dimethyl	x					
124403	Methanamine, N-methyl	x	U				
62759	Methanamine, N-methyl-n-nitroso		U,P,8	x			
74839	Methane, bromo		U,8	x			
75-27-4	Methane, bromodichloro	x					
74873	Methane, chloro		U,8				
107302	Methane, chloromethoxy		U,8				
74953	Methane, dibromo		U,8				
124481	Methane, dibromochloro		U				
75092	Methane, dichloro	x	U,8				
75718	Methane, dichlorodifluoro		U				
74884	Methane, iodo		U,8				
624839	Methane, isocyanato		P,8				
542881	Methane, oxybis(chloro)		P,8				
62500	Methanesulfonic acid, ethyl ester		U,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
66273	Methanesulfonic acid, methyl ester		8				
56235	Methane, tetrachloro	x	U,8				
509148	Methane, tetranitro		P				
74931	Methanethiol	x	U				
75707	Methanethiol, trichloro		P,8				
75252	Methane, tribromo	x	U,8				
67663	Methane, trichloro	x	U,8				
75694	Methane, trichlorofluoro		U				
33089611	Methanimidamide, N'-(2,4-dimethylphenyl)-N-((2,4-dimethylphenyl)imino)methyl)-N-methyl-			x			
57749	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro	x					
76448	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro	x	P,8	x			
1031078	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachlor-1,5,5a,6,9,9a-hexahydro-, 3,3-dioxide	x					
33213659	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachlor-1,5,5a,6,9,9a-hexahydro-,3-oxide,(3alpha, 5a alpha, 6 beta, 9 beta, 9a alpha)	x					
115297	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachlor-1,5,5a,6,9,9a-hexahydro-,3-oxide	x	P,8				
959988	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,1-hexachloro-1,5,5a,6,9,9a-hexahydro-,3-oxide, (3 alpha, 5a beta, 6 alpha, 9 alpha, 9a beta)	x					
1024573	2,5-Methano-2H-indeno(1,2-b)oxirene, 2,3,4,5,6,7,8-heptachloro-1a,1b,5,5a,6,6a-hexahydro	x	8				
67561	Methanol		U				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
124414	Methanol, sodium salt	x					
2385855	1,3,4-Metheno-1H-cyclobuta(cd)pentalene,1,1a,2,2,3,3a,4,5,5,5a,5b,6-dodecachlorooctahydro			x			
143500	1,3,4-Metheno-2H-cyclobuta(cd)pentalen-2-one, 1,1a,3,3a,4,5,5a,5b,6-decachlorooctahydro-	x	U,8	x			
59892	Morpholine, 4-nitroso-		8				
20830813	5,12-Naphthacenedione, 8-acetyl-10[(3-amino-2,3,6-trideoxy-alpha-L-lyxo-hexapyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-,(8S-cis)		U,8				
91598	2-Naphthalenamine		U,8				
134327	1-Naphthalenamine		U,8				
494031	Naphthalenamine, N,N'-bis(2-chloroethyl)		U,8				
90131	Naphthalene, 1-chloro	x	8				
1825305	Naphthalene, 1,5-dichloro	x	8				
1825316	Naphthalene, 1,4-dichloro	x	8				
2050693	Naphthalene, 1,2-dichloro	x	8				
2050728	Naphthalene, 1,6-dichloro	x	8				
2050739	Naphthalene, 1,7-dichloro	x	8				
2050740	Naphthalene, 1,8-dichloro	x	8				
2050751	Naphthalene, 2,3-dichloro	x	8				
2065705	Naphthalene, 2,6-dichloro	x	8				
2198756	Naphthalene, 1,3-dichloro	x	8				
2198778	Naphthalene, 2,7-dichloro	x	8				
28699889	Naphthalene, dichloro-	x	8				
91587	Naphthalene, 2-chloro	x	U,8				
91203	Naphthalene	x	U,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
130154	1,4-Naphthalenedione		U,8				
117806	1,4-Naphthalenedione, 2,3-dichloro	x					
72571	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl(1,1'-biphenyl)-4,4'-diyl)bis(azo)] bis(5-amino-4-hydroxy-, tetrasodium salt		U,8				
2234131	Naphthalene, octachloro	x	8				
6358538	2-Naphthalenol, 1-[(2,5-dimethoxyphenyl)azo]		8				
63252	1-Naphthalenol, methylcarbamate	x					
192654	Naphtho(1,2,3,4-def)chrysene	x	8				
1338245	Naphthenic acid	x					
13463393	Nickel carbonyl, (t-4)-		P,8				
37211055	Nickel chloride	x					
7718549	Nickel chloride (NiCl2)	x					
557197	Nickel cyanide		P,8				
12054487	Nickel hydroxide (Ni(OH)2)	x					
7440020	Nickel	x					
14797558	Nitrate				x		
7697372	Nitric acid	x					
7787555	Nitric acid, beryllium salt, trihydrate	x					
18256989	Nitric acid, lead salt	x					
7761888	Nitric acid, silver (1+) salt	x					
13597994	Nitric acid, beryllium salt	x					
10421484	Nitric acid, iron(3+) salt	x					
10099748	Nitric acid, lead(2+) salt	x					
10415755	Nitric acid, mercury(1+) salt	x					
7782867	Nitric acid, mercury(1+) salt, monohydrate	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
10045940	Nitric acid, mercury(2+) salt	x					
13138459	Nitric acid, nickel(2+) salt	x					
14216752	Nitric acid, nickel salt	x					
10102451	Nitric acid, thallium (1+) salt		U,8				
7779886	Nitric acid, zinc salt	x					
13746899	Nitric acid, zirconium(4+) salt	x					
10544726	Nitrogen oxide (N2O4)		P,8				
10102440	Nitrogen oxide (NO2)	x	P,8			x	
10102439	Nitrogen oxide (NO)		P,8				
7632000	Nitrous acid, sodium salt	x					
16543558	Nornicotine, N-nitroso-		8				
1072351	Octadecanoic acid, lead(2+) salt	x					
7428480	Octadecanoic acid, lead salt	x					
20816120	Oxmium oxide (OSO4)(T-4)		P,8				
145733	7-Oxabicyclo(2.2.1)heptane-2,3-dicarboxylic acid		P,8				
1120714	1,2-Oxathiolane, 2,2-dioxide		U,8				
50180	2H-1,3,2-Oxazaphosphorin-2-amine,N,N-bis(2-chloroethyl) tetrahydro-,2-oxide		U,8				
7530054	Oxirane, 2-chloromethyl-3-methyl		8				
75218	Oxirane		U				
765344	Oxiranecarboxaldehyde		U,8				
106898	Oxirane, (chloromethyl)	x	U,8				
75569	Oxirane, methyl	x					
10028156	Ozone					x	

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
30525894	Paraformaldehyde	x					
504609	1,3-Pentadiene		U				
620111	3-Pentanol, acetate	x					
626380	2-Pentanol, acetate	x					
108101	2-Pentanone, 4-methyl		U				
7722647	Permanganic acid (HMnO4), potassium salt	x					
85018	Phenanthrene	x					
578949	Phenarsazine, 10-chloro-5,10-dihydro			x			
88857	Phenol, 2-(1-methylpropyl)-4,6-dinitro		P,8				
70304	Phenol, 2,2'-methylenebis(3,4,6-trichloro)		U,8				
97187	Phenol, 2,2'-thiobis(4,6-dichloro)			x			
4901513	Phenol, 2,3,4,5-tetrachloro	x	8				
58902	Phenol, 2,3,4,6-tetrachloro	x	U,8				
64006	Phenol, 2,3,4,6-tetrachloro	x	8				
933755	Phenol, 2,3,6-trichloro	x	8				
526750	Phenol, 2,3-dimethyl	x					
95954	Phenol, 2,4,5-trichloro	x	U,8				
88062	Phenol, 2,4,6-trichloro	x	U,8				
131748	Phenol, 2,4,6-trinitro-, ammonium salt		P				
120832	Phenol, 2,4-dichloro	x	U				
105679	Phenol, 2,4-dimethyl		U,8				
51285	Phenol, 2,4-dinitro	x	U,P,8				
583788	Phenol, 2,5-dichloro	x	8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
329715	Phenol, 2,5-dinitro	x					
87650	Phenol, 2,6-dichloro	x	U,8				
573568	Phenol, 2,6-dinitro	x					
95578	Phenol, 2-chloro		U,8				
131895	Phenol, 2-cyclohexyl-4,6-dinitro		P,8				
534521	Phenol, 2-methyl-4,6-dinitro		P,8				
95487	Phenol, 2-methyl	x	U				
88755	Phenol, 2-nitro	x					
2032657	Phenol, 3,5-dimethyl-4-(methylthio)-, methyl-carbamate	x					
108689	Phenol, 3,5-dimethyl	x					
108394	Phenol, 3-methyl	x	U				
558847	Phenol, 3-nitro	x					
56531	Phenol, 4,4'-(1,2-ethendyl)bis-,(E)		U,8				
59507	Phenol, 4-chloro-3-methyl		U,8				
315184	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester)	x					
609938	Phenol, 4-methyl-2,6-dinitro	x					
106445	Phenol, 4-methyl	x	U				
100027	Phenol, 4-nitro	x	U,8				
108952	Phenol	x	U,8				
25167800	Phenol, chloro	x	8				
25167811	Phenol, dichloro	x	8				
1300716	Phenol, dimethyl	x					
1319773	Phenol, methyl		U				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
25154556	Phenol, nitro	x					
87865	Phenol, pentachloro	x	U,P,8				
25167833	Phenol, tetrachloro	x	8				
25167822	Phenol, trichloro	x	8				
58366	10H-Phenoxarsine, 10,10'-oxybis			x			
148823	L-Phenylalanine, 4-(bis(2-chloroethyl)amino)		U,8				
7803512	Phosphine		P,8				
52686	Phosphonic acid, (2,2,2-trichloro-1-hydroxyethyl)-, dimethyl ester	x					
944229	Phosphonodithiocic acid, ethyl-, O-ethyl 5-phenyl ester			x			
22224926	Phosphoramidic acid, (1-methylethyl)-, ethyl 3-methyl-4-(methylthio)phenyl ester			x			
300765	Phosphoric acid, 1,2-dibromo-2,2-dichloroethyl dimethyl ester	x					
62737	Phosphoric acid, 2,2-dichloroethenyl dimethyl ester	x					
470906	Phosphoric acid, 2-chloro-1-(2,4-dichlorophenyl) ethenyl diethyl ester			x			
13171216	Phosphoric acid, 2-chloro-3-(diethylamino)-1-methyl-3-oxo-1-propenyl dimethyl ester			x			
7664382	Phosphoric acid	x					
311455	Phosphoric acid, diethyl 4-nitrophenyl ester		P,8				
6923224	Phosphoric acid dimethyl 1-methyl-3-(methylamino)-3-oxo-1-propenyl ester, (E)			x			
7558794	Phosphoric acid, disodium salt	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
10028247	Phosphoric acid, disodium salt, dihydrate	x					
10039324	Phosphoric acid, disodium salt, dodecahydrate	x					
10140655	Phosphoric acid, disodium salt, hydrate	x					
7446277	Phosphoric acid, lead(2+) salt (2:3)		U,8				
7601549	Phosphoric acid, trisodium salt	x					
10361894	Phosphoric acid, trisodium salt, decahydrate	x					
10101890	Phosphoric acid, trisodium salt, dodecahydrate	x					
13194484	Phosphorodithioic acid, O-ethyl S,S dipropyl ester			x			
298022	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio) methyl) ester		P	x			
3288582	Phosphorodithioic acid, O,O-diethyl ester, S-methyl ester		U,8				
60515	Phosphorodithioic acid, O,O-dimethyl S-(2-(methylamino) -2-oxoethyl) ester		P,8				
86500	Phosphorodithioic acid, O,O-dimethyl S-((4-oxo-1,2,3-benzotriazin-3(4H)-yl)methyl) ester	x		x			
563122	Phosphorodithioic acid, S,S'-methylene O,O,O',O'-tetraethyl ester	x					
298044	Phosphorodithioic acid, O,O-diethyl S-(2-(ethylthio) ethyl) ester	x	P,8	x			
55914	Phosphorofluoridic acid, bis(1-methylethyl) ester		P,8				
56724	Phosphorothioic acid, O-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl) O,O-diethyl ester	x					
126750	Phosphorothioic acid, O,O-diethyl S-(2-(ethylthio) ethyl) ester			x			

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
2921882	Phosphorothioic acid, 0,0-diethyl 0-(3,5,6-trichloro-2-pyridinyl) ester	x					
115902	Phosphorothioic acid, 0-0-diethyl 0-[4-(methylsulfinyl) phenyl] ester	x					
56382	Phosphorothioic acid, 0,0-diethyl 0-(4-nitrophenyl) ester	x	P,8	x			
333415	Phosphorothioic acid, 0,0-diethyl 0-(6-methyl-2-(1-methylethyl)-4-pyrimidinyl) ester	x					
297972	Phosphorothioic acid, 0,0-diethyl 0-pyrazinyl ester		P,8				
298000	Phosphorothioic acid, 0,0-dimethyl 0-(4-nitrophenyl) ester	x	P,8	x			
52857	Phosphorothioic acid, 0-[4-[(dimethylamine) sulfonyl]phenyl]0,0-dimethyl ester		P,8				
126681	Phosphorothioic acid, 0,0,0-triethyl ester		8				
7719122	Phosphorous trichloride	x					
7723140	Phosphorus	x					
12185103	Phosphorus, mol. (P4)	x					
1314803	Phosphorus sulfide (P2S5)	x	U				
10025873	Phosphoryl chloride	x					
78342	Phosphorodithioic acid, S,S'-1,4-dioxane-2,3-diyl 0,0,0',0'-tetraethyl ester			x			
100754	Piperidine, 1-nitroso		U,8				
78002	Plumbane, tetraethyl	x	P,8			x	
9004982	Poly(oxy-1,2-ethanediyl), alpha,-9-octadecenyl-, omega,-hydroxy-, (Z)		P,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
53467111	Poly[oxy(methyl-1,2-ethanediyl)], alpha -(2,4-di-chlorophenoxy)acetyl-omega-butoxy	x					
151508	Potassium cyanide	x	P,8				
1310583	Potassium hydroxide	x					
116063	Propanal, 2-methyl-2-(methylthio)-o-((methylamino)carbonyl)oxime		P,8	x			
75649	2-Propanamine, 2-methyl	x					
78819	1-Propanamine,2-methyl	x					
107108	1-Propanamine		U				
621647	1-Propanamine, N-nitroso-n-propyl		U,8				
142847	1-Propanamine, N-propyl		U				
78999	Propane, 1,1-dichloro	x	8				
96184	Propane, 1,2,3-trichloro		8				
96128	Propane, 1,2-dibromo-3-chloro-		U,8	x			
78875	Propane, 1,2-dichloro	x	U,8				
142289	Propane, 1,3-dichloro	x	8				
108601	Propane, 2,2'-oxybis(1-chloro-		8				
39638329	Propane, 2,2'-oxybis(2-chloro-		U,8				
79469	Propane, 2-nitro		U				
26638197	Propane, dichloro	x	U,8				
109773	Propanedinitrile		U,8				
57556	1,2-Propanediol		P,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
107120	Propanenitrile		P,8				
75865	Propanenitrile, 2-hydroxy-2-methyl	x	P,8				
126987	2-Propanenitrile, 2-methyl		U				
542767	Propanenitrile, 3-chloro		P,8				
1185575	1,2,3-Propanetricarboxylic acid, 2-hydroxy-, ammonium iron(3+) salt	x					
3012655	1,2,3-Propanetricarboxylic acid, 2-hydroxy-, diammonium salt	x					
55630	1,2,3-Propanetriol, trinitrate		P,8				
93721	Propanoic acid, 2-(2,4,5-trichlorophenoxy)	x	U,8		x		
32534955	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-, isooctyl ester	x					
75990	Propanoic acid, 2,2-dichloro	x					
79312	Propanoic acid, 2-methyl	x					
79094	Propanoic acid	x					
123626	Propanoic acid, anhydride	x					
126727	1-Propanol, 2,3-dibromo-, phosphate (3:1)		U,8				
75650	2-Propanol, 2-methyl	x					
78831	1-Propanol, 2-methyl		U				
598312	2-Propanone, 1-bromo		P,8				
67641	2-Propanone		U				
107186	2-Propen-1-ol	x	P,8	x			
107028	2-Propenal	x	P,8	x			

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
79061	2-Propenamide		U,8				
1888717	1-Propene, 1,1,2,3,3,3-hexachloro		U,P,8				
542756	1-Propene, 1,3-dichloro	x	U,8				
8003198	1-Propene, 1,3-dichloro-, mixt with dichloropropane	x					
78886	1-Propene, 2,3-dichloro	x	8				
107051	1-Propene, 3-chloro	x					
26952238	1-Propene, dichloro	x					
107131	2-Propenenitrile	x	U,8	x			
97632	2-Propenoic acid, 2-methyl-, ethyl ester		U				
80626	2-Propenoic acid, 2-methyl-, methyl ester	x	U,8				
79107	2-Propenoic acid		U				
140885	2-Propenoic acid, ethyl ester		U				
107197	2-Propyn-1-ol		P,8				
129000	Pyrene	x					
123331	3,6-Pyridazinedione, 1,2-dihydro		U				
504245	4-Pyridinamine		P,8				
109068	Pyridine, 2-methyl		U				
54115	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-,(S)-		P,8				
65316	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-,(S)-,(R,R*,R*)) 2,3-dihydroxybutanedioate (1:2)		P,8				
65305	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-,(S)-, sulfate (2:1)		P,8				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
2820511	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, hydrochloride, (S)		P,8				
110861	Pyridine		U,8				
1918021	2-Pyridinecarboxylic acid, 4-amino-3,5,6-trichloro			x			
66751	2,4-(1H,3H)-Pyrimidinedione,5-[bis(2-chloroethyl) amino]		U,8				
56042	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo		U,8				
51525	4(1H)-Pyrimidinone, 2,3-dihydro-6-propyl-2-thioxo		8				
930552	Pyrrolidine, 1-nitroso		U,8				
56575	Quinoline, 4-nitro, 1-oxide		8				
91225	Quinoline	x					
7446222	Selenic acid (H2Se04), dithallium(1+) salt	x					
7783008	Selenious acid		U,8				
10102188	Selenious acid (H2Se03), disodium salt	x					
7782823	Selenious acid (H2Se03), monosodium salt	x					
7782492	Selenium		8		x		
7446084	Selenium oxide (Se02)	x					
7446346	Selenium sulfide (SeS)		U,8				
7488564	Selenium sulfide (SeS2)	x					
630104	Selenourea		P,8				
115026	L-Serine, diazpacetate (ester)		U,8				
16919190	Silicate(2-), hexafluoro-, diammonium	x					
16871719	Silicate(2-), hexafluoro-, zinc (1:1)	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
7440224	Silver		8		x		
506649	Silver cyanide (Ag(CN))		P,8				
7440235	Sodium	x					
26628228	Sodium azide		P				
143339	Sodium cyanide	x	P,8	x			
7681494	Sodium fluoride	x		x			
1333831	Sodium fluoride (Na(HF2))	x		x			
1210732	Sodium hydroxide	x					
16721805	Sodium sulfide (Na(SH))	x					
7789619	Stibine, tribromo	x					
10025919	Stibine, trichloro	x					
7783564	Stibine, trifluoro	x					
8001501	Strobane			x			
1314961	Strontium sulfide		P,8				
357573	Strychnidin-10-one, 2,3-dimethoxy		P,8				
57249	Strychnidin-10-one	x	P,8	x			
60413	Strychnidin-10-one, sulfate (2:1)		P,8				
14017415	Sulfamic acid, cobalt(2+) salt (2:1)	x					
7773060	Sulfamic acid, monoammonium salt	x					
12771083	Sulfur chloride	x					
10025679	Sulfur chloride (S2Cl2)	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
7446095	Sulfur dioxide					x	
7664939	Sulfuric acid	x					
10043013	Sulfuric acid, aluminum salt (3:2)	x					
10045893	Sulfuric acid, ammonium iron (2+) salt (2:2:1)	x					
7783859	Sulfuric acid, ammonium iron(2+) salt (2:2:1), hexahydrate	x					
15699180	Sulfuric acid, ammonium nickel(2+) salt (2:2:1)	x					
10101538	Sulfuric acid, chromium(3+) salt (3:2)	x					
7758987	Sulfuric acid copper(2+) salt (1:1)	x					
7758998	Sulfuric acid, copper(2+) salt (1:1), pentahydrate	x					
77781	Sulfuric acid, dimethyl ester		U,8				
7446186	Sulfuric acid, dithallium(1+) salt	x					
7720787	Sulfuric acid, iron(2+) salt (1:1)	x					
7782630	Sulfuric acid, iron(2+) salt (1:1), heptahydrate	x					
10028225	Sulfuric acid, iron(3+) salt (3:2)	x					
7446142	Sulfuric acid, lead(2+) salt (1:1)	x					
15739807	Sulfuric acid, lead salt	x					
7783359	Sulfuric acid, mercury(2+) salt (1:1)	x					
7786814	Sulfuric acid, nickel (2+) salt (1:1)	x					
10031591	Sulfuric acid, thallium salt	x	P,8				
7733020	Sulfuric acid, zinc salt (1:1)	x					
14644612	Sulfuric acid, zirconium(4+) salt (2:1)	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
7446313	Sulfuric acid, zirconium(4+) salt (2:1), tetrahydrate	x					
2312358	Sulfurous acid, 2-(4-(1,1-dimethylethyl)phenoxy) cyclohexyl 2-propynyl ester	x					
140578	Sulfurous acid, 2-chloroethyl 2-(4-(1,1-dimethylethyl) phenoxy)-1-methylethyl ester		8	x			
10196040	Sulfurous acid, diammonium salt	x					
10192300	Sulfurous acid, monoammonium salt	x					
7631905	Sulfurous acid, monosodium salt	x					
61788338	Terphenyl, chlorinated			x			
61788338	Terphenyl, chlorinated			x			
757584	Tetraphosphoric acid, hexaethyl ester		P,8				
7440280	Thallium	x	8				
7791120	Thallium chloride (TlCl)		U,8				
1314325	Thallium oxide (Tl03)		P,8				
12039520	Thallium selenide (TlSe)		P,8				
1762954	Thiocyanic acid, ammonium salt	x					
592870	Thiocyanic acid, lead (2+) salt	x					
592858	Thiocyanic acid, mercury (2+) salt	x					
3689245	Thiodiphosphoric acid ((HO)2P(S)2O), tetraethyl ester		P,8	x			
541537	Thioimidodicarbonic diamide		P,8				
137268	Thioperoxydicarbonic diamide (((H2N)C(S))2S2),tetramethyl		U,P,8				
7783188	Thiosulfuric acid (H2S2O3), diammonium salt	x					

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
5344821	Thiourea, (2-chlorophenyl)		P,8				
97994	Thiourea, 1-naphthalenyl		P,8				
62566	Thiourea		U,8				
103855	Thiourea, phenyl		P,8				
8001352	Toxaphene	x	U,8		x		
61825	1H-1,2,4-Triazol-3-amine		U,8				
123637	1,3,5-Trioxane, 2,4,6-trimethyl		U				
7758294	Triphosphoric acid, pentasodium salt	x					
541093	Uranium, bis(acetato-0)dioxo-	x					
10102064	Uranium, bis(nitrato-0) dioxo-	x					
36478769	Uranium, bis(nitrato-0,0')dioxo-, (OC-6-11)	x					
330541	Urea, N'-(3,4-dichlorophenyl)-N,N-dimethyl	x					
150685	Urea, N'-(4-chlorophenyl)-N-N-dimethyl			x			
759739	Urea, N-ethyl-n-nitroso		U,8				
684935	Urea, N-methyl-n-nitroso		U,8				
7803556	Vanadic acid (HV03), ammonium salt		P,8				
1314621	Vanadium oxide (V205)	x	P,8				
27774136	Vanadium, oxo(sulfato(2-)-0)	x					
4549400	Vinylamine, N-methyl-N-nitroso		P,8				
50555	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-((3,4,5-trimethoxybenzoyl)oxy)-, methyl ester, (3 beta, 16 beta, 17 alpha, 18 beta, 20 alpha)-		U				

CAS #	Substance	CWA	RCRA	FIFRA	SDWA	CAA	TSCA
14639975	Zincate(2-), tetrachloro-, diammonium, (T-4)	x					
14639986	Zincate(3-), pentachloro-, triammonium	x					
7699458	Zinc bromide	x					
7646857	Zinc chloride	x					
557211	Zinc cyanide	x	P,8				
7783495	Zinc fluoride	x					
1314847	Zinc phosphide (Zn3P2)	x	P,8				
7440666	Zinc	x					
10026116	Zirconium chloride (ZrCl4)	x					
62010100	Zirconium oxide sulfate						

RCRA Hazardous Substances from Prior Regulations

Industry and EPA Hazardous Waste No.	Hazardous Waste
Generic:	
F001	The spent halogenated solvents used in degreasing, tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and the chlorinated fluorocarbons; and sludges from the recovery of these solvents in degreasing operations
F002	The spent halogenated solvents, tetrachloroethylene, methylene chloride, trichloroethylene, 1,2,2-trifluoroethane, o-dichlorobenzene, trichlorofluoromethane and the still bottoms from the recovery of these solvents
F003	The spent nonhalogenated solvents, xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, n-butyl alcohol, cyclohexanone, and the still bottoms from the recovery of these solvents
F004	The spent nonhalogenated solvents, cresols and cresylic acid, nitrobenzene, and the still bottoms from the recovery of these solvents
F005	The spent nonhalogenated solvents, methanol, toluene, methyl ethyl ketone, methyl isobutyl ketone, carbon disulfide, isobutanol, pyridine and the still bottoms from the recovery of these solvents
F006	Wastewater treatment sludges from electroplating operations
F007	Spent plating bath solutions from electroplating operations
F008	Plating bath sludges from the bottom of plating baths from electroplating operations
F009	Spent stripping and cleaning bath solutions from electroplating operations
F010	Quenching bath sludge from oil baths from metal heat treating operations
F011	Spent solutions from salt bath pot cleaning from metal heat treating operations

Industry and EPA Hazardous Waste No.	Hazardous Waste
F012	Quenching wastewater treatment sludges from metal heat treating operations
F013	Flotation tailings from selective flotation from mineral metals recovery operations
F014	Cyanidation wastewater treatment tailing pond sediment from mineral metals recovery operations
F015	Spent cyanide bath solutions from mineral metals recovery operations
F016	Dewatered air pollution control scrubber sludges from coke ovens and blast furnaces

RCRA Hazardous Waste From Specific Sources

Wood Preservation:

K001	Bottom sediment sludge from the treatment of wastewaters from wood processes that use cresote and/or pentachlorophenol

Inorganic Pigments:

K002	Wastewater treatment sludge from the production of chrome yellow and orange pigments
K003	Wastewater treatment sludge from the production of molybdate orange pigments
K004	Wastewater treatment sludge from the production of zinc yellow pigments
K005	Wastewater treatment sludge from the production of chrome green pigments
K006	Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated)
K007	Wastewater treatment sludge from the production of iron blue pigments
K008	Oven residue from the production of chrome oxide green pigments

Industry and EPA Hazardous Waste No.	Hazardous Waste
Organic Chemicals:	
K009	Distillation bottoms from the production of acetaldehyde from ethylene
K010	Distillation side cuts from the production of acetaldehyde from ethylene
K011	Bottom stream from the wastewater stripper in the production of acrylonitrile
K012	Still bottoms from the final purification of acrylonitrile in the production of acrylonitrile
K013	Bottom stream from the acetonitrile column in the production of acrylonitrile
K014	Bottoms from the acetronitrile purification column in the productidon of acrylonitrile
K015	Still bottoms from the distillation of benzyl chloride
K016	Heavy ends or distillation residues from the production of carbon tetrachloride
K017	Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin
K018	Heavy ends from fractionation in ethyl chloride production
K019	Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production
K020	Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production
K021	Aqueous spent antimony catalyst waste from fluoromethanes production
K022	Distillation bottom tars from the production of phenol/acetone from cumene
K023	Distillation light ends from the production of phthalic anhydride from naphthalene

Industry and EPA Hazardous Waste No.	Hazardous Waste
K024	Distillation bottoms from the production of phthalic anhydride from naphthalene
K025	Distillation bottoms from the production of nitrobenzene by the nitration of benzene
K026	Stripping still tails from the production of methyl ethyl pyridines
K027	Centrifuge residue from toluene diisocyanate production
K028	Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane
K029	Waste from the product stream stripper in the production of 1,1,1-trichloroethane
K030	Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene
Pesticides:	
K031	Byproducts salts generated in the production of MSMA and cacodylic acid
K032	Wastewater treatment sludge from the production of chlordane
K033	Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane
K034	Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane
K035	Wastewater treatment sludges generated in the production of creosote
K036	Still bottoms from toluene reclamation distillation in the production of disulfoton
K037	Wastewater treatment sludges from the production of disulfoton
K038	Wastewater from the washing and stripping of phorate production

Industry and EPA Hazardous Waste No.	Hazardous Waste
K039	Filter cake from the filtration of diethylphosphorodithoric acid in the production of phorate
K040	Wastewater treatment sludge from the production of phorate
K041	Wastewater treatment sludge from the production of toxaphene
K042	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T
K043	2,6-Dichlorophenol waste from the production of 2,4-D
Explosives:	
K044	Wastewater treatment sludges from the manufacturing and processing of explosives
K045	Spent carbon from the treatment of wastewater containing explosives
K046	Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds
K047	Pink/red water from TNT operations
Petroleum REfining:	
K048	Dissolved air flotation (DAF) float from the petroleum refining industry
K049	Slop oil emulsion solids from the petroleum refining industry
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry
K051	API separator sludge from the petroleum refining industry
K052	Tank bottoms (leaded) from the petroleum refining industry

Industry and EPA Hazardous Waste No.	Hazardous Waste
Leather Tanning Finishing:	
K053	Chrome (blue) trimmings generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearling
K054	Chrome (blue) shavings generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish, hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearing
K055	Buffing dust generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; and through-the-blue
K056	Sewer screenings generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearing
K057	Wastewater treatment sludges generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish/ hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue and shearing
K058	Wastewater treatment sludges generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; and through-the-blue
K059	Wastewater treatment sludges generated by the following subcategory of the leather tanning and finishing industry: hair save/non-chrome tan/retan/wet finish
Iron and Steel:	
K060	Ammonia still lime sludge from coking operations
K061	Emission control dust/sludge from the electric furnace production of steel
K062	Spent pickle liquor from steel finishing operations

Industry and EPA Hazardous Waste No.	Hazardous Waste
K063	Sludge from lime treatment of spent pickle liquor from steel finishing operations
Primary Copper:	
K064	Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production
Primary Lead:	
K065	Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities
Primary Zinc:	
K066	Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production
K067	Electrolytic anode slimes/sludges from primary zinc production
K068	Cadmium plant leach residue (iron oxide) from primary zinc production
Secondary Lead:	
K069	Emission control dust/sludge from secondary lead smelting

APPENDIX C

CANDIDATE LIST OF HAZARDOUS SUBSTANCES,

PRIORITY 1

Designation codes are as follows:

Co = Corrosive

F = Flammable

Fs = Flammable Solid

H = Health Hazard

H/W = Hazardous When Wet

X = Oxidizer or Explosive

Py = Pyrophoric

CAS #	Substance	Designation Criteria
79027	Acetaldehyde, dichloro	H
127195	Acetamide, N,N-dimethyl	H
108214	Acetic acid, 1-methylethyl ester	F
79118	Acetic acid, chloro-	Co
541888	Acetic acid, chloro-, anhydride	Co
79141	Acetic acid, hydroxy	Co
79209	Acetic acid, methyl ester	F
109604	Acetic acid, propyl ester	F
7327608	Acetonitrile, 2,2', 2''-nitrilotris	H
79049	Acetyl chloride, chloro	Co
7446700	Aluminum chloride	Co
7784181	Aluminun fluoride	Co
97938	Aluminum, triethyl-	Py
1726654	Aluminum, trihexadecyl	Py
1116730	Aluminum, trihexyl	Py
1070004	Aluminum, trioctyl	Py
1726665	Aluminum, tridecyl	Py
68279549	9,10-Anthracenediol, 6-ethyl-1,2,3,4-tetrahydro	H
67923880	9,10-Anthracenediol, ethyl-9,10-dihydro	H
15547178	9,10-Anthracenedione, 6-ethyl-1,2,3,4-tetrahydro	H
101848	Benzene, 1,1'-oxybis	H
95636	Benzene, 1,2,4-trimethyl	H
13414545	Benzene, 1-[(2-methyl-2-propenyl)oxy]-2-nitro	H
91087	Benzene, 1,3-diisocyanato-2-methyl	H
100185	Benzene, 1,4-bis(1-methylethyl)	H
88733	Benzene, 1-chloro-2-nitro	H
100005	Benzene, 1-chloro-4-nitro	H
5216251	Benzene, 1-chloro-4-(trichloromethyl)	H
98566	Benzene, 1-chloro-4-(trifluoromethyl)	H

CAS #	Substance	Designation Criteria
98839	Benzene, (1-methylethenyl)	H
584849	Benzene, 2,4-diisocyanato-1-methyl	H
103639	Benzene, (2-bromoethyl)	H
25321099	Benzene, bis(1-methylethyl)	H
719324	1,4-Benzenedicarbonyl dichloride, 2,3,5,6-tetrachloro	H
100210	1,4-Benzenedicarboxylic acid	Co
25724587	1,2-Benzenedicarboxylic acid, decyl hexyl ester	H
26761400	1,2-Benzenedicarboxylic acid, diisodecyl ester	
3648202	1,2-Benzenedicarboxylic acid, diundecyl ester	H
25340174	Benzene, diethyl	
123319	1,4-Benzenediol	H
123013	Benzene, dodecyl	H
25550145	Benzene, ethylmethyl	H
103651	Benzene, propyl	H
98113	Benzenesulfonic acid	Co
104154	Benzenesulfonic acid, 4-methyl	H
50854949	Benzenesulfonic acid, undecyl	H
1459105	Benzene, tetradecyl	H
6742547	Benzene, undecyl	H
13414556	Benzofuran, 2,3-dihydro-2,2-dimethyl-7-nitro	H
68298464	7-Benzofuranamine, 2,3-dihydro-2,2-dimethyl-, sulfate (2:1)	H
1563388	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl	H
118489	2H-3,1-Benzoazine-2,4(1H)-dione	H
12161829	Bertrandite (BE4(OH)2O(SiO3)2)	H
32741927	[1,1'-Biphenyl]-2,4', 5-tricarboxylic acid, trimethyl ester	H
92524	1,1'-Biphenyl	H
7726956	Bromine	Co
106990	1,3-Butadiene	F
106978	Butane	F
107891	Butanal, 3-hydroxy	F
123728	Butanal	F

CAS #	Substance	Designation Criteria
78784	Butane, 2-methyl	F
17773410	Butanenitrile, 2-hydroxy-4-(methylthio)	H
583915	Butanoic acid, 2-hydroxy-4-(methylthio)	H
106310	Butanoic acid, anhydride	Co
106989	1-Butene	F
107017	2-Butene	F
25167673	Butene	F
2431507	1-Butene, 2,3,4-trichloro	H
513359	2-Butene, 2-methyl	F
563462	1-Butene, 2-methyl	F
760236	1-Butene, 3,4-dichloro	H
563451	1-Butene, 3-methyl	F
624646	2-Butene, (E)	F
590181	2-Butene, (Z)	F
26760645	Butene, methyl	F
16529569	3-Butenenitrile 2-methyl	H
110656	2-Butyne-1,4-diol	H
126998	1,3-Butadiene, 2-chloro	H
7789755	Calcium fluoride	Co
1305620	Calcium hydroxide	Co
1305788	Calcium oxide	Co
1305799	Calcium peroxide	Co
40861298	Carbonic acid, ammonium zinc salt (2:1:2)	H
2941642	Carbonochloridothioic acid, S-ethyl ester	H
140932	Carbonodithioic acid, O-(1-methylethyl) ester, sodium salt	H
9004700	Cellulose, nitrate	X
10049044	Chlorine oxide (Cl02)	X
1333820	Chromium oxide (Cr03)	H
57455375	Color Index Pigment Blue 29	H
1344372	Color Index Pigment Yellow 34	H
51274001	Color Index Pigment Yellow 42	H

CAS #	Substance	Designation Criteria
12013159	Copper hydroxide sulfate	H
22205454	Copper sulfide (Cu2S)	H
108918	Cyclohexanamine	F
94600	1,4-Cyclohexanedicarboxylic acid, dimethyl ester	F
108930	Cyclohexanol	F
100641	Cyclohexanone, oxime	H
96377	Cyclopentane, methyl	F
75194	Cyclopropane	F
124185	Decane	F
112312	Decanal	F
872059	1-Decene	F
7775146	Dithionous acid, disodium salt	H
67481	Ethanaminium, 2-hydroxy-N,N,N-trimethyl-,chloride	H
1325877	Ethanaminium, n-[4-[[4-(diethylamino)phenyl][4-(ethylamino)-1-naphthalenyl]methylene]-2,5-cyclohexadien-1-ylidene]-N-ethyl-, molybdate-tungstatephosphate	H
505602	Ethane, 1,1'-thiobis(2-chloro	H
74840	Ethane	F
111400	1,2-Ethanediamine, N-(2-aminoethyl)	H
144627	Ethanedioic acid	H
63494597	Ethanesulfonamide, 2-(ethyl(3-methyl-4-nitrosophenyl)amino)-N-methyl	H
102716	Ethanol, 2,2',2''-nitrilotris	H
111422	Ethanol, 2,2'-iminobis	H
141435	Ethanol, 2-amino	H
107073	Ethanol, 2-chloro	H
110805	Ethanol, 2-ethoxy	F
111159	Ethanol, 2-ethoxy-, acetate	F
109864	Ethanol, 2-methoxy	F
64175	Ethanol	F

CAS #	Substance	Designation Criteria
540498	Ethene, 1,2-dibromo	
74851	Ethene	F
116143	Ethene, tetrafluoro	F
74862	Ethyne	F
8049170	Ferrosilicon	F
7789211	Fluorosulfuric acid	Co
68122	Formamide, N,N-dimethyl	H
109944	Formic acid, ethyl ester	F
107313	Formic acid, methyl ester	F
98000	2-Furanmethanol	F
96480	2(3H)-Furanone, dihydro	F
142825	Heptane	F
592767	1-Heptene	F
25339564	Heptene	F
110543	Hexane	F
124094	1,6-Hexanediamine	F
111693	Hexanedinitrile	F
1772254	1,3,6-Hexanetricarbonitrile	H
111273	1-Hexanol	H
104767	1-Hexanol, 2-ethyl	F
110123	2-Hexanone, 5-methyl	F
645625	2-Hexenal, 2-ethyl	F
592416	1-Hexene	F
1119853	3-Hexenedinitrile	F
13042029	2-Hexenedinitrile	F
10035106	Hydrobromic acid	Co
1333740	Hydrogen	F
7722841	Hydrogen peroxide	X
3071327	Hydroperoxide, 1-phenylethyl	X
10039540	Hydroxylamine, sulfate (2:1)	H
7790923	Hypochlorous acid	Co

CAS #	Substance	Designation Criteria
1854268	2-Imidazolidinone, 4,5-dihydroxy-1,3-bis(hydroxymethyl)	H
68797397	1H-Imidazolium, 1(or 3)-(carboxymethyl)-4,5-dihydro-1-(2-hydroxyethyl)-2-undecyl-, salt with alpha-sulfo-omega-(tridecyloxy) poly(oxy-1,2-ethanediyl), monosodium salt	H
108190	Imidodicarbonic diamide	H
7553562	Iodine	H
1310436	Iron phosphide (Fe2P)	H
1317379	Iron sulfide (FeS)	H
31394544	Isoheptane	F
1314416	Lead oxide (Pb304)	H
1317368	Lead oxide (PbO)	H
7439954	Magnesium	FS
1313139	Manganese oxide (Mn02)	H
593817	Methanamine, N,N-dimethyl-, hydrochloride	H
115106	Methane, oxybis	F
594423	Methanesulfenyl chloride, trichloro	Co
77736	4,7-Methano-1H-indene, 3a,4,7,7a-tetrahydro	H
3085356	Methanol, butoxy	F
4461523	Methanol, methoxy	F
1313275	Molybdenum oxide (Mo03)	H
2027170	Naphthalene, 2-(1-methylethyl)	H
38640629	Naphthalene, bis(1-methylethyl)	H
1937377	2,7-Naphthalenedisulfonic acid, 4-amino-3-[(4'-[(2,4-diaminophenyl)azo][1,1'-biphenyl]-4-yl]azo]-5-hydroxy-6-(phenylazo)-,disodium salt	H
12035722	Nickel sulfide	H
13780115	Nitric acid, ammonium calcium salt (3:1:1)	X
6484522	Nitric acid ammonium salt	X
10124375	Nitric acid, calcium salt	X
7757791	Nitric acid, potassium salt	X
7631994	Nitric acid sodium salt	X
10042769	Nitric acid, strontium salt	X

CAS #	Substance	Designation Criteria
10024972	Nitrogen oxide (N20)	X
7782776	Nitrous acid	Co
123966	2-Octanol	F
111875	1-Octanol	F
111660	1-Octene	F
674828	2-Oxetanone, 4-methylene	H
107835	Pentane, 2-methyl	F
109660	Pentane	F
4553622	Pentanedinitrile, 2-methyl	H
123422	2-Pentanone, 4-hydroxy-4-methyl	F
25377724	Pentene	F
141797	3-Penten-2-one, 4-methyl	F
107391	1-Pentene, 2,4,4-trimethyl	F
107404	2-Pentene, 2,4,4-trimethyl	F
109671	1-Pentene	F
646048	2-Pentene, (E)	F
4635874	3-Pentenenitrile	F
7632044	Perboric acid, sodium salt	X
7790989	Perchloric acid, ammonium salt	X
7601890	Perchloric acid, sodium salt	X
7727540	Peroxydisulfuric acid [((HO)S(0)2)202], diammonium salt	X
25168063	Phenol, (1-methylethyl)	H
13414589	Phenol, 2-(2-methylallyl)-6-nitro	H
90051	Phenol, 2-methoxy	H
98544	Phenol, 4-(1,1-dimethylethyl)	H
80057	Phenol, 4,4'-(1-methylethylidene)bis	H
1121706	Phenol, 4-methyl-, sodium salt	H
27193868	Phenol, dodecyl	H
25154523	Phenol, nonyl	H
13847171	Phosphoric acid, cadmium salt	H

CAS #	Substance	Designation Criteria
2524030	Phosphorochloridothioic acid, 0,0-dimethyl ester	H
756809	Phosphorodithioic acid, 0,0-dimethyl ester	H
121459	Phosphorous acid, trimethyl ester	H
101020	Phosphorous acid, triphenyl ester	H
25586429	Phosphorous acid, tris(methylphenyl) ester	H
1314563	Phosphorus oxide (P205)	Co
1762272	Plumbane, diethyldimethyl	H
1762283	Plumbane, triethylmethyl	H
7789233	Potassium fluoride	H
78842	Propanal, 2-methyl	F
597319	Propanal, 3-hydroxy-2,2-dimethyl	F
3268493	Propanal, 3-(methylthio)	H
123386	Propanal	F
919302	1-Propanamine, 3-(triethoxysilyl)	H
108203	Propane, 2,2'-oxybis-	F
75285	Propane, 2-methyl	F
74986	Propane	F
598787	Propanoic acid, 2-chloro	H
97858	Propanoic acid, 2-methyl-, 2-methylpropyl ester	F
110974	2-Propanol, 1,1'-iminobis	H
76084	2-Propanol, 1,1,1-tribromo-2-methyl	H
78897	1-Propanol, 2-chloro	H
67630	2-Propanol	F
71238	1-Propanol	F
26545733	Propanol, dichloro	H
115117	1-Propene, 2-methyl	F
563473	1-Propene, 3-chloro-2-methyl	H
115071	1-Propene	F

CAS #	Substance	Designation Criteria
103117	2-Propenoic acid, 2-ethylhexyl ester	F
79414	2-Propenoic acid, 2-methyl-	Co
141322	2-Propenoic acid, butyl ester	F
96333	2-Propenoic acid, methyl ester	F
74997	1-Propyne	F
872504	2-Pyrrolidinone, 1-methyl	H
10026047	Silane, tetrachloro	Co
10025782	Silane, trichloro	Co
16925396	Silicate(2-), hexafluoro-, calcium (1:1)	Co
16961834	Silicate(2-), hexafluoro-, dihydrogen	Co
16893859	Silicate(2-), hexafluoro-, disodium	Co
56802994	Sodium hypochlorite phosphate	X
1313822	Sodium sulfide (Na2S)	H
5329146	Sulfamic acid	Co
10545990	Sulfur chloride (SCl2)	Co
7785877	Sulfuric acid, manganese(2+) salt (1:1)	H
8014957	Sulfuric acid, mixt with sulfur trioxide	Co
7681381	Sulfuric acid, monosodium salt	Co
7782992	Sulfurous acid	Co
7446119	Sulfur trioxide	Co
7791255	Sulfuryl chloride	Co
8007452	Tar, coal	H
100970	1,3,5,7-Tetraazatricyclo(3.3.1.13,7)decane	H
7719097	Thionyl chloride	Co
3982910	Thiophosphoryl chloride	Co
7440326	Titanium	FS
7550450	Titanium chloride (TiCl4), (T-4)	Co
108805	1,3,5-Triazine-2,4,6(1H,3H,5H)-trione	H
2782572	1,3,5-Triazine-2,4,6(1H,3H,5H)-trione 1,3-dichloro	X
2893789	1,3,5-Triazine-2,4,6(1H,3H,5H)-trione, 1,3-dichloro-, sodium salt	X

CAS #	Substance	Designation Criteria
36452218	1,3,5-Triazine-2,4,6(1H,3H,5H)-trione, disodium salt	H
108770	1,3,5-Triazine, 2,4,6-trichloro	H
121824	1,3,5-Triazine, hexahydro-1,3,5-trinitro	X
110883	1,3,5-Trioxane	H
10380082	Triphosphoric acid	Co
8006642	Turpentine	H
1120214	Undecane	F
1314132	Zinc oxide	H
51810709	Zinc phosphide	H
62010100	Zirconium oxide sulfate	H

APPENDIX D

CANDIDATE LIST OF HAZARDOUS SUBSTANCES, PRIORITY 2

Designation codes are as follows:

- Co = Corrosive
- F = Flammable
- FS = Flammable Solid
- H = Health Hazard
- H/W = Hazardous When Wet
- X = Oxidizer or Explosive
- Py = Pyrophoric

CANDIDATE LIST OF HAZARDOUS SUBSTANCES, PRIORITY 2

CAS #	Substance	Designation Criteria
93710	Acetamide, 2-chloro-N,N-di-2-propenyl	H
40137608	Acetic acid, chloro-, 1-methyl-2-(2-methylpropoxy) ethyl ester	H
5330176	Acetic acid, chloro-, 2-butoxyethyl ester	H
590023	Acetic acid, chloro-, butyl ester	H
96344	Acetic acid, chloro-, methyl ester	H
3926623	Acetic acid, chloro-, sodium salt	H
25103097	Acetic acid, mercapto-, isooctyl ester	H
298124	Acetic acid, oxo	Co
76039	Acetic acid, trichloro	Co
79367	Acetyl chloride, dichloro	Co
14484696	Aluminate (1-), tetrafluoro-, potassium, (T-4)	H
64147473	Aluminate (2-), difluoro (phosphato (3-)-01-, sodium hydrogen	H
7784216	Aluminum hydride	Py
60304361	Aluminum potassium fluoride	H
1116707	Aluminum, tributyl	Py
12124979	Ammonium bromide	H
6219665	1,2-Anthracenedicarboxylic acid, 7-acetyl-6-ethyl-9, 10-dihydro-3,5,8-trihydroxy-9,10-dioxo	H
68310496	1H-Azepine-1-carboxamide, N,N', N''-[(2,4,6-trioxo-1,3,5-triazine-1,3,5 (2H,4H,6H)-triyl)tris(methyl-3,1-phenylene)] tris(hexahydro-2-oxo	H
111499	1H-Azepine, hexahydro	H
10302155	Aziridine, 1-(phenylsulfonyl)	H
10361372	Barium chloride	H
11138117	Barium iron oxide	H
90028	Benzaldehyde, 2-hydroxy	H
100527	Benzaldehyde	H

CAS #	Substance	Designation Criteria
1334787	Benzaldehyde, methyl	H
88686	Benzamide, 2-amino	H
25834804	Benzenamine, 2,4-bis[(4-aminophenyl)methyl]	H
95534	Benzenamine, 2-methyl-	H
88744	Benzenamine, 2-nitro	H
569619	Benzenamine, 4-[(4-aminophenyl)(4-imino-2,5-cyclo-hexadien-1-ylidene)methyl)-monohydrochloride	H
768525	Benzenamine, N-(1-methylethyl)	H
121697	Benzenamine, N,N-dimethyl	H
122394	Benzenamine, N-phenyl	H
588590	Benzene, 1,1'-(1,2-ethenediyl)bis	H
1163195	Benzene, 1,1'-oxybis(2,3,4,5,6-pentabromo)	H
98511	Benzene, 1-(1,1-dimethylethyl)-4-methyl	H
98066	Benzene, (1,1-dimethylethyl)	H
634662	Benzene, 1,2,3,4-tetrachloro	H
99627	Benzene, 1,3-bis(1-methylethyl)	H
68360	Benzene, 1,4-bis(trichloromethyl)	H
105055	Benzene, 1,4-diethyl	H
121733	Benzene, 1-chloro-3-nitro	H
104121	Benzene, 1-chloro-4-isocyanato	H
100298	Benzene, 1-ethoxy-4-nitro	H
104938	Benzene, 1-methoxy-4-methyl	H
602017	Benzene, 1-methyl-2,3-dinitro	X
6144043	Benzene, (1-methylethenyl)-, dimer	H
393759	Benzene, 2-chloro-1,3-dinitro-5-(trifluoromethyl)	H
118967	Benzene, 2-methyl-1,3,5-trinitro	X
619158	Benzene, 2-methyl-1,4-dinitro	X
610399	Benzene, 4-methyl-1,2-dinitro	X
13005362	Benzeneacetic acid, potassium salt	H
114705	Benzeneacetic acid, sodium salt	H
614459	Benzenecarboperoxoic acid, 1,1-dimethylethyl ester	H

CAS #	Substance	Designation Criteria
25168052	Benzene, chloromethyl	H
793248	1,4-Benzenediamine, N-(1,3-dimethylbutyl)-N'-phenyl	H
91156	1,2-Benzenedicarbonitrile	H
626175	1,3-Benzenedicarbonitrile	H
100209	1,4-Benzenedicarbonyl dichloride	H
85701	1,2-Benzenedicarboxylic acid, 2-butoxy-2-oxoethyl butyl ester	H
6422862	1,4-Benzenedicarboxylic acid, bis (2-ethylhexyl) ester	H
117828	1,2-Benzenedicarboxylic acid, bis(2-methoxyethyl)ester	H
84695	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl)ester	H
85698	1,2-Benzenedicarboxylic acid, butyl 2-ethylhexyl ester	H
119073	1,2-Benzenedicarboxylic acid, decyl octyl ester	H
131179	1,2-Benzenedicarboxylic acid, di-2-propenyl ester	H
84617	1,2-Benzenedicarboxylic acid, dicyclohexyl ester	H
84775	1,2-Benzenedicarboxylic acid, didecyl ester	H
131113	1,2-Benzenedicarboxylic acid, dimethyl ester	H
1459934	1,3-Benzenedicarboxylic acid, dimethyl ester	H
119062	1,2-Benzenedicarboxylic acid, ditridecyl ester	H
58353632	Benzene, dodecylnitro	H
60128	Benzeneethanol	H
64800835	Benzene, ethyl(phenylethyl)	H
56939	Benzenemethanaminium, N,N,N-trimethyl-chloride	H

CAS #	Substance	Designation Criteria
2650182	Benzenemethanaminium, N-ethyl-N-[4-[[4-(ethyl [(3-sulfophenyl)methyl]amino] phenyl](2-sulfophenyl)methylene)-2,5-cyclohexadien-1-ylidene]-3-sulfo-, hydroxide, inner salt, diammonium salt	H
467629	Benzenemethanol, 4-amino-, alpha, alpha, -bis(4-aminophenyl)	H
2131182	Benzene, pentadecyl	H
38888981	Benzene, (phenylethyl)	H
6683198	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, 2,2-bis[(3-[3,5-bis (1,1-dimethylethyl)-4-hydroxyphenyl]-1-oxopropoxy]methyl]-1,3-propanediyl ester	H
6386385	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, methyl ester	H
2082793	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, octadecyl ester	H
88197	Benzenesulfonamide, 2-methyl	H
70553	Benzenesulfonamide, 4-methyl	H
1077561	Benzenesulfonamide, N-ethyl-2-methyl	H
28348530	Benzenesulfonic acid, (1-methylethyl)-, sodium salt	H
13863315	Benzenesulfonic acid, 2,2'-(1,2-ethenediyl) bis[[4-[(2-hydroxyethyl)methylamino]-6-(phenylamino)-1,3,5-triazin-2-yl]aminol-, disodium salt	H
16090021	Benzenesulfonic acid, 2,2'-(1,2-ethenediyl) bis(4-morpholinyl)-6-(phenylamino)-1,3,5-triazin-2-yl]amino]-, disodium salt	H
16470249	Benzenesulfonic acid, 2,2'-(1,2-ethenediyl) bis[5-[[4-[bis(2-hydroxyethyl)amino]-6-[(4-sulfophenyl)amino]-1,3,5-triazin-2-yl] amino]-, tetrasodium salt	H
68155680	Benzenesulfonic acid, 2,2'-(1,2-ethenediyl) bis[5-[[4-chloro-6-[4-sulfophenyl)amino]-1,3,5-triazin-2-yl]amino]-, dipotassium disodium salt	H
81118	Benzenesulfonic acid, 2,2'-(1,2-ethenediyl) bis(5-amino)	H

CAS #	Substance	Designation Criteria
7336201	Benzenesulfonic acid, 2,2'-(1,2-ethenediyl) bis(5-amino)-, disodium salt	H
128427	Benzenesulfonic acid, 2,2'-(1,2-ethenediyl) bis(5-nitro)	H
15883597	Benzenesulfonic acid, 2,2'-(1,2-ethenediyl) bis(5-nitro)-, sodium salt	H
88539	Benzenesulfonic acid, 2-amino-5-chloro-4-methyl	H
121039	Benzenesulfonic acid, 2-methyl-5-nitro	H
127684	Benzenesulfonic acid, 3-nitro-, sodium salt	H
18777543	Benzenesulfonic acid, 4-(1-ethyldecyl)	H
16066356	Benzenesulfonic acid, 4-(1-methylethyl)	H
54322315	Benzenesulfonic acid, 4-(2-bromoethyl)	H
80513	Benzenesulfonic acid, 4,4'-oxybis-, dihydrazide	H
1324761	Benzenesulfonic acid, [[4-[[4-(phenylamino) phenyl][4-(phenylimino)-2,5-cyclohexadien-1-yliden]methyl]phenyl(amino]	H
140603	Benzenesulfonic acid, 4-decyl	H
2627067	Benzenesulfonic acid, 4-decyl-, sodium salt	H
98691	Benzenesulfonic acid, 4-ethyl	H
14995381	Benzenesulfonic acid, 4-ethyl-, sodium salt	H
5160021	Benzenesulfonic acid, 5-chloro-2-[(2-hydroxy-1-naphthalenyl)azo]-4-methyl-, barium salt (2:1)	H
6973133	Benzenesulfonic acid, 5-chloro-4-methyl-2-nitro	H
25321419	Benzenesulfonic acid, dimethyl	H
28519020	Benzenesulfonic acid, dodecyl (sulfophenoxy)-, disodium salt	H
27457289	Benzenesulfonic acid, ethenyl-, sodium salt	H
57352348	Benzenesulfonic acid, ethyl	H
30995654	Benzenesulfonic acid, ethyl-, sodium salt	H
12068030	Benzenesulfonic acid, methyl-, sodium salt	H
25496019	Benzenesulfonic acid, tridecyl	H
26248248	Benzenesulfonic acid, tridecyl-, sodium salt	H
133595	Benzenesulfonyl chloride, 2-methyl	H

CAS #	Substance	Designation Criteria
121631	Benzenesulfonyl chloride, 4,4'-oxybis	H
98599	Benzenesulfonyl chloride, 4-methyl	H
930698	Benzenethiol, sodium salt	H
68186312	1,2,4-benzenetricarboxylic acid, 2-ethylhexyl ester	H
132672	Benzoic acid, 2-[(1-naphthalenylamino) carbonyl-, monosodium salt	H
34408258	Benzoic acid, 2,5-dichloro-3-nitro-, methyl ester	H
2905693	Benzoic acid, 2,5-dichloro-, methyl ester	H
134203	Benzoic acid, 2-amino-, methyl ester	H
40188838	Benzoic acid, 3,6-dichloro-2-nitro-, methyl ester	H
98737	Benzoic acid, 4-(1,1-dimethylethyl)	H
1571080	Benzoic acid, 4-formyl-, methyl ester	H
99752	Benzoic acid, 4-methyl-, methyl ester	H
68540409	Benzoic acid, 5-hexadecyl-2-hydroxy-, calcium salt (2:1)	H
25567106	Benzoic acid, methyl	H
91645	2H-1-Benzopyran-2-one	H
95329	Benzothiazole, 2-(4-morpholinyldithio)	H
2492264	2(3H)-Benzothiazolethione, sodium salt	H
90164	1,2,3-Benzotriazin-4(1H)-one	H
24310416	1,2,3-Benzotriazin-4(3H)-one, 3-(chloromethyl)	H
2905604	Benzoyl chloride, 2,3-dichloro	Co
2905615	Benzoyl chloride, 2,5-dichloro	Co
2905615	Benzoyl chloride, 2,5-dichloro	Co
13327327	Beryllium hydroxide	H
80568	Bicyclo(3,1,1)hept-2-ene, 2,6,6-trimethyl	F
25640782	1,1'-Biphenyl, (1-methylethyl)	H
90437	[1,1'-Biphenyl]-2-ol	H
612839	(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dichloro-, dihydrochloride	H
28652724	1,1'-Biphenyl, methyl	H

CAS #	Substance	Designation Criteria
121437	Boric acid, trimethyl ester	F
590192	1,2-Butadiene	F
67755979	Butanal, 2-hydroxy-3-methyl	H
541355	Butanamide	H
6358856	Butanamide, 2,2'-[(3,3'-dichloro(1,1'-biphenyl) -4,4'-diyl)bis(azo)]bis (3-oxo-N-phenyl	H
102012	Butanamide, 3-oxo-n-phenyl	H
616217	Butane, 1,2-dichloro	H
6863587	Butane, 2,2'-oxybis	F
75832	Butane, 2,2-dimethyl	F
79298	Butane, 2,3-dimethyl	F
6865970	Butane, 2-chloro-3-nitroso-, dimer	H
17611824	Butanedinitrile, ethyl	H
106650	Butanedioic acid, dimethyl ester	F
577117	Butanedioic acid, sulfo-, 1,4-bis(2-ethylhexyl)ester, sodium salt	H
1639663	Butanedioic acid, sulfo-, 1,4-dioctyl ester, sodium salt	H
13419595	Butanedioic acid, sulfo-, trisodium salt	H
109740	Butanenitrile	H
141979	Butanoic acid, 3-oxo-, ethyl ester	F
105453	Butanoic acid, 3-oxo-, methyl ester	F
14481608	Butanoic acid, 4-(octadecylamino)-4-oxo-2-sulfo-, disodium salt	H
52871188	Butanoic acid, 4-(octadecylamino)-4-oxosulfo-, disodium salt	H
14287048	Butanoic acid, ammonium salt	H
97950	1-Butanol, 2-ethyl	F
75854	2-Butanol, 2-methyl	F
3085301	1-Butanol, aluminum salt	FS
1320667	Butanol, chloro	H
2372454	1-Butanol, sodium salt	FS
75978	2-Butanone, 3,3-dimethyl	F
689974	1-Buten-3-yne	F

CAS #	Substance	Designation Criteria
503606	2-Butene, 1-chloro-3-methyl	F
30574971	2-Butenenitrile, 2-methyl-, (E)	H
20068024	2-Butenenitrile, 2-methyl-, (Z)	H
3724650	2-Butenoic acid	Co
1306190	Cadmium oxide	H
7440702	Calcium	FS
9007130	Calcium resinate	FS
65105002	Carbamic acid, (3-isocyanatomethylphenyl)-, 1-methyl-1,3-propanediyl ester	H
68413832	Carbamic acid, bis(hydroxymethyl)-, 2-(1-methyl-ethoxy)ethylester	H
52304173	Carbamic acid, bis(hydroxymethyl)-,2-methyl-propyl ester	H
67953326	Carbamic acid, (hydroxymethyl)-, 2-methylpropyl ester	H
3566107	Carbamodithioc acid, 1,2-ethanediylbis-, diammonium salt	H
51821	Carbamodithioic acid, dimethyl-, (dimethylamino)methyl ester	H
105588	Carbonic acid, diethyl ester	F
3333673	Carbonic acid, nickel(2+) salt (1:1)	H
108236	Carbonochloridic acid, 1-methylethyl ester	H
106752	Carbonochloridic acid, oxydi-2, 1-ethanediyl ester	H
109615	Carbonochloridic acid, propyl ester	H
13889924	Carbonochloridothioic acid, S-propyl ester	H
25306756	Carbonodithioic acid, O-(2-methylpropyl) ester, sodium salt	H
151019	Carbonodithioic acid, O-ethyl ester	H
35200023	Carbonodithioic acid, S-methyl O-(1-methylethyl)ester	H
2231574	Carbonothioic dihydrazide	H
463581	Carbon oxide sulfide	H
7791211	Chlorine oxide (Cl2O)	X

CAS #	Substance	Designation Criteria
3021316	Chlorosulfurous acid, 2-(p-tert-butylphenoxy)cyclohexyl ester	H
13530659	Chromic acid (H2CR04), zinc salt (1:1)	H
7758976	Chromic acid, lead(2+) salt (1:1)	H
1308141	Chromium hydroxide	H
12336957	Chromium hydroxide sulfate	H
1308389	Chromium oxide (Cr203)	H
11118573	Chromium oxide	H
7440484	Cobalt	H
1325377	Color Index Direct Yellow 11	H
12656858	Color Index Pigment Red 104	H
8007189	Color Index Pigment Yellow 53	H
68389468	Color Index Solvent Blue 3, leuco base	H
147148	Copper, [29H,31H-phthalocyaninato(2-)-N29,N30,N31,N32]-, (SP-4-1)	H
7758896	Copper chloride	H
1317391	Copper oxide	H
1317404	Copper sulfide	H
5124301	Cyclohexane, 1,1'-methylenebis(4-isocyanato)	H
87843	Cyclohexane, 1,2,3,4,5-pentabromo-6-chloro	H
3322938	Cyclohexane, 1,2-dibromo-4-(1,2-dibromoethyl)	H
99821	Cyclohexane, 1-methyl-4-(1-methylethyl)	F
26762925	Cyclohexane, 1-methyl-4-(1-methylethyl)-, monohydroperoxy derivative	F
4098719	Cyclohexane, 5-isocyanato-1-(isocyanatomethyl)-1,3,3-trimethyl	F
542187	Cyclohexane, chloro	F
694837	1,2-Cyclohexanediamine	F
1942718	Cyclohexanol, 2-(p-tert-butylphenoxy)	F
31198762	2-Cyclohexen-1-one, 2-methyl-5-(1-methylethenyl)-,oxime	F

CAS #	Substance	Designation Criteria
2622211	Cyclohexene, 1-ethyenyl	F
138863	Cyclohexene, 1-methyl-4-(1-methylethenyl)	F
5989275	Cyclohexene, 1-methyl-4-(1-methylethenyl)-,(R)	F
100403	Cyclohexene, 4-ethenyl	F
111784	1,5-Cyclooctadiene	F
542927	1,3-Cyclopentadiene	F
5500210	Cyclopropanecarbonitrile	H
26389606	Cyclopropanemethanamine, N-propyl	H
280579	1,4-Diazabicyclo(2,2,2)octane	H
126158	4a(4H)-Dibenzofurancarboxaldehyde, 1,5a,6,9,9a,9b-hexahydro	H
13560899	1,4:7,10-Dimethanodibenzo(a,e)cyclooctene, 1,2,3,4,7,8,9,10,13,13,14,14-dodecachloro-1,4,4a,5,6,6a,7,10,10a,11,12,12a-dodecahydro	H
646060	1,3-Dioxolane	F
107460	Disiloxane, hexamethyl	F
142789	Dodecanamide, N-(2-hydroxyethyl)	H
869249	Ethanamine, 2-chloro-n,n-diethyl-, hydrochloride	H
79276	Ethane, 1,1,2,2-tetrabromo	H
534156	Ethane, 1,1-dimethoxy	H
693072	Ethane, 1-chloro-2-(ethylthio)	H
107222	Ethanedial	H
628966	1,2-Ethanediol, dinitrate	X
79210	Ethaneperoxoic acid	X
1562001	Ethanesulfonic acid, 2-hydroxy-, monosodium salt	H
75081	Ethanethiol	H
4439207	Ethanol, 2,2'-(1,2-ethanediyldiimino)bis	H
14806725	Ethanol, 2,2',2''-nitrilotris-, acetate (salt)	H
14426212	Ethanol, 2,2'-iminobis-, hydrochloride	H
111411	Ethanol, 2-((2-aminoethyl)amino)	H
78513	Ethanol, 2-butoxy-, phosphate (3:1)	H

CAS #	Substance	Designation Criteria
52663577	Ethanol, 2-butoxy-, sodium salt	FS
140089	Ethanol, 2-chloro-, phosphite (3:1)	H
100378	Ethanol, 2-(diethylamino)	H
110770	Ethanol, 2-(ethylthio)	H
60242	Ethanol, 2-mercapto	H
122996	Ethanol, 2-phenoxy	H
141526	Ethanol, sodium salt	FS
64147484	Ferrate(2-), difluoro[phosphato(3-)-O]-, sodium hydrogen	H
13746662	Ferrate(3-), hexakis(cyano-C)-,tripotassium, (OC-6-11)	H
75127	Formamide	H
590294	Formic acid, potassium salt	H
616024	2,5-Furandione, 3-methyl	F
97994	2-Furanmethanol, tetrahydro	F
64028	Glycine, N,N'-1,2-ethanediylbis[n-(carboxymethyl)-, tetrasodium salt	H
140012	Glycine, N,N-bis(2-(bis(carboxymethyl) amino)ethyl)-, pentasodium salt	H
19525598	Glycine, N-phenyl-, monopotassium salt	H
10265697	Glycine, N-phenyl-, monosodium salt	H
506934	Guanidine, mononitrate	X
556887	Guanidine, nitro	X
111148	Heptanoic acid	Co
110430	2-Heptanone	F
108838	4-Heptanone, 2,6-dimethyl	F
822060	Hexane, 1,6-diisocyanato	H
143237	1,6-Hexanediamine, N-(6-aminohexyl)	H
68052493	1,6-Hexanediaminium, N,N,N',N'-tetrabutyl-N, N'-diethyl-, bis(ethyl sulfate)	H
2432748	Hexanenitrile, 6-amino	H

CAS #	Substance	Designation Criteria
136527	Hexanoic acid, 2-ethyl-, cobalt (2+) salt	H
591786	2-Hexanone	F
25264931	Hexene	F
30951952	3-Hexene, 3,4-dimethyl	F
20469710	Hydrazinecarbodithioic acid, compd, with hydrazine (1:1)	H
110214	1,2-Hydrazinenedicarboxamide	H
7778667	Hypochlorous acid, potassium salt	X
13253446	2,4-Imidazolidinedione, 5-[2-(methylthio) ethyl]	F
68647449	Imidazolium, 1-(carboxymethyl)-4,5-dihydro-1 (or 3)-2-hydroxyethyl)-2-undecyl-, hydroxide, monosodium salt	F
4035896	Imidodicarbonic diamide, N,N',2-tris (6-isocyanatohexyl)	F
95136	1H-Indene	H
496117	1H-Indene, 2,3-dihydro	H
1203174	1H-Indene, 2,3-dihydro-1,1,2,3,3-pentamethyl	H
85438	1,3-Isobenzofurandione, 3a,4,7,7a-tetrahydro	H
117088	1,3-Isobenzofurandione, 4,5,6,7-tetrachloro	H
67874355	Isodecanediamine	H
25103542	Isodecanol, hydrogen phosphorodithioate, zinc salt	H
133073	1H-Isoindole-1,3(2H)-dione, 2-((trichloro-methyl)thio)	H
85405	1H-Isoindole-1,3(2H)-dione, 3a,4,7,7a-tetrahydro	H
1319466	Lead, bis[(carbonato(2-)]dihydroxytri	H
39390006	Lead chloride silicate	H
1309600	Lead oxide (PbO2)	H
12065906	Lead oxide sulfate (Pb5O4(SO4))	H
67711868	Lead silicate sulfate (Pb2(SiO3)(SO4))	H
7783406	Magnesium fluoride	H
74975	Methane, bromochloro	H

CAS #	Substance	Designation Criteria
109875	Methane, dimethoxy	F
27159906	Methanesulfonamide, N-(2-(ethyl(3-methyl-phenyl)amino)ethyl)-, sodium salt	H
75752	Methanesulfonic acid	Co
870724	Methanesulfonic acid, hydroxy-, monosodium salt	Co
10278714	Methanimidamide, N,N-dimethyl-N'-(2-methyl-phenyl)	H
18868434	Molybdenum oxide (MoO2)	H
11098843	Molybdic acid, ammonium salt	H
27546072	Molybdic acid, diammonium salt	H
6158458	Naphthalene, 1-(1-methylethyl)	H
90120	Naphthalene, 1-methyl	H
91576	Naphthalene, 2-methyl	H
92706	2-Naphthalenecarboxylic acid, 3-hydroxy	H
1321944	Naphthalene, methyl	H
81163	1-Naphthalenesulfonic acid, 2-amino	H
68540410	1-Naphthalenesulfonic acid, 2-amino-, monoammonium salt	H
25417203	Naphthalenesulfonic acid, dibutyl-, sodium salt	H
12607704	Nickel, (carbonato(2-))tetrahydroxytri	H
13473900	Nitric acid, aluminum salt	X
10022318	Nitric acid, barium salt	X
10377603	Nitric acid, magnesium salt	X
68201843	9,12-Octadecadienoic acid, 12-sulfo-, (?,Z)-	H
110305	Octadecanamide, N,N'-1,2-ethanediylbis-	H
557051	Octadecanoic acid, zinc salt	H
2717159	9-Octadecenoic acid (Z)-, compd, with 2,2',2''-nitrilotris(ethanol) (1:1)	H
111659	Octane	F
111853	Octane, 1-chloro	H
7795951	1-Octanesulfonyl chloride	Co
40630635	1-Octanesulfonyl fluoride	Co

CAS #	Substance	Designation Criteria
307357	1-Octanesulfonyl fluoride, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-helptadecafluoro-	Co
111137	2-Octanone	F
3083258	Oxirane, (2,2,2-trichloroethyl)	H
2426086	Oxirane, (butoxymethyl)	F
106887	Oxirane, ethyl	F
540841	Pentane, 2,2,4-trimethyl	F
96140	Pentane, 3-methyl	F
96220	3-Pentanone	F
25167708	Pentene, 2,4,4-trimethyl	F
3404679	1-Pentene, 2-ethyl-3-methyl	F
598969	2-Pentene, 3,4,4-trimethyl	F
627203	2-Pentene, (Z)	F
123546	2,4-Pentenedione	F
592518	4-Pentenenitrile	H
25899507	2-Pentenenitrile, (Z)	H
7778747	Perchloric acid, potassium salt	X
110054	Peroxide, bis(1,1-dimethylethyl)	X
80433	Peroxide, bis(1-methyl-1-phenylethyl)	X
94360	Peroxide, dibenzoyl	X
7727211	Peroxydisulfuric acid, dipotassium salt	X
7775271	Peroxydisulfuric acid, disodium salt	X
7722863	Peroxymonosulfuric acid	X
1333137	Phenol, (1,1-dimethylethyl)-3-methyl	H
25567402	Phenol, (1,1-dimethylethyl)-4-methyl	H
27576869	Phenol, (1-methyl-1-phenylethyl)	H
88608	Phenol, 2-(1,1-dimethylethyl)-5-methyl	H
68527628	Phenol, 2,2'-methylenebis(4-(1,1,3,3-tetramethylbutyl)-, calcium salt	H
2416946	Phenol, 2,3,6-trimethyl	H
136323	Phenol, 2,4,5-trichloro-, sodium salt	H
497392	Phenol, 2,4-bis(1,1-dimethylethyl)-5-methyl	H
50884305	Phenol, 2,4-dichloro-, potassium salt	H

CAS #	Substance	Designation Criteria
137995	Phenol, 2,4-dinonyl	H
95874	Phenol, 2,5-dimethyl	H
128370	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl	H
576261	Phenol, 2,6-dimethyl	H
90006	Phenol, 2-ethyl	H
28983268	Phenol, 2-isononyl-4-methyl	H
123079	Phenol, 4-ethyl	H
19277919	Phenol, 4-ethyl-, sodium salt	H
104405	Phenol, 4-nonyl	H
1806264	Phenol, 4-octyl	H
28987179	Phenol, nonyl-, barium salt	H
26523784	Phenol, nonyl-, phosphite (3:1)	H
2819865	Phenol, pentamethyl	H
139026	Phenol, sodium salt	H
13598362	Phosphonic acid (H3O3P)	H
2809214	Phosphonic acid, (1-hydroxyethylidene)bis	H
2781115	Phosphonic acid, ((bis(2-hydroxyethyl)amino) methyl)-, diethyl ester	H
1809194	Phosphonic acid, dibutyl ester	H
2235430	Phosphonic acid, (nitrilotris(methylene)) tris-, pentasodium salt	H
55566308	Phosphonium, tetrakis(hydroxymethyl)-, sulfate (2:1) (salt)	H
1497683	Phosphonuchloridothioic acid, ethyl-, O-ethyl ester	H
5075138	Phosphonochloridothioic acid, phenyl-, O-ethyl ester	H
3497005	Phosphonothioic dichloride, phenyl	H
644973	Phosphonous dichloride, phenyl	H
17321470	Phosphoramidothioic acid, O,O-dimethyl ester	H
33125869	Phosphoric acid, 1,2-ethanediyl tetrakis (2-chloroethyl) ester	H
1241947	Phosphoric acid, 2-ethylhexyl diphenyl ester	H

CAS #	Substance	Designation Criteria
68460037	Phosphoric acid, bis(2-chloro-1-(chloromethyl)ethyl 2,3-dichloropropyl ester	H
29761215	Phosphoric acid, isodecyl diphenyl ester	H
126738	Phosphoric acid tributyl ester	H
78400	Phosphoric acid, triethyl ester	H
115866	Phosphoric acid, triphenyl ester	H
7778532	Phosphoric acid, tripotassium salt	H
13598373	Phosphoric acid, zinc salt (2:1)	H
7779900	Phosphoric acid, zinc salt (2:3)	H
2524041	Phosphorochloridothioic acid, O,O-diethyl ester	H
10043911	Phosphorodiamidic acid	H
1498517	Phosphorodichloridic acid, ethyl ester	H
107562	Phosphorodithioic acid, O,O-bis(1-methylethyl) ester	H
298066	Phosphorodithioic acid, O,O-diethyl ester	H
3338247	Phosphorodithioic acid, O,O-diethyl ester, sodium salt	H
28631449	Phosphorodithioic acid, O,O-diisodecyl ester	H
26999291	Phosphorodithioic acid, O,O-diisoctyl ester	H
28629665	Phosphorodithioic acid, O,O-diisooctyl ester, zinc salt	H
26377297	Phosphorodithioic acid, O,O-dimethyl ester, sodium salt	H
3070153	Phosphorothioic acid, O,O-diethyl O-[4-methylsulfinyl)phenyl]ester	H
1254780	Phosphorous acid, didecyl phenyl ester	H
54771301	Phosphorous acid, dinonylphenyl bis (nonylphenyl) ester	H
26544230	Phosphorous acid, isodecyl diphenyl ester	H
122521	Phosphorous acid, triethyl ester	H
16883833	Phthalic acid, benzyl 3-hydroxy-1-isopropyl-2, 2-dimethylpropyl ester isobutyrate	H

CAS #	Substance	Designation Criteria
110850	Piperazine	H
6531380	1,4-Piperazinediethanamine	H
31295542	1,4-Piperazinediethanamine, N-(2-aminoethyl)	H
140318	1-Piperazineethanamine	H
1762261	Plumbane, ethyltrimethyl	H
75741	Plumbane, tetramethyl	H
12034309	Plumbate, disodium	H
7681110	Potassium iodide	H
1310618	Potassium sulfide	H
463490	1,2-Propadiene	F
1646759	Propanal, 2-methyl-2-(methylthio)-, oxime	H
24948810	2-Propanamine, N-chloro-N-(1-methylethyl)	H
3327228	1-Propanaminium, 3-chloro-2-hydroxy-N,N,N-trimethyl-, chloride	H
540545	Propane, 1-chloro	H
75296	Propane, 2-chloro	H
1634044	Propane, 2-methoxy-2-methyl	F
109557	1,3-Propanediamine, N,N-dimethyl	F
3296900	1,3-Propanediol, 2,2-bis(bromomethyl)	F
93141	1,2-Propanediol, 3-(2-methoxyphenoxy)	F
6423434	1,2-Propanediol, dinitrate	X
78671	Propanenitrile, 2,2'-azobis(2-methyl-	H
19355692	Propanenitrile, 2-amino-2-methyl	H
78977	Propanenitrile, 2-hydroxy-	H
111944	Propanenitrile, 3,3'-iminobis-	H
1738256	Propanenitrile, 3-(dimethylamino)	H
126830	1-Propanesulfonic acid, 3-chloro-2-hydroxy-, monosodium salt	H
75661	2-Propanethiol, 2-methyl-	H
3938952	Propanoic acid, 2,3-dimethyl-, ethyl ester	F
67969817	Propanoic acid, 2-chloro-, 1-methyl-2-(2-methylpropoxy)ethyl ester	F

CAS #	Substance	Designation Criteria
547648	Propanoic acid, 2-hydroxy-, methyl ester	F
97723	Propanoic acid, 2-methyl-, anhydride	Co
2935902	Propanoic acid, 3-mercapto-, methyl ester	F
105373	Propanoic acid, ethyl ester	F
554121	Propanoic acid, methyl ester	F
116370	2-Propanol, 1,1'-[(1-methylethylidene)bis (4,1-phenyleneoxy)]bis-	H
107982	2-Propanol, 1-methoxy	F
107119	2-Propen-1-amine	H
124027	2-Propen-1-amine, N-2-propenyl	H
7398698	2-Propen-1-aminium,N,N-dimethyl-N-2-propenyl-chloride	H
2210255	2-Propenamide, N-(1-methylethyl)	H
924425	2-Propenamide, N-(hydroxymethyl)	H
590216	1-Propene, 1-chloro	H
557982	1-Propene, 2-chloro	H
103753	2H-Pyran, 2-ethoxy-3,4-dihydro	F
108894	Pyridine, 4-methyl	H
59676	3-Pyridinecarboxylic acid	Co
1333411	Pyridine, methyl	H
37439342	2(1H)-Pyridinone, 3,5,6-trichloro-, sodium salt	H
75774	Silane, chlorotrimethyl	Co
98124	Silane, trichlorocyclohexyl	Co
75796	Silane, trichloromethyl	Co
16871902	Silicate(2-), hexafluoro-, dipotassium	H
12650281	Silicic acid, barium salt	H
11113705	Silicic acid, chromium lead salt	H
10099760	Silicic acid, lead(2+) salt (1:1)	H
11120222	Silicic acid, lead salt	H

CAS #	Substance	Designation Criteria
23606328	Silver(1+), diammine-, nitrate	X
7785231	Silver bromide	F
7782925	Sodium amide	FS
1313606	Sodium peroxide	X
7646788	Stannane, tetrachloro	Co
9056386	Starch nitrate	X
1005352	Sulfonium, (4-hydroxyphenyl)dimethyl-, chloride	H
2551624	Sulfur fluoride (SF6), (OC-6-11)	H
13814874	Sulfuric acid, ammonium zinc salt (2:2:1)	H
64675	Sulfuric acid, diethyl ester	H
151417	Sulfuric acid, monododecyl ester	H
2235543	Sulfuric acid, monododecyl ester, ammonium salt	H
139968	Sulfuric acid, monododecyl ester, compd, with 2,2',2''-nitrilotris(ethanol) (1:1)	H
16924008	Tantalate(2-), heptafluoro-, dipotassium	H
2691410	1,3,5,7-Tetrazocine, octahydro-1,3,5,7-tetranitro	H
13776846	Thioantimonic acid, trisodium salt	H
5930712	Thioperoxydiphosphoric acid, tetramethyl ester	H
77792	Thiophene, 2,5-dihydro-, 1,1-dioxide	H
126330	Thiophene, tetrahydro-, 1,1-dioxide	H
16919270	Titanate(2-), hexafluoro-, dipotassium, (OC-6-11)	H
12047277	Titanate (TiO3(2-)) barium (1:1)	H
87901	1,3,5-Triazine-2,4,6(1H,3H,5H)-trione, 1,3,5-trichloro-,	H
839907	1,3,5-Triazine-2,4,6(1H,3H,5H)-trione, 1,3,5-tris(2-hydroxyethyl)	H
3047334	1,3,5-Triazine-2,4,6(1H,3H,5H)-trione, trisodium salt	H
68568467	1,3,5-Triazine-2,4,6-triamine, tris (methoxymethyl)tris((octadecyloxy)methyl)	H

CAS #	Substance	Designation Criteria
5915413	1,3,5-Triazine-2,4-diamine, 6-chloro-N-(1,1-dimethylethyl)-N'-ethyl	H
91769	1,3,5-Triazine-2,4-diamine, 6-phenyl	H
11120255	Tungstic acid, decaammonium salt	H
689112	Urea, (1-methylpropyl)	H
1746812	Urea, N'-(4-chlorophenyl)-N-methoxy-n-methyl	H
101202	Urea, N-(4-chlorophenyl)-N'-(3,4-dichlorophenyl)	H
141071	Urea, N,N'-bis(methoxymethyl)	H
68510996	Vanadic acid, (H4V6017) disodium salt	H
13718268	Vanadic acid (HV03) sodium salt	H
7440622	Vanadium	H
1314347	Vanadium oxide	H
14324551	Zinc, bis(diethylcarbamodithioato-S,S')-, (T-4)-	H
20427581	Zinc hydroxide	H
1314983	Zinc sulfide	H
7440677	Zirconium	FS

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APPENDIX E

HAZARD INDEX

The Hazard Index is a scoring system designed to assess the relative potential threat to human health and to the environment of chemical substances released to the air, water, and soil. The system consists of various rating factors used to examine the types of hazards that may result, and to the extent possible, the degree of hazard. Each rating factor has a defined rating scale by which chemicals receive numerical scores based on known data. The rating factors are combined in an equation to arrive at a single unitless number that is used to rank a chemical relative to other chemicals processed through the same equation.

DEVELOPMENT OF THE HAZARD INDEX

The rating of hazardous substances can be accomplished in a number of ways and by the use of any number of criteria. However, the depth of an analysis that can be applied is limited by the availability and quality of data needed for each substance to arrive at a defensible rating. The primary complications are: (1) human effects data limitations; (2) ecological impact data limitations; and (3) uncertainty in the effects of continuous exposures to low-level concentrations of hazardous substances. Such limitations of the data base confine the rater to make certain choices about how the "degree of hazard" can be described.

From a practical point of view and in consideration of the state of knowledge concerning hazardous substances and related effects, it is better to limit the evaluation criteria to those for which appropriate evaluation data are available. The approach taken during this study was to select criteria for evaluation of hazardous substances in such a way that the most important health and environmental effects were included for consideration.

Basically, five steps were followed in developing the hazard index: (1) determine the technical criteria; (2) derive alternative equations, with and without weighting factors; (3) establish appropriate rating scales for the criteria; (4) test each equation on a selected list of 27 hazardous substances; and finally (5) provide a final ranking list.

Four alternative HI equations which have been derived for rating hazardous substances are summarized in Table E1 and are discussed in more detail in the following sections. These alternative equations differ in logic and in the number of potential health and environmental effects parameters considered. Included is a discussion of alternative rating scales available for certain parameters. Finally, a brief review of related models which are currently available for rating hazardous waste sites and a summary of other models available for rating hazardous chemicals for other purposes is presented.

Hazard Index Criteria

The criteria which have been considered to a greater or lesser extent in development of each of the four alternative HI equations fall into four general categories as outlined below:

A. Health Effects

- o Carcinogenicity
- o Mutagenicity
- o Teratogenicity
- o Toxicity (Human and Mammalian)

B. Welfare Effects

- o Flammability
- o Explosivity
- o Corrosivity
- o Reactivity
- o Aquatic Toxicity

TABLE E-1. ALTERNATIVE HI EQUATIONS AND RATING FACTORS

EQUATION 1

HI = (Carcinogenicity) + (Mutagenicity) + (Teratogenicity) + (Human Toxicity) + (Mammalian Toxicity)

EQUATION 2

HI = (Health Effects) + (Welfare Effects) + (Aggravating Effects) - (Mitigating Effects)

(Health Effects)	(Welfare Effects)	(Aggravating Effects)	(Mitigating Effects)
. Carcinogenicity	. Flammability	. Persistence	. Innocuous Transformation Products
. Mutagenicity	. Explosivity	. Bioaccumulation	. Evaporation Potential
. Teratogenicity	. Corrosivity	. Toxic Combustion Products	
. Human Toxicity	. Reactivity		
. Mammalian Toxicity			

EQUATION 3

HI = [(Health Effects) x (Aggravating Health Factors) + (Welfare Effects)] x (Aggravating/Mitigating Transformation Products)

(Health Effects)	(Aggravating Health Factors)	(Welfare Effects)	(Aggravating/Mitigating Transformation Products)
. Carcinogenicity	. Bioaccumulation	. Flammability	. Mitigating (Innocuous Products)
. Human Toxicity	. Persistence	. Explosivity	. Aggravating (Hazardous Products)
. Mammalian Toxicity		. Corrosivity	
		. Reactivity	

EQUATION 4

HI = (Health Effects) + (Welfare Effects) + (Environmental Mobility) + (Aggravating Characteristics)

(Health Effects)	(Welfare Effects)	(Environmental Mobility)	(Aggravating Characteristics)
. Carcinogenicity	. Ignitability	. Volatility	. Bioaccumulation
. Mutagenicity	. Reactivity	. Solubility	. Persistence
. Teratogenicity	. Aquatic Toxicity		
. Toxicity - Inhalation - Ingestion - Dermal			

C. Aggravating Characteristics

- o Persistence
- o Bioaccumulation
- o Toxic Combustion Products

D. Biological and Physical Transformation Characteristics

- o Hydrolysis
- o Photolysis
- o Oxidation
- o Biolysis

E. Environmental Mobility

- o Volatility
- o Solubility

The primary information sources which have been used for evaluating each of these criteria for the twenty-seven selected substances have been the SANSS, OHMTADS, and RTECS data files in the CIS data base. Details of the CIS data base are given in Section 8. In cases where data were not available for the twenty-seven hazardous substances, information was obtained to the extent possible by hand searching various secondary data references.

<u>First Alternative Equation</u>

The first alternative equation was deliberately formulated to rank chemicals entirely on major potential health effects. It is a simple additive equation comprised of five components:

HI = (Carcinogenicity) + (Mutagenicity) + (Teratogenicity) +
(Human Toxicity) + (Mammalian Toxicity)

The rating scales for each of these components are summarized in Table E-2. Carcinogenicity, mutagenicity, and teratogenicity are rated on a simple scale of 0 to 3 according to the following:

TABLE E-2. RATING FACTORS AND SCALES FOR FIRST ALTERNATIVE HI EQUATION

CARCINOGENICITY	MUTAGENICITY	TERATOGENICITY	TOXICITY* (HUMAN AND MAMMALIAN)
0 = Negative	0 = negative	0 = negative	0 = $>$10,000 ppm
1 = not tested/no data	1 = not tested/no data	1 = not tested/no data	1 = 1000 - 10,000
2 = suspected/potential	2 = suspected/potential	2 = suspected/potential	2 = 100 - 1000
3 = positive	3 = positive	3 = positive	3 = 10 - 100
			4 = $<$10

* The toxicity rating scale may have to be revised if a cutoff value of 500 ppm is used in the designation step.

0 = Negative correlation (animal or human)

1 = No data or not tested

2 = Suspected or potential (animal or human)

3 = Positive correlation (animal or human)

The choice of this particular rating scale is based on data reported in the OHMTADS file and in the NIOSH RTECS toxicity file. Known or suspected carcinogens, mutagens, and teratogens are not ranked in terms of their relative potency for two reasons: First, it is extremely difficult to determine the potency of these chemicals and to determine no-effect levels. Secondly, the fact that a chemical has been classified as a suspected animal, known human, or animal positive carcinogen, mutagen, or teratogen is often a measure of the extent to which the chemical has been tested rather than its potency.

Alternative rating scales used in other rating systems for these same criteria are summarized in Tables E-3 through E-5. The extent to which they differ from the proposed rating scale is either in the relative weighting of the scales (i.e., 0 to 3, 0 to 5, 0 to 7) or in the specific data requirements which further define the status of testing. It is our opinion that a more definitive rating scale is not justified at the present time because of a lack of data.

Human and mammalian toxicity are rated as follows:

0 = $>$10,000 ppm

1 = 1000-10,000

2 = 100-1000

3 = 10-100

4 = $<$10

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TABLE E-3

ALTERNATIVE RATING SCALES FOR CARCINOGENICITY

1. Category	Score
Known or suspected human carcinogen	5
Known mammalian carcinogen	4
Suspected mammalian carcinogen or known mammalian mutagen	3
Ames test positive	2
Precursor or carcinogen	1

Source: Margler, L.W., M.B. Rogozen, R.A. Ziskind, and R. Reynolds. 1979. Rapid Screening and Identification of Airborne Carcinogens of Greatest Concern in California. J.AirPollut Control Assoc. 29(11): 1153-1157.

2. Category	Score
Human positive, potential human, animal positive	7
Potential animal	3
Carcinogenic by a route other than oral or dermal, strongly suspect carcinogen by accepted mutagenicity screening tests	2
Suspect carcinogen by accepted mutagenicity screening tests	1
Not carcinogenic	0
Insufficient Information	*

Source: Michigan Department of Natural Resources. 1979. Critical Materials Register 1979. Publication Number 4833-5323. Lansing, Michigan. 71 pp.

3. Effects Noted or Status	Score
Carcinogenic	5
Produces Neoplasm	4
Under Test	3
Not Tested	0
Negative	0

Source: Fuller, B., J. Hushon, M. Kornreich, R. Quelette, L. Thomas, and P. Walker. 1976. Preliminary Scoring of Selected Organic Air Pollutants. EPA-450/3-77-008a, PB 264 442. Mitre Corp., McLean, Virginia. 104 pp.

TABLE E-4

ALTERNATIVE RATING SCALES FOR MUTAGENICITY

1.

Status	Score
Mutagenic	5
Not Tested	0
Negative	0

Source: Fuller, B., J. Hushon, M. Kornreich, R. Quelette, L. Thomas, and P. Walker. 1976. Preliminary Scoring of Selected Organic Air Pollutants. EPA-450/3-77-008a, PB 264 442. Mitre Corp., McLean, Virginia. 104 pp.

2.

Category	Score
Confirmed	7
Potential (multicellular organisms)	4
Potential (microorganisms)	2
Not a hereditary mutagen	0
Insufficient Information	*

Source: Michigan Department of Natural Resources. 1979. Critical Materials Register 1979. Publication Number 4833-5323. Lansing, Michigan. 71 pp.

3.

Criteria	Score
Evidence of mutagenicity in one or more whole mammalian tests	9
Evidence of in-vitro mutagenicity in more than one test system; or in one test system and interacts specifically with germinal-cell DNA in vivo	6
Evidence of in-vitro mutagenicity in one test system, but no evidence of germinal-cell DNA interaction.	4
No data, but suspect mutagen based on professional judgment using such parameters as structure/activity relationships	3
No data, but considered a suspect mutagen based on professional judgment	1
Adequate evidence (negative test results) of no mutagenicity	0

Source: Modified from Toxic Substances Control Act - Interagency Testing Committee Workshop, 1979, Table 3, p. 17.

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TABLE E-5. ALTERNATIVE RATING SCALES FOR TERATOGENICITY

1. Category	Score
Confirmed	7
Potential	3
Not Teratogenic	0
Insufficient Information	*

Source: Michigan Department of Natural Resources. 1979. Critical Materials Register 1979. Publication Number 4833-5323. Lansing, Michigan. 71 pp.

2. Status	Score
Teratogenic	5
Not Tested	0
Negative	0

Source: Fuller, B., J. Hushon, M. Kornreich, R. Quelette, L. Thomas, and P. Walker. 1976. Preliminary Scoring of Selected Organic Air Pollutants. EPA-450/3-77-008a, PB 264 442. Mitre Corp., McLean, Virginia. 104 pp.

3. Teratogenicity Scores for Toxic Substances Control Act -- Interagency Testing Committee Scoring System

Category	Score
Confirmed teratogen in humans or in two appropriate animal species	3
Confirmed teratogen in one animal species	2
Insufficient or inadequate experimental data for definite conclusions, but either (a) no experimental or structural reason for suspicion, or (b) low biological activity	1
Adequately tested in two suitable animal species with negative findings for teratogenic activity	0

Source: Federal Register (1979), p. 55073.

These scales are similar to those used by Hann and Jensen (1977), the Michigan Department of Natural Resources (State of Michigan, 1980), and Loomis (1974). These are based on LD_{50} values and LD_{10} values. In cases where these data were not available, the following relationships were used to estimate values from LC_{10}, LC_{50}, and TLV data.

Human Toxicity

Oral LD_{10} (mg/Kg) or inhalation LC_{10} (ppm) (in order of preference) where:

$$LD_{10} = 5.85 \times 10^{-3} \times \text{molecular weight (gm)} \times LC_{10} \text{ (ppm)} \qquad (1)$$

Calculated LD_{10} expressed in terms of mg/Kg/day

Mammalian Toxicity (in order of preference)

Oral-rat LD_{50} (mg/Kg) or

TLV (mg/m^3 or ppm) where

$$LD_{50} = 34.5 \text{ TLV } (mg/m^3) \qquad (2)$$

Calculated LD_{50} expressed in terms of mg/Kg or

LC_{50} (mg/l) where

$$LD_{50} = LC_{50} \text{ (mg/l)} \times 1/35 \qquad (3)$$

Calculated LD_{50} expressed in terms of mg/Kg/day

Alternative rating scales used in other rating systems for acute toxicity data are summarized in Table E6.

Equations (1) and (2) adopted from Handy and Schindler, 1976. Equation (3) Dacre, et al., 1980.

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TABLE E-6

ALTERNATIVE RATING SCALES FOR ACUTE TOXICITY DATA

LD_{50} in mg/Kg

1.

Range	Score
< 50	5
≥ 50 to <250	4
≥ 250 to <1000	3
≥ 1000 to <5000	2
≥ 5000 to <10000	1
≥ 10000	0

LC_{50} in ppm

2.

Range	Score
< 100	5
≥ 100 to <200	4
≥ 200 to <1000	3
≥ 1000 to <-3000	2
≥ 3000 to <.5000	1
≥ 5000	

Source: Fuller, B., J. Hushon, M. Kornreich, R. Quelette, L. Thomas, and P. Walker. 1976. Preliminary Scoring of Selected Organic Air Pollutants. EPA-450/3-77-008a, PB 264 442. Mitre Corp., McLean, Virginia. 104 pp.

3.

Oral LD_{50} mg/Kg	Dermal LD_{50} mg/Kg	Aquatic 96-H LC_{50} mg/L	Score
< 5	< 5	< 1	7
> 5-50	> 5-200	> 1-10	3
> 50-500	> 200-500	> 10-100	2
> 500-5000	> 500-5000	> 100-1000	1
> 5000	> 5000	> 1000	0
Insufficient Information			*

Source: Michigan Department of Natural Resources. 1979. Critical Materials Register 1979. Publication Number 4833-5323. Lansing, Michigan. 71 pp.

TABLE E-6

ALTERNATIVE RATING SCALES FOR ACUTE TOXICITY DATA

(CONTINUED)

4.	Hazard Description	LD_{50} (mg/Kg)	Grade
	Insignificant	Above 5000	0
	Slight	500-5000	1
	Moderate	50-500	2
	High	5-50	3
	Extreme	Below 5	4

Source: Beckman, R.B., 1974. System for Evaluation of the Hazards of Bulk Water Transportation of Industrial Chemicals. National Academy of Sciences, Washington, D.C.

Table E-7 lists the possible maximum and minimum rating values for each criterion and summarizes the maximum and minimum HI rating which a substance can receive using this equation.

Second Alternative Equation

The second alternative equation which was developed is slightly more sophisticated in that, in addition to potential health effects, it permits evaluation of other adverse effects that may occur (fire, explosion, reaction) and aggravating characteristics (persistence and bioaccumulation). In addition, this particular equation allows evaluation of certain mitigating effects. The basic form of the equation is additive and consists of the following simplified terms:

$$HI = \begin{pmatrix}\text{Health}\\ \text{Effects}\end{pmatrix} + \begin{pmatrix}\text{Welfare}\\ \text{Effects}\end{pmatrix} + \begin{pmatrix}\text{Aggravating}\\ \text{Effects}\end{pmatrix} - \begin{pmatrix}\text{Mitigating}\\ \text{Effects}\end{pmatrix}$$

The individual rating factors which comprise each of the four terms are outlined below and the rating scales are summarized in Table E-8.

Health Effects

- Carcinogenicity
- Mutagenicity
- Teratogenicity
- Human Toxicity
- Mammalian Toxicity

Welfare Effects

- Flammability
- Explosivity
- Corrosivity
- Reactivity

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TABLE E-7

MINIMUM AND MAXIMUM POTENTIAL HI RATING/FIRST EQUATION

Rating Factor	Minimum Value	Maximum Value
Carcinogenicity	0	3
Mutagenicity	0	3
Teratogenicity	0	3
Human Toxicity	0	4
Mammalian Toxicity	0	4
TOTAL	0	17

TABLE E-8

RATING FACTORS AND SCALES FOR SECOND ALTERNATIVE AI EQUATION

HEALTH EFFECTS	
Carcinogenicity Mutagenicity Teratogenicity Toxicity (Human, Mammalian)	Same scales as specified in Table E-2

WELFARE EFFECTS

1. Flammability

   Based on the NFPA classification of Table E-9

2. Explosivity

   0 = Nonexplosive/Unknown
   4 = Explosive

3. Corrosivity

   0 = Noncorrosive/Unknown
   4 = Corrosive

4. Reactivity

   Based on the NFPA classification of Table E-10

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TABLE E-8

RATING FACTORS AND SCALES FOR SECOND ALTERNATIVE HI EQUATION
(CONTINUED)

AGGRAVATING EFFECTS

1. Persistence

0 = Nonpersistent
1 = Unknown
2 = Persistent

2. Bioaccumulation

0 = Nonbioaccumulative
1 = Unknown
2 = Bioaccumulative

3. Toxic Combustion Products

0 = None
1 = Slight
2 = Moderate
3 = Severe

MITIGATING EFFECTS

1. Innocuous Transformation Products

0 = None
3 = Positive Evidence

2. Evaporation Potential

0 = None (B.P. >100°C)
3 = BP <100°C and substance satisfies all of the following:

$$\left\{\begin{array}{l}\text{Nontoxic via inhalation}\\ \text{Nonflammable}\\ \text{Nonexplosive}\\ \text{Unreactive In Air}\end{array}\right\}$$

Aggravating Effects

- Persistence
- Bioaccumulation
- Toxic Combustion Products

Mitigating Effects

- Innocuous Transformation Products
- Evaporation Potential

The rating scales for the health effects criteria remain the same as for the first equation. In the category of welfare effects, flammable substances are rated on a simple scale of 0 to 4 based on the flammability classification of the National Fire Protection Association (NFPA) as defined in Table E-9. Flash point data is used as an additional rating guide for flammable liquids in the following manner:

NFPA Level 0	
NFPA Level 1	Flash Point $>200^{o}F$
NFPA Level 2	Flash Point $100-200^{o}F$
NFPA Level 3	Flash Point $<100^{o}F$
NFPA Level 4	Flash Point $<100^{o}F$
	(The distinction between Level 3 and Level 4 is that Level 4 must have a vapor pressure >78 mm Hg.)

These flash point ranges were selected based on the Department of Transportation's (DOT) definition of combustible and flammable materials in 49CFR173.115.

Reactivity is also assigned a value of 0 to 4 based on the classification system of the National Fire Protection Association (NFPA) as shown in Table E-10. For explosivity, it is difficult to rate the degree of hazard. A simple rating of YES (4) and NO (0) is proposed, as determined from the NFPA classification to ensure equal weighting between criteria. Similarly, the degree of corrosiveness for a given chemical substance cannot be determined from the data base. A rating of YES (4) and NO (0) is proposed based on information in the OHMTADS

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TABLE E-9

FLAMMABILITY RATING

Assigned Value	N.F.P.A. Level
4	Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.
3	Liquids which can be ignited under all normal temperature conditions. Any material that ignites spontaneously at normal temperatures in air.
2	Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.
1	Materials that must be preheated before ignition can occur. Most combustible solids have a flammability rating of 1.
0	Materials that will not burn.

TABLE E-10

REACTIVITY RATING

Assigned Value	N.F.P.A. Level
4	Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. Includes materials which are sensitive to mechanical or localized thermal shock.
3	Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. Includes materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat or confinement.
2	Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Includes materials which can undergo chemical change with rapid release of energy at normal temperatures and pressures or which can undergo violent chemical change at elevated temperatures and pressures. Also includes those materials which may react violently with water or which may form potentially explosive mixtures with water.
1	Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.
0	Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

file describing possible corrosive action to materials commonly used for packaging, or equipment that might be required at a spill site.

Aggravating characteristics such as persistence, bioaccumulation, and the potential to form toxic combustion products are considered a necessary element of a comprehensive hazard index. However, because there are no standardized procedures for measuring these and the availability of data is limited, it is difficult to estimate degrees of hazard for one chemical relative to another. Tables E-11 and E-12 summarize some of the available rating schemes for persistence and bioaccumulation.

The persistence of chemicals is often measured by half-lives. However, degradative half-lives for many of the compounds are not available in the data base or the literature, and serious limitations exist in the usefulness of experimentally derived half-lives. This is because there are no standardized test procedures, and the methods and conditions for conducting rate studies vary widely. A rating scheme based on chemical structure has been proposed by Abrams (1975). However, for this equation we have decided to rate the persistence of substances on a YES/NO basis. A rating of 0 is assigned if a substance is nonpersistent, and a rating of 1 if its persistence is unknown, and a rating of 2 if it is known to persist.

A similar problem exists for measuring the bioaccumulation potential of chemicals. One measure is the bioconcentration factor (BCF) which is defined as the concentration of a chemical in an organism divided by the concentration in water. BCF values reported in the literature vary considerably for a single compound depending upon the surface area of the test organism, the lipid content, and the ability of the organism to metabolize the compound. Furthermore, the laboratory data represent experiments performed on different biological

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TABLE E-11

ALTERNATIVE RATING SCALES FOR PERSISTENCE

1.

Score	Category
+3	Infinite
+2	Up to 1 Year
+1	1 to 8 Weeks
0	Up to 1 Week
-1	Suspected Low; No Data
-2	Suspected High; No Data

Source: TSCA-ITC Workshop (1979), Table 4, p. 60.

2.

Score	Category
0	Easily Biodegradable
1	Straight Chain Hydrocarbons
2	Substituted and Other Ring Compounds
3	Metals, Polycyclic Compounds, and Halogenated Hydrocarbons

Source: Abrams, E.F., et al. Identification of Organic Compounds in Effluents from Industrial Sources. EPA-560/3-75-002. April 1975.

3.

Score	Category	Half-Life in Weeks (Soil or Water)
4	Very persistent	> 52
3	Persistent	40-52
2	Slowly degradable	27-39
1	Moderately degradable	14-26
0	Readily degradable	0-13
*	Insufficient Information	

Source: Michigan Department of Natural Resources. 1979. Critical Materials Register 1979. Publication Number 4833-5323. Lansing, Michigan. 71 pp.

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TABLE E-12

ALTERNATIVE RATING SCALE FOR BIOACCUMULATION

1.

Score	Bioaccumulation	Log P
7	> 4000	> 6.00
3	1000-3999	5.00-5.99
2	700-999	4.50-4.99
1	300-699	4.00-4.49
0	< 300	< 4.00
*	Insufficient Information	

Source: Michigan Department of Natural Resources. 1979. Critical Materials Register 1979. Publication Number 4833-5323. Lansing, Michigan. 71 pp.

2.

Score	Potential
+3	High
+2	Appreciable
+1	Low
0	Negligible
-1	Suspected Low; No Data
-2	Suspected High; No Data

Note: Bioaccumulation potential based on the n-octanol/water partition coefficient.

Source: TSCA-ITC Workshop (1979), Table 4. p. 60.

species, each with potentially different abilities to bioconcentrate the test materials. Consequently, BCF values are of limited use for rating relative chemical hazard unless test conditions are similar for the various compounds being compared.

A second measure of bioaccumulation potential is based on the n-octanol/water partition coefficient (P) which is a measure of the distribution of a chemical between the two immiscible solvents, octanol and water. The Log P has been found to correlate with solubility and bioconcentration (Kenaga and Goring, 1978). Although Log P is a useful measure, experimental values are not always available. Several methods are available for estimating Log P from solubility, but errors in excess of 75% are common. For these reasons, we have decided to rate the bioaccumulation potential of substances in this report on a YES/NO basis. A substance is assigned a rating of 0 if it is known that it does not bioaccumulate, a rating of 1 if its bioaccumulation potential is unknown and a rating of 2 if the substance is known to bioaccumulate.

The degree of hazard for potential toxic combustion products which may be released when a substance of concern is burned or heated to decomposition is estimated from information in the OHMTADS file. A rating of 0 to 3 (0 = none, 1 = slight, 2 = moderate, 3 = severe) is assigned based on the nature of the toxic combustion products generated and the severity of the inhalation toxicity of such products.

Finally, it was felt that if certain mitigating characteristics of the hazardous substances could be assessed, then these should serve to reduce the overall hazard index score. Such mitigating characteristics are defined as transformation by physical, chemical, or biological processes into innocuous products, or evaporation of a substance into a nontoxic, nonflammable, non-explosive and unreactive vapor.

Table E-13 lists the possible maximum and minimum rating values for each criterion and summarizes the maximum and minimum HI rating which a substance can receive using the second HI equation. The maximum HI rating would be 40, the sum of the health effects, welfare effects, and aggravating effects terms. This value could be reduced if there were appropriate mitigating factors involved.

In combination with the rating of hazardous substances according to the specific criteria already discussed, weighting factors can be applied to each of the criteria to denote the relative importance of each in the final hazard index score. Table E-14 lists weighting factors which were assigned to the various rating factors included in the second equation. The comparison of results (with and without the weighting factors) can be found in Table E-20. It is apparent from these results that the rater must be very careful in his assignment of weighting factors so as not to overrate certain criteria, in this case toxicity, and therefore, swamp out the measurement of other important criteria, (i.e., welfare effects).

Third Alternative Equation

The third alternative equation is an extension of the second. It is comprised of essentially the same rating factors; however, the mathematical logic is different. Rather than being strictly additive, it incorporates multiplicative arrangements to arrive at a final rating. This third equation has the following form:

$$HI = \left[\begin{pmatrix}\text{Health}\\\text{Effects}\end{pmatrix} \times \begin{pmatrix}\text{Aggravating}\\\text{Health}\\\text{Factors}\end{pmatrix} + \begin{pmatrix}\text{Welfare}\\\text{Effects}\end{pmatrix}\right] \times \begin{pmatrix}\text{Aggravating/Mitigating}\\\text{Transformation Properties}\end{pmatrix}$$

The individual rating factors which comprise each of the terms are outlined below.

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TABLE E-13. MINIMUM AND MAXIMUM POTENTIAL HI RATINGS/SECOND EQUATION

Rating Factor	Minimum Value	Maximum Value
1. Health Effects		
Carcinogenicity	0	3
Mutagenicity	0	3
Teratogenicity	0	3
Human Toxicity	0	4
Mammalian Toxicity	0	4
TOTAL	0	17
2. Welfare Effects		
Flammability	0	4
Explosivity	0	4
Corrosivity	0	4
Reactivity	0	4
TOTAL	0	16
3. Aggravating Effects		
Persistence	0	2
Bioaccumulation	0	2
Toxic Combustion Prod.	0	3
TOTAL	0	7
GRAND TOTAL	0	40
4. Mitigating Effects		
Innocuous Transformation Products	0	3
Evaporation	0	3
TOTAL	0	6

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TABLE E-14. SUMMARY OF WEIGHTING FACTORS APPLIED TO THE SECOND ALTERNATIVE HI EQUATION

	Min	Max		Weighting Factor		Min	Max
Human Health Effects							
Carcinogenicity	0	3	x	6	=	0	18
Mutagenicity	0	3	x	6	=	0	18
Teratogenicity	0	3	x	6	=	0	18
Human Toxicity (LD or TLV or LC)	0	4	x	12	=	0	48
Mammalian Toxicity	0	4	x	6	=	0	24
TOTAL						0	126
Welfare Effects							
Flammability	0	4	x	1	=	0	4
Explosiveness	0	4	x	1	=	0	4
Corrosiveness	0	4	x	1	=	0	4
Reactivity	0	4	x	1	=	0	4
TOTAL						0	16
Aggravating Effects							
Persistence	0	2	x	3	=	0	6
Bioaccumulation Potential	0	2	x	3	=	0	6
Toxic Combustion Products	0	3	x	3	=	0	9
TOTAL						0	21
GRAND TOTAL						0	163
Mitigating Effects							
Innocuous Transformation Products	0	3	x	2	=	0	6
Evaporation Potential	0	3	x	1	=	0	3
TOTAL						0	3

Health Effects

- Carcinogenicity
- Human Toxicity
- Mammalian Toxicity

The rating scores for each of the health effects factors are summed.

Aggravating Health Factors

- Bioaccumulation
- Persistence

The rating scores for bioaccumulation and persistence are multiplied together.

Welfare Effects

- Flammability
- Explosivity
- Corrosivity
- Reactivity

The rating scores for each of the welfare effects factors are summed.

Aggravating/Mitigating Transformation Properties

- Mitigating (Innocuous Products)
- Aggravating (Hazardous Products)

The major changes reflected in this third alternative are the following:

1. Bioaccumulation and persistence, both of which are aggravating characteristics related primarily to health effects, are multiplied against the sum of the rating values for health effects.
2. Transformation of a substance by physical, chemical, or biological processes can result in either mitigating or aggravating products for Health Effects as well as Welfare Effects. The rating score for transformation is therefore multiplied against the sum of both these terms.

Table E-15 presents modified rating scales for bioaccumulation, persistence, and mitigating and aggravating transformation properties only. The rating scales for all other factors remain the same as previously defined. The choice in rating values for bioaccumulation, persistence, and mitigating and aggravating transformation properties was made to accommodate the multiplicative arrangement of terms. A rating value of 1 is assigned if the potential for bioaccumulation and persistence is negative or unknown and if the aggravating or mitigating transformation properties of a substance have no effect or are unknown. A rating value of 0 in this case would wipe out the other terms in the equation. A rating of 1.5 is assigned for positive evidence of bioaccumulation, 1.25 for positive evidence of persistence, 0.5 for mitigating transformation properties, and 1.5 for aggravating transformation properties. These particular values were selected as multipliers so as not to overemphasize the effects they are measuring relative to the other rating factors in the equation. Table E-16 presents the minimum and maximum HI ratings which can be obtained with the third algorithm.

Fourth Alternative Equation

The fourth alternative equation is similar in concept to the second in that it evaluates major health effects (carcinogenicity, mutagenicity, teratogenicity), welfare effects (ignitability, reactivity) and aggravating characteristics, in an additive manner. It differs, however, in the following:

1. It does not consider mitigating characteristics such as innocuous transformation products.
2. It incorproates media specific toxicity measurements for air (inhalation toxicity) and water (ingestion toxicity), as well as toxicity via direct contact (dermal toxicity).
3. The rating scale for persistence is based on a chemical structure/ classification scheme proposed by Abrams, et al. (See Table E-11.)

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TABLE E-15

AGGRAVATING HEALTH FACTORS

1. Bioaccumulation

   1.0 = Unknown or None
   1.5 = Positive

2. Persistence

   1.0 = Unknown or None
   1.25 = Positive

AGGRAVATING/MITIGATING TRANSFORMATION PROPERTIES

1.	Mitigating (innocuous products)	= 0.5
2.	No Effect/Unknown	= 1.0
3.	Aggravating (Hazardous Products)	= 1.5

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TABLE E-16

MINIMUM AND MAXIMUM POTENTIAL HI RATINGS/THIRD EQUATION

Rating Factor	Minimum Value	Maximum Value
1. Health Effects		
Carcinogenicity	0	3
Human Toxicity	0	4
Mammalian Toxicity	0	4
TOTAL	0	11
2. Aggravating Health Factors		
Bioaccumulation	1	1.50
Persistence	1	1.25
TOTAL	1	1.875
3. Welfare Effects		
Flammability	0	4
Explosivity	0	4
Corrosivity	0	4
Reactivity	0	4
TOTAL	0	16
Subtotal	0	36.62
4. Aggravating/Mitigating Transformation Properties		
Mitigating	--	0.5
No Effect/Unknown	--	1.0
Aggravating	--	1.5
GRAND TOTAL	0	55

4. In the category of welfare effects, specific ratings for explosivity and corrosivity have been deleted and are included in the definitions of ignitability and reactivity, which are based on the NFPA scheme.
5. The concept of environmental mobility has been introduced using solubility and volatility as criteria.
6. Aquatic toxicity is included in the general welfare category because it is a measure of lethal effects on specified freshwater and marine fauna resources.

The form of the fourth equation is as follows:

$$HI = \begin{pmatrix}\text{Health}\\ \text{Effects}\end{pmatrix} + \begin{pmatrix}\text{Welfare}\\ \text{Effects}\end{pmatrix} + \begin{pmatrix}\text{Environmental}\\ \text{Mobility}\end{pmatrix} + \begin{pmatrix}\text{Aggravating}\\ \text{Characteristics}\end{pmatrix}$$

The individual rating factors which comprise each of the four terms are outlined below.

Health Effects

- Carcinogenicity
- Mutagenicity
- Teratogenicity
- Inhalation Toxicity (human or mammalian--LC_{1o}, LC_{50})
- Ingestion Toxicity (human or mammalian--LD_{1o}, LD_{50})
- Dermal Toxicity (human or mammalian--LD_{50})

Welfare Effects

- Ignitability
- Reactivity
- Aquatic Toxicity

Environmental Mobility

- Volatility
- Solubility

Aggravating Characteristics

- o Bioaccumulation
- o Persistence

The rating scales for each of these components are summarized in Tables E-17 through E-18.

This fourth equation also departs from the previous three hazard index formulas in that any available data regarding mammalian toxicity was considered pertinent. If human or rat toxicity data was unavailable, mouse, rabbit, or guinea pig toxicity information was used. This departure avoids reliance on sometimes scarce human toxicity data.

Inhalation toxicity values are scaled as before, where parts per million represents the concentration in the air. Ingestion and dermal toxicity values are also scaled as before, where parts per million represents mg of dose per Kg of animal weight. Carbon disulfide and trinitrotoluene are both known to enter the body via skin absorption. Since skin toxicity data was not available for these two compounds, subcutaneous toxicity data was utilized. Table E-19 presents a matrix of the unavailable toxicity data as it pertains to Equation 4.

Table E-20 presents for each of the 27 test substances (arranged alphabetically) the HI values calculated using each of the alternative equations. Column I lists the values obtained from the first equation. Column IIa lists the values obtained from the second, without using weighting factors, and Column IIb lists the values obtained from the second using various weighting factors. Columns III and IV list the HI values obtained from the third and fourth alternative equations respectively. The larger the HI value, the more hazardous a substance is.

For the purpose of comparison, Table E-21 presents the relative rankings of the 27 hazardous substances according to the alternative equations, using

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TABLE E-17

RATING SCALES FOR FOURTH ALTERNATIVE HI EQUATION

HEALTH EFFECTS	
. Carcinogenicity	
. Mutagenicity	Same rating scales as in Table E-2.
. Teratogenicity	
. Toxicity (Inhalation, Ingestion, Dermal)	

WELFARE EFFECTS
. Ignitability (Same as Table E-9)
. Reactivity (Same as Table E-10)
. Aquatic Toxicity (Same as Table E-2)

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TABLE E-18

ENVIRONMENTAL MOBILITY

Volatility

		Vapor Pressure (1st Choice)	Boiling Point (2nd Choice)
0	=	VP < 0.1 mm Hg	B.P. > 200°C
1	=	VP 0.1 - 25 mm Hg	B.P. 100-200°C
2	=	VP 25 - 78 mm Hg	B.P. 25-100°C
3	=	VP > 78 mm Hg	B.P. < 25°C

Solubility

		CRC Handbook Code (1st Choice)		Solubility Data (2nd Choice)
0	=	Insoluble	I	100 mg/l
1	=	Slightly Soluble	S/S^h	100-1000 mg/l
2	=	Soluble	S	1000-10,000 mg/l
3	=	Very Soluble Infinitely Soluble	V	10,000 mg/l

AGGRAVATING CHARACTERISTICS

Bioaccumulation

0 = Nonbioaccumlative
1 = Unknown
2 = Bioaccumulative

Persistence*

0 = Easily Biodegradable
1 = Straight Chain Hydrocarbons
2 = Substituted and Other Ring Compounds
3 = Metals, Polycyclic Compounds, and Halogenated Hydrocarbons

*Source: Abrams, E.F., et al., Identification of Organic Compounds in Effluents from Industrial Sources, EPA-560/3-75-002, April, 1976.

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TABLE E-19

UNAVAILABLE MAMMALIAN TOXICITY DATA PER ROUTE OF ENTRY
FOR EQUATION 4

	Inhalation Toxicity	Ingestion Toxicity	Dermal Toxicity
Acetyl Bromide	X	X	X
Acetylene		X	X
Acrolein			
Acrylonitrile			
Ammonium Bichromate	X		X
Benzene			
Benzidine	X		X
Benzo(a)pyrene	X	X	X
Bis(2-ethylhexyl)phthalate	X		
Carbon Disulfide			
Carbon Tetrachloride			
Chloroform			X
DDT	X		
Heptachlor Epoxide	X		X
Methyl Chloride			X
Nitric Acid			X
N-Nitrosodimethylamine			X
PCB's	X		
Phenol	X		
Phosgene		X	
Phosphorus (White)	X		X
Potassium Permanganate	X		X
Sodium Amide	X	X	X
Sodium Dichromate	X		
2,4,6-TNT	X		
Vinyl Chloride			X
Vinylidene Chloride			X

NOTE: X denotes unavailable data

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TABLE E-20

HAZARD INDEX SCORES DETERMINED FROM THE ALTERNATIVE EQUATIONS

	I	IIa	IIb	III	IV
Acetyl Bromide	3	24	49	26	14
Acetylene	3	14	29	18	16
Acrolein	10	25	109	28	27
Acrylonitrile	8	23	69	26	30
Ammonium Bichromate	7	16	61	17	20
Benzene	7	18	63	20	18
Benzidine	9	13	74	10	18
Benzo(a)pyrene	7	9	48	3	12
Bis(2-ethylhexyl)phthalate	7	8	44	2	16
Carbon Disulfide	11	26	105	27	29
Carbon Tetrachloride	9	22	93	26	26
Chloroform	11	24	105	29	24
DDT	8	15	79	18	19
Heptachlor Epoxide	9	11	60	6	13
Methyl Chloride	4	21	47	24	17
Nitric Acid	8	18	74	21	20
N-Nitrosodimethylamine	12	19	121	12	18
PCB's	5	14	58	10	14
Phenol	6	18	68	18	18
Phosgene	8	19	79	20	14
Phosphorus (White)	11	31	122	41	20
Potassium Permanganate	4	10	30	12	16
Sodium Amide	3	18	35	28	9
Sodium Dichromate	9	17	74	20	22
2,4,6-TNT	2	14	32	15	12
Vinyl Chloride	8	23	67	26	26
Vinylidene Chloride	8	20	66	21	23
RANGE OF VALUES					
Low	2	8	29	2	9
High	12	31	122	41	30

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TABLE E-21

RELATIVE RANKINGS OF HAZARDOUS SUBSTANCES

Hazardous Substance	I	IIa	IIb	III	IV
Acetyl Bromide	24	4	20	6	21
Acetylene	24	20	27	16	18
Acrolein	5	3	3	3	3
Acrylonitrile	10	6	12	6	1
Ammonium Bichromate	16	18	17	19	9
Benzene	16	13	16	13	13
Benzidine	6	23	9	23	13
Benzo(a)pyrene	16	26	21	26	25
Bis(2-ethylhexyl)phthalate	16	27	23	27	18
Carbon Disulfide	2	2	4	5	2
Carbon Tetrachloride	6	8	6	6	4
Chloroform	2	4	4	2	6
DDT	10	19	7	16	12
Heptachlor Epoxide	6	24	18	25	24
Methyl Chloride	22	9	22	10	17
Nitric Acid	10	13	9	11	9
N-Nitrosodimethylamine	1	11	2	21	13
PCB's	21	20	19	23	21
Phenol	20	13	13	16	13
Phosgene	10	11	7	13	21
Phosphorus (White)	2	1	1	1	9
Potassium Permanganate	22	25	26	21	18
Sodium Amide	24	13	24	3	27
Sodium Dichromate	6	17	9	13	8
2,4,6-TNT	27	20	25	20	25
Vinyl Chloride	10	6	14	6	4
Vinylidene Chloride	10	10	15	11	7

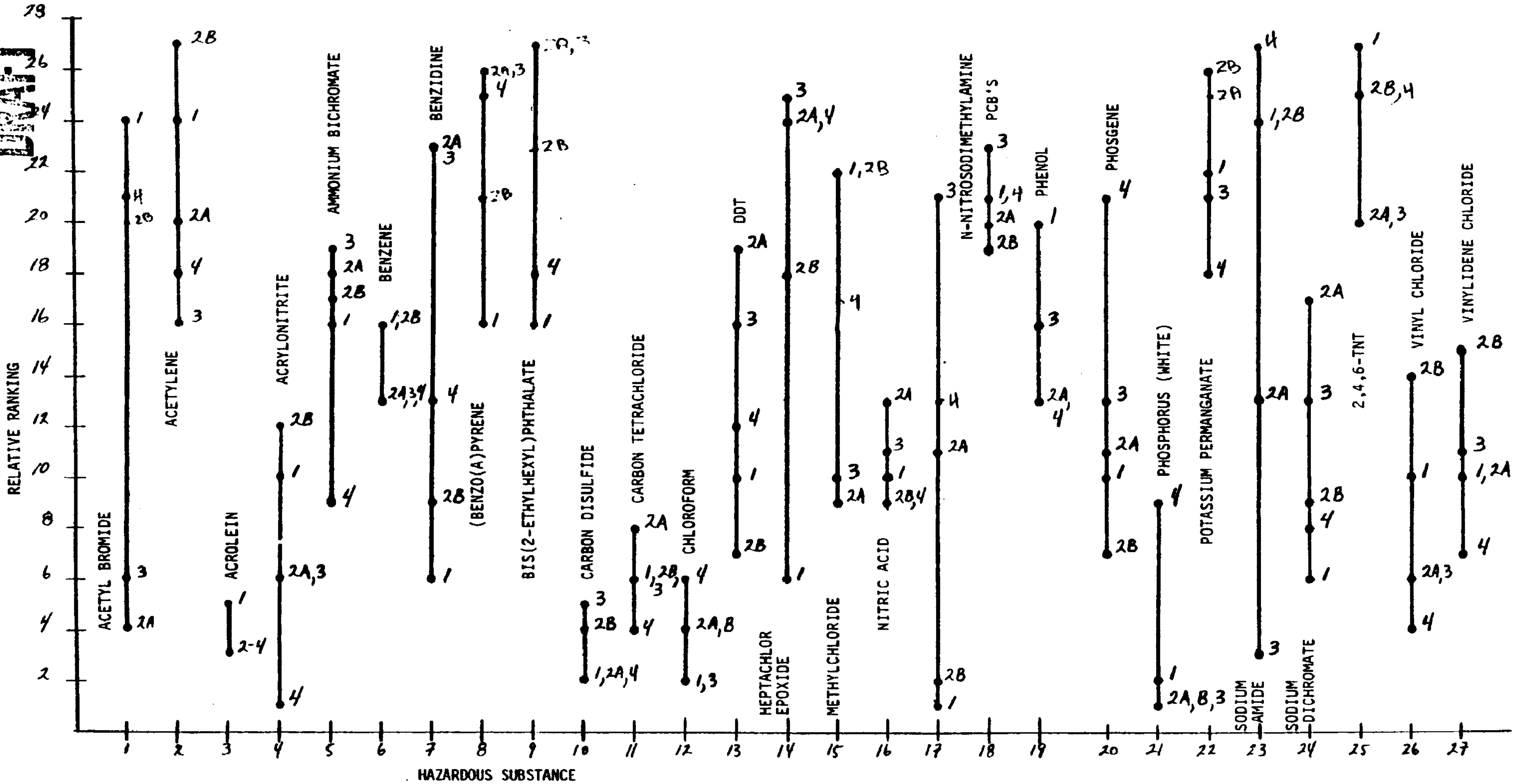
the same column assignments. The substances are ranked from 1 (most hazardous) to 27 (least hazardous) in the following manner.

For each equation, the substance with the highest HI value is taken to be the most hazardous and therefore is assigned a relative rank of 1. The substance with the next highest HI value is assigned a relative rank of 2, and so on. If two or more substances share the same HI value, then each receives an identical ranking. In such cases the next relative rank assigned will be equal to the last relative rank assigned, plus the number of identical rankings. The following from Equation 1 should serve as an example.

Hazardous Substance	HI Value	Relative Rank
N-Nitrosodimethylamine	12	1
Carbon Disulfide	11	2
Chloroform	11	2
Phosphorus (White)	11	2
Acrolein	10	5

Figure E-1 presents graphically the range and the variance in the relative rankings for each hazardous substance. The equation from which each data point was taken is denoted. The range of differences in the relative rankings obtained by the various alternative equations can be quite large. However, in several cases, the relative rankings fall fairly close together (i.e., acrolein, benzene, carbon disulfide, carbon tetrachloride, chloroform, nitric acid, and PCB's). It is clear from this figure that the relative ranking of chemicals depends very much on the number of selected criteria and the emphasis placed on these criteria in each equation.

FIGURE E-1. VARIANCE IN THE RELATIVE RANKINGS OF SELECTED HAZARDOUS SUBSTANCES



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Finally, Table E-22 denotes the various data which were unavailable for rating the selected 27 hazardous substances.

Certain conclusions about the hazard index system in general can be made:

1. The hazard index does not measure degree of hazard where data are missing. For this reason it relies on what is known about a substance.
2. Because of limitations in the available data base, the hazard index does not measure chronic toxicity. This is most apparent in the rating results obtained for PCB's.
3. In addition, the hazard index does not measure difficulty of cleanup (i.e., PCB's again), nor the public perception of hazard, exposure, and distribution, or other considerations that may be pertinent in specific spill or exposure situations.

REVIEW OF OTHER AVAILABLE MODELS

Several models have been developed for rating the relative potential hazard to public health and the environment posed by releases of hazardous substances as well as for hazardous waste disposal facilities. The characteristics of these models and their relevance to development of a hazard index for assignment of Reportable Quantities are outlined in the following sections. Aspects of these systems which were used in the development of the four alternative equations presented in this report will be indicated.

Models for Rating Hazardous Waste Facilities

A number of models have been developed to evaluate and rank the hazard potential of specific waste disposal sites and uncontrolled hazardous waste facilities, for the purpose of determining remedial action priorities. These include the LeGrand (1980a, b) model, the Rating Methodology Model (Kufs, 1980), and the Site Ranking Model (S. Chang, et al., 1981).

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TABLE E-22

SUMMARY OF UNAVAILABLE DATA

	CARCINOGENICITY	MUTAGENICITY	TERATOGENICITY	HUMAN TOXICITY	MAMMALIAN TOXICITY	IGNITABILITY	EXPLOSIVENESS	CORROSIVENESS	REACTIVITY	TRANSFORMATION PROPERTIES
Acetyl Bromide	X	X	X	X	X					
Acetylene	X	X	X	X						X
Acrolein			X							
Acrylonitrile			X	X						
Ammonium Bichromate		X	X	X			X			
Benzene			X							
Benzidine			X	X			X	X		
Benzo(a)pyrene			X	X	X	X		X	X	X
Bis(2-ethylhexyl)phthalate	X			X				X		
Carbon Disulfide	X									
Carbon Tetrachloride										
Chloroform			X							
DDT								X		
Heptachlor Epoxide			X	X		X	X	X	X	X
Methyl Chloride	X	X	X	X						
Nitric Acid	X	X	X							
N-Nitrosodimethylamine			X			X	X	X		X
PCB's		X	X	X				X		
Phenol		X	X							
Phosgene	X	X	X							
Phosphorus (White)	X	X	X							
Potassium Permanganate	X	X	X	X						
Sodium Amide	X	X	X	X	X					
Sodium Dichromate			X	X						
2,4,6-TNT				X				X		
Vinyl Chloride			X	X				X		
Vinylidene Chloride			X	X				X		

NOTE: X denotes unavailable data

The LeGrand Model describes the potential for groundwater contamination (primarily wells). The Rating Methodology Model addresses both ground and surface water contamination. The Site Ranking Model, which is an extension of the Rating Methodology Model, is the most advanced and comprehensive of these. It is designed to address five routes of contamination: ground water, surface water, air, fire and explosion, and direct contact.

Application of each of these models requires, to a lesser or greater extent, knowledge of site specific physical attributes data used to estimate the relative potential hazard of a facility. Data requirements include:

- Horizontal distance between the waste and the nearest ground well
- Depth of the water table below the waste
- Ground water use
- Water flow gradients
- Permeability of the unsaturated zone
- Soil type
- Net precipitation
- Transmissivity of the aquifier
- Surface water use
- Land use/zoning
- Distance to the nearest population
- Critical environments
- Site slope
- Flood potential
- Ignition sources
- Distance to nearest buildings
- Waste management designs and procedures
- Total waste quantity

- Evidence of releases
- Measured levels of contamination

The final rating obtained in both the Rating Methodology Model and the Site Ranking Methodology reflects to some extent the intrinsic potential hazard of the wastes present at each site. Wastes are characterized for toxicity, persistence, ignitability, reactivity, and volatility. The toxicity rating system is oversimplified and represents the most serious flaw. It is based only on Hazardous Properties of Industrial Materials (Sax) and the National Fire Protection Associations Guide on Hazardous Materials.

Summary of Other Available Chemical Rating Systems--

The concept of ranking and screening chemicals based on their potential health and environmental risk has been the subject of several reports and papers. Each of these differs in purpose, selection of criteria, and form of the rating system. It is not the intent to review each of these here but rather to summarize the available references. The first of these, Chemical Scoring System Development (Ross and Lu, 1981) represents work performed for the Assessment Division of the EPA Office of Pesticides and Toxic Substances, which is responsible for the first phases of evaluating chemicals under the Toxic Substances Control Act (TSCA). In addition to proposing a scoring system, this report reviews in some detail the other 16 rating systems referenced at the end of this section. Certain aspects of these systems were considered in the development of the four alternative algorithms presented in this report. For the most part, however, these other models were either too limited in scope for our purposes, did not provide sufficient procedural detail, or incorporated subjective judgment in differing degrees.

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