TASK 2 REPORT
SELECTION OF THE CHEMICALS AND RADIONUCLIDES OF CONCERN

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Prepared By:

ChemRisk® Division
McLaren/Hart

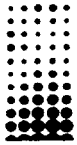
For:

Colorado Department of Health

DOSE RECONSTRUCTION PROJECT

Phase I of the Health Studies

ROCKY FLATS



PROJECT BACKGROUND

ChemRisk is conducting a Rocky Flats Toxicologic Review and Dose Reconstruction study for The Colorado Department of Health. The two year study will be completed by the fall of 1992.

The ChemRisk study is composed of twelve tasks that represent the first phase of an independent investigation of off-site health risks associated with the operation of the Rocky Flats nuclear weapons plant northwest of Denver. The first eight tasks address the collection of historical information on operations and releases and a detailed dose reconstruction analysis. Tasks 9 through 12 address the compilation of information and communication of the results of the study.

Task 1 will involve the creation of an inventory of chemicals and radionuclides that have been present at Rocky Flats. Using this inventory, chemicals and radionuclides of concern will be selected under Task 2, based on such factors as the relative toxicity of the materials, quantities used, how the materials might have been released into the environment, and the likelihood for transport of the materials off-site. An historical activities profile of the plant will be constructed under Task 3. Tasks 4, 5, and 6 will address the identification of where in the facility activities took place, how much of the materials of concern were released to the environment, and where these materials went after the releases. Task 7 addresses historical land-use in the vicinity of the plant and the location of off-site populations potentially affected by releases from Rocky Flats. Task 8 activities will quantify the doses of the materials of concern received by off-site populations.

ChemRisk will also perform four more tasks involving the compilation of project information and community relations. Activities from Tasks 9, 10, and 11 will result in the establishment of systems to manage the data from the study, compile a bibliography of references, and place the information in a repository for use in further studies. Task 12 activities will involve the Rocky Flats community in the study by means of interviews, health advisory panel meetings and public meetings.

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EXECUTIVE SUMMARY

In Task 1, ChemRisk identified about 2,500 chemicals that were classified as being of moderate to high toxicity. The objective of Task 2 is to select chemicals and radionuclides that were most likely to have posed an off-site health hazard under historical routine operation of the plant.

ChemRisk identified 5 radioactive elements and their isotopes (12 radionuclides in total) as being those most likely to have posed an off-site health hazard for further study. The selection is based on the quantities of radionuclides present at the Rocky Flats Plant, effluent monitoring data and environmental sampling data.

ChemRisk devised a three-stage process to select chemicals of concern. In Stage 1, well-known environmental toxicants are identified including: carcinogens, chemicals identified by the U.S. EPA as important chronic toxicants and known human reproductive and developmental toxicants. In addition, chemicals with inventory quantities greater than 5 kg are also identified. A total of 629 chemicals are selected in Stage 1 for further screening.

In Stage 2, the toxicologic properties and inventory quantities of the chemicals selected in Stage 1 are evaluated. Chemical release assumptions and screening dispersion models that are likely to overestimate the dose received by the community (conservative models), are used to evaluate the potential of each chemical to pose an off-site health hazard. A total of 46 chemicals are selected in Stage 2 for further screening.

In Stage 3, detailed information on storage locations, annual usage rates, nature of usage, nature of toxicity and environmental fate of the chemicals selected in Stage 2 are reviewed. Based on this individual evaluation of each chemical, a total of 20 industrial chemicals and pesticides and herbicides as a group are identified as having been of potential concern for off-site impacts.

The 5 radioactive elements and their isotopes (12 radionuclides in total), the 20 chemicals and the pesticides/herbicide group will be the subject of further project investigations to evaluate potential historic off-site exposures to these compounds.

1.0 INTRODUCTION

The objective of Task 2 is the selection of those compounds that will be the subject of further study for their historical impact on off-site populations from among the dozens of radionuclides and thousands of chemicals that have been identified as having been present at the Rocky Flats Plant (RFP). It is important to note that this selection process is primarily intended to address the study of chemical and radionuclide releases associated with routine operations at the plant. Accidents and incidents will be identified in the course of the reconstruction of the history of operations at the plant (Task 3). Those accidents or incidents identified as having the potential for posing impacts to off-site populations will become the subject of further study by the project. The investigations of these accidents or incidents will not be limited to those compounds selected by this task, but will include all those compounds of potential concern for the individual event.

The nature of the selection process employed in this task for the radionuclides of concern differs considerably from that used to select the chemicals. The difference stems from the fact that virtually all radionuclides have the potential for posing an impact or contributing to radiation exposure if released in significant quantities while not all chemicals are associated with the same level of concern for potential health impacts. Also, public awareness and concerns are principally focussed on radionuclides since Rocky Flats is a nuclear facility. The radionuclide selection process has therefore focused on the identification of the those isotopes known to have been present in large quantities and used in a manner likely to have resulted in a release to the environment.

As discussed in the Task 1 report, radionuclides have been tracked and inventoried at the plant for the majority of its operating history and have been the subject of extensive monitoring of both emissions and environmental media. The quality of our knowledge regarding the types and relative quantities of radionuclides present at the plant and

detected in the environment surrounding the plant is very good. The list of radionuclides handled in large quantities (greater than 1 kilogram) identified in Task 1 is relatively short. Therefore, an elaborate selection scheme was not deemed necessary to select isotopes for further study, since it is believed that all isotopes having a reasonable potential for posing off-site impacts can be addressed by the project. This report identifies radionuclides believed to fall into that category.

In view of the large number of chemical compounds identified as having been present at the site and the less certain knowledge of the nature of their use and release, a much more elaborate selection scheme is presented in this report for the chemicals. The selection scheme relies on some limited knowledge of the relative quantities of the compounds present at the plant site, as identified by project Task 1, and known intrinsic properties related to the chemical's toxicity.

2.0 SELECTION OF RADIONUCLIDES

The Task 1 report identifies radionuclides that have been present at the plant site, grouping them into three categories:

- Group 1: production related radionuclides handled in kilogram quantities,
- Group 2: research and analytic related radionuclides handled in gram quantities, and
- Group 3: other sources (sealed solids, plated, liquids, and analytic stock solutions).

The list of radionuclides identified in each of these groupings as historically present at the site is reproduced from the Task 1 report in Appendix A. Of the radionuclides present at the plant site, only those falling in Group 1 are likely to be associated with off-site

impacts, if any, under normal operating conditions. The Group 1 listing includes those isotopes associated with metal fabrication and assembly and chemical recovery and purification of process-produced transuranic radionuclides. Group 1 includes isotopes of plutonium, enriched uranium, depleted uranium, natural uranium, uranium-233, and to a lesser degree natural thorium. Americium-241, a decay product of plutonium-241, also occurs in significant quantities. Radionuclides in the other two groupings are present in quantities and physical forms that generally preclude them from being a radiological dose concern to an off-site population.

Effluent monitoring and environmental sampling data were reviewed to establish whether plant related radionuclides other than Group 1 isotopes have been detected. The documents identified in Appendix B were reviewed for this purpose. With the exception of tritium, monitoring data are consistent with the release of only Group 1 compounds from the facility. Tritium has been detected in plant effluents and in off-site environmental media. Tritium was also associated with a release incident in 1973.

The plant effluent data indicate the presence of most of the primary production radionuclides (Group 1). The radionuclides detected include plutonium-238, 239, and 240; uranium-233, 234, and 238; americium-241; and tritium. Effluent sampling does not routinely include plutonium 241 and 242, uranium-235, and thorium-232 for a number of reasons. Plutonium 241 is a beta emitter and as such is a small dose contributor relative to the other plutonium isotopes. Plutonium 242 is present in small quantities relative to the other plutonium isotopes. In enriched uranium, uranium-235 is present at levels above the approximate 0.7% by weight found in naturally occurring uranium, however the uranium-234 isotope usually accounts for a great majority of total alpha radioactivity. Thorium-232 is not used in significant quantities relative to other production radionuclides.

Environmental sampling data indicate the presence of isotopes of plutonium and uranium, americium-241 and tritium. These radionuclides appear in measurable quantities in some samples of ambient air, water, soil, and vegetation. Plutonium concentrations in the immediate vicinity of the plant are reported to be higher than normal environmental levels. Detectable quantities of other radionuclides characteristic of nuclear weapons fallout, such as strontium-89 and 90, zirconium-95, cesium-137, and cerium-144 were also found in environmental samples from 1970 through 1981. Detection of these compounds is consistent with the presence of fission products from worldwide fallout and the detected levels are typical of other sites sampled in the western United States.

The radionuclides that will be the subject of further study have been selected based on:

- Known relative quantities of radionuclides present at the Rocky Flats Plant,
- Effluent monitoring data, and
- Environmental sampling data.

Those radionuclides present in sufficient quantity and used in such a manner that they have the potential to impact off-site populations or have been detected in effluents or environmental media include:

- Americium - 241,
- Plutonium - 238, 239, 240, 241, and 242,
- Thorium - 232,
- Uranium - 233, 234, 235, and 238, and
- Hydrogen - 3 (tritium).

These radionuclides and their significant decay products will be the subject of further project investigations related to normal operations. Accidents or incidents that are selected for study by the project will be evaluated separately and will not necessarily be limited to these radionuclides.

3.0 SELECTION OF CHEMICALS

The Task 2 plan identified two methods for the selection of chemicals of concern. The first method is a qualitative approach employing experts to review the available information and take public concerns into account in the identification of those compounds that should be the subject of further study. The second method is quantitative in nature, employing a formal selection scheme for identifying the chemicals of concern. The qualitative evaluation and general review are being performed by individuals on the Rocky Flats Health Advisory Panel (HAP) and by other experts selected by the HAP. The results of these activities are not part of this report. This report describes the quantitative process employed by ChemRisk to identify those chemicals that are recommended for further study by the project.

The Task 1 report presented the first step of the selection scheme by grouping the chemicals that have been present at the plant site into three categories:

- Group 1: those chemicals that should be subjected to formal evaluation to identify the chemicals of concern (Priority 1),
- Group 2: trade name products (Priority 2), and
- Group 3: those trade name products or substances that are believed to have little or no potential for posing an off-site health hazard (Priority 3).

There are two lists within each grouping. The first list is those chemicals and their quantities found on the 1988/89 inventory. The first list also identifies quantities for those chemical that were also on the 1974 inventory. The second list is those chemicals that are unique to the 1974 inventory. The lists associated with each grouping were presented in Appendices A-C of the Task 1 report.

As discussed in the Task 1 report, there are two primary sources for the listing of the chemicals used at the Rocky Flats Plant (RFP). The first is a computer database containing one of the latest Rocky Flats Chemical Inventory Lists obtained from the Environmental Restoration and Waste Management Group at Rocky Flats. This list is an updated version of the 1988/89 Chemical Inventory List on file in the Rocky Flats Public Reading Room. The second is a chemical inventory prepared by Dow Chemical Company in January, 1974. The Dow inventory represents a compilation of separate inventories conducted in all the plant areas.

In addition to these inventories, information regarding annual consumption rates was obtained from the April 1980 Final Environmental Impact Statement (EIS) for the plant. Although the EIS contains information for only a handful of chemicals, it provides information on the relationship between inventory quantities and chemical usage at the RFP. Finally, information from the three reports identified in Task 1 that identify chemicals present in environmental media and that are the subject of clean-up efforts was also used for the purpose of the selection process.

The sources of toxicologic information used in the chemical selection process include the following:

- Slope factors (SF) for carcinogens and reference doses (RfD) for noncarcinogens are obtained from the Health Effects Assessment Summary

Tables (HEAST)(U.S. EPA, 1990a) or the Integrated Risk Information System (IRIS)(U.S. EPA, 1990b). The SF, which is expressed in units of $(mg/kg\text{-}day)^{-1}$, is the 95 percent upper confidence limit of the probability of carcinogenic response per unit daily intake of a chemical over a lifetime. A RfD, as defined by the U.S. EPA, is the dose (mg/kg-day) of a chemical that is not expected to cause adverse health effects over a lifetime of daily exposure.

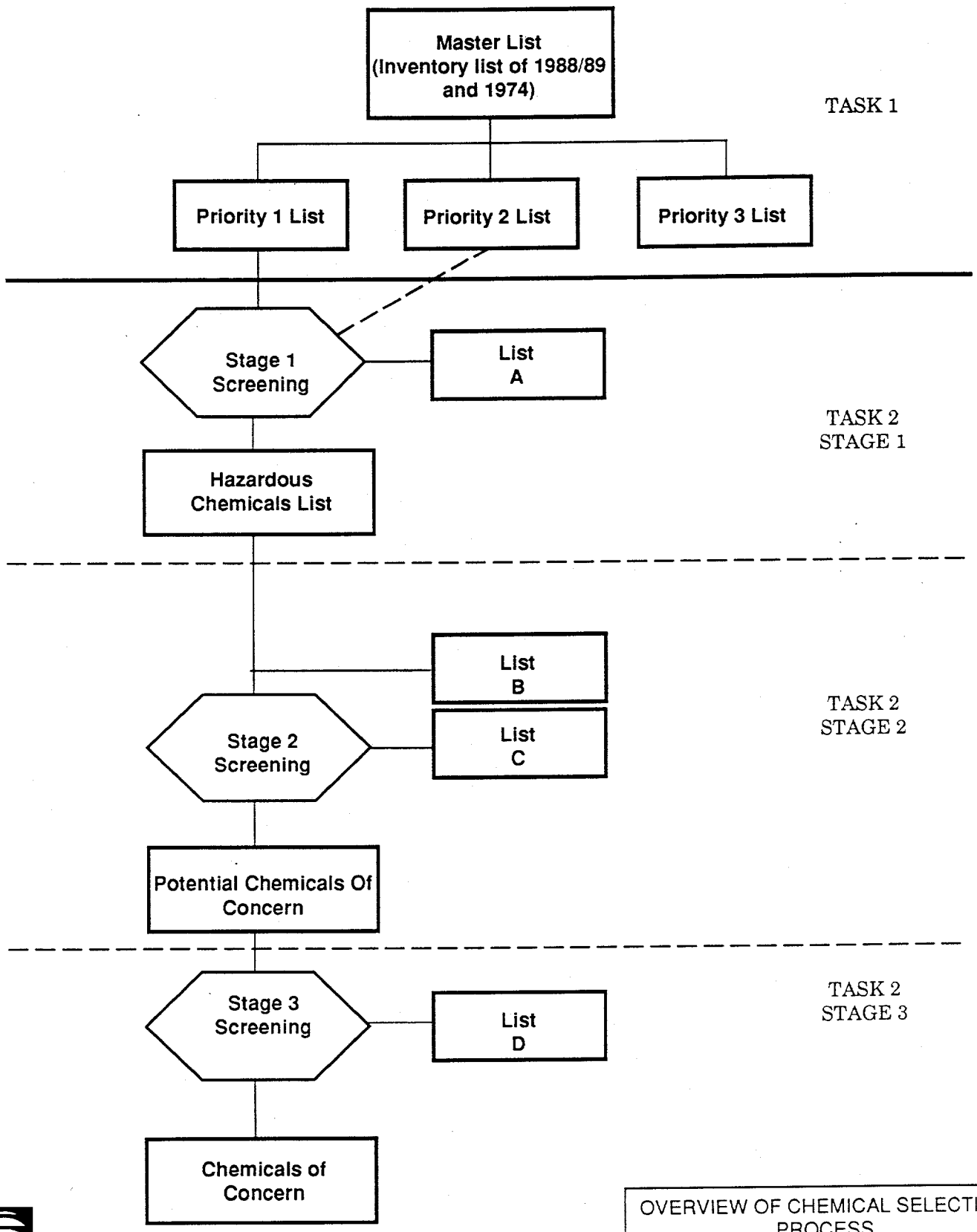
- Reproductive and developmental toxicants are identified by reference to those listed under the California Safe Drinking Water and Toxic Enforcement Act (also known as Proposition 65) (CHWA, 1990) and the Catalog of Teratogenic Agents (Shepard, 1989).

- Oral LD_{50} and other general toxicological information are obtained from the National Library of Medicine's electronic databases: Registry of Toxic Effects of Chemical Substances (RTECS) and Hazardous Substances Data Bank (HSDB). If no toxicological information for a chemical is found in either of these databases, Dangerous Properties of Industrial Material (Sax, 1989) is also used.

3.1 Overview of the Chemical Selection Process

In Task 1, ChemRisk identified more than 8,000 chemical and product names that have been used at the RFP. Each of these items is assigned to one of three priority lists. The Priority 1 list consists of chemicals that are believed to have the potential to pose an off-site health hazard and require further evaluation. The Priority 2 list is comprised of trade name products and the Priority 3 list consists of substances and trade name products that are believed to have little or no potential for posing an off-site health hazard.

There are approximately 2,500 chemicals on the Priority 1 list. The objective of Task 2 is to select those chemicals that are believed to be the most likely to pose an off-site health hazard. Given the enormity of this task, the selection process is divided into 3 stages to optimize the use of time and resources. Three flow charts are provided in Figures 3-1, 3-2 and 3-3 to describe the screening process that is employed for this purpose. Figure 3-1 provides an overview of the entire chemical identification and selection process under Tasks 1 and 2.



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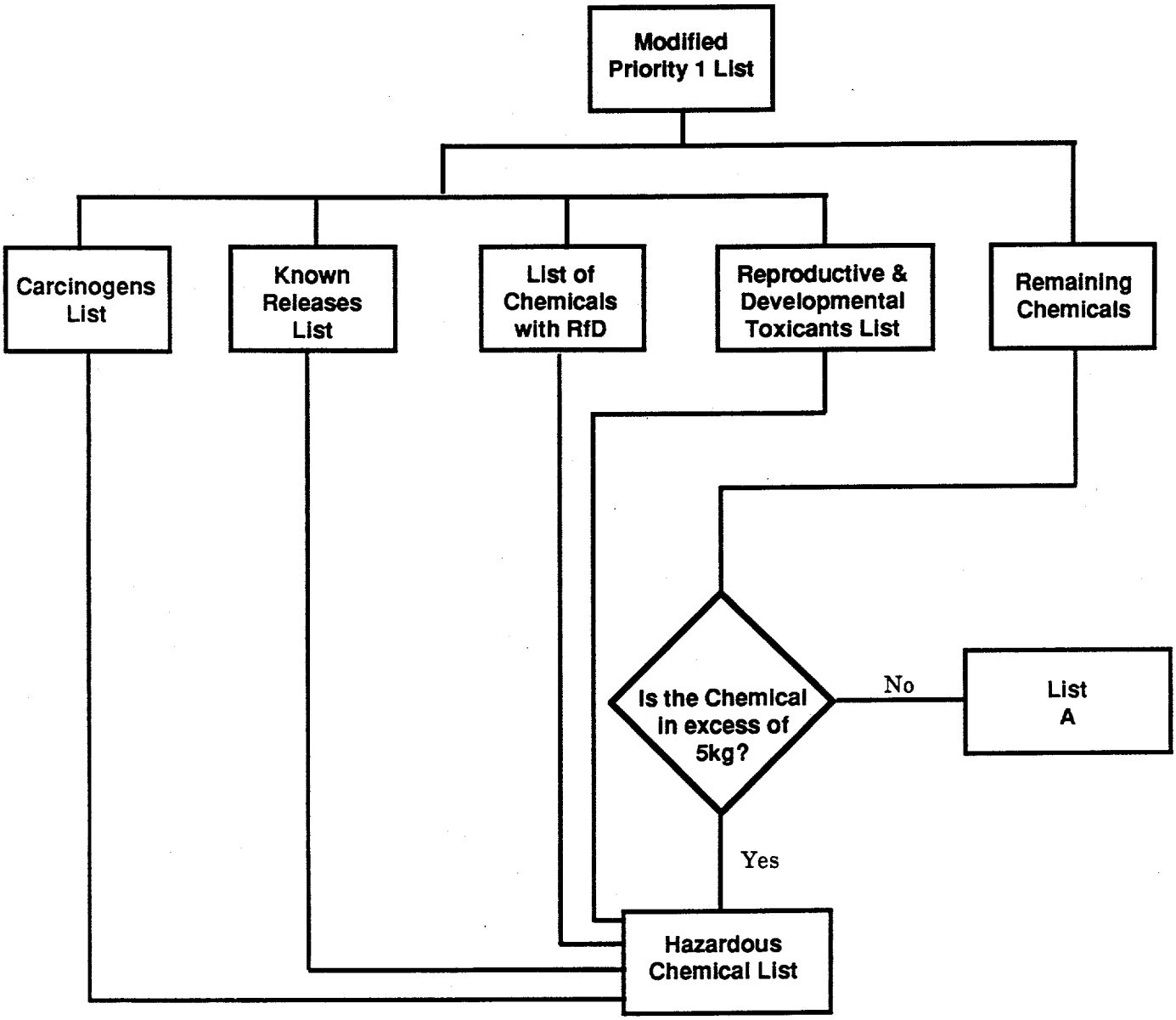
OVERVIEW OF CHEMICAL SELECTION PROCESS

FIGURE 3-1



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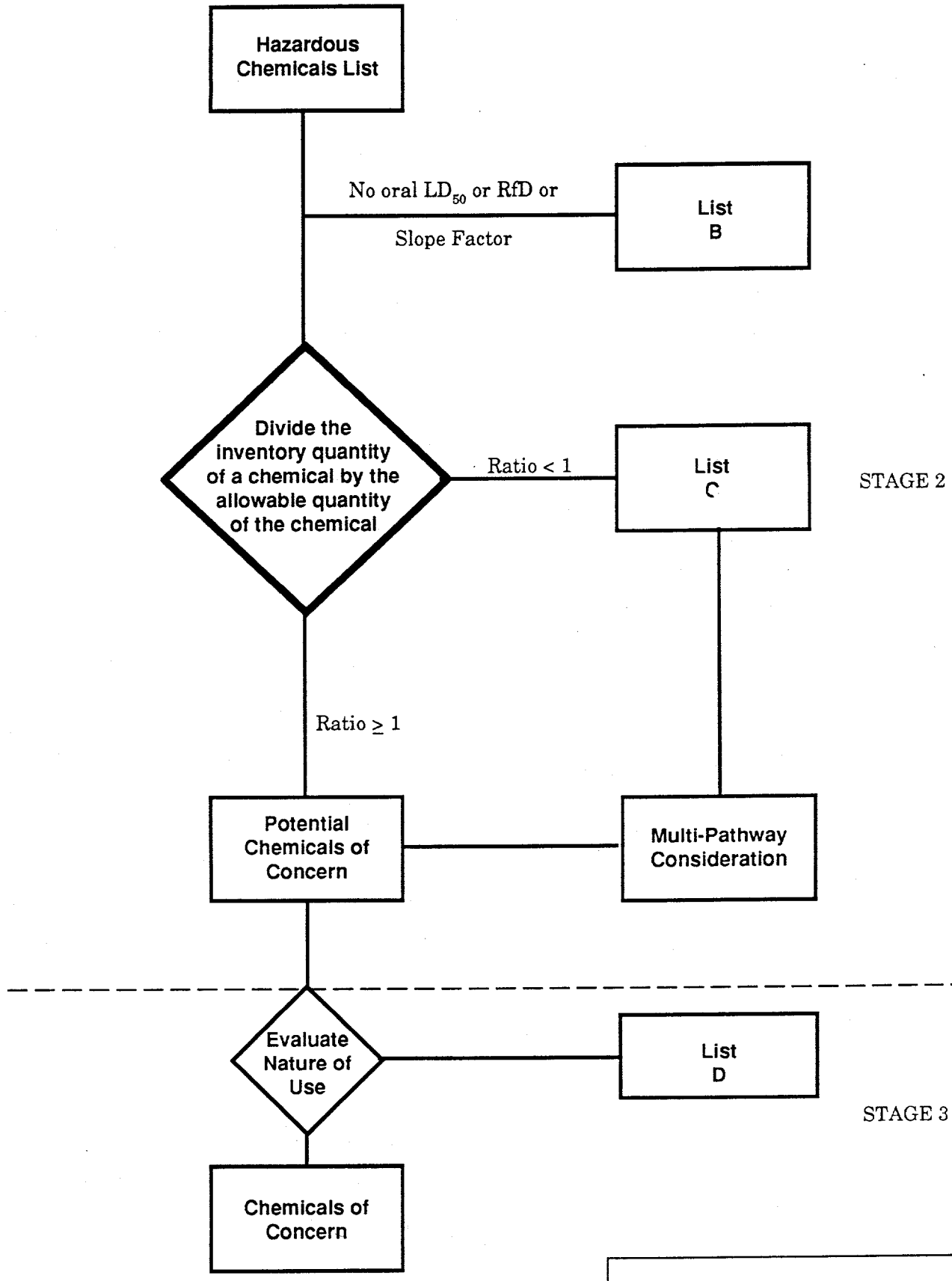
STAGE 1 SCREENING

FIGURE 3-2



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STAGE 2 AND 3 SCREENING

FIGURE 3-3

The purpose of Stage 1 screening (Figure 3-2) is to rapidly select those chemicals that should be the subject of further consideration based on readily available information. First, well-known toxicants, i.e., known or suspected human and animal carcinogens and chemicals with an assigned reference dose (RfD), are identified from the Priority 1 list and assigned to the Hazardous Chemicals List. Secondly, those chemicals that are known to have been released into the environment are identified and assigned to the Hazardous Chemicals List. Thirdly, those chemicals recognized as reproductive or developmental toxicants are identified. Finally, chemicals with inventory quantities in excess of 5 kg are identified from the remaining chemicals on the Priority 1 list and assigned to the Hazardous Chemicals List. Therefore, Stage 1 screening identifies those chemicals believed to be most likely to pose an off-site health hazard based on:

- Qualitative toxicity information, or
- Estimated quantity

The purpose of Stage 2 screening (Figure 3-3) is to make a rough estimate of whether the quantity of a chemical on-site is sufficient to pose an off-site health hazard. To perform this evaluation, quantitative toxicity information was located using various authoritative sources for the chemicals on the Hazardous Chemicals List. Using chemical release and dispersion estimates for drinking water and inhalation exposures that are likely to overestimate contaminant concentrations (conservative estimates), the maximum (or allowable) quantity of a chemical that can be present on-site without potentially posing an off-site health hazard is estimated. The reported inventory quantity of a chemical is then divided by the estimated maximum (or allowable) quantity. If the resulting ratio (quantity ratio) is greater than one, the chemical is assumed to be present in sufficient quantity to potentially pose an off-site health hazard. Conversely, if the quantity ratio is less than one, the chemical is probably not present in sufficient quantity to pose an off-site health hazard.

The purpose of Stage 3 screening is to evaluate chemicals selected in Stage 2 to determine the likelihood of their release to the environment based on their usage, quantity and location within the Rocky Flats facility.

3.2 Consistency of Reported Quantities

The identified screening process relies on toxicity and quantity to select chemicals for further consideration. Manufacturing processes and the usage rate of chemicals at the RFP are likely to have changed over the past 38 years. The quantities reported in the 1974 and 1988/89 inventories are compared in this section with the intent of evaluating the degree of change over time. In addition, inventory quantities are compared with reported annual usage rates for the purposes of evaluating the relationship between inventory and use.

Altogether, a total of 1,020 Priority 1 chemicals are common to both the 1974 and 1988/89 inventories. To compare the quantities on these two inventories, the 1988/89 inventory quantity has been divided by the 1974 inventory quantity for each chemical. A listing of the resulting ratios is presented in Appendix C. Some simple statistics associated with the ratios are helpful in characterizing the variability of the inventory quantities. The mean value of these ratios is 15, suggesting that, on average, the quantities in the 1988/89 inventory are fifteen times higher than those on the 1974 inventory. However, the standard deviation of the ratios is 326, suggesting that there is a very wide range of ratios, making broad generalizations about the quantity comparison difficult. There are many possible sources of differences in the reported quantities in the two inventories, including:

- Differences in the inventory methods,
- General change in facility size and production rates,

- Changes in production processes, or
- Trends in chemical substitution.

Figure 3-4 graphically summarizes the result of these quantity comparisons. As shown in the figure, 9% of the chemicals have almost identical inventory quantities and about 72% of the chemicals have a ratio between 0.1 and 10 (i.e., within an order of magnitude). About 19% of the chemicals have a ratio less than 0.1 or greater than 10. This comparison illustrates that while the reported inventory quantities of the Priority 1 chemicals at the RFP in 1974 and 1988/89 vary considerably, the majority differ by an order of magnitude or less.

As will be discussed further in Section 3.3.2, an estimate of the annual usage rate of each chemical is needed to evaluate the likelihood of a chemical posing a potential off-site health hazard. To calculate the potential relationship between the inventory quantity and annual use rates, the 1977 annual usage rates of 30 chemicals as reported in the 1980 Final Environmental Impact Statement are compared with the 1974 and 1988/89 inventory quantities. The result of these comparisons is summarized in Table 3-1. Out of the 50 comparisons, there are 8 instances where the ratios are substantially greater than 10, and 3 instances where the ratios lie between 10 and 15. In all other cases the ratio is 10 or less. Based on this limited comparison between annual usage rates and inventory quantities, a general assumption that the inventory quantity of a chemical represents approximately 10% of its annual usage is made for the purpose of the selection process.

3.3 Implementation of the Screening Process

The following sections describe in detail the three screening stages performed in this task. It is important to note that some modifications were made in the screening process

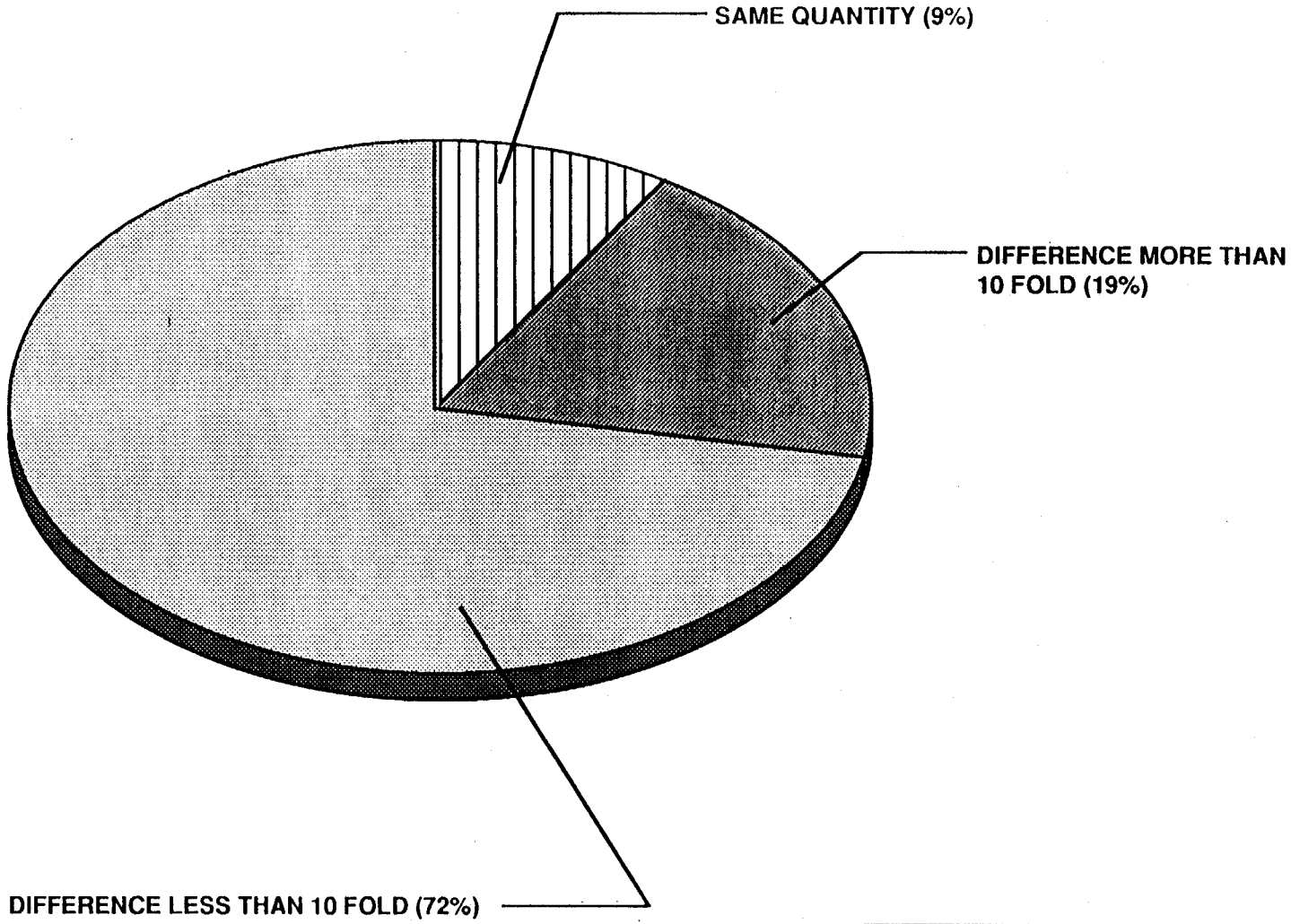

FIGURE 3-4
RATIOS OF INVENTORY QUANTITIES
(1988/1974)

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TABLE 3-1
COMPARISON OF REPORTED CHEMICAL QUANTITIES

Chemical Name	1974 Inventory Quantity (kg)	1988-89 Inventory Quantity (kg)	1977 Annual Usage Rate (kg/yr)	Ratio 1977/1974	Ratio 1977/1988-89
Acetic acid	244	138	11	0.05	0.08
Acetone	1,562	508	174	0.11	0.34
Carbon tetrachloride	12,502	7,058	31,697	2.54	4.49
Caustic potash	NR	1,315	94,455	NR	71.83
Caustic soda	NR	1,066	1,327	NR	1.24
Chlorine	870	NR	2,588	2.97	NR
Chromic acid	1	2	91	104.60	54.79
Chromium	8	1	50	6.67	52.80
Chromium oxide	3	4	NR	NR	NR
Chromic oxide	NR	NR	116	NR	NR
Cyclohexane	91	108	88	0.97	0.81
Ethylene glycol	22,349	692	NR	NR	NR
Freon 113	NR	2,006	NR	NR	NR
Freon 12	16	1,312	10,896	664.39	8.31
Freon 22	4,250	NR	1,348	0.32	NR
Freon 502	62	358	57	0.92	0.16
Hydrochloric acid	1,300	1,272	2,849	2.19	2.24
Hydrofluoric acid	1,487	41	253	0.17	6.22
Hydrogen peroxide	NR	1,836	692	NR	0.38
Isopropanol	333	693	22	0.07	0.03
Mercury	442	4	10	0.02	2.75
Methanol	NR	333	246	NR	0.74
Nitric acid	12,450	52,624	508,466	40.84	9.66
Nitrous oxide	NR	10	844	NR	84.40
Phosphoric acid	10,100	2,443	2,385	0.24	0.98
Sodium chromate	110	47	23	0.21	0.49
Sodium hydroxide	4,261	14,511	NR	NR	NR
Sodium nitrate	1,231	2,472	908	0.74	0.37
Sodium nitrite	63	46	45	0.71	0.98
Sulfuric acid	21,000	7,043	816	0.04	0.12
Toluene	300	93	3,020	10.07	32.41
111-Trichloroethane	22,763	1,749	23,711	1.04	13.56
Trichloroethylene	NR	140	1,824	NR	13.03
Xylene	128	98	33	0.26	0.34

Note: NR = not recorded

outlined in the Task 2 Plan. These modifications have resulted in a streamlining of the screening process. It is also important to note that two groups of chemicals were taken side-by-side through the screening process. The first group is those chemicals that appear on the 1988/89 inventory. In the event that a chemical is also listed on the 1974 inventory, the larger of the two inventory quantities was used when chemicals appeared on both lists. The second group is those chemicals that are unique to the 1974 inventory.

It also should be noted that numerous spelling and/or syntax errors are present in the 1988/89 and 1974 inventories, and some chemicals have been entered into the database under more than one synonym. In these cases, errors have been corrected and the quantities for individual entries are summed prior to Stage 1 screening. A complete record of which inventory quantities have been summed is presented in Appendix D.

In implementing the screening process, the following modifications to the Task Plan were made:

- The list of chemicals was divided into 3 priority groups as part of Task 1.

- To estimate the allowable quantity of a chemical for Stage 2 screening, it was necessary to locate some information regarding the toxicity of each chemical. In Task 1, approximately 2,500 chemicals were classified under Priority 1. For some chemicals, the quantitative toxicity information is not readily available or non-existent. U.S. EPA's Health Effects Assessment Summary Tables (HEAST) (USEPA, 1990a) are used as the sole information source to identify those Priority 1 chemicals with an established RfD or SF. A more thorough search of the available literature for toxicity information (e.g., oral LD_{50}s) was undertaken for those chemicals with an inventory quantity in excess of 5 kg. Based on the release and dispersion models described in greater detail in Section 3.3.2.3, it is estimated that a highly toxic chemical with an inventory quantity of 5 kg or less is not likely to pose an off-site health hazard.

- Based on the results of Stage 2 screening, it is estimated that 46 chemicals could pose a potential health risk to off-site individuals under either drinking water or inhalation exposure scenarios. Stage 3 screening, as proposed in the task plan, was not pursued since it is felt that the proposed quantitative ranking would imply greater precision in the selection process

than the available information could support. Instead, a modified Stage 3 screening process is employed to further evaluate the chemicals identified in Stage 2.

3.3.1 Stage 1 Screening

As described above, the purpose of Stage 1 is to rapidly identify those chemicals that can be removed from further consideration using readily available information. This section provides a detailed description of the steps taken to implement Stage 1.

3.3.1.1 Evaluation of Priority 2 List

The Task 1 report identified a large number of trade name products that were classified as Priority 2 substances. An initial effort was made to identify the individual constituents of Priority 2 substances having the greatest inventory quantities, e.g., those with 1988/89 inventory quantities greater than approximately 30 kg. The primary source of information was Material Safety Data Sheets (MSDSs) supplied to the RFP by the manufacturers. In addition, a chemical list produced during a revision of the RFP Hazardous Materials Manual in 1975 includes some information regarding the constituents of trade name products. No attempt was made to determine the composition of trade name products appearing only on the 1974 inventory since the availability of MSDSs for that period was expected to be limited.

The quality of information regarding chemical constituents of trade name products varies widely. In most cases, however, the major constituent(s) and the percent composition can be identified. The quantity of each product constituent (i.e., the quantity of the substance in the inventory multiplied by the percentage of that constituent in the substance) can generally be established using information provided in the MSDS. When chemicals

identified as being present in products on the Priority 2 List were already listed as Priority 1, the chemical quantity associated with the product was added to the Priority 1 inventory quantity. If the chemical constituent was not already listed on the inventory, it was classified as a Priority 1 or 3 chemical (as described in Task 1) and added to the appropriate list. The revised quantity for each Priority 1 chemical is then used in the screening process. Those Priority 2 substances for which only qualitative composition information is available were treated in the following manner:

- If a Priority 2 trade name product contains only one major chemical, it is conservatively assumed that the quantity of the chemical is equal to the quantity of the product.
- If a Priority 2 trade name product contains several constituents, no assumptions were made and no changes were made to the Priority 1 List.

With the exception of two substances, constituent information of all Priority 2 substances with 1988/89 inventory quantities greater than 300 kg was located. The Priority 2 substances for which composition information was identified are presented in Table 3-2.

The above described changes resulted in a Modified Priority 1 list, which was carried through the remainder of Stage 1 of the screening process.

3.3.1.2 Subdivision of Priority 1 Chemicals

The chemicals on the modified Priority 1 list have been placed into the following groups:

- Chemicals with carcinogenic potency slope factors,
- Chemicals with noncarcinogenic reference doses,

TABLE 3-2

PRODUCTS REPORTED ON THE 1988/89 PLANT INVENTORY AND THEIR PRIMARY CHEMICAL CONSTITUENTS

PRODUCT NAME	PRIMARY CHEMICAL CONSTITUENT (%)	TOTAL PRODUCT AMOUNT (KG)	ADJUSTED AMOUNT FOR EACH COMPONENT (KG)
Anokleen	Sodium hydroxide (55%)	45	25
Bleach	Sodium hypochlorate (NA)	75	NA
BP Dielectric 200	Light distillate C12 to C15 (60-70%)	719	503
Cimstar 40 Concentrate	Water	387	NA
Coil Rite	NA	46	NA
Conap S1 Solvent	Toluene (complex mixture) (NA)	49	NA
Conquest	NA	208	NA
Coop Lubricant Solvents	Saturated paraffinic distillate (>95%)	397	397
Corrosion Inhibitor 2020 (Betz 2020)	NA	387	NA
Corrosion Inhibitor 2040 (Betz 2040)	Potassium Hydroxide (NA)	194	NA
	Phosphonic Acid (NA)	194	NA
	1-H-Benzotriazole (NA)	194	NA
DAG 41	Mineral Spirits (90%)	66	59
DDO-19	Refined Petroleum Oils (100%)	308	308
DDO-20	Paraffinic Distillate (100%)	644	644
De-Solv-it	Petroleum Distillate (100%)	855	855
Dearborn 537	Sodium nitrate (<15%)	246	37
	Sodium borate (<10%)	246	25
Dequest 2000	Aminotri(methylenephoshonic acid) (50%)	544	272
Dielectric 30	Petroleum Hydrocarbon Distillate (100%)	625	625
Dope and Laoquer Thinner (266D)	Isobutyl Acetate (>9%)	3.7	0.33
	Toluene (>9%)	3.7	0.33
	Methyl Ethyl Ketone (>9%)	3.7	0.33
Dow Corning 200 Fluid	Silicone (100%)	147	147
Dow Corning 550 Fluid	Silicone (100%)	608	608
Dowflake	Calcium chloride (79%)	2835	2240
Drierite	Calcium sulfate (97%)	61	59
Dykem Remover and Thinner	Denatured alcohol (80%)	143	114
	Butyl acetate (20%)	143	29
Ebonol SS-48	Caustic soda (>80%)	56	45
ELnic 100 RP-1	Nickel sulfate (39%)	72	28
	Sodium hypophosphite, ammonium bicarbonate (NA)	45	NA
Endox 117	Caustic soda (>60%)	45	27
Enplate Conditioner 474	Chromic Acid (>95%)	45	43
Enstrip Au-78	Potassium cyanide (15%)	45	7
Foam Trol 205	NA	416	NA
Formula "A" Paint Remover	Dichloropropane	1185	NA
	Isopropanol (<20%)	1185	237
	Methylene Chloride (<50%)	1185	593
	Ammonium Hydroxide	1185	NA
	Naphtha hydrocarbon fraction	1185	NA
Freon TF Solvent	1,1,2-Trichloro-1,2,2-Trifluoroethane (100%)	9406	9406
Fybr Fluff Fabrilife	Ammonium Chloride (25%)	315	79
Fyrquel	Tri-aryl phoshate (100%)	208	208
Genesolv D	Trichlorotrifluoroethane (100%)	572	572
Genetron 113	Trichlorotrifluoroethane (100%)	90	90
Geotex 30	Heavy paraffinic petroleum distillates (95-99%)	2082	2082
Glyptal	Xylene (34%)	46	16
GP 811	Xylene (45%)	151	68
	Lead (26%)	151	39
Halon 1211	Bromochlorodifluoromethane (100%)	1998	1998
Ionifixeau	Acrylic emulsion/titanium oxide (42%)	68	29
Liquid Heat 810	Barium chloride (30%)	363	109
Mariko Low Foam	Sodium xylene sulfonate (NA)	4136	NA
	Tetrapotassium pyrophosphate (NA)	4136	NA
Metal Conditioner	Glycol ethers (butylcellosolve also called 2-Butoxyethanol) (2%)	56	1
Microsol E-1008-Blue	PVC Resins (54%)	363	196
	Plasticizers (38%)	363	138
Misty Take Off Stripper	Sodium Silicate (2.9%)	387	11
	Butyl Cellosolve (3.9%)	387	15
Mobil Met S122	Refined mineral oils (>80%)	208	166
Mobil Vactra 2	Refined mineral oils (>95%)	721	721
Mobil Vactra 4	Refined Mineral Oils (>95%)	511	511
Mogul Ag-471	Alkyl dimethyl benzyl ammonium chloride (3%)	56	2
Mogul WS-102	Sodium hydroxide (10%)	323	32
Monoplex DOS	Di-2-ethylhexyl adipate (100%)	54	54
Nalco 2536 Corrosion Inh.	Sodium Nitrite (10%),	650	65
	Sodium Tetraborate (10%)	650	65
Nalco 2818 Microbiocide	Sodium hypochlorite (8%)	227	18
Nalco 39M Corrosion Inh.	Borates/nitrates/silicates/nitrites/mercaptobenzothiazole (NA)	189	NA
Neutrameen	Diethylaminoethanol (NA)	208	NA
Norpar 12	Paraffins, C11-C12 (100%)	98	98
Nuocure 28 Catalyst	Stannous 2-ethylhexanoate (100%)	129	129
Oakite Aluminum Cleaner	Hydroxypropyl ethylenediamine (<10%)	5210	521
Oakite Drycid	Sulfamic acid (>95%)	181	181
Pierce II	Sodium Hydroxide (15%)	408	61

PRODUCTS REPORTED ON THE 1988/89 PLANT INVENTORY AND THEIR PRIMARY CHEMICAL CONSTITUENTS

PRODUCT NAME	PRIMARY CHEMICAL CONSTITUENT (%)	TOTAL PRODUCT AMOUNT (KG)	ADJUSTED AMOUNT FOR EACH COMPONENT (KG)
Plastidip	1,1,1-Trichloroethane (24%)	46	11
	Toluene (14%)	46	6
Platinum Plus	Formaldehyde/Dibutylphthalate (<1%)	606	NA
Polymer 1195	NA	1320	NA
Pro 3 Fountain Solution	Ethylene glycol monobutyl ether (10%)	41	4
Purifloc A23 Flocculant	Hydrolyzed polyacrylamide (NA)	4150	NA
	Sodium carbonate (NA)	4150	NA
	Sodium sulfate/sodium sulfite (NA)	4150	NA
Pydraul 312C (PLM "649")	Mixture of alkyl aryl phosphates	38	NA
	Triphenyl phosphate	38	NA
Quenchtex B	Heavy paraffinic petroleum distillates (95-99%)	208	208
Racon 11	Trichlorofluoromethane (Freon 11)	3814	3814
Racon 12	Dichlorodifluoromethane [Freon 12] (100%)	299	299
Racon 22	Chlorodifluoromethane (100%)	313	313
Reversal Bath and Replenesher	Sodium propionate (20%)	56	11
RPM 2001	2-Butoxyethanol (<60%)	323	194
RTV-21	Ethylsilicate (5%)	49	2
Safety Cool 831	Monoethanolamine (20%)	416	83
Sel-Rex Cubath M-HY 70/30	Sulfuric acid (5%)	208	10
Servac	Phosphoric Acid (60%)	337	202
Servant	Dichloro-s-triazine-2,4,6-trione sodium salt (35%)	318	111
Solka Floc	Cellulose (100%)	340	340
Solvent III	1,1,1-Trichloroethane (95.5%)	1157	1105
Solvent-Mineral Spirits	Mineral Spirits (<100%)	416	416
Sunquench 1021	Light paraffinic distillate and residual oil gas (NA)	2290	NA
	Residual oil gas (NA)	2290	NA
Thinner (T-143)	Methyl isobutyl ketone (51%)	38	19
	Isopropanol (49%)	38	19
Thinner Dope and Laquer	Isobutyl Acetate (31%)	168	52
	Toluene (20%)	168	34
	Methyl Ethyl Ketone (15%)	168	25
Thuban SAE 140	Petroleum oils (50-65%)	71	46
Transformer Oil 600	Light naphthenic petroleum distillate (99%)	322	322
Transultex A	Light naphthenic petroleum distillates (35-49%)	2460	1205
	Heavy paraffinic petroleum distillates (35-49%)	2460	1205
Transultex F	Heavy paraffinic petroleum distillates (80-95%)	2139	2032
Trim Rinse	Amine (NA)	238	NA
Trim Sol	NA	3714	NA
Turco 4104	Ammonium bifluoride (20%)	1249	250
	Acetic Acid (15%)	1249	187
Turco 4215	Sodium tetraborate pentahydrate (50%)	67	34
	Sodium tripolyphosphate (35%)	67	23
Turco 5580-G	Perchloroethylene (75%)	38	29
Turco Decon 4324	Ammonium bicarbonate (NA)	100	NA
Turco Nitradd	Ammonium bifluoride (20%)	265	53
	Acetic acid (15%)	265	40
Udylite Bry-cad 153	Sodium cyanide (80%)	46	37
	Cadmium oxide (20%)	46	9
Unichrome 1081	Chromic Acid (>80%)	45	36
Unichrome CF-500	Chromic acid (40%)	49	20
Unisyn 6085	Organic esters (NA)	208	NA
Ursa Super Plus 20	Heavy paraffinic petroleum distillates (80-95%)	208	198
Ursa Super Plus 30	Heavy paraffinic petroleum distillates (80-95%)	208	198
Varsol 1	C7-C10 Hydrocarbons (83%)	537	446
ZL-22A Zyglo Penetrant	Petroleum Distillates (<50%)	28	14
Zyglo Penetrant ZL-30A	Alkyl Benzene (100%)	870	870

Note: NA = Not Available

- Reproductive and developmental toxicants, and
- Chemicals that are known to have been released into the environment surrounding the RFP.

It should be noted that a chemical can be placed in one or more of the groups listed above. Chemicals placed in any one of the these groups become part of the Hazardous Chemicals List and are evaluated in Stage 2. The Reproductive and Developmental Toxicants List is presented in Appendix E.

Based on several remedial investigation reports, it is known that a number of chemicals were detected in the soil or groundwater at RFP. Chlorinated solvents, and metals were detected at the 881 Hillside, East Trenches, 903 Pad and Solar Ponds. Acetone, cyanide and nitrates were also detected at a number of locations. A listing of chemicals detected in the environment can be found in on page 27 and 28 of the Task 1 report.

Most of the chemicals detected in environmental media are included in the Hazardous Chemicals List. A few common ions like: nitrates, calcium, iron, potassium and sodium, are not included. It is believed that even if these ions were released into the environment in significant quantities, they are not likely to pose an off-site health hazard.

Chemicals not falling in one of the four groups identified above are further subdivided as follows:

- Chemicals with 1988/89 and 1974 inventory quantities less than 5 kg are placed on list A (Figure 3-2). Based on the release and dispersion models described in greater detail in Section 3.3.2.3, it is estimated that a highly toxic chemical with an inventory quantity of 5 kg or less is not likely to pose an off-site health hazard. The list A chemicals are presented in Appendix F.

- Those chemicals with 1988/89 or 1974 inventory quantities greater than 5 kg are included in the Hazardous Chemicals List (Figure 3-2).

The complete Hazardous Chemicals List is presented in Appendix G.

3.3.2 Stage 2 Screening

This section provides a detailed description of the steps required to implement the Stage 2 screening of the Hazardous Chemicals List. As with Stage 1, two groups of chemicals, those on the 1988/89 inventory and those unique to the 1974 inventory, were evaluated. For the chemicals on the Hazardous Chemicals List that do not have a SF or RfD, several authoritative sources were searched for available toxicity information (specifically, an oral LD_{50}). Chemicals having no published SF, RfD or oral LD_{50} values are placed on List B (Figure 3-3) and are presented in Appendix H. Some acids in List B that have large reported inventory quantities are qualitatively evaluated in Stage 3 screening.

3.3.2.1 Adjustments of Chemical Quantities

The bulk of the Stage 2 screening procedure is based on a chemical's toxicity (e.g., slope factor) and its inventory quantity. The toxicity criteria are used to determine an "allowable" quantity, which is then compared to the quantity reported in the inventory. In some cases a single toxicity value, and therefore a single allowable quantity, has been assigned to a group or class of compounds, e.g., those compounds that contain a common element (metal). For example, hexavalent chromium, a known human carcinogen by the inhalation route, occurs in a variety of chromium compounds (e.g., chromic acid, potassium dichromate). Therefore, the allowable quantity calculated based on the hexavalent chromium slope factor should be compared against the total quantity of all hexavalent chromium compounds. Inventory quantities of the following elements were

summed prior to comparison with the allowable quantity calculated based on the toxicity of the elemental form:

- arsenic
- barium
- beryllium
- boron
- cadmium
- chromium
- lead
- manganese
- mercury
- nickel
- selenium
- tin

For silver, zinc, and vanadium, the compounds silver cyanide, zinc cyanide and vanadium pentoxide have unique toxicity criteria and were therefore treated separately. All other compounds for these elements were summed and assigned the toxicity of the elemental form. For aluminum, antimony, lithium, and magnesium, there are no toxicity criteria for the elements, rather the toxicity criteria are based on specific compounds. In this case, the toxicity values for specific compounds were used to evaluate the corresponding elemental group. No toxicity criteria were found for sodium and potassium, and the majority of sodium and potassium compounds have individual toxicity criteria. As such, sodium and potassium compounds were treated individually.

There are five other instances where inventory quantities were summed. First, all of the Aroclors were considered together, since the toxicity criteria for Aroclor 1260 is applied to all of them. Similarly the inventories for quantities of all polyaromatic hydrocarbons (PAHs) were summed, and the toxicity for benzo(a)pyrene is used to evaluate the group in Stage 2. Third, there were two entries on the inventory for tetrachloroethane that did

not identify the specific isomer. As such, these quantities were conservatively added to the quantity for 1,1,2,2-tetrachloroethane, which is classified as a carcinogen. Fourth, the inventory quantities of hydrazine and hydrazine sulfate were summed. Lastly, a single entry on the inventory, Toluene T-324, was included with the quantity for toluene. The total quantities for each group are presented in Appendix I.

3.3.2.2 Exposure Scenarios

In Stage 2 of the screening process, quantitative toxicity criteria and inventory quantity information are used to predict whether a sufficient quantity of a chemical is likely to be present at the RFP to pose a potential off-site health hazard. This is accomplished by determining the maximum allowable quantity of a chemical that can be present at the site without posing an off-site health hazard based on conservatively designed exposure scenarios. Two exposure scenarios, inhalation of vapors or particulates and ingestion of drinking water, are included in the screening procedure.

3.3.2.2.1 Inhalation Exposure

The maximum allowable quantity of a chemical that can be present at RFP without posing a potential inhalation hazard can be determined in three steps, each of which are described below.

The first step is to calculate the maximum annual average air concentration of a chemical (mg/m^3) that can be inhaled by an off-site individual without adverse health effects. This calculation is based on the maximum allowable lifetime average daily dose as defined by a certain level of risk (carcinogens) or exposure (noncarcinogens).

The maximum allowable lifetime average daily dose for a carcinogen is derived from the carcinogenic potency slope factor (SF) and a defined level of risk. By using the 95 percent upper confidence limit, this estimate of carcinogenic response is conservative in that it usually over-estimates the actual risk posed by the chemical. For the purposes of this screening procedure, an excess cancer risk of one in one million (1×10^{-6}) over a lifetime was used as the cut-off point. Using an excess cancer risk of 1×10^{-6} and assuming a SF of 10 $(mg/kg\text{-}day)^{-1}$, the maximum allowable lifetime average daily dose of a carcinogen can be calculated as follows:

$$\text{Maximum Allowable Lifetime Average Daily Dose} = \frac{1 \times 10^{-6}}{10\ (mg/kg\text{-}day)^{-1}}$$

$$= 1 \times 10^{-7}\ mg/kg\text{-}day$$

For noncarcinogens, the maximum allowable lifetime average daily dose is simply equal to the reference dose (RfD). When a chemical does not have a RfD, a "derived RfD" can be estimated by multiplying the oral LD_{50} (mg/kg) of the chemical by a factor of 1×10^{-5} (Layton, 1987).

In a few instances where an oral LD_{50} cannot be obtained for a chemical, the lowest toxic dose (TD_{LO}) is used instead. If a TD_{LO} is based on animal data, the "derived RfD" is estimated by multiplying the TD_{LO} (mg/kg) by a factor of 1×10^{-5}. However, if TD_{LO} is based on human data, the "derived RfD" is estimated by multiplying the TD_{LO} (mg/kg) by a factor of 1×10^{-4}. This is because a safety factor of 10 is usually used to compensate for the potential difference in sensitivity between laboratory animals and humans.

The maximum allowable annual average air concentration can then be determined using the following equation:

$$\text{Dose} = \frac{[\text{Air}] \times BR}{BW} \quad \text{or} \quad [\text{Air}] = \frac{\text{Dose} \times BW}{BR}$$

Where:

Dose = Maximum allowable lifetime average daily dose (as described above; mg/kg-day)

[Air] = Maximum allowable annual average air concentration (mg/m^3)

BR = Breathing rate (m^3/day)

BW = Body weight (kg)

Assuming an allowable lifetime average daily dose of 1×10^{-7} mg/kg-day (see above), an average adult body weight of 70 kg, and an adult daily breathing rate of 20 m^3/day (U.S. EPA, 1990a), the allowable annual average air concentration equals:

$$[\text{Air}] = \frac{1 \times 10^{-7} \text{ mg/kg-day} \times 70 \text{ kg}}{20 \text{ m}^3/\text{day}}$$

$$= 3.5 \times 10^{-7} \text{ mg/m}^3$$

The second step in defining an "allowable quantity" is to relate the maximum allowable air concentration to an emission rate. For the purposes of this screening procedure, a screening-level air dispersion model approved by the U.S. EPA, SCREEN, was used. In using the SCREEN model, several conservative (i.e. assumption likely to overestimate contaminant concentrations) input parameters and assumptions were used regarding the emission condition and the location of the receptor. Conservative parameters were assigned to the source type, stack height, stack exit velocity and stack exit temperature (Appendix J). It was also conservatively assumed that the receptor was at the downwind property line of the RFP (1,800 m away from the assumed emission source) 24 hours per

day, 365 days per year. Based on a unit emission rate of 1 g/sec (31,536 kg/year), the SCREEN model predicted a maximum one-hour air concentration of 271.9 $\mu g/m^3$ at the receptor location under worst-case meteorological conditions. The complete results from the SCREEN model are provided in Appendix J. The maximum one-hour air concentration can then be used to develop an estimate of average annual air concentration by multiplying by 0.1 (CARB, 1987). Thus, an emission rate of 31,536 kg/yr is required to produce a maximum annual average air concentration of 27.2 $\mu g/m^3$, 1,800 m away from the emission source.

This relationship between the maximum allowable annual average air concentration and the corresponding emission rate can be used to determine the emission rate for any chemical based on its SF or RfD. For example, using the previous example of a SF equal to 10 $(mg/kg\text{-}day)^{-1}$, the maximum allowable annual average air concentration was shown to be 3.5×10^{-7} mg/m^3. The corresponding emission rate can be determined as follows:

$$\frac{31536 \text{ kg/yr}}{27.2 \ \mu g/m^3} = \frac{\text{Emission Rate}}{3.5 \times 10^{-7} \text{ mg/m}^3 \times 1000 \ \mu g/mg}$$

or

$$\text{Emission Rate} = \frac{31536 \text{ kg/yr} \times 3.5 \times 10^{-7} \text{ mg/m}^3 \times 1000 \ \mu g/mg}{27.2 \ \mu g/m^3}$$

$$= 0.41 \text{ kg/yr}$$

By simple proportion, if the SF of a carcinogen is decreased by a factor of 10, the corresponding "allowable" emission rate would be increased by a factor of 10. Thus, a carcinogen with a slope factor of 1 $(mg/kg\text{-}day)^{-1}$ would have a maximum allowable dose equal to 1×10^{-6} mg/kg-day, a maximum allowable air concentration equal to 3.5×10^{-6} mg/m^3 and a corresponding allowable emission rate of 4.1 kg/yr. This relationship can

be extended to noncarcinogens as well. For a chemical with a RfD of 1×10^{-4} mg/kg-day, the maximum allowable air concentration would be 3.5×10^{-4} mg/m^3, and a corresponding allowable emission rate of 410 kg/yr. The emission rates for carcinogens and non-carcinogens with different SFs and RfDs were similarly calculated and are presented in Tables 3-3 and 3-4.

The third and final step is to relate the emission rate of a chemical to its inventory quantity. For the purposes of this screening process, it was assumed that the inventory quantities represent 10% of the annual usage rate. This assumption is supported by a comparison of 1977 usage rates reported by the RFP in the 1980 Final Environmental Impact Statement with either 1974 or 1988/89 inventory quantities. In most cases, the inventory quantity represented 10% or more of the usage quantity (Section 3.2) making this a reasonable estimate. Lastly, it was assumed that 25% of all chemicals used are released into the environment. This is likely an overestimate for the majority of the chemicals considered, since physical state (especially for non-volatiles and insolubles), means of storage (e.g., stored in bottles or vials) and usage make 25% release unlikely. The only exception may be volatile compounds, which under certain circumstances, may be eventually released entirely to the environment.

The allowable inventory quantity of a chemical is calculated from the allowable emission rate as follows:

$$\text{Allowable inventory quantity (kg)} = \frac{\text{Allowable emission rate (kg/yr)}}{0.25 \times 10}$$

For example, if the allowable emission rate of a chemical is estimated to be 410 kg/yr, then its corresponding allowable inventory quantity would be 160 kg as shown in Table 3-3 and 3-4.

TABLE 3-3

INHALATION EXPOSURE (CARCINOGENIC EFFECT)

It is conservatively assumed that the receptor is at the fence line, exposed 24 hr/day and 365 days/year. The slope factor is defined as the increase of cancer risk over a life-time per unit dose in mg/kg/day.

Increase of Cancer Risk	Slope Factor $(mg/kg/day)^{-1}$	Concentration in Inhaled Air (mg/m^3)	Allowable Emission Rate (kg/yr)	Allowable Inventory Quantity (kg)
1×10^{-6}	100,000	3.5×10^{-11}	4.1×10^{-5}	1.6×10^{-5}
1×10^{-6}	10,000	3.5×10^{-10}	4.1×10^{-4}	1.6×10^{-4}
1×10^{-6}	1,000	3.5×10^{-9}	4.1×10^{-3}	1.6×10^{-3}
1×10^{-6}	100	3.5×10^{-8}	4.1×10^{-2}	1.6×10^{-2}
1×10^{-6}	10	3.5×10^{-7}	4.1×10^{-1}	1.6×10^{-1}
1×10^{-6}	1	3.5×10^{-6}	4.1×10^{0}	1.6×10^{0}
1×10^{-6}	0.1	3.5×10^{-5}	4.1×10^{1}	1.6×10^{1}
1×10^{-6}	0.01	3.5×10^{-4}	4.1×10^{2}	1.6×10^{2}
1×10^{-6}	0.001	3.5×10^{-3}	4.1×10^{3}	1.6×10^{3}
1×10^{-6}	0.0001	3.5×10^{-2}	4.1×10^{4}	1.6×10^{4}

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TABLE 3-4

INHALATION EXPOSURE (NON-CARCINOGENIC EFFECT)

It is conservatively assumed that the receptor was at the fence line and exposed 24 hr/day. The RfD is defined as the amount of a chemical to which an individual can be exposed on a daily basis over a lifetime without appreciable health risk.

RfD (mg/kg/day)	Concentration in Inhaled Air (mg/m^3)	Allowable Emission Rate (kg/yr)	Allowable Inventory Quantity (kg)
1×10^{-5}	3.5×10^{-5}	4.1×10^{1}	1.6×10^{1}
1×10^{-4}	3.5×10^{-4}	4.1×10^{2}	1.6×10^{2}
1×10^{-3}	3.5×10^{-3}	4.1×10^{3}	1.6×10^{3}
1×10^{-2}	3.5×10^{-2}	4.1×10^{4}	1.6×10^{4}
1×10^{-1}	3.5×10^{-1}	4.1×10^{5}	1.6×10^{5}
1	3.5×10^{0}	4.1×10^{6}	1.6×10^{6}
$1 \times 10^{+1}$	3.5×10^{1}	4.1×10^{7}	1.6×10^{7}

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3.3.2.2.2 Drinking Water Exposure

Two drinking water sources are within 5 miles of the RFP. For the purposes of this screening process, it was assumed that chemicals from RFP could be released directly into the Great Western Reservoir. This reservoir was chosen over Standley Lake, because it is closer to the RFP, has traditionally received any plant discharges and has a smaller capacity. This is a conservative assumption, since for a given quantity of release, discharge to a smaller body of water would result in a higher water concentration. It was also assumed that chemicals were released in a single event and were fully mixed in the reservoir, although it is more likely that any discharge would be gradual and maintained over a period of time. As such, the actual chemical concentrations in the Great Western Reservoir would probably be lower than those assumed in this scenario.

The maximum allowable quantity of a chemical that can be present at the RFP without posing a potential drinking water ingestion hazard is determined in a similar manner as described above for the inhalation scenario. First, the maximum allowable dose is calculated from a defined level of risk (carcinogens) or exposure (noncarcinogens). Second, the corresponding drinking water concentration is determined using conservative exposure assumptions. Lastly, the allowable drinking water concentration is related to the maximum allowable inventory quantity. The following example illustrates each of the three steps.

As described above, the maximum allowable lifetime average daily dose for a carcinogen with a slope factor of 10 is equal to 1×10^{-7} mg/kg-day. The corresponding drinking water concentration can be determined using the following equation:

$$\text{Dose} = \frac{[\text{Water}] \times \text{IR}}{\text{BW}}$$

or

$$[\text{Water}] = \frac{\text{Dose} \times \text{BW}}{\text{IR}}$$

Where:

Dose = Maximum allowable lifetime average daily dose (mg/kg-day)

[Water] = Annual average drinking water concentration (mg/L)

IR = Water ingestion rate (L/day)

BW = Body weight (kg)

Assuming an allowable lifetime average daily dose of 1×10^{-7} mg/kg-day, an average adult body weight of 70 kg, and a water ingestion rate of 2 L/day (U.S. EPA, 1990a), the allowable annual average drinking water concentration is:

$$[\text{Water}] = \frac{1 \times 10^{-7} \text{ mg/kg-day} \times 70 \text{ kg}}{2 \text{ L/day}}$$

$$= 3.5 \times 10^{-6} \text{ mg/kg-day}$$

As before, if the SF is decreased by a factor of 10, the corresponding allowable annual average drinking water concentration would be increased by a factor of 10. This relationship also applies to non-carcinogens. For a chemical with an RfD of 1×10^{-4} mg/kg-day, the allowable annual average drinking water concentration would be 3.5×10^{-3} mg/L.

The next step is to relate the allowable annual average drinking water concentration to the amount of chemical that must be released into the Great Western Reservoir at one time to achieve that concentration. According to the Rocky Flats Plant Site Final

Environmental Impact Statement (DOE, 1980), the capacity of the Great Western Reservoir is 4.0×10^9 L, and over 70% of this volume of water is consumed annually. If it is assumed that the annual quantity of a chemical released is fully mixed into Great Western Reservoir at one time, an upper limit on the annual average drinking water concentration can be determined from:

$$[\text{Water}] = \frac{\text{Released Quantity}}{\text{Volume in Reservoir}}$$

This results in the following estimate of the release quantity that will keep annual average drinking water concentration below the allowable level:

$$\text{Released Quantity} = [\text{Water}] \times \text{Volume in Reservoir}$$

Assuming an allowable annual average drinking water concentration of 3.5×10^{-3} mg/L (see above), the corresponding released quantity equals:

$$\text{Released Quantity} = 3.5 \times 10^{-3} \text{ mg/L} \times 4.0 \times 10^9 \text{ L}$$

$$= 1.4 \times 10^7 \text{ mg or } 14 \text{ kg}$$

Given that the water is treated as it leaves the Great Western Reservoir (e.g., alum precipitation, pH adjustment, polymer coagulation and filtration) and that the concentration of a chemical in the reservoir will be decreased due to adsorption or absorption to the sediments, biodegradation, photo-oxidation, evaporation, or dilution due to inflows and outflows, it is reasonable to assume that these processes decrease the chemical concentrations in the water by a factor of 10. Therefore, the allowable release quantity associated with a drinking water concentration of 3.5×10^{-3} mg/L is 140 kg/yr.

The allowable release quantities for carcinogens and noncarcinogens with different SFs and RfDs are presented in Tables 3-5 and 3-6.

The final step is to relate the released quantity of a chemical to its inventory quantity. As described for the inhalation scenario, it was again assumed that the inventory represents 10% of the annual usage rate, and that 25% of all chemicals used are released into the environment. Therefore, for a released quantity of 140 kg/yr, the corresponding inventory quantity is equal to 56 kg. Allowable inventory quantities for carcinogens and noncarcinogens with different SFs and RfDs are presented in Tables 3-5 and 3-6.

3.3.2.3 Quantity Limit for Stage 1 Screening

As discussed in Section 3.3.1.2, an inventory quantity of 5 kg was used to eliminate some Priority 1 compounds that do not have an established SF or RfD from further consideration. The purpose of the cut-off quantity was to reduce the number of chemicals that were to be investigated for toxicity information. Given that some chemicals were eliminated without any consideration of their toxicity, it is important that the cut-off quantity be very conservative (i.e. tend to include compounds that are not a hazard rather than exclude ones that might be). The 5 kg cut-off quantity was selected using the inhalation and ingestion of drinking water exposure scenarios described above and some additional assumptions.

As stated previously, the cut-off quantity was used only for compounds not having an established SF or RfD. For those chemicals that are environmentally important and recognized as highly toxic, it is likely that the majority of them are recognized as such by the U.S. EPA and are included in the Health Effects Assessment Summary Tables (USEPA, 1990a). However, to select a cut-off quantity related to toxicity for those chemicals without a SF or RfD, oral LD_{50}s were evaluated.

TABLE 3-5

DRINKING WATER EXPOSURE (CARCINOGENIC EFFECT)

It is conservatively assumed that the receptor obtains all his/her drinking water from a contaminated source.

Increase of Cancer Risk	Slope Factor $(mg/kg/day)^{-1}$	Concentration in Drinking Water (mg/l)	Allowable Release Rate (kg/yr)	Allowable Inventory Quantity (kg)
1×10^{-6}	100,000	3.5×10^{-10}	1.4×10^{-5}	5.6×10^{-6}
1×10^{-6}	10,000	3.5×10^{-9}	1.4×10^{-4}	5.6×10^{-5}
1×10^{-6}	1,000	3.5×10^{-8}	1.4×10^{-3}	5.6×10^{-4}
1×10^{-6}	100	3.5×10^{-7}	1.4×10^{-2}	5.6×10^{-3}
1×10^{-6}	10	3.5×10^{-6}	1.4×10^{-1}	5.6×10^{-2}
1×10^{-6}	1	3.5×10^{-5}	1.4×10^{0}	5.6×10^{-1}
1×10^{-6}	0.1	3.5×10^{-4}	1.4×10^{1}	5.6×10^{0}
1×10^{-6}	0.01	3.5×10^{-3}	1.4×10^{2}	5.6×10^{1}
1×10^{-6}	0.001	3.5×10^{-2}	1.4×10^{3}	5.6×10^{2}
1×10^{-6}	0.0001	3.5×10^{-1}	1.4×10^{4}	5.6×10^{3}

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TABLE 3-6

DRINKING WATER EXPOSURE (NON-CARCINOGENIC EFFECT)

It is conservatively assumed that the receptor obtains all his/her drinking water from a contaminated source.

RfD (mg/kg/day	Concentration in Drinking Water (mg/l)	Allowable Release Rate (kg/yr)	Allowable Inventory Quantity (kg)
1×10^{-5}	3.5×10^{-4}	1.4×10^{1}	5.6×10^{0}
1×10^{-4}	3.5×10^{-3}	1.4×10^{2}	5.6×10^{1}
1×10^{-3}	3.5×10^{-2}	1.4×10^{3}	5.6×10^{2}
1×10^{-2}	3.5×10^{-1}	1.4×10^{4}	5.6×10^{3}
1×10^{-1}	3.5×10^{0}	1.4×10^{5}	5.6×10^{4}
1	3.5×10^{1}	1.4×10^{6}	5.6×10^{5}
1×10^{1}	3.5×10^{2}	1.4×10^{7}	5.6×10^{6}

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A chemical with an oral LD_{50} of 10 mg/kg or below is considered extremely toxic (Klaasen, 1986). Based on a LD_{50} of 10 mg/kg, the derived RfD is equal to 1×10^{-4} mg/kg-day (Layton, 1987). Using the tables created in the previous section, the required inventory quantities associated with the inhalation and drinking water scenarios are 164 kg and 56 kg, respectively. Using the lower value of 56 kg and adding an additional safety factor of 10, the cut-off inventory quantity is 5.6 kg. Therefore, based on conservative screening exposure analysis for inhalation and drinking water ingestion and the stated release assumptions, extremely toxic chemicals that do not have an established toxicity criteria and are present in inventory quantities of 5 kg or less are unlikely to pose an off-site health hazard.

3.3.2.4 Comparison of Actual with Allowable Inventory Quantities

Chemicals on the Hazardous Chemicals List are separated into two groups, carcinogens and noncarcinogens. Benzene will be used as an example to show how carcinogens are evaluated in this screening process. According to EPA's HEAST document (U.S. EPA, 1990a), benzene has a SF of 2.9×10^{-2} $(mg/kg\text{-}day)^{-1}$ for both oral and inhalation exposures. Note that, for some carcinogens, the SF for oral and inhalation exposure pathways may not be the same and the appropriate SF should be used for the particular exposure pathway.

For the inhalation scenario, the closest SFs to 2.9×10^{-2} $(mg/kg\text{-}day)^{-1}$ listed in Table 3-3 are the entries for 0.01 and for 0.1 $(mg/kg\text{-}day)^{-1}$. As this is a screening exercise, a carcinogen with a higher SF, i.e., 0.1 $(mg/kg\text{-}day)^{-1}$, is conservatively chosen as the reference to evaluate benzene. According to the table, the required inventory quantity that a chemical with a SF of 0.1 $(mg/kg\text{-}day)^{-1}$ must have to pose a potential off-site health hazard is estimated to be 16 kg. The inventory quantities of benzene in 1974 and 1988/89 are 6.0 and 42.5 kg, respectively. The higher inventory quantity of benzene is

used for this evaluation. The ratio of the inventory quantity to the allowable inventory quantity for benzene is therefore equal to 42.5/16 or 2.7.

Similarly, the potential for benzene to pose a drinking water hazard is evaluated using Table 3-5. As explained above, the SF table entry of 0.1 $(mg/kg\text{-}day)^{-1}$ is used, and the 1988/89 reported inventory quantity is chosen to evaluate benzene. The ratio of the inventory quantity to the allowable inventory quantity for benzene equals 42.5/5.6 or 7.6, which is a higher value than that obtained from the inhalation scenario. The higher of the two calculated ratios of allowable quantity for the two pathways is used to determine the need for subsequent evaluation of the chemical.

The evaluation of noncarcinogens is similar to carcinogens, except RfDs are used instead of SFs. 1,1,1-Trichloroethane can be used to illustrate the evaluation of noncarcinogens. According to the HEAST (U.S. EPA, 1990a), 1,1,1-trichloroethane has an inhalation RfD of 0.3 mg/kg-day and an oral RfD of 0.09 mg/kg-day. Using Table 3-4 to evaluate the chemical's inhalation hazard, the required inventory quantity is 160,000 kg. Similarly, using Table 3-6 to evaluate the chemical as a drinking water health hazard, the required inventory quantity is 5,600 kg. The inventory quantity for 1,1,1-trichloroethane in the 1974 inventory is 22,763 kg. The quantity ratio of the chemical for inhalation exposure is equal to 22,763/160,000 or 0.14 and its quantity ratio for drinking water exposure is equal to 22,763/5,600 or 4.1. As explained above, the higher value of the two quantity ratios is used to determine the need for subsequent evaluation of the chemical. Therefore, 1,1,1-trichloroethane has a quantity ratio value of 4.1.

Each chemical on the Hazardous Chemicals List was similarly evaluated to determine it's quantity ratio. The result of this screening exercise is presented in Table 3-7 and in Appendix K. There are 41 chemicals with a quantity ratio greater than 1 based on the combined 1974 and 1988/89 inventories, and 4 chemicals based on chemicals unique to

the 1974 inventory. Together, these chemicals comprise the potential chemicals of concern for the RFP based on Stage 2 of this screening analysis.

3.3.2.5 Evaluation of Reproductive and Developmental Toxicants

In Stage 1 screening, 12 potential reproductive and developmental toxicants were identified (Appendix E). Based on health effects unrelated to reproductive or developmental effects, five of these toxicants: ethylene oxide, hexachlorobenzene, lead compounds, mercury compounds and Aroclors (PCBs) were identified as chemicals of potential concern in Stage 2 screening.

The remaining seven toxicants are evaluated in this section using an approach similar to that used for noncarcinogenic chemicals with RfDs in Stage 2 screening. Since there is no official health criterion for evaluating reproductive hazard of these chemicals, a reproductive screening dose is developed for each of them.

The majority of screening doses derived for this analysis are based on reproductive toxicity information from animal testing. The lowest observable effect level (LOEL) or no observable effect level (NOEL) is commonly used to define the dose associated with minimal or no adverse health effects in the tested animals. In the derivation of reproductive screening dose for humans, the NOEL is preferred over LOEL when both values are reported. However, when only the LOEL is available for a chemical, the standard practice is to divide the LOEL by 10 to estimate the NOEL.

The reproductive screening dose for a chemical is determined for the purposes of this analysis by dividing the animal NOEL by a safety factor of 100. The safety factor of 100 includes a safety factor of 10 to allow for potentially higher sensitivities of humans

TABLE 3-7

POTENTIAL CHEMICALS OF CONCERN

CAS #	COMPOUND	QUANTITY RATIO
	1974/1988/89 INVENTORY	
7440-41-7	BERYLLIUM COMPOUNDS	1.63E+05
7440-47-3	CHROMIUM COMPOUNDS	4.95E+04
56-23-5	CARBON TETRACHLORIDE	2.23E+04
	DIBENZOFURAN	3.57E+03
79-01-6	TRICHLOROETHENE	2.73E+03
	PAHs	1.07E+03
7439-92-1	LEAD COMPOUNDS	9.00E+02
127-18-4	TETRACHLOROETHYLENE	7.97E+02
7440-43-9	CADMIUM COMPOUNDS	6.25E+02
302-01-3	HYDRAZINE	5.36E+02
67-66-3	CHLOROFORM	3.45E+02
91-22-5	QUINOLINE	2.86E+02
1310-73-2	SODIUM HYDROXIDE	2.78E+02
7440-38-2	ARSENIC COMPOUNDS	2.54E+02
1310-58-3	POTASSIUM HYDROXIDE	1.65E+02
75-09-2	METHYLENE CHLORIDE	1.31E+02
7440-02-0	NICKEL COMPOUNDS	1.24E+02
79-06-1	ACRYLAMIDE	1.07E+02
7439-97-6	MERCURY COMPOUNDS	2.84E+01
50-00-0	FORMALDEHYDE	2.61E+01
118-74-1	HEXACHLOROBENZENE	1.81E+01
333-41-5	DIAZINON	1.71E+01
7439-96-5	MANGANESE COMPOUNDS	1.64E+01
7601-90-3	PERCHLORIC ACID	1.53E+01
62-73-7	VAPONITE 2 INSECTICIDE	1.18E+01
95-53-4	o-TOLUIDINE	7.86E+00
71-43-2	BENZENE	7.59E+00
7664-41-7	AMMONIA	6.23E+00
123-91-1	p-DIOXANE	5.63E+00
314-40-9	BROMACIL	4.82E+00
71-55-6	1,1,1-TRICHLOROETHANE	4.06E+00

TABLE 3-7

POTENTIAL CHEMICALS OF CONCERN

CAS #	COMPOUND	QUANTITY RATIO
	1974/1988/89 INVENTORY (CONTINUED)	
151-50-8	POTASSIUM CYANIDE	3.68E+00
75-01-4	VINYL CHLORIDE	3.57E+00
10024-97-2	NITRIC OXIDE	3.00E+00
7647-01-0	HYDROCHLORIC ACID	2.32E+00
	AROCLORS (PCBs)	2.18E+00
107-06-2	1,2-DICHLOROETHANE	2.12E+00
7664-38-2	PHOSPHORIC ACID	1.80E+00
118-75-2	CHLORANIL	1.79E+00
101-77-9	METHYLENE DIANALINE	1.79E+00
1307-96-6	COBALT OXIDE	1.21E+00
7632-00-0	SODIUM NITRITE	1.13E+00
	UNIQUE 1974 INVENTORY	
7440-41-7	BERYLLIUM COMPOUNDS	1.61E+05
75-21-8	ETHYLENE OXIDE	1.20E+05
106-99-0	BUTADIENE	7.06E+02
92-87-5	BENZIDINE	4.46E+01
7440-02-0	NICKEL COMPOUNDS	7.07E+00
7440-43-9	CADMIUM COMPOUNDS	2.81E+00
75-56-9	PROPYLENE OXIDE	2.68E+00
	MULTIPATHWAY EXPOSURE	
621647	N-NITROSO-DI-N-PROPYLAMINE	1.08E-02

compared to the experimental animals and another factor of 10 to allow for differences in sensitivities among individuals.

The LOEL is reported for humans for one of the chemicals. In this case, the reproductive screening dose is determined by dividing the human LOEL by a factor of 100. This includes a safety factor of 10 to estimate the NOEL and another factor of 10 to allow for differences in sensitivities among individuals.

Table 3-8 identifies the reproductive screening dose for each of the seven chemicals evaluated in this section and the reproductive toxicity information used to derive them.

An allowable quantity for each chemical is determined using the same methodology described in Section 3.3.2.2 using the reproductive screening dose. In most cases the drinking water exposure scenario generates a lower allowable quantity and is therefore the basis for the evaluation. However, for carbon monoxide, the inhalation exposure scenario is the most restrictive pathway and is used to determine the allowable quantity. Table 3-9 identifies the allowable quantities for each of the seven reproductive toxicants.

The potential reproductive health impact to off-site individuals for each chemical is evaluated by calculating its quantity ratio. This ratio is calculated by dividing the inventory quantity of a chemical by its allowable quantity. For the purpose of this screening process, if the quantity ratio of a chemical is greater than 1, it poses a potential reproductive hazard to off-site individuals. If the ratio is less than 1, then it is unlikely for the chemical to have posed a reproductive hazard to off-site individuals.

As shown in Table 3-9, all of the chemicals evaluated have a quantity ratio below 1. Therefore based on this screening evaluation, it is unlikely that these chemicals have posed a reproductive hazard to off-site individuals.

TABLE 3-8

DERIVATION OF REPRODUCTIVE SCREENING DOSE

Chemicals	Inhalation Exposure		Oral Exposure		Reproductive Screening Dose (mg/kg-day)
	LOEL (mg/m^3)[a]	NOEL (mg/m^3)[a]	LOEL (mg/kg-day)	NOEL (mg/kg-day)	
Carbon Disulfide	10 (rat) [1]	NA	NA	NA	3.39×10^{-3}
Coumarin	NA	NA	0.3 (human) [2]	NA	3.00×10^{-4}
Dinitrobenzene	NA	NA	NA	1 (rat)*[3]	1.00×10^{-4}
Ethylene Glycol Monoethyl Ether (2-Ethoxyethanol)	NA	190 (rat) [4]	NA	NA	6.44×10^{-1}
Ethylene Glycol Monomethyl Ether (2-Methoxyethanol)	NA	32 (rat) [4]	NA	NA	1.08×10^{-1}
Lithium	NA	NA	NA	4 (monkey) [1]	4.00×10^{-2}
Carbon Monoxide	100 (rabbit) [1]	NA	NA	NA	3.12×10^{-2}
Ethylene Oxide	evaluated in Stage 3 screening				
Hexachlorobenzene	evaluated in Stage 3 screening				
Lead	evaluated in Stage 3 screening				
Mercury Compounds	evaluated in Stage 3 screening				
PCB's (Aroclors)	evaluated in Stage 3 screening				

Note: [1] Shepard, 1989 [3] Blackburn, 1988
[2] IRIS USEPA, 1990b [4] Paustenbach, 1989

* No adverse effect was observed after a single oral dose of 10 mg/kg of 1,3 dinitrobenzene. The chronic NOEL is assumed to be one tenth of the acute NOEL.

a When animal inhalation data are used to calculate the daily dose, the average body weight and inhalation rate for rats are taken to be 0.425 kg and 0.144 m^3/day, respectively. The average body weight and inhalation rate for rabbits are taken to be 3 kg and 0.936 m^3, respectively.

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TABLE 3-9

EVALUATION OF REPRODUCTIVE AND DEVELOPMENTAL TOXICANTS

Chemicals	Reproductive Screening Dose (mg/kg-day)	Exposure Scenario	Allowable Quantity (kg)	Inventory Quantity (kg)	Quantity Ratio
Carbon Disulfide	3.39×10^{-3}	drinking water	$5.60 \times 10^{+2}$	5.9	1.1×10^{-2}
Coumarin	3.00×10^{-4}	drinking water	$5.60 \times 10^{+1}$	1.8	3.2×10^{-2}
Dinitrobenzene	1.00×10^{-2}	drinking water	$5.60 \times 10^{+3}$	0.12	2.1×10^{-5}
Ethylene Glycol Monoethyl Ether (2-Ethoxyethanol)	6.44×10^{-1}	drinking water	$5.60 \times 10^{+4}$	8.2	1.5×10^{-4}
Ethylene Glycol Monomethyl Ether (2-Methoxyethanol)	1.08×10^{-1}	drinking water	$5.60 \times 10^{+4}$	246	4.4×10^{-3}
Lithium	4.00×10^{-2}	drinking water	$5.60 \times 10^{+3}$	239.9	4.3×10^{-2}
Carbon Monoxide	3.12×10^{-2}	inhalation	$1.60 \times 10^{+4}$	60	3.8×10^{-3}

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3.3.2.6 Multipathway Exposure Considerations

Indirect pathways of exposure may contribute significantly to the total dose received by a receptor for some chemicals. Such indirect exposures result from chemical deposition on crops, soils and surface water and transmission to the receptor through vegetables, fish, meat, dairy products and mother's milk. Chemicals for which indirect exposures are considered important have been identified by the California Air Pollution Control Officers Association (CAPCOA, 1990) and these chemicals are listed in Table 3-10. All chemicals identified on the table, with the exception of nitrosamines, are already included in the Potential Chemicals of Concern List generated by the screening process (Table 3-7).

Three nitrosamines were identified in the 1988/89 RFP inventory: N-nitroso-di-n-propylamine (0.001 kg), N-nitroso-diphenylamine (0.005 kg) and N-nitroso-phenylamine (0.01 kg). The only nitrosamine identified in the 1974 inventory is N-nitroso-diphenylamine (0.02 kg).

Based on information in the HEAST (U.S. EPA, 1990a), N-nitroso-di-n-propylamine has an oral SF of 7 $(mg/kg\text{-}day)^{-1}$ and N-nitroso-diphenylamine has an oral SF of 0.005 $(mg/kg\text{-}day)^{-1}$. No inhalation toxicity criterion was found for these 2 nitrosamines. N-nitroso-phenylamine is not listed in Table 3-10 and no oral or inhalation toxicity criterion was found for this chemical.

If the two nitrosamines having SFs are subjected to Stage 2 screening for drinking water exposure, the ratios of the inventory quantities to the allowable quantities for N-nitroso-di-n-propylamine and N-nitroso-diphenylamine are 0.018 and 8.9×10^{-5}, respectively. Based on its quantity ratio, it is unlikely that N-nitroso-diphenylamine would pose an off-site health hazard even taking the potential multi-pathway exposures into account.

TABLE 3-10

SUBSTANCES TO BE EVALUATED FOR
MULTI-PATHWAY EXPOSURES

Arsenic
Beryllium
Cadmium
Chromium (hexavalent)
Dioxins/Dibenzofurans (as TCDD equivalents)
Lead
Mercury
Nitrosamines:
N-Nitrosodiethylamine
N-Nitrosodimethylamine
N-Nitrosodiphenylamine
N-Nitrosodi-n-butylamine
PAHs (Polycyclic aromatic hydrocarbons) including but not limited to:
Benz(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Dibenz(a,h)anthracene

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The quantity ratio of N-nitroso-di-n-propylamine is less than two orders of magnitude below unity and could therefore be of potential concern if multipathway exposures contribute to the off-site dose. N-nitroso-di-n-propylamine should be considered for inclusion in the list of potential chemicals of concern.

3.3.2.7 Strengths and Weaknesses of Stage 1 and Stage 2 Screening

Given the complexity of identifying a limited set of potential chemicals of concern from a list of more than 8,000 entries, it is to be expected that any selection process would contain both strengths and weaknesses. The selection process utilized here is no exception. However, this process has been conservatively designed in order to minimize the possibility of eliminating any chemicals that could possibly pose a health hazard to an off-site individual. The strengths and weaknesses of Stage 1 and Stage 2 screening are listed in Table 3-11.

Concerns have been raised with regards to potential synergistic effects between chemicals and transformation of one chemical to another. These concerns are discussed in the following sections.

3.3.2.8 Chemical Synergism

A synergistic effect is when the combined effect of two chemicals is much greater than the sum of the effect of each agent given alone. A closely related effect is potentiation, which occurs when a noneffective chemical increases the magnitude of the effect produced by another chemical.

There are numerous instances where synergism or potentiation have been observed in laboratory animals. However, most of these exposure conditions are very different from

TABLE 3-11

FACTORS THAT MAY OVERESTIMATE OR UNDERESTIMATE
POTENTIAL HEALTH HAZARD POSED BY A
CHEMICAL EVALUATED IN STAGE 1 AND 2 SCREENING

Factors That May Overestimate Potential Health Hazard	Factors That May Underestimate Potential Health Hazard
• Chemicals in solution were conservatively assumed to be pure chemical. This may over-estimate the inventory quantity by a factor of 10 to 100.	• RfDs derived from oral LD_{50}s were used to evaluate health hazards from both drinking water and inhalation exposure routes. It is possible that for certain chemicals, the inhalation route has a lower RfD than the oral route.
• For some inorganic compounds, only the cation or anion is considered toxic. Rather than calculating the exact amount of the ion of concern, its quantity is conservatively assumed to be equal to the quantity of the compound. For example, 8 kg of potassium dichromate is evaluated as 8 kg of chromium. Furthermore, to be extremely conservative, it is also assumed that all the chromium ions are in the +6 valence state.	• Potential synergistic effects of exposure to multiple chemicals was not considered in this screening exercise. Similarly, potential antagonistic effects of exposure to multiple chemicals was not considered. The current state-of-knowledge of synergistic and antagonistic effects is very limited.
• For all of the chemicals considered, it was conservatively assumed that 25% of the inventory quantity was released into both the air and drinking water. The actual percentage of release for most of the chemicals is expected to be much less due to their physical state (non-volatiles, insolubles, etc.), means of storage (e.g., stored in bottles, vials, etc.) and usage. The only exception may be volatile compounds for which, under certain situations, nearly 100% may be eventually released into the environment.	• Some compounds may degrade or react with other chemicals in the environment and form products that can be more toxic or less toxic than the parent compound. The potential health impact of this type of chemical transformation has not been addressed in this screening procedure.
• Several conservative assumptions were used in the application of the air dispersion model, SCREEN. First, it was assumed that the off-site receptor was at the fence line of the RFP and was exposed 24 hr/day, 365 days/year for a lifetime. Second, for a given emission rate, the meteorological condition that results in the highest one-hour average air concentration at the fence line was used to calculate the annual average air concentration. Furthermore, it was assumed that this worst-case exposure scenario was sustained over the entire lifetime of the receptor. For the non-volatile chemicals, it was assumed that they could be released to the air as particulates. The effect of deposition which would reduce downwind concentrations was not taken into account by the dispersion model. These conservative assumptions may over-estimate the amount of a chemical inhaled by an off-site individual by a factor of 100 to 10,000.	• Only chronic adverse health effects were considered in this screening exercise. Possible acute health effects due to episodic releases were not included, but would be evaluated as part of any characterization of accidents or incidents.

TABLE 3-11

FACTORS THAT MAY OVERESTIMATE OR UNDERESTIMATE
POTENTIAL HEALTH HAZARD POSED BY A
CHEMICAL EVALUATED IN STAGE 1 AND 2 SCREENING

Factors That May Overestimate Potential Health Hazard	Factors That May Underestimate Potential Health Hazard
• Several conservative assumptions were used in calculating the concentration of a chemical in drinking water. Regardless of solubility, it was conservatively assumed that 25% of the assumed annual consumption was dissolved in the Great Western Reservoir. This reservoir was chosen over Standley Lake because it has a smaller capacity, receives any releases from the RFP waste treatment plant and holding ponds and is closer to the RFP site. It was also assumed that the chemical was discharged into the water in a single event, although it is more likely that any discharge would have been gradual and maintained over a period of time. It was also assumed that the chemical was discharged directly into the water. These conservative assumptions may over-estimate the amount of a chemical ingested by an off-site individual through drinking water by a factor of 100 to 1000.	
• When no RfD was located for a chemical, a derived RfD is calculated from its oral LD_{50}. This approach conservatively assumed that the severity of the toxic effect being considered is proportional to the dose. Many irritants and compounds that represent essential nutrients may have a high threshold and this no threshold approach may be too conservative.	
• In implementing Stage 2 screening, only a limited number of toxicity criteria (order-of-magnitude) were listed in the screening tables. In calculating the required quantity, the most conservative criteria was always used.	

human experience, such as laboratory animals are usually given 2 pure chemicals in relatively high concentration and for a short period of time. Humans are exposed to hundreds of chemicals in very low concentrations for 60-70 years. Chemicals are also often administered to the test animals in a way that has no relevance to humans exposure conditions.

Furthermore, most screening tests for interactions employ simultaneous exposure. This approach may miss some potential interactions, such as when the two agents being evaluated affect the same cellular mechanism in causing a toxic effect but they may have a different time of onset. More specifically, dermal exposure to an initiator like benzo[a]pyrene must take place before the exposure to the promoter (e.g., croton oil or phorbol esters) for the interaction to occur. Therefore, while animal results can suggest the potential interaction of multiple chemical exposures and give insights to the mechanism of interaction, direct extrapolation of animal data to humans is difficult.

Another approach is to conduct epidemiologic studies based on human exposure experiences. There are several reported potential synergistic interactions involving tobacco smoking or alcohol drinking:

- asbestos and smoking
- radon gas and smoking
- alcohol drinking and smoking
- carbon disulfide and drinking
- some chlorinated aliphatics and drinking

The interaction between tobacco smoking and occupational exposures in the causation of lung cancer has been a highly researched area. In 1968, Selikoff et al. first reported there is a strong synergistic effect between asbestos and smoking. Other researchers studied

asbestos factory workers and revealed that both additive and multiplicative models fit the data, with the multiplicative model fitting slightly better.

It is important to note that even though smoking and asbestos are among the best investigated interactions, the data are still insufficient for a clear-cut determination of the nature of their interaction (additive vs multiplicative) (Calabrese, 1991).

A considerable number of occupational epidemiologic studies have examined the possible interaction of smoking and radon exposure on the incidence of lung cancer. While the result of several smaller studies supported additive, submultiplicative and multiplicative models, the largest study reported by Whittemore and McMitlan in 1983 supported a multiplicative interaction (Calabrese, 1991).

The potential synergistic interaction of alcohol consumption and other chemical exposures in causing cancer is highly controversial and not as well studied. Rothman (1975) reported that heavy drinkers have a risk of 2 to 6 times greater than nondrinkers, depending on the degree of concomitant smoking activity. However, in many instances, considerable controversy persists, and data from different studies often conflict with each other.

Studies have indicated that individuals exposed to alcohol and carbon disulfide or alcohol and carbon tetrachloride are more susceptible to liver damage. Both carbon disulfide and carbon tetrachloride require bioactivation by certain liver enzymes to exert their liver toxicity. Alcohol consumption is known to increase the activity of these liver enzymes and therefore enhance the toxicity of these two chemicals.

Almost all of the synergism studies discussed above are based on occupational exposures. However, in most environmental exposures, the concentration of the chemical under

consideration is usually many times lower than in an occupational setting. It is argued that when the chemical dose is very low, synergistic effect or multiplicative effect is virtually indistinguishable from additive effect. This is one of the reasons why the U.S. EPA recommends summing of cancer risks when evaluating the health effects of more than one carcinogen. The agency has also developed a hazard index approach to evaluate the noncarcinogenic effect of chronic toxicants. The hazard index is equal to the sum of the ratios of the subthreshold exposures to acceptable exposures. The following equation is presented in the Risk Guidance for Superfund (Volume 1), human health evaluation manual (USEPA, 1989).

$$\text{Hazard Index} = E_1/RfD_1 + E_2/RfD_2 + \ldots\ldots\ldots + E_i/RfD_i$$

Where :

E_i = exposure level (or intake) for the i^{th} toxicant;

RfD_i = reference dose for the i^{th} toxicant; and

E and RfD are expressed in the same units and represent the same exposure period (i.e. chronic, subchronic or short-term). It is also recommended that this equation only be applied to chemicals that produce similar toxic effects or have similar mechanisms of action.

Clearly the topic of synergism is an area of investigation for scientists where there is still much to be learned. Current practice argues for the summation of hazards from exposure to multiple chemicals having similar toxic endpoints. The screening process employed in this analysis incorporates numerous conservatisms that greatly overstate the potential for hazard from an individual chemical for the purposes of identifying compounds of potential concern. As estimated doses and risks from chemicals and radionuclides are quantified later in the project it will be appropriate to consider the additivity of these risks.

However, for the purposes of identifying chemicals for further study on the project it is believed that the screening process is sufficiently conservative such that potential hazards are not significantly understated even if synergistic effects were to occur.

3.3.2.9 Chemical Transformation

The consideration of chemical transformation has also been identified as a concern for identifying potential hazards. The screening process evaluates the potential hazards from chemicals that are used in various plant processes and released to the environment. The concern is that chemicals could be transformed as a result of processing or degradation in the environment to more toxic compounds. These concerns, like synergism, touch on a very complex topic for which there are no simple answers.

The identification of chemicals that are byproducts of processes performed at the plant require a fairly detailed knowledge of the chemical processes at the plant. Detailed waste stream characterization reports have been prepared for the plant that identify a large number of chemicals from hundreds of waste streams that are present in widely varying concentrations down to trace concentrations. These waste stream reports present an extremely complex picture of individual process liquid streams. As the project proceeds, one objective is to develop an understanding of the basic plant processes, and in turn to develop an understanding of any major byproducts of these processes that have been released to the environment.

The scientific community is in an early stage in understanding how released pollutants interact with other chemical and physical components in the environment. Nevertheless, we have developed some understanding about transformation of some major groups of chemicals and well-known chemicals in the environment. In general, substances can be

divided into two categories, refractory and non-refractory substances, based on their relative susceptibility to chemical transformation in the environment.

The refractory substances tend to retain their chemical composition, physical properties and toxicity in the environment for a long period of time. Examples are: metals, polychlorinated aromatics and chlorinated aliphatics.

The non-refractory substances have a relatively short life-time in the environment. They either contain reactive functional groups that react with other environmental components, or are often degraded by microorganisms in the environment. Many highly toxic chemicals contain reactive functional groups e.g., ethylene oxide, propylene oxide, and acrylamide that exert their toxic effects through the interaction between their reactive functional groups and biological materials. Thus when the reactive functional groups are changed through reaction or conjugation with other environmental materials, they also become less toxic.

Strong acids (hydrochloric acid, sulfuric acid and nitric acid) and strong bases (ammonia, sodium hydroxide and potassium hydroxide) normally do not retain their strength for long in either soil or natural water. Organic and inorganic matters in these media have substantial buffering power and tend to resist drastic changes in pH. However, if the quantity of acid or base release is large and last over a long period of time, the buffering capacity of the system can be overwhelmed and a change of pH observed.

Chemicals with a strong oxidizing or reducing power usually do not have a long half-live in the environment. They tend to react with other oxidants or reductants in the environment to attain a more stable state or form. For example, hexavalent chromium is reduced to trivalent state in natural waters by Fe (II), dissolved sulfides, and organic compounds with sulfhydryl groups (USEPA, 1979). Theoretically, MnO_2 in soil can

oxidize trivalent chromium to the hexavalent state, however, in reality this process is seldom observed in the environment. This is because at pH greater than 5, trivalent chromium quickly precipitates due to the formation of the insoluble hydroxide or oxide (USEPA, 1979). As a result, a major fraction of trivalent chromium is immobilized and separated from oxidizing agents in the environment.

There are numerous types of microorganisms in soils, lakes, rivers and seas. Each type is capable of using a particular type of chemicals as a nutrient and source of energy. Together, they can breakdown a wide range of chemical substances to smaller and less toxic molecules. Most of the organic compounds included in the potential chemicals of concern list can be biodegraded within a reasonable period of time. There are a few exceptions: hexachlorobenzene, aroclors (PCBs), polyaromatic hydrocarbons and chlorinated short chain aliphatics. These chemicals are rather resistent to biodegradation and may persist in the environment for a long period of time. Chlorinated short chain aliphatics like chloroform, trichloroethene and methylene chloride do not stay in exposed surface water or soil. They tend to volatilize from the soil and aquatic systems to the atmosphere. Once in the troposphere, they are photo-oxidized relatively rapidly with an atmospheric lifetime ranging from several days to a few months.

There are examples where microorganisms increase the toxicity of a chemical through their activities. Conversion of mercury to dimethylmercury by anaerobic bacteria is a good example. In this case, the metabolic product is more mobile and toxic than the parent substance.

Chemical reactions (transformation) are generally favored by a high concentration of reacting components and a high temperature. Except for some highly reactive reagents, ambient temperature is usually too low for chemical reactions to take place. Due to dilution and dispersion, contaminant concentrations in the environment are usually very

low, in the parts per million to parts per thousand ranges. As a result, it is rare to observe chemical reactions taking place in the environment to an appreciable extent. However, when sufficient energy is given to chemicals in the environment, reactions do take place. One well-known example is the absorption of solar energy by certain organic compounds in air or water to form reactive species or free radicals. These intermediates can then decompose or react further with other chemicals in the environment to form products which may be more or less toxic than the parent compounds. Polycyclic aromatic hydrocarbons absorb solar radiation at wavelengths above 300 nm and undergo photo-oxidation. For example, benzo[a]pyrene, benzo[a]anthracene and anthracene have photo-oxidation half-lives in water of 1.2, 3 and 0.6 hr, respectively (USEPA, 1979).

Some reactive chemicals may react spontaneously with water or moisture in the environment. For example, potassium and sodium metal react with water to form hydroxides and hydrogen gas. Aluminum sulfide reacts with water to form aluminum hydroxide and hydrogen sulfide gas.

While a number of factors determine whether a compound is likely to pose a hazard, toxicity and quantity are the key considerations. Given the very conservative screening performed for the selection of chemicals of concern, only in the case where plant processes result in the transformation of large amounts of a chemical to a much more toxic chemical is the selection scheme used for Task 2 likely to exclude an important chemical. Those chemicals that are identified as being of potential concern will be studied in detail to determine their use at the plant and their ultimate fate including transformation at the plant or in the environment. While there is no efficient method of identifying whether important transformation products that should be the subject of further study are formed at this point in the project, subsequent project investigations will continue to seek information suggesting the need to consider additional chemicals as a result of the transformation.

3.3.3 Stage 3 Screening

Stage 2 screening identified 46 potential chemicals of concern. If sufficient quantities of these chemicals were released, they might adversely affect the health of off-site individuals. In Stage 3 screening, these chemicals are individually evaluated to determine their likelihood and relative quantity of release based on their actual storage and normal usage. The route of release and environmental fate of some chemicals are also evaluated for their potential to result in health impacts.

The 46 potential chemicals of concern are divided into two groups based on their largest reported quantities in either the 1988/89 or 1974 inventories. Chemicals in the first group have inventory quantities below 100 kg. These chemicals are believed to be mainly used in research laboratories and are not involved in production operations. Chemicals in the second group have inventory quantities above 100 kg, and are probably used in production. Tables 3-12 and 3-13 presents the two groups of potential chemicals of concern.

3.3.3.1 Group One: Chemicals with Inventory Quantities less than 100 kg

Twenty-two potential chemicals of concern belong to this group. Most of the chemicals in this group are located and used in laboratories. Their annual usage is probably not much higher and in some cases much less than the inventory quantities. Since these are not production chemicals, the assumption used in Stage 2 screening that 25% of the annual usage quantity was released into the environment is also probably too conservative. To confirm usage, likelihood of release and quantity of release of these chemicals, the following information was obtained from personnel working at the RFP:

TABLE 3-12

POTENTIAL CHEMICALS OF CONCERN LIST
Group One: Inventory Quantity < 100 kg

CAS #	COMPOUND	QUANTITY RATIO	INVENTORY QUANTITY (KG)
621-64-7	N-Nitroso-di-N-Propylamine	1.79×10^{-2}	1.00×10^{-3}
132-64-9	Dibenzofuran	$3.57 \times 10^{+3}$	2.00×10^{-2}
92-87-5	Benzidine	$4.46 \times 10^{+1}$	2.50×10^{-2}
	Aroclors	$2.18 \times 10^{+0}$	1.22×10^{-1}
75-01-4	Vinyl Chloride	$3.57 \times 10^{+0}$	2.00×10^{-1}
118-75-2	Chloranil	$1.79 \times 10^{+0}$	$1.00 \times 10^{+0}$
101-77-9	Methylene Dianaline	$1.79 \times 10^{+0}$	$1.00 \times 10^{+0}$
118-74-1	Hexachlorobenzene	$1.81 \times 10^{+1}$	$1.02 \times 10^{+0}$
75-56-9	Propylene Oxide	$2.68 \times 10^{+0}$	$1.50 \times 10^{+0}$
91-22-5	Quinoline	$2.86 \times 10^{+2}$	$1.60 \times 10^{+0}$
7440-38-2	Arsenic Compounds	$2.54 \times 10^{+2}$	$4.06 \times 10^{+0}$
95-53-4	o-Toluidine	$7.86 \times 10^{+0}$	$4.40 \times 10^{+0}$
79-06-1	Acrylamide	$1.07 \times 10^{+2}$	$6.00 \times 10^{+0}$
	PAHs	$1.07 \times 10^{+3}$	$6.00 \times 10^{+0}$
107-06-2	1,2-Dichloroethane	$2.12 \times 10^{+0}$	$1.19 \times 10^{+1}$
62-73-7	Vaponite 2 Insecticide	$1.18 \times 10^{+1}$	$1.89 \times 10^{+1}$
151-50-8	Potassium Cyanide	$3.68 \times 10^{+0}$	$2.06 \times 10^{+1}$
302-01-3	Hydrazine	$5.60 \times 10^{+2}$	$3.13 \times 10^{+1}$
123-91-1	p-Dioxane	$5.63 \times 10^{+0}$	$3.15 \times 10^{+1}$
71-43-2	Benzene	$7.59 \times 10^{+0}$	$4.25 \times 10^{+1}$
7632-00-0	Sodium Nitrite	$1.13 \times 10^{+0}$	$6.30 \times 10^{+1}$
333-41-5	Diazinon	$1.71 \times 10^{+1}$	$9.60 \times 10^{+1}$

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TABLE 3-13

POTENTIAL CHEMICALS OF CONCERN LIST
Group Two: Inventory Quantity > 100 kg

CAS #	COMPOUND	QUANTITY RATIO	INVENTORY QUANTITY (KG)
7440-43-9	Cadmium Compounds	$6.25 \times 10^{+2}$	$1.00 \times 10^{+2}$
106-99-0	Butadiene	$7.06 \times 10^{+2}$	$1.13 \times 10^{+2}$
50-00-0	Formaldehyde	$2.61 \times 10^{+1}$	$1.46 \times 10^{+2}$
7440-02-0	Nickel Compounds	$1.24 \times 10^{+2}$	$1.99 \times 10^{+2}$
7439-97-6	Mercury Compounds	$2.84 \times 10^{+1}$	$5.69 \times 10^{+2}$
1307-96-6	Cobalt Oxide	$1.21 \times 10^{+0}$	$6.77 \times 10^{+2}$
7440-47-3	Chromium Compounds	$4.95 \times 10^{+4}$	$7.93 \times 10^{+2}$
7647-01-0	Hydrochloric Acid	$2.32 \times 10^{+0}$	$1.30 \times 10^{+3}$
75-09-2	Methylene Chloride	$9.39 \times 10^{+1}$	$1.50 \times 10^{+3}$
7439-96-5	Manganese Compounds	$1.64 \times 10^{+1}$	$2.62 \times 10^{+3}$
127-18-4	Tetrachloroethylene	$7.97 \times 10^{+2}$	$4.46 \times 10^{+3}$
67-66-3	Chloroform	$3.45 \times 10^{+2}$	$5.51 \times 10^{+3}$
7601-90-3	Perchloric Acid	$1.53 \times 10^{+1}$	$8.58 \times 10^{+3}$
7440-41-7	Beryllium Compounds	$1.63 \times 10^{+5}$	$9.14 \times 10^{+3}$
7664-38-2	Phosphoric Acid	$1.80 \times 10^{+0}$	$1.01 \times 10^{+4}$
56-23-5	Carbon Tetrachloride	$2.23 \times 10^{+4}$	$1.25 \times 10^{+4}$
79-01-6	Trichloroethene	$2.73 \times 10^{+3}$	$1.53 \times 10^{+4}$
1310-73-2	Sodium Hydroxide	$2.78 \times 10^{+2}$	$1.56 \times 10^{+4}$
71-55-6	1,1,1-Trichloroethane	$4.06 \times 10^{+0}$	$2.28 \times 10^{+4}$
314-40-9	Bromacil	$4.82 \times 10^{+0}$	$2.70 \times 10^{+4}$
1310-58-3	Potassium Hydroxide	$1.65 \times 10^{+2}$	$9.09 \times 10^{+4}$
75-21-8	Ethylene Oxide	$1.20 \times 10^{+5}$	$1.92 \times 10^{+5}$
7439-92-1	Lead Compounds	$9.00 \times 10^{+2}$	$5.04 \times 10^{+5}$
7664-41-7	Ammonia	$6.23 \times 10^{+0}$	$9.96 \times 10^{+5}$

- verification of inventory quantities as being consistent with those reported in 1988/89,
- verification of storage location,
- characterization of normal usage,
- characterization of disposal practice, and
- estimated release.

The information that was obtained is summarized in Appendix L. The location and quantity information reported in the inventory were confirmed for most of the chemicals. A majority of the chemicals are no longer used or have a very low annual usage rate. For those chemicals having annual usage rates greater than the inventory quantities, their releases to the environment are estimated to be minimal. Based on the usage and release information provided in Appendix L, it is unlikely for the listed chemicals to pose a significant off-site health hazard. Therefore limited use laboratory chemicals are not included in the Stage 3 chemicals of concern list.

It is possible that some of the chemicals listed in Appendix L were used differently in the past. Table 3-14 compares the inventory quantities of the chemicals that are reported in both 1988/89 and 1974. The inventory quantities of many chemicals are higher in the 1974 report than in the 1988/89 report. However, most of the chemicals are listed below 10 kg. This indicates that these chemicals were probably also used in laboratories in 1974. There are three exceptions: benzene, hydrazine and sodium nitrite were reported in quantities in excess of 10 kg in 1974.

Sodium nitrite is reported to have an inventory quantity of 10 kg in 1988/89 and 63 kg in 1974. It can be used as a fertilizer or food preservative. With its relatively low toxicity and small inventory quantity, it is unlikely that sodium nitrite posed a significant health

TABLE 3-14

COMPARISON OF 1988/89 AND 1974
INVENTORY QUANITITIES FOR GROUP ONE CHEMICALS

CAS #	Compound	1988/89 Inventory Quantity (kg)	1974 Inventory Quantity (kg)
79-06-1	Acrylamide	0.01	6.000
7440-38-2	Arsenic Compounds	3.06	4.060
71-43-2	Benzene	5.956	42.500
132-64-9	Dibenzofuran	0.01	0.020
107-06-2	1,2-Dichloroethane	0.006	8.1
123-91-1	p-Dioxane	22.72	9.6
118-74-1	Hexachlorobenzene	1.015	1
302-01-3	Hydrazine	0.5	30.000
101-77-9	Methylene Dianaline	1.00	0.12
151-50-8	Potassium Cyanide	20.592	0.025
91-22-5	Quinoline	1.075	1.600
7632-00-0	Sodium Nitrite	10.628	63.000
95-53-4	o-Toluidine	0.01	4.400
75-01-4	Vinyl Chloride	0.004	0.200

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hazard to off-site individuals. Therefore, sodium nitrite is not included in the chemicals of concern list.

Benzene is a human carcinogen and hydrazine is an animal carcinogen. These two chemicals were reported in larger quantities in the past and might have been used in production. They are included in the chemicals of concern list.

Benzidine and propylene oxide are only reported in the 1974 inventory. As they are no longer used in RFP, their usage and disposal could not be readily characterized. Benzidine is a human carcinogen and propylene oxide is an animal carcinogen. Since there is no usage or release information available for these two chemicals, they are included in the chemicals of concern list.

Aroclors or polychlorinated biphenyls (PCBs) were reported to have an inventory quantity of 0.12 kg in the 1988/89 report. It is believed that PCBs might have been used in transformers in much greater quantities. However, any environmental release of PCBs from transformers would more likely be related to accidents and spills than to routine plant operation. For this reason, PCBs are not included in the chemicals of concern list, but are recommended to be evaluated if found to be associated with any accidents or incidents. Also, should environmental contamination by PCBs be confirmed as a potential concern, sediment and soil sampling would be the most efficient way of evaluating the hazards associated with this persistent chemical.

There are four pesticides on the potential chemicals of concern list. Chloranil, vaponite 2 insecticide and diazinon have inventory quantity less than 100 kg. In the 1974 inventory, bromacil was reported to have an inventory quantity greater than 100 kg. It is known that there are many more pesticides and herbicides that have been used at the RFP, however, no information about the quantities used and method of application have been identified

at this point in the project. Furthermore, it is known that outside contractors were hired to apply pesticides and herbicides at the RFP and that materials used by these contractors would not be reported in the plant inventories.

Pesticides and herbicides are likely to have been applied throughout the history of the plant with the specific product used and the nature of the application varying over time as different compounds came into and went out of use. In many cases contractors or entities other than the plant operator were responsible for the application of these materials. The use of these materials were not unique to the plant and are not directly related to the production processes at the plant. However, the historic presence of these compounds in holding ponds at the site has been the subject of public concern and for this reason will be addressed by this project. Pesticides and herbicides have therefore been retained as a group of compounds that need to be addressed further by the study as chemicals of concern.

3.3.3.2 Group Two: Chemicals with Inventory Quantities Greater than 100 kg

There are 24 chemicals in group two. Most of these chemicals are reported in large inventory quantities and are probably used in production. These chemicals have been separated into 4 subgroups based on the similarity of their chemical and physical properties:

- acids and bases
- elements
- chlorinated hydrocarbons
- others

3.3.3.2.1 Acids and Bases

The following six acids and bases are on the potential chemicals of concern list from Stage 2 screening: sodium hydroxide, potassium hydroxide, perchloric acid, hydrochloric acid, phosphoric acid and ammonia. Sulfuric acid, nitric acid and hydrofluoric acid were listed on List B because they have neither an established health criterion nor an oral LD_{50}. In both the 1974 and 1988/89 inventory reports, these three acids are listed in large inventory quantities and are probably used in production. The potential health impacts of these three acids are discussed together with the other acids and bases on the potential chemicals of concern list.

In general, when strong acids and bases are released into soil or surface water, they are likely to be quickly diluted, neutralized and buffered by natural components in the environment. It is expected that if the acids and bases discussed in this section were released into the soil, groundwater or surface water, their concentrations and strengths would decrease drastically with increasing distance from the source. Since the closest community is about 1 mile away from the RFP, these chemicals are not likely to pose a significant health impact to off-site individuals.

Based on the 1988/89 inventory report and other documents, it is apparent that most of the acids and bases used at the RFP are destroyed on-site. For example, the major use of potassium hydroxide identified in the inventory is for neutralization (Appendix M). Potassium hydroxide is used to neutralize chemicals (like nitric acid) in reaction vessels, tanks and fume scrubbers. In all these processes, potassium hydroxide is consumed, rendering it less toxic. According to the 1988/89 inventory report, about 70% of the total inventory quantity of potassium hydroxide is used for these processes. In other words, only about 30% of the potassium hydroxide reported in the inventory is available for potential release.

Similarly, sodium hydroxide is used in regenerating demineralizer, acid neutralization, water treatment and pH adjustment (Appendix M). According to the 1988/89 inventory report, about 90% of the total inventory quantity of sodium hydroxide is used for these operations.

Ammonia is used to neutralize nitric acid and precipitate uranium and plutonium oxides (APEN, 1990). However, it is not clear how much ammonia is neutralized on-site.

According to the 1988/89 inventory report, about 80% of sulfuric acid is neutralized on site (Appendix M). It is mainly used to regenerate the demineralizers, treat water in cooling towers, control the pH of cooling water and precipitate chemicals. Therefore, only about 20% of the sulfuric acid reported is available for potential release.

Based on the Air Pollution Emission Notices (APEN, 1990), most nitric acid used in building 771 is either neutralized or evaporated and scrubbed with bases on-site. These processes effectively convert nitric acid into salts of low toxicity and drastically reduce the quantity of nitric acid available for release. The APEN estimated that in 1988, about 59,890 kg of nitric acid was used building 771 and a majority of the acid is neutralized on-site.

Acids and bases are skin and respiratory irritants. They generally cause acute health effects and do not have cumulative toxicities. Since any liquid effluents are likely to be buffered in the environment, only air emissions pose some potential for transport of these compounds. Sodium hydroxide, potassium hydroxide, phosphoric acid, perchloric acid and sulfuric acid are not volatile. The only mechanism of potential transport in air is in the form of mist and aerosols. It is unlikely that sufficiently large quantities of these acids or bases could be aerosolized to pose a significant health hazard to off-site individuals.

Therefore, sodium hydroxide, potassium hydroxide, phosphoric acid, perchloric acid and sulfuric acid are not included in the chemicals of concern list.

Hydrochloric acid, ammonia, hydrofluoric acid and nitric acid in high concentrations can give off fumes and vapors even at room temperature and could be transported off-site. Table 3-15 lists the air concentrations of hydrochloric acid and ammonia at the RFP fence line predicted by the air dispersion model described in the Stage 2 screening. The estimated allowable quantities and the quantity ratios of these 2 chemicals are also presented. Based on the inhalation exposure scenario, the quantity ratio of hydrochloric acid is 0.81. Therefore, hydrochloric acid is unlikely to pose a health hazard to off-site individuals and has not been included as a chemical of concern.

The predicted screening concentration of ammonia at the fence line is 2.1 mg/m^3. This predicted air concentration is higher than the U.S. EPA reference concentration of 0.36 mg/m^3 (USEPA, 1990a). However, this reference concentration is not based on adverse health effects, but rather on the odor threshold of humans. An ammonia odor would have been detected off-site at concentrations well below those associated with a health hazard if significant ammonia releases were occurring. Therefore, ammonia is not included in the chemicals of concern list.

Hydrofluoric acid is a strong irritant and highly corrosive. Most of the hydrofluoric acid used at the RFP is in gaseous form and almost 100% pure. It is mainly used and consumed in the hydrofluorination process in Building 771 (APEN, 1990). According to the APEN report, the annual release rate of hydrofluoric acid from this building is estimated to be about 1,000 kg/year. Hydrofluoric acid dissolved in water is also used in other buildings for plating, cleaning and etching of metal and glass parts. However, the quantities of hydrofluoric acid used in these operations are considered insignificant when compared with the hydrofluorination process.

TABLE 3-15

EVALUATION OF HYDROCHLORIC ACID AND AMMONIA

Chemical	Health Criteria (inhalation) (mg/kg/day)	Predicted Air Concentration[1] (mg/m^3)	Allowable Quantity (kg)	Actual Inventory Quantity (kg)	Quantity Ratio
Hydrochloric Acid	0.009	0.0028	1600	1300	0.8125
Ammonia	0.1	2.1	160000	996000	6.225

1 At the fence line of RFP

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Using the estimated release rate of 1,000 kg/year and the air dispersion model described in the Stage 2 screening, the concentration of hydrogen fluoride in air at the fence line is estimated to be 8.6×10^{-4} mg/m^3. According to ACGIH (fifth edition), the occupational ceiling limit for hydrogen fluoride is 2.5 mg/m^3; which is about 2,900 times higher than the predicted fence line air concentration. This margin of safety should be sufficient to cover the uncertainties in the estimation of annual usage rate and release quantities and still be health protective for sensitive and susceptible human subpopulations. Hydrofluoric acid is not included in the chemicals of concern list.

Large quantities of nitric acid are used at RFP. Many production operations involving the use of nitric acid have built-in systems to scrub the exit gas stream before release. Waste nitric acid solutions are normally treated on-site by neutralization. Nevertheless, it was estimated that in 1988 1,952 kg of nitric acid was released as fugitive emissions and 38,590 kg was released through stack emissions (Rockwell International, 1989). Thus, the total annual release rate is estimated to be about 40,542 kg/year. Based on the air dispersion model described in the Stage 2 screening, the predicted concentration of nitric acid in air is 3.5×10^{-2} mg/m^3. According to ACGIH (1990-1991), the occupational 8-hour exposure criterion (threshold limit value) for nitric acid is 5.2 mg/m^3; which is about 148 times higher than the predicted fence line air concentration. As shown in Table 3-1, annual usage of nitric acid in 1977 in about 41 times greater than the 1974 inventory quantity. Therefore, it is felt that this margin of safety may not be sufficient to cover the uncertainty in the estimated release quantity of nitric acid and to protect the health of susceptible human subpopulations. For this reason, nitric acid is included in the chemicals of concern list.

3.3.3.2.2 Elements

There are eight elements on the potential chemicals of concern list. Three of them are essential nutrients: manganese, cobalt and chromium (trivalent state). These elements in low concentrations are required by the human body to maintain good health. However, they may produce adverse health effects when the average daily intake exceeds a certain level.

In Stage 2 screening, a derived RfD was calculated for cobalt by dividing its LD_{50} by a factor of 100,000. This approach is appropriate for chronic toxicants but is probably too conservative for essential nutrients like cobalt. The human daily dietary intake of cobalt is estimated to be about 0.1-0.25 mg/day (California State Water Resources Control Board, 1963). Using the exposure scenarios described in Section 3.3.2.2, concentrations of cobalt in air and water are calculated. The average daily dose of cobalt received by a maximally exposed individual through inhalation and drinking water ingestion are 0.029 mg/day and 0.085 mg/day, respectively (Table 3-16). These doses are lower than the daily dietary intake level and are unlikely to pose a health hazard to off-site individuals. Table 3-16 compares the predicted cobalt screening air concentration at the RFP fence line with the occupational air standard set by American Conference of Governmental Industrial Hygienists (ACGIH, 1990-1991). The predicted air concentration is about 35 times lower than the occupational air standard, and since the air dispersion model neglects the effect of deposition, this predicted air concentration is likely to be much greater than the actual concentration. For this reason, cobalt is not included in the chemicals of concern list.

Manganese is also an essential nutrient for humans. The safe and adequate dietary allowance of manganese recommended for an adult is 10 mg/day (California State Water Resources Control Board, 1963). Using the exposure scenarios described in section

TABLE 3-16

EVALUATION OF COBALT AND MANGANESE COMPOUNDS

DRINKING WATER EXPOSURE SCENARIO

Compound	Predicted Water Concentration (mg/l)	Average Daily Dose (mg/day)	Recommended Daily Dietary Intake (mg/day)	Oral RfD (mg/day)
Manganese Compound	0.16	0.33	10 [1]	7
Cobalt Compounds	0.04	0.085	0.1 - 0.25 [1]	NA

INHALATION EXPOSURE SCENARIO

Compound	Predicted Air Concentration (mg/m^3)	Average Daily Dose (mg/day)	Occupational Standard (mg/m)3	Predicted Air Concentration/ Occupational Standard
Manganese Compounds	0.0056	0.11	5 (TWA) [2]	0.001
Cobalt Compounds	0.0014	0.029	0.05 (TWA) [2]	0.028

[1] California State Water Resources Control Board, 1963
[2] ACGIH, 1990-1991

TWA = 8 hour time weighed average

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3.3.2.2, concentrations of manganese in air and water are predicted. The average daily dose of manganese received by a maximally exposed individual through drinking water ingestion is 0.33 mg/day (Table 3-16). As this dose is below the dietary allowance, manganese compounds are not considered to pose a drinking water health hazard to off-site individuals. However, the health criterion for manganese through inhalation is about 660 times more stringent than that for the oral route. U.S. EPA recommends manganese in air not to exceed 0.001 mg/m^3 (U.S. EPA, 1990a), which is about 5 times lower than the predicted manganese screening air concentration at the RFP fence line. Nevertheless, manganese is not likely to pose a significant health hazard to off-site individuals because of the following reasons:

- the predicted manganese air concentration is at the fence line and most residential and industrial areas are much farther away from the facility;
- manganese and manganese compounds are not volatile and can only be dispersed through air as particulates. The screening air model does not take into account the effect of deposition which would reduce downwind air concentration of manganese;
- multipathway exposure to manganese is not a concern. As explained above, oral route of exposure to the predicted level of manganese does not pose a health hazard.

The manganese air concentration is also compared with the occupational air standard set by American Conference of Governmental Industrial Hygienists (ACGIH, 1990-1991). As shown in Table 3-16, the predicted air concentration is about 1,000 times lower than the occupational air standard. Manganese is not included in the chemical of concern list.

Cadmium, nickel, chromium, beryllium and lead are potential animal and human carcinogens. Mercury is a neurotoxin and a potential reproductive and developmental toxicant. These metals are found in relatively large inventory quantities at the RFP and

are probably used in production. If significant quantities of these chemicals were released into the environment, they could adversely affect the health of off-site individuals. These six metals are included in the chemicals of concern list.

3.3.3.2.3 Chlorinated Aliphatics

There are six chlorinated aliphatics on the potential chemicals of concern list that belong to this group. They are methylene chloride, tetrachloroethylene, chloroform, carbon tetrachloride, trichloroethene and 1,1,1-trichloroethane. With the exception of 1,1,1-trichloroethane, they are all suspected animal or human carcinogens. If significant quantities of any of these chemicals were released into the environment, they might adversely affect the health of off-site individuals. They are all included in the chemicals of concern list.

3.3.3.2.4 Others

There are three chemicals in group two that have not yet been evaluated. They are butadiene, formaldehyde and ethylene oxide. Butadiene and ethylene oxide are reported only in the 1974 inventory. There is no specific information about the usage and storage location of these two chemicals. All three chemicals are suspected animal or human carcinogens that may have been used in production. If these chemicals were released in sufficient quantities, they might have posed a health impact on off-site individuals. Therefore, butadiene, formaldehyde and ethylene oxide are included in the chemicals of concern list.

3.3.3.3 Result of Stage 3 Screening

A total of 20 chemicals and the pesticide/herbicide group remain on the chemicals of concern list after Stage 3 screening (Table 3-17). A brief discussion of the usage, environmental fate and acute and chronic toxicity of each chemical is presented in Appendix N. The chemicals that were evaluated in Stage 3 but not selected are identified on List D (Table 3-18).

4.0 CONCLUSIONS

The objective of Task 2 was to identify those materials that have been present at the Rocky Flats Plant which could have exposure off-site populations to health hazards during the operating history of the plant. Using both qualitative and quantitative screening criteria a number of compounds that could potentially have been associated with off-site impact from normal operations have been identified for further detailed study by the project. The compounds of concern which will be the subject of further study include the radionuclides listed in Table 3-19 and the chemicals listed on Table 3-17.

TABLE 3-17

CHEMICALS OF CONCERN LIST

Chemical Name
Benzidine
Propylene Oxide
Butadiene
Ethylene Oxide
Benzene
Hydrazine
Cadmium Compounds
Nickel Compounds
Chromium Compounds
Beryllium Compounds
Mercury Compounds
Lead Compounds
Methylene Chloride
Chloroform
Carbon Tetrachloride
Tetrachloroethylene
Trichloroethene
1,1,1-Trichloroethane
Formaldehyde
Nitric Acid
Pesticides/Herbicides Group

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TABLE 3-18

LIST D CHEMICALS

Compound
N-Nitroso-Di-N-Propylamine
Dibenzofuran
Aroclors
Vinyl Chloride
Chloranil
Methylene Dianaline
Hexachlorobenzene
Quinoline
Arsenic Compounds
o-Toluidine
Acrylamide
PAHs
1,2-Dichloroethane
Vaponite 2 Insecticide
Potassium Cyanide
p-Dioxane
Sodium Nitrite
Diazinon
Cobalt Oxide
Hydrochloric Acid
Manganese Compounds
Perchloric Acid
Phosphoric Acid
Sodium Hydroxide
Bromacil
Potassium Hydroxide
Ammonia

TABLE 3-19

RADIONUCLIDES OF CONCERN

• Americium - 241
• Plutonium - 238, 239, 240, 241, and 242
• Thorium - 232
• Uranium - 233, 234, 235, and 238
• Hydrogen - 3 (tritium)

0116ALR5

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APPENDIX A

RADIOACTIVE MATERIALS AT THE ROCKY FLATS PLANT

APPENDIX A
RADIOACTIVE MATERIALS AT THE ROCKY FLATS PLANT

Radioactive Material Handled in Kilogram Quantities

Americium-241

Plutonium
- Pu-238
- Pu-239
- Pu-240
- Pu-241
- Pu-242

Thorium-232

Uranium
- U-233
- U-234
- U-235
- U-238

Radioactive Material Handled in Gram Quantities (<1 Kg)

Curium-244

Hydrogen-3 (Tritium)

Neptunium-237

Thorium-228

Other Sources

Includes sealed solid sources, plated sources, liquid sources, and analytical stock solutions.

Actinium	Ac-228	Californium	Cf-250, 251, 252
Aluminum	Al-26	Carbon	C-14
Americium	Am-243	Cerium	Ce-139, 144
Antimony	Sb-124, 125	Cesium	Cs-134, 137
Argon	Ar-39	Chlorine	Cl-36
Barium	Ba-133	Cobalt	Co-57, 60
Beryllium	Be-7	Curium	Cm-245, 246
Bismuth	Bi-207, 210	Europium	Eu-152, 154, 155
Cadmium	Cd-109	Holmium	Ho-166m

Iodine	I-129, 131
Iridium	Ir-192
Iron	Fe-55
Krypton	Kr-85
Lead	Pb-210
Manganese	Mn-54
Mercury	Hg-203
Nickel	Ni-63
Plutonium	Pu-236, 244
Polonium	Po-210
Potassium	K-40
Promethium	Pm-147
Protactinium	Pa-231, 234
Radium	Ra-226
Ruthenium	Ru-106
Selenium	Se-75
Silver	Ag-110, 110m
Sodium	Na-22
Strontium	Sr-85, 89, 90
Technetium	Tc-99, 99m
Thallium	Tl-204
Thorium	Th-230, 231, 234
Tin	Sn-113
Uranium	U-232, 236
Ytterbium	Yb-169
Yttrium	Y-88, 90
Zinc	Zn-65

APPENDIX B

RADIONUCLIDE MONITORING REPORTS REVIEWED

APPENDIX B

RADIONUCLIDE MONITORING REPORTS REVIEWED

U.S. DOE Effluent Information System, Nuclide Database Master List for Calendar Years 1953 to 1989.

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APPENDIX C

COMPARISON OF INVENTORY QUANTITIES: 1974 VS. 1988/89

Chemical	1988 Kilograms	1974 Kilograms	RATIO
ACENAPHTHENE	.015	.020	.7500
ACETAL	.020	.020	1.0000
ACETALDEHYDE SODIUM BISULFITE	.010	.020	.5000
ACETAMIDE	.466	1.400	.3326
ACETANILIDE	.010	.520	.0192
ACETOACETANILIDE	.010	.020	.5000
ACETONAPHTHONE 1	.010	.040	.2500
ACETONE	443.973	1562.000	.2842
ACETONE OXIME	.010	.020	.5000
ACETONITRILE	12.966	12.400	1.0457
ACETONYLACETONE	.050	.060	.8333
ACETOPHENONE	.010	.020	.5000
ACETYL 2 THIOUREA 1	.020	.020	1.0000
ACETYL ACETONE	.010	.020	.5000
ACETYL BROMIDE 132	.010	.070	.1429
ACROLEIN	.005	.100	.0500
ACRYLAMIDE	.010	6.000	.0017
ACRYLIC ACID	.010	.020	.5000
ACRYLONITRILE	.015	.520	.0288
ADIPAMIDE	.010	.020	.5000
ADIPIC ACID	.010	.020	.5000
ADIPONITRILE	.010	.020	.5000
ALDEHYDE AMMONIA	.010	.020	.5000
ALDOL	.010	.020	.5000
ALIQUAT 336	.500	1.900	.2632
ALKALINE IODINE AZIDE	.038	.100	.3800
ALLYL ACETATE	.012	.020	.6000
ALLYL ALCOHOL 138	.010	.020	.5000
ALLYL BROMIDE	.020	.020	1.0000
ALLYL CHLORIDE	.010	.020	.5000
ALLYL ETHER	.011	.020	.5500
ALLYLAMINE	.010	.020	.5000
ALUMINIUM NITRATE	6433.452	1456.000	4.4186
ALUMINUM CHLORIDE	3.324	4.900	.6784
ALUMINUM FLUORIDE	.100	2.300	.0435
ALUMINUM HYDROXIDE	9.672	3.600	2.6867
AMINO 2 HYDROXYMETHYL 1 3 PROPANEDIOL 2	.010	.720	.0139
AMINO 2 METHYL 1 3 PROPANEDIOL 2	.010	.020	.5000
AMINO 2 METHYL 1 PROPANOL 2	.010	.020	.5000
AMINO 2 NAPHTHOL 4 SULFONIC ACID 1	.700	1.600	.4375
AMINO 2 PROPANOL 1	.010	.040	.2500
AMINO 4 NITROPHENOL 2	.020	.020	1.0000
AMINO ANTHRAQUINONE 2	.020	.020	1.0000
AMINO NAPHTHOL SULFONIC ACID	.500	1.600	.3125
AMINO PYRIDINE 2	.010	.020	.5000
AMINO THIAZOLE 2	.010	.020	.5000
AMINOBENZENETHIOL O	.010	.020	.5000
AMINOETHYL HYDROGEN SULFATE 2	.020	.020	1.0000
AMINOETHYLAMINO ETHANOL 2,2	.010	.020	.5000
AMINOPHENOL O	.020	.060	.3333
AMINOPHENYL ETHYL ALCOHOL P	.010	.020	.5000
AMMONIA	10.000	996000.000	.0000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
AMMONIUM 1-PYRROLIDINE-DITHIOCARBAMATE	.200	.130	1.5385
AMMONIUM BIFLUORIDE	24.731	31.600	.7826
AMMONIUM DICHROMATE	1.183	2.600	.4549
AMMONIUM FLUORIDE	14.712	11.600	1.2682
AMMONIUM FORMATE	.454	.450	1.0080
AMMONIUM HYDROXIDE	217.906	479.000	.4549
AMMONIUM HYPOPHOSPHITE	.454	.950	.4775
AMMONIUM IODIDE	3.980	12.500	.3184
AMMONIUM OXALATE	5.036	24.500	.2056
AMMONIUM PERCHLORATE	1.361	2.300	.5917
AMMONIUM PHOSPHOTUNGSTATE	.454	.450	1.0080
AMMONIUM SULFAMATE	1.000	1.300	.7692
AMMONIUM SULFIDE	.020	.460	.0435
AMMONIUM TETRAFLUOROBORATE	.454	.450	1.0080
AMMONIUM THIOCYANATE	7.556	875.000	.0086
AMMONIUM VANADATE	.907	4.600	.1972
ANETHOLE	.010	.020	.5000
ANILINE	.473	1.000	.4731
ANILINE PHTHALATE	.207	.630	.3286
ANILINOETHANOL 2	.010	.020	.5000
ANISALDEHYDE	.010	.120	.0833
ANISIDINE O	.010	.040	.2500
ANISIDINE P	.010	.040	.2500
ANTHRACENE	.015	.520	.0288
ANTHRANILIC ACID	.110	.020	5.5000
ANTHRAQUINONE	.010	.020	.5000
ANTHRAQUINONE SULFONIC ACID,SODIUM SALT 2	.020	.270	.0741
ANTIMONY IODIDE	.454	.227	1.9982
ANTIMONY OXIDE	.002	2.400	.0008
ARSANILIC ACID	.200	.020	10.0000
ARSENIC ACID	.454	.450	1.0080
ARSENIC PENTOXIDE	.454	3.000	.1512
ARSENOUS ACID	.118	.614	.1926
ARSONOPHENYLAZO 4,5 DIHYDROXY 2,7 NAPHTHALENE DISULFONI	.010	.050	.2000
ASBESTOS	.572	27000.000	.0000
AURIN TRICARBOXYLIC ACID	.100	.215	.4651
BARIUM ACETATE	1.381	1.800	.7671
BARIUM CARBONATE	3.313	1.900	1.7439
BARIUM CHLORANILATE	.325	.475	.6842
BARIUM CHLORIDE	9.587	23.000	.4168
BARIUM CHROMATE	.907	1.400	.6480
BARIUM DIPHENYLAMINE SULFONATE	.050	.026	1.9231
BARIUM FLUORIDE	.454	1.300	.3489
BARIUM HYDROXIDE	3.406	3.900	.8734
BARIUM NITRATE	1.494	.760	1.9655
BARIUM OXIDE	6.990	1.000	6.9896
BARIUM PERCHLORATE	.454	1.000	.4536
BENZALDEHYDE	.010	.770	.0130
BENZAMIDE	.010	.020	.5000
BENZENE	5.956	42.500	.1401
BENZENE DISULFONIC ACID M	.020	.020	1.0000
BENZENE SULFONIC ACID	.020	.020	1.0000
BENZENE SULFONYL CHLORIDE	.010	.020	.5000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
BENZENEPHOSPHONOUS ACID	.020	.020	1.0000
BENZENETHIOL	.020	.020	1.0000
BENZHYDROL	.010	.020	.5000
BENZILIC ACID	.010	.040	.2500
BENZOIN	.010	.020	.5000
BENZOIN OXINE	.100	.590	.1695
BENZONITRILE	.270	1.200	.2250
BENZOPHENONE	.020	.020	1.0000
BENZOQUINONE P	.100	1.000	.1000
BENZOTHIAZOLE 2	.010	.020	.5000
BENZOTHIAZOLOL 2	.010	.020	.5000
BENZOXAZOLE	.010	.020	.5000
BENZYL ACETATE	.020	.020	1.0000
BENZYL ALCOHOL	.015	.020	.7500
BENZYL BENZOATE	.010	.020	.5000
BENZYL CHLORIDE	.010	.470	.0213
BENZYL DISULFIDE	.020	.020	1.0000
BENZYL SULFIDE	.020	.020	1.0000
BENZYL THIOCYANATE	.010	.026	.3846
BENZYLAMINE	.010	.820	.0122
BERYLLIUM	.085	9000.000	.0000
BERYLLIUM CARBONATE	.030	.084	.3520
BERYLLIUM OXIDE	.149	141.000	.0011
BERYLLIUM SULFATE	.474	.976	.4852
BIBENZYL	.011	.020	.5500
BICYCLO 2 2 1 5 HEPTENE 2 3 DICARBOXYLIC ANHYDRIDE	.010	.020	.5000
BIPHENYL	.010	.020	.5000
BIPYRIDINE	.060	.045	1.3333
BIS (2-ETHOXYETHYL) ETHER	.005	.020	.2500
BIS 2 CHLOROETHOXY ETHANE 1,2	.010	.020	.5000
BIS 2 CHLOROETHYL CARBONATE	.010	.020	.5000
BIS 2 ETHOXYETHYL ADIPATE	.010	.020	.5000
BIS 2 ETHOXYETHYL PHTHALATE	.010	.020	.5000
BIS 2 ETHOXYETHYL SEBACATE	.010	.020	.5000
BIS 2 ETHOXYETHYL ETHER	.010	.020	.5000
BIS 2 ETHYLHEXYL ADIPATE	.010	.020	.5000
BIS 2 METHOXYETHOXY ETHANE 1,2	.010	.020	.5000
BIS 2 METHOXYETHYL PHTHALATE	.010	.020	.5000
BIS 2 METHOXYETHYL ETHER	.010	.020	.5000
BIS 2 N BUTOXYETHYL PHTHALATE	.010	.020	.5000
BIS 2 PHENOXYETHYL ETHER	.010	.020	.5000
BIS O METHOXYPHENYL CARBONATE	.010	.020	.5000
BIS P BROMOPHENYL ETHER	.010	.020	.5000
BIS(2-ETHYLBUTYL)-PHTHALATE 516	.010	.020	.5000
BISMUTH CHLORIDE	.454	1.400	.3240
BISMUTH NITRATE	.474	3.700	.1280
BISMUTH TRIOXIDE	.593	.325	1.8258
BIUREA	.010	.020	.5000
BIURET	.010	.020	.5000
BORON CARBIDE	3.431	6.500	.5279
BORON METAL	.120	20.700	.0058
BROMACIL	.001	2700.000	.0000
BROMINE	.150	2.600	.0577

Chemical	1988 Kilograms	1974 Kilograms	RATIO
BROMO 2 CHLOROETHANE 1	.010	.020	.5000
BROMO 2 METHYLBUTANE 1	.010	.020	.5000
BROMO 2 METHYLPROPANE 2	.010	.040	.2500
BROMO 3 CHLOROPROPANE 1	.012	.040	.3000
BROMO 3 METHYLBUTANE 1	.010	.020	.5000
BROMO 4 CHLOROBENZENE 1	.010	.020	.5000
BROMO 4 PHENYL PHENOL 2	.010	.020	.5000
BROMOACETANALIDE P	.010	.020	.5000
BROMOBENZENE,M-	6.366	7.600	.8376
BROMOBUTANE 1	.015	.040	.3750
BROMOCHLOROMETHANE PURITY-99+% 0-604	.005	.270	.0185
BROMOCYCLOHEXANE	.010	.020	.5000
BROMODECANE 1	.010	.020	.5000
BROMODODECANE 1	.010	.020	.5000
BROMOFORM	5.515	1.400	3.9393
BROMOHEXANE 1	.010	.020	.5000
BROMOMANDELIC ACID P	.225	.110	2.0455
BROMOPENTANE 1	.012	.040	.3000
BROMOSUCCINIMIDE N	.010	.220	.0455
BROMOTOLUENE P	.010	.020	.5000
BROMOTRICHLOROMETHANE	.012	.060	.2000
BRUCINE SULFATE	.400	.510	.7843
BUTOXYETHANOL 2	.010	2.000	.0050
BUTOXYETHANOL,2-	.500	2.000	.2500
BUTOXYETHOXY ETHYL ACETATE 2,2	.010	.020	.5000
BUTOXYETHOXYETHANOL	.010	2.000	.0050
BUTOXYPHENOL P N	.010	.020	.5000
BUTYL ACETATE	.020	7.000	.0029
BUTYL ACETATE N	.473	.020	23.6560
BUTYL CHLOROFORMATE N	.010	.020	.5000
BUTYL LACTATE	.010	.020	.5000
BUTYL PHTHALATE N	.010	.020	.5000
BUTYLMENTHACRYLATE	.010	.020	.5000
BUTYRALDEHYDE N	.010	.020	.5000
BUTYRIC ANHYDRIDE N	.010	.020	.5000
BUTYROLACTONE 4	.010	.720	.0139
CADMIUM	.907	57.000	.0159
CADMIUM ACETATE	.277	.402	.6880
CADMIUM CHLORIDE	1.427	3.800	.3756
CADMIUM IODIDE	.118	.225	.5257
CADMIUM NITRATE	.138	34.000	.0041
CADMIUM OXIDE	25.642	2.800	9.1579
CADMIUM SULFATE	.479	1.800	.2659
CALCIUM HYPOCHLORITE	184.440	198.500	.9292
CALCIUM OXALATE	.059	2.000	.0296
CALCIUM SILICOFLUORIDE	.454	.450	1.0080
CALCIUM STEARATE	.454	.450	1.0080
CALCIUM SULFIDE	3.175	3.700	.8582
CAMPHENE	.010	.120	.0833
CAPRIC SULFATE	24.000	.020	1200.0000
CAPROIC ACID N	.010	.220	.0455
CAPROLACTAM	.010	.020	.5000
CARBANILIDE	.010	.020	.5000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
CARBON DISULFIDE	5.912	3.300	1.7917
CARBON TETRACHLORIDE	7058.399	12502.000	.5646
CARBOXYMETHYL IMINO BIS-ETHYLENE NITRILO TETRAACETIC AC	.600	3.000	.2000
CATECHOL	.010	.520	.0192
CERIC AMMONIUM NITRATE	20.020	1.000	20.0200
CERIC AMMONIUM SULFATE	1.814	2.900	.6257
CERIC SULFATE	6.082	46.600	.1305
CERIUM CHIPS	.050	5.500	.0091
CEROUS NITRATE	.454	.227	1.9982
CESIUM BROMIDE	.474	.227	2.0863
CESIUM CHLORIDE	2.870	.520	5.5192
CESIUM IODIDE	.050	.200	.2500
CESIUM NITRATE	.012	2.000	.0060
CESIUM SULFATE	.045	.400	.1114
CHLORANIL	.250	1.000	.2500
CHLORANILIC ACID	.100	.180	.5556
CHLORO 1 NITROPROPANE 1	.010	.020	.5000
CHLORO 2 METHYLPROPANE 2	.010	.020	.5000
CHLORO 2 METHYLPROPENE 3	.010	.020	.5000
CHLORO 2 NITROANILINE 4	.010	.040	.2500
CHLORO 2 NITROBENZENE 1	.010	.060	.1667
CHLORO 2 NITROPHENOL 4	.010	.020	.5000
CHLORO 2 PROPANONE	.010	.020	.5000
CHLORO 3 METHYLBUTANE 1	.011	.080	.1375
CHLORO 4 NITROBENZENE 1	.010	.060	.1667
CHLOROACETAMIDE 2	.010	.020	.5000
CHLOROACETIC ACID	.115	8.300	.0139
CHLOROBENZENE	.488	6.000	.0814
CHLOROBENZENE SULFONIC ACID P	.020	.020	1.0000
CHLOROBENZOIC ACID P	.010	.020	.5000
CHLOROBUTANE 1	.010	.140	.0714
CHLORODIPHENYLMETHANE	.010	.020	.5000
CHLOROETHANOL 2	.020	.820	.0244
CHLOROFORM	491.884	5513.000	.0892
CHLOROHEXANE 1	.011	.020	.5500
CHLOROMETHYL HEPTANE 3	.010	.020	.5000
CHLORONAPHTHALENE 1	.010	.270	.0370
CHLOROOCTADECANE 1	.010	.020	.5000
CHLOROPENTANE 1	.011	.020	.5500
CHLOROPHENOL O	.020	.120	.1667
CHLOROPHENOXYACETIC ACID P	.010	.120	.0833
CHLOROPHENYL ACETYLNITRILE P	.010	.020	.5000
CHLOROPLATINIC ACID	.030	.007	4.2243
CHLOROPROPIONIC ACID 2	.010	.040	.2500
CHLOROPROPIONITRILE 3	.010	.020	.5000
CHLOROSUCCINIMIDE N	.010	.020	.5000
CHLOROTOLUENE O	.010	1.200	.0083
CHROMIC ACID	1.207	.870	1.3876
CHROMIUM	.947	7.500	.1262
CHROMIUM CHLORIDE	2.742	48.500	.0565
CHROMIUM NITRATE	72.596	8.900	8.1569
CHROMIUM OXIDE	3.969	3.300	1.2027
CHROMIUM POTASSIUM SULFATE	.954	.450	2.1191

Chemical	1988 Kilograms	1974 Kilograms	RATIO
CHROMIUM SULFATE	2.268	4.500	.5040
CHROMIUM TRIOXIDE	647.229	23.000	28.1404
CITRACONIC ANHYDRIDE	.010	.120	.0833
COBALT (METAL, POWDER, WIRE, FOIL)	4.625	4.600	1.0054
COBALT CHLORIDE	.474	5.600	.0846
COBALT NITRATE	.020	1.600	.0125
COBALT OXIDE	.454	677.000	.0007
COBALT SULFAMATE	2.957	4.500	.6571
COBALT SULFATE	.907	5.800	.1564
COPPER SULFATE	.250	14.700	.0170
CRESOL M	.020	.520	.0385
CROTONALDEHYDE	.010	.020	.5000
CROTONIC ACID	.010	.020	.5000
CUMENE	.020	.020	1.0000
CUPFERRON	4.707	5.100	.9229
CUPRIC ACETATE	1.381	1.200	1.1507
CUPRIC CARBONATE	.454	1.700	.2668
CYANOACETAMIDE 2	.010	.020	.5000
CYANOACETIC ACID	.010	.020	.5000
CYANURIC ACID	.010	.020	.5000
CYCLOHEXANE	108.354	90.800	1.1933
CYCLOHEXANE CABOXYLIC ACID	.010	.020	.5000
CYCLOHEXANEDICARBOXILIC ANHYDRIDE 1,2	.010	.040	.2500
CYCLOHEXANOL	.488	.100	4.8812
CYCLOHEXANONE	.020	.020	1.0000
CYCLOHEXYL ACETATE	.010	.020	.5000
CYCLOHEXYL AMINE	.010	.270	.0370
CYCLOHEXYLENE DINITRILO TETRAACETICACID 1,2	.100	.100	1.0000
CYCLOPENTANE	.010	.120	.0833
CYCLOPENTANONE	.020	.020	1.0000
CYMENE P	.020	.020	1.0000
DECANEDIOL 1,10	.010	.017	.5882
DECANOIC	.010	.020	.5000
DECYL ALCOHOL N	.010	.020	.5000
DEHYDROACETIC ACID	.010	.020	.5000
DEUTERIUM SULFIDE	10.000	10.000	1.0000
DI N BUTOXYBENZENE P	.010	.020	.5000
DI N BUTYL 2 THIOUREA 1,3	.010	.020	.5000
DI N PROPYLAMINE	.010	.020	.5000
DIACETONE ALCOHOL	.010	.020	.5000
DIALLYL ADIPATE	.010	.020	.5000
DIALLYL AMINE	.010	.020	.5000
DIALLYL MALEATE	.010	.020	.5000
DIALLYL PHTHALATE	.010	13.500	.0007
DIAMINO DIPROPYLAMINE 3,3	.010	.020	.5000
DIAMYL AMYL PHOSPHONATE	2.000	4.000	.5000
DIAMYL PHTHALATE	.010	.020	.5000
DIBENZO FURAN	.010	.020	.5000
DIBENZYL AMINE	.010	.020	.5000
DIBENZYL SUCCINATE	.010	.020	.5000
DIBROMO 1 PROPANOL 2,3	.010	.020	.5000
DIBROMO 1,1 DICHLOROETHANE 1,2	.010	.020	.5000
DIBROMO 8 QUINOLINOL 5,7	.050	.050	1.0000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
DIBROMO CHLOROMETHANE	.010	7.600	.0013
DIBROMO METHANE	.020	.020	1.0000
DIBROMO TETRAFLUORO BENZENE 12	.237	1.000	.2366
DIBROMO THIOPHENE	.025	.020	1.2500
DIBROMOBIPHENYL 4,4	.005	.020	.2500
DIBROMOPROPANE 1,2	.010	.040	.2500
DIBROMOTHIOPHENE 2,5	.010	.020	.5000
DIBROMOTHYMOL SULFONE PHTHALEIN	.001	.008	.1250
DIBUTYL ADIPATE	.020	.020	1.0000
DIBUTYL BUTYL PHOSPHONATE	.600	.100	6.0000
DIBUTYL CARBITOL	3.785	13.100	.2889
DIBUTYL CARBONATE	.020	.020	1.0000
DIBUTYL DIETHYL CARBAMYL PHOSPHONATE	.100	.100	1.0000
DIBUTYL MALEATE	.010	.020	.5000
DIBUTYL PHOSPHATE	5.285	5.000	1.0570
DIBUTYL SUCCINATE	.010	.020	.5000
DIBUTYLTIN DIETHYLHEXOATE	.010	.100	.1000
DICHLORO 2 BUTENE, TRANS 1,4	.010	.020	.5000
DICHLORO 3,6 DIHYDROXY P BENZOQUINONE MERCURY SALT 2,5	.010	.010	1.0000
DICHLORO FLUORESCEIN	.010	.001	10.0000
DICHLORO ISOCYANURIC ACID SODIUM SALT	1.250	3.000	.4167
DICHLORO PHENYL PHOSPHINE	.010	.020	.5000
DICHLORO PHENYL PHOSPHINE OXIDE	.010	.020	.5000
DICHLORO PHENYL PHOSPHINE SULFIDE	.010	.020	.5000
DICHLOROBENZENE O	.015	1.600	.0094
DICHLOROBUTANE 1,4	.020	.020	1.0000
DICHLOROETHANE 1,2	.006	8.100	.0007
DICHLOROETHYLENE CIS 1,2	.011	.040	.2750
DICHLOROETHYLENE PURITY CIS 97%, TRANS 2% 0-659 CIS 1,2	.001	.020	.0500
DICHLOROPENTANE 1,5	.010	.020	.5000
DICHLOROPHENOL 2,4	.020	.020	1.0000
DICHLOROPROPANE 1,2	.020	.040	.5000
DICHLOROTOLUENE 2,4	.010	.040	.2500
DICYANO DIAMIDE	.010	.010	1.0000
DICYCLOHEXANONE OXALYL DIHYDRAZONE	.160	.100	1.6000
DICYCLOHEXYL ADIPATE SOLID	.010	.020	.5000
DICYCLOHEXYL AMINE	.010	.020	.5000
DICYCLOHEXYL AMINE NITRILE	.100	.450	.2222
DICYCLOHEXYL PHTHALATE	.020	.020	1.0000
DICYCLOPENTANDIENE	.010	.020	.5000
DIETHANOLAMINE	.956	.020	47.8120
DIETHOXYBENZENE O	.010	.040	.2500
DIETHYL ADIPATE	.020	.020	1.0000
DIETHYL AMINE HYDROCHLORIDE	.010	.020	.5000
DIETHYL BENZENE	11.375	4.700	2.4202
DIETHYL BROMOMALONATE	.010	.020	.5000
DIETHYL CARBONATE	.010	.020	.5000
DIETHYL DIETHYL MALONATE	.010	.020	.5000
DIETHYL DITHIOCARBAMIC ACID SODIUM SALT	.210	.380	.5526
DIETHYL ETHYL MALONATE	.010	.020	.5000
DIETHYL ETHYL PHOSPHONATE	.010	.020	.5000
DIETHYL FUMARATE	.020	.020	1.0000
DIETHYL MALEATE	.020	.020	1.0000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
DIETHYL MALONATE	.010	.020	.5000
DIETHYL OXALATE	.010	.208	.0481
DIETHYL PHENYL MALONATE	.010	.020	.5000
DIETHYL SEBACATE	.020	.020	1.0000
DIETHYLAMINOETHANOL 2	.010	.020	.5000
DIETHYLAMINOPHENOL M	.500	.620	.8065
DIETHYLAMINOPROPIONITRILE 3	.010	.020	.5000
DIETHYLENE GLYCOL	4.010	36.700	.1093
DIETHYLENE TRIAMINE	.010	.020	.5000
DIETHYLENE TRIAMINE PENTAACETIC ACID	.437	5.800	.0753
DIHYDROQUERCETIN	.010	.030	.3333
DIHYDROXY 3,3 DIMETHYLDIPHENYL 4,4	.030	.030	1.0000
DIHYDROXY 3,6 DISULFO 2 NAPHTHYL AZO SALICYLIC ACID 4,1	.010	.010	1.0000
DIHYDROXYACETOPHENONE 2,4	.020	.020	1.0000
DIHYDROXYPHENYLAZO BENZENE SULFONIC ACID SODIUM SALT P	.075	1.725	.0435
DIISOBUTYLENE	.010	.020	.5000
DIISOPROPYL 2,3 DIMETHYBUTANE PURITY-99+% 0-730	.002	.020	.1000
DIISOPROPYL BENZENE	7.570	.020	378.4960
DIMETHOXYBENZENE P	.010	.020	.5000
DIMETHYL 1,4 CYCLOHEXANE DICARBOXYLATE	.005	.020	.2500
DIMETHYL 4 HEPTANONE 2,6	.020	.020	1.0000
DIMETHYL ACETAMIDE N N	.010	.020	.5000
DIMETHYL ADIPATE	.020	.020	1.0000
DIMETHYL AMINOBENZYLIDENE RHODANINE	.001	.018	.0556
DIMETHYL CARBONATE	.015	.020	.7500
DIMETHYL DODECYLAMINE N N	.010	.020	.5000
DIMETHYL FORMAMIDE	23.183	6.500	3.5666
DIMETHYL GLYOXIME	4.370	7.700	.5675
DIMETHYL HYDRAZINE 1,1	.010	.020	.5000
DIMETHYL ITACONATE	.020	.020	1.0000
DIMETHYL NAPHTHALENE	.010	.020	.5000
DIMETHYL OXALATE	2.110	1.900	1.1105
DIMETHYL PHTHALATE	4.820	.060	80.3327
DIMETHYL SEBACATE	.020	.020	1.0000
DIMETHYL SULFATE	.020	.520	.0385
DIMETHYL SULFOLANE	.060	.075	.8000
DIMETHYL SULFOXIDE	.500	9.200	.0543
DIMETHYLAMINE HYDROCHLORIDE	.010	.020	.5000
DIMETHYLAMINO 2 PROPANOL 1	.010	.020	.5000
DIMETHYLAMINO BENZALDEHYDE	.010	.280	.0357
DIMETHYLAMINOBENZYLIDENE RHODANINE 5 P	.014	.018	.7778
DIMETHYLANILINE 2,4	.010	2100.040	.0000
DIMETHYLBENZYL ALCOHOL D D	.010	.040	.2500
DIMETHYLPHENOL 2,6	.010	.225	.0444
DIMETHYLPYRAZOLE 3,5	.010	.020	.5000
DIMETHYLUREA 1,3	.010	.020	.5000
DIMETHYPIPERIDINE 2,6	.010	.020	.5000
DINITRO 1 NAPHTHOL 2,4	.025	.020	1.2500
DINITROANILINE 2,4	.010	.020	.5000
DINITROBENZENE M	.010	.120	.0833
DINITROBENZOYL CHLORIDE 3,5	.010	.020	.5000
DINITROPHENYLHYDRAZINE 2,4	.010	.040	.2500
DIOCTYL PHENYL PHOSPHONATE	.100	.100	1.0000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
DIOCTYL PHTHALATE	1.105	3300.000	.0003
DIOCTYL SULFOSUCCINATE SODIUM SALT	2.000	2.300	.8696
DIOXANE	22.720	9.600	2.3666
DIPENTENE	.010	.020	.5000
DIPHENOXYETHANE 1,2	.010	.020	.5000
DIPHENYL ACETIC ACID	.010	.020	.5000
DIPHENYL AMINE	1.030	1.800	.5723
DIPHENYL BENZIDINE N N	.001	.002	.5000
DIPHENYL CARBAZONE	.030	.350	.0857
DIPHENYL CARBOHYDRAZIDE	.100	.417	.2398
DIPHENYL CARBONATE	.010	.020	.5000
DIPHENYL GLYOXIME	.010	.020	.5000
DIPHENYL METHANE	.010	.020	.5000
DIPHENYL OXAZOLE	.250	.025	10.0000
DIPHENYL PHOSPHITE	.020	.020	1.0000
DIPHENYL PHTHALATE	.020	.020	1.0000
DIPHENYL THIOCARBAZONE	.070	.125	.5600
DIPHENYLAMINE SULFONIC ACID BARIUM SALT P	.010	.020	.5000
DIPHENYLCARBOHYDRAZIDE 1,5	.100	.020	5.0000
DIPROPYLENE GLYCOL	.010	1.000	.0100
DISODIUM ETHYLENEDINITRILO TETRAACETATE	1.144	2.600	.4399
DITERTBUTYL HYDROQUINONE 2,5	2.000	2.000	1.0000
DITHIOBISBENZOTHIAZOLE 2,2	.010	.020	.5000
DITHIODIBENZOIC ACID 2,2	.010	.020	.5000
DITHIODIMORPHOLINE 4,4'	.010	.020	.5000
DOCOSENOIC ACID	.010	.020	.5000
DODECANETHIOL 1	.020	.020	1.0000
DODECYL SODIUM SULFATE, 95% SODIUM LAURYL SULFATE	.100	.125	.8000
DURENE	.010	.020	.5000
EICOSANE	.015	.020	.7500
EPICHLOROHYDRIN	.010	.020	.5000
EPOXY 3 PHENOXYPROPANE 1,2	.010	.020	.5000
EPOXYETHYLBENZENE 1,2	.010	.020	.5000
ETHANOLAMINE	.010	.020	.5000
ETHOXYETHOXY ETHANOL	.010	.020	.5000
ETHOXYETHOXY ETHYL ACETATE 2,2	.010	.020	.5000
ETHOXYNAPHTHALENE 2	.010	.020	.5000
ETHOXYPROPIONITRILE 3	.010	.020	.5000
ETHYL 1,3 HEXANEDIOL 2	.010	1.300	.0077
ETHYL 2 BROMOPROPIONATE	.010	.060	.1667
ETHYL ACETATE	4.528	26.700	.1696
ETHYL ACETOACETATE	.010	.020	.5000
ETHYL ACRYLATE	.010	.020	.5000
ETHYL BENZENE	.927	7.000	.1325
ETHYL BENZOYLACETATE	.010	.020	.5000
ETHYL BROMIDE	.010	.020	.5000
ETHYL BROMOACETATE	.010	.020	.5000
ETHYL CARBAMATE	.010	15.020	.0007
ETHYL CHLOROACETATE	.010	.040	.2500
ETHYL CHLOROFORMATE	.010	.020	.5000
ETHYL CHLOROSULFONATE	.020	.020	1.0000
ETHYL CINNAMATE	.010	.020	.5000
ETHYL CYANOACETATE	.010	.020	.5000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
ETHYL FORMATE	.020	.020	1.0000
ETHYL HEXADECYLDIMETHYL AMMONIUM BROMIDE	.010	.020	.5000
ETHYL IODIDE	.010	.020	.5000
ETHYL MERCAPTOACETATE	.010	.020	.5000
ETHYL METHACRALATE	.010	.020	.5000
ETHYL MORPHOLINE N	.010	.020	.5000
ETHYL N BUTYRIC ACID 2	.010	.020	.5000
ETHYL OLEATE	.020	.020	1.0000
ETHYL ORTHOSILICATE	.020	.020	1.0000
ETHYL OXALATE	3.785	.475	7.9683
ETHYL P HYDROXYBENZOATE	.010	.020	.5000
ETHYL P-TOLUENESULFONATE	.010	.020	.5000
ETHYL PHENYLACETATE	.010	.020	.5000
ETHYL SULFATE	.020	.020	1.0000
ETHYL VINYL ETHER	.010	.020	.5000
ETHYLAMINE HYDROCHLORIDE	.010	.020	.5000
ETHYLAMINO ETHANOL 2	.010	.020	.5000
ETHYLENE BROMIDE	.010	.514	.0195
ETHYLENE CHLORIDE	.015	.144	.1042
ETHYLENE DIACETATE	.020	.920	.0217
ETHYLENE DIAMINE	5.259	.360	14.6071
ETHYLENE GLYCOL	691.957	22349.000	.0310
ETHYLENE GLYCOL MONOBUTYL ETHER	.010	.020	.5000
ETHYLENE GLYCOL MONOETHYL ETHER	.010	8.200	.0012
ETHYLHEXYLAMINE 2	.010	.910	.0110
ETHYLIDENE DIACETATE	.010	.020	.5000
FENCHONE	.010	.020	.5000
FERRIC AMMONIUM OXALATE	.454	.450	1.0080
FERRIC NITRATE	4.788	20.100	.2382
FERROUS AMMONIUM SULFATE	7.288	6.500	1.1212
FERROUS SULFAMATE	908.390	5.600	162.2126
FERROUS SULFIDE	.020	452.000	.0000
FLUOBORIC ACID	2.454	10.100	.2429
FLUORANTHENE	.015	.120	.1250
FLUORENE	.015	.020	.7500
FLUORO BENZENE	.005	.020	.2500
FLUOSILICIC ACID	23.036	4.400	5.2355
FORMALDEHYDE	134.948	27.000	4.9981
FORMAMIDE	1.912	9.200	.2079
FORMIC ACID	5.319	7.000	.7599
FORMIC ACID THALLOUS SALT	.150	.200	.7500
FREON 11	1521.359	7537.000	.2019
FREON 12	1311.832	16.400	79.9898
FURFURAL	.010	.020	.5000
FURFURYL ACETATE	.010	.020	.5000
FURILDIOXINE	.050	.045	1.1111
GADOLINIUM METAL	.018	.001	18.0000
GADOLINIUM OXIDE	.927	.070	13.2457
GALLIUM OXIDE	.032	.005	6.4000
GERMANIUM	.010	.085	.1176
GLYCINE ETHYL ESTER HYDROCHLORIDE	.010	.020	.5000
GLYCOLIC ACID	4.510	2.600	1.7346
GLYOXAL	.010	.020	.5000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
HAFNIUM	.005	.109	.0459
HEPTYL ALCOHOL N	.010	.020	.5000
HEXACHLORO 1,3 BUTADIENE	.464	.020	23.1800
HEXACHLORO BENZENE	1.005	1.000	1.0050
HEXACHLORO ETHANE	.020	.020	1.0000
HEXADECYLAMINE	.010	.020	.5000
HEXAFLUORO ISOPROPANOL	.454	.606	.7490
HEXAMETHYL DISILAZANE	.100	.700	.1429
HEXAMETHYL PHOSPHORAMIDE	.050	.650	.0769
HEXAMETHYLENE TETRAMINE	1.964	1.500	1.3091
HEXANE	62.365	61.000	1.0224
HEXANEDIAMINE 1,6	.010	.020	.5000
HEXANETHIOL 1	.020	.020	1.0000
HEXANETRIOL 1,2,6	.010	.020	.5000
HEXANIT RODIPHENYLAMINE	.025	.025	1.0000
HEXANONE 2	.025	.060	.4167
HEXENE 2	.010	.020	.5000
HEXYL ALCOHOL N	.010	.020	.5000
HEXYLAMINE N	.010	.020	.5000
HOLMIUM CHLORIDE	.010	.005	2.0000
HOLMIUM METAL	.010	.005	2.0000
HOLMIUM OXIDE	.010	.010	1.0000
HYDRACRYLONITRILE	.010	.020	.5000
HYDRAZINE 95%	.500	30.000	.0167
HYDRAZINE DIHYDROCHLORIDE	.610	.720	.8472
HYDROBROMIC ACID	3.334	9.000	.3704
HYDROCHLORIC ACID	682.639	1300.000	.5251
HYDROCINNAMALDEHYDE	.010	.020	.5000
HYDROCINNAMIC ACID	.010	.020	.5000
HYDROFLUORIC ACID*	40.645	1487.000	.0273
HYDROQUINONE	4.860	2.800	1.7357
HYDROXY 1 NAPHTHYLAZO BENZENE SULFONIC ACID SODIUM SALT	.025	.025	1.0000
HYDROXYACETOPHENONE O	.010	.040	.2500
HYDROXYANTHRAQUINONE 1	.120	.120	1.0000
HYDROXYBENZALDEHYDE P	.010	.020	.5000
HYDROXYETHYL ACETATE 2	.011	.020	.5500
HYDROXYETHYL ETHYLENEDIAME TRIACETIC ACID N	.200	.225	.8889
HYDROXYLAMINE HYDROCHLORIDE	31.914	14.600	2.1859
HYDROXYLAMINE SULFATE	2.268	81.000	.0280
HYDROXYMETHYL 2 METHYL 1 3 PROPANEDIOL 2	.010	.020	.5000
HYDROXYPHENYL ARSONIC ACID P	.500	.300	1.6667
HYDROXYPHENYL BENZOXAZOLE 2 O	.025	.025	1.0000
HYDROXYPHENYL GLYCINE N P	.010	.120	.0833
HYDROXYQUINOLINE 8	.010	.020	.5000
HYDROXYSTEARIC ACID 12	.010	.020	.5000
HYPOPHOSPHOROUS ACID	2.819	4.600	.6129
IMIDAZOLIDINETHIONE 2	.015	.020	.7500
INDIGO DISULFONIC ACID DISODIUM SALT 5,5	.200	.400	.5000
INDOLE	.010	.020	.5000
IODIC ACID	1.025	2.000	.5127
IODINE	10.811	10.500	1.0296
IODINE PENTOXIDE	.025	.933	.0268
IODOBENZENE	.010	.020	.5000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
IODOFORM	.010	.220	.0455
IODOPROPANE 1	.010	.040	.2500
IODOTOLUENE P	.010	.020	.5000
IRIDIUM	.006	.001	6.0000
ISATIN	.010	.020	.5000
ISOAMYL BENZYL ETHER	.010	.020	.5000
ISOAMYL ETHER	.011	.020	.5500
ISOPHORONE	.010	.020	.5000
ISOPRENE	.010	.020	.5000
ISOPROPANOL	2.000	333.000	.0060
ISOPROPYL ETHER	3.785	1.000	3.7850
ITACONIC ACID	4.045	.020	202.2480
LACTONITRILE	.010	.020	.5000
LAUROYL CHLORIDE	.010	.020	.5000
LEAD	2.000	504000.000	.0000
LEAD ACETATE	.927	.620	1.4955
LEAD CARBONATE	.454	.002	283.5000
LEAD CHLORIDE	2.288	1.800	1.2711
LEAD CITRATE AR	.100	.100	1.0000
LEAD FLUORIDE	.454	.200	2.2680
LEAD NITRATE	2.451	1.800	1.3617
LEAD OXIDE	.072	38.100	.0019
LEAD SULFATE	.454	2.300	.1972
LIMONENE D	.010	.020	.5000
LITHIUM ALUMINUM HYDRIDE	6.850	.200	34.2500
LITHIUM CARBONATE	1.328	4.200	.3163
LITHIUM CHLORIDE	5.933	14.500	.4092
LITHIUM FLUORIDE	3.084	1.900	1.6234
LITHIUM HYDROXIDE	1.814	7.300	.2485
LITHIUM IODIDE	.025	.100	.2500
LITHIUM METAL	.025	1.100	.0227
LITHIUM NITRATE	.257	1.400	.1833
LITHIUM PERCHLORATE	.454	1.500	.3024
LITHIUM SULFATE	.138	.204	.6778
LUMOGALLION	.020	.020	1.0000
LUTIDINE 2,4	.010	.040	.2500
MAGNESIUM	1.287	95.700	.0134
MAGNESIUM ACETATE	3.792	5.400	.7021
MAGNESIUM CARBONATE	.237	13.400	.0177
MAGNESIUM CHLORIDE	295.024	195.000	1.5129
MAGNESIUM FLUORIDE	2.268	5.000	.4536
MAGNESIUM HYDROXIDE	2.000	4.500	.4444
MAGNESIUM IODATE	.118	.113	1.0467
MAGNESIUM NITRATE	16.649	10.300	1.6164
MAGNESIUM OXIDE	2.636	1280.000	.0021
MAGNESIUM PERCHLORATE	8.618	17.500	.4925
MAGNESIUM SILICOFLUORIDE	.454	.450	1.0080
MAGNESIUM ZIRCONATE	.454	180.000	.0025
MALEIC ACID	.010	.120	.0833
MALEIC ACID HYDRAZIDE	.010	.020	.5000
MALEIC ANHYDRIDE	.010	.020	.5000
MALONIC ACID	1.600	4.900	.3265
MANDELIC ACID	.100	.920	.1087

Chemical	1988 Kilograms	1974 Kilograms	RATIO
MANGANESE	.050	13.800	.0036
MANGANESE DIOXIDE	.085	1.100	.0773
MANGANOUS CHLORIDE	.020	5.000	.0040
MANGANOUS NITRATE	.473	.594	.7965
MANGANOUS SULFATE	.040	2560.000	.0000
MELAMINE	.011	.020	.5500
MERCAPTOBENZOIC ACID O	.010	.020	.5000
MERCAPTOBENZOTHIAZOLE 2	.010	.120	.0833
MERCAPTOETHANOL 2	.110	.020	5.5000
MERCAPTOPROPIONIC ACID 2	.010	.020	.5000
MERCURIC ACETATE	.020	.212	.0943
MERCURIC CHLORANILATE	.025	.010	2.5000
MERCURIC CHLORIDE	2.078	7.100	.2926
MERCURIC IODIDE	.907	1.300	.6978
MERCURIC NITRATE	.927	2.400	.3863
MERCURIC OXIDE	.002	1.100	.0018
MERCURIC POTASSIUM THIOCYANATE	.118	.114	1.0375
MERCURY	3.632	442.000	.0082
MESITYL OXIDE	.020	2.000	.0100
MESITYLENE	.010	.020	.5000
METHACRYLAMIDE	.010	.020	.5000
METHACRYLIC ACID,SODIUM SALT	.010	.020	.5000
METHANE SULFONIC ACID	.010	.020	.5000
METHOXY 1 BUTANOL 3	.010	.020	.5000
METHOXY 1 BUTYL ACETATE 3	.010	.020	.5000
METHOXY 2 PROPANOL 1	.010	.020	.5000
METHOXYACETIC ACID	.010	.020	.5000
METHOXYETHYL ACETATE 2	.015	.040	.3750
METHOXYETHYL ACRYLATE 2	.010	.020	.5000
METHOXYNAPHTHALENE 2	.010	.020	.5000
METHOXYPHENOL P	.002	.040	.0500
METHOXYPROPIONITRILE 3	.010	.020	.5000
METHOXYPROPYLAMINE 3	.010	.020	.5000
METHYL 8 QUINOLINOL 2	.025	.005	5.0000
METHYL ABIETATE	.020	.020	1.0000
METHYL ACETAMIDE N	.010	.020	.5000
METHYL ACETATE	.010	.020	.5000
METHYL ACRYLATE	.010	.020	.5000
METHYL ALCOHOL	91.988	485.000	.1897
METHYL AMINOETHANOL 2	.010	.020	.5000
METHYL ANILINE N	.010	.970	.0103
METHYL BENZENESULFONATE	.010	.020	.5000
METHYL BENZOATE	.010	.020	.5000
METHYL BUTYRATE	.010	.020	.5000
METHYL CELLOSOLVE	15.140	246.000	.0615
METHYL CYCLOHEXYLAMINE N	.010	.020	.5000
METHYL CYCLOPENTANE	.010	.020	.5000
METHYL ETHYL KETONE	68.445	30.000	2.2815
METHYL ISOBUTYL KETONE	35.891	21.000	1.7091
METHYL METHACRYLATE	.010	4.500	.0022
METHYL MORPHOLINE N	.010	.050	.2000
METHYL N NITROSOANILINE N	.010	.020	.5000
METHYL OCTANOATE	.010	.020	.5000

Chemical	1988 Kilograms	1974 Kilograms	RATIO
METHYL P HYDROXYBENZOATE	.010	.020	.5000
METHYL P-TOLUENE SULFONATE	.010	.080	.1250
METHYL PIPERIDINE 2	.010	.020	.5000
METHYL QUINOLINOL	.005	.005	1.0000
METHYL SALICILATE	.010	.020	.5000
METHYL SULFOXIDE	6.055	.025	242.1984
METHYL SULFURIC ACID,POTASSIUM SALT	.020	.020	1.0000
METHYLACETOPHENONE P	.010	.120	.0833
METHYLAMINE HYDROCHLORIDE	.060	.020	3.0000
METHYLBENZOTHIAZOLE 2	.010	.020	.5000
METHYLCYCLOHEXENE 4	.010	.020	.5000
METHYLENE CHLORIDE	279.231	1502.000	.1859
METHYLENE DIANILINE	1.000	.120	8.3333
MOLYBDENUM DISULFIDE	5.897	.569	10.3634
MOLYBDENUM METAL	.200	23.900	.0084
MOLYBDENUM TRIOXIDE	2.842	2.500	1.1368
MOLYBDIC ACID	.454	.800	.5670
MORPHOLINE	.010	1.000	.0100
MUCIC ACID	.010	.020	.5000
MUREXIDE	.030	.900	.0333
NAPHTHALENE	.922	1.800	.5123
NAPHTHALENE SULFONIC ACID 2	.010	.020	.5000
NAPHTHALENEACETIC ACID 1	.010	.020	.5000
NAPHTHALENEDIOL 1,5	.010	.040	.2500
NAPHTHOL 3,6 DISULFONIC ACID, DISODIUM SALT 2	.020	.040	.5000
NAPHTHOL BENZOATE 2	.010	.020	.5000
NAPHTHOQUINONE 1,4	.010	.020	.5000
NAPHTHYL ETHYLENEDIAMINE DIHYDROCHLORIDE N 1	.045	.080	.5625
NEODYMIUM OXIDE	.500	.010	50.0000
NEODYMIUM SULFATE	.010	.010	1.0000
NICKEL ACETATE	2.268	4.100	.5532
NICKEL CYANIDE	.907	1.200	.7560
NICKEL METAL	.572	133.000	.0043
NICKEL OXIDE	1.010	.351	2.8775
NICKEL SULFAMATE	4.250	.260	16.3462
NICKEL SULFATE	74.250	22.400	3.3147
NICKELOUS CHLORIDE	4.302	31.500	.1366
NICKELOUS NITRATE	4.556	5.700	.7993
NICOTINIC ACID	.010	.040	.2500
NIOBIUM METAL	.001	1635.000	.0000
NIOBIUM OXIDE	.010	.665	.0150
NITRIC ACID*	52446.831	12450.000	4.2126
NITRIC OXIDE	10.000	168142.000	.0001
NITRILO TRIACETIC ACID	1.600	1.350	1.1852
NITROBARBITURIC ACID 5	.100	.100	1.0000
NITROBENZENE	2.376	4.000	.5939
NITROETHANE	.010	.020	.5000
NITROGEN DIOXIDE	10.000	198.000	.0505
NITRONAPHTHALENE 1	.010	.020	.5000
NITROPROPANE 1	.020	.040	.5000
NITROSALICYLALDEHYDE 5	.025	.050	.5000
NITROSO 2 NAPHTHOL 1	.120	.920	.1304
NITROSO DIPHENYLAMINE N	.005	.020	.2500

APPENDIX D

SUMMATION OF INVENTORY QUANTITIES

Newname	Sum of Kilos
DI 2 ETHYLHEXYL PHTHALATE	.010
DI 2 ETHYLHEXYL SEBACATE	.010
DI CYCLOHEXYL ADIPATE	.010
DI CYCLOHEXYL AZELATE	.010
DI ISOAMYL OXALATE	.010
DI ISOBUTYL ADIPATE	.010
DI ISOBUTYL PHTHALATE	.030
DI ISOBUTYL PHTHALATE 522	.030
DI ISODECYL ADIPATE	.010
DI ISODECYL AZELATE	.010
DI ISODECYL MALEATE	.010
DI ISODECYL PHTHALATE	.010
DI ISONONYL ADIPATE	.010
DI ISONONYL PHTHALATE	.010
DI ISOOCTYL ISOPHTHALATE	.010
DI ISOOCTYL PHTHALATE	.010
DI ISOPROPANOL AMINE	.010
DI ISOPROPYL 2,3 DIMETHYLBUTANE	.002
DI ISOPROPYL BENZENE	.020
DI METHYLCYCLOHEXYL PHTHALATE	.010
DI N AMYL PHTHALATE	.010
DI N AMYL PHTHALATE 520	.010
DI N BUTOXYBENZENE P	.010
DI N BUTYL 2 THIOUREA 1,3	.010
DI N BUTYL FUMARATE	.010
DI N BUTYL MALEATE	.010
DIBUTYL MALEATE	.010
DI N BUTYL N,N DI N BUTYL CARBAMOYL METHYLENE PHOSPHONATE	.500
DI N BUTYL OXALATE	.010
DI N BUTYL SEBACATE	.210
DI N BUTYL SUCCINATE	.010
DIBUTYL SUCCINATE	.010
DI N BUTYL TIN ACETATE	.020
DI N BUTYL TIN DICHLORIDE	.020
DI N BUTYLAMINE	.010
DI N BUTYLAMINOETHANOL 2	.010
DI N DECYL ADIPATE	.010
DI N HEXYL MALEATE	.010
DI N HEXYL PHTHALATE	.010
DI N OCTYL ADIPATE	.010
DI N PROPYLAMINE	.010
DI NONYL PHTHALATE NARCOIL 40	3.785
DI O BENZAMIDODIPHENYL DISULFIDE	.010
DI O TOLYL GUANIDINE 1,3	.010
DI TETRAHYDROFURFURYL ADIPATE	.010
DI TETRAHYDROFURFURYL ADIPATE 504	.010
DI TRIDECYL PHTHALATE	.010
DI TRIDECYL SEBACATE	.010
DIACETIN 509	.010
DIACETONE ALCOHOL	.010
DIALLYL ADIPATE	.010
DIALLYL AMINE	.010
DIALLYL MALEATE	.010
DIAMINO DIPROPYLAMINE 3,3	.010
DIAMINOACRIDINE HYDROCHLORIDE 3,6	.100

Newname	Sum of Kilos
DIAMINOBENZIDINE TETRAHYDROCHLORIDE DIHYDRATE, 97% 3,3	.010
DIAMINOCYCLOHEXANE TETRAACETIC ACID 1,2	.100
DIAMINOPROPIONIC ACID MONOHYDROCHLORIDE DL-A-B	.025
DIAMYL AMYL PHOSPHONATE	2.000
DIAMYL PHTHALATE	.010
DIAZALD METHYL NITROSO TOLUENE SULFONAMIDE	.100
DIBENZANTHRACENE 1,2,5,6	.005
DIBENZOPERYLENE 1,2	.005
DIBENZYL AMINE	.010
DIBENZYL SEBACATE	.010
DIBENZYL SUCCINATE	.010
DIBROMO 1 PROPANOL 2,3	.010
DIBROMO 1,1 DICHLOROETHANE 1,2	.010
DIBROMO 8 QUINOLINOL 5,7	.050
DIBROMO METHANE	.030
DIBROMO METHANE PURITY-99+% 0-633	.030
DIBROMO TETRAFLUORO BENZENE 12	.237
DIBROMO THIOPHENE	.025
DIBROMOBIPHENYL 4,4	.005
DIBROMOPROPANE 1,2	.010
DIBROMOPROPANE 1,3	.010
DIBROMOTHIOPHENE 2,5	.010
DIBROMOTHYMOL SULFONE PHTHALEIN	.001
DIBUTOXYETHOXYETHYL ADIPINE	.010
DIBUTOXYETHYL PHTHALATE	.010
DIBUTOXYETHYL SEBACATE	.010
DIBUTYL ADIPATE	.020
DIBUTYL BUTYL PHOSPHONATE	.600
DIBUTYL CARBONATE	.020
DIBUTYL CRESOL	.010
DIBUTYL DIETHYL CARBAMYL PHOSPHONATE	.100
DIBUTYLTIN DIETHYLHEXOATE	.010
DIBUTYLTIN DILAURATE	.010
DIBUTYLTIN MALEATE	.010
DICAPRYL PHTHALATE	.010
DICHLORO 1 PROPANOL 2,3	.010
DICHLORO 2 BUTENE, TRANS 1,4	.010
DICHLORO 2 PROPANOL 1,3	.010
DICHLORO 3,6 DIHYDROXY P BENZOQUINONE MERCURY SALT 2,5	.010
DICHLORO 3,6 DIHYDROXY P QUINONE 2,5	.025
DICHLORO 4 NITROANILINE 2,6	.010
DICHLORO ACETIC ACID	.010
DICHLORO DIMETHYLSILANE, 99%	.500
DICHLORO FLUORESCEIN	.010
DICHLORO ISOCYANURIC ACID SODIUM SALT	1.250
DICHLORO PHENYL PHOSPHINE	.010
DICHLORO PHENYL PHOSPHINE OXIDE	.010
DICHLORO PHENYL PHOSPHINE SULFIDE	.010
DICHLOROANILINE 2,5	.010
DICHLOROANILINE 3,4	.010
DICHLOROBENZENE M	.010
DICHLOROBUTANE 1,4	.022
DICHLOROBUTANE PURITY-99+% 0-636 1,4	.022
DICHLOROPENTANE 1,5	.010
DICHLOROPROPANE 1,3	.015

Newname	Sum of Kilos
DICHLOROPROPYLENE CIS 1,3	.015
DICHLOROPROPYLENE, TRANS 1,3	.015
DICHLOROTOLUENE 2,4	.010
DICHLOROTOLUENE A A	.010
DICHLOROTOLUENE A P	.005
DICYANO DIAMIDE	.010
DICYCLOHEXANONE OXALYL DIHYDRAZONE	.160
DICYCLOHEXYL ADIPATE SOLID	.010
DICYCLOHEXYL AMINE	.010
DICYCLOHEXYL AMINE NITRILE	.100
DICYCLOHEXYL PHTHALATE	.020
DICYCLOPENTADIENYL IRON FERROCENE	.100
DIDODECYLAMINE PRACTICAL	.025
DIETHANOLAMINE	.956
DIETHOXYBENZENE O	.010
DIETHOXYBENZENE P	.010
DIETHOXYETHYL ADIPATE	.010
DIETHOXYETHYL PHTHALATE	.010
DIETHOXYETHYL SEBACATE	.010
DIETHYL 1,3 PROPANEDIOL 2,2	.010
DIETHYL ADIPATE	.020
DIETHYL AMINE HYDROCHLORIDE	.010
DIETHYL BROMOMALONATE	.010
DIETHYL BROMOMALONATE 513	.010
DIETHYL CARBAMOYL METHYL DIHEXYL PHOSPHINE OXIDE	.030
DIETHYL CARBAMOYL PHOSPHONATE	1.300
DIETHYL CARBONATE	.010
DIETHYL DIETHYL MALONATE	.010
DIETHYL DIPHENYL UREA	.010
DIETHYL DITHIOCARBAMIC ACID SODIUM SALT	.210
DIETHYL ETHYL MALONATE	.010
DIETHYL ETHYL PHOSPHONATE	.010
DIETHYL FUMARATE	.020
DIETHYL MALEATE	.020
DIETHYL MALONATE	.010
DIETHYL OXALATE	.010
DIETHYL PHENYL MALONATE	.010
DIETHYL PHENYL MALONATE 524	.010
DIETHYL SEBACATE	.020
DIETHYL SUCCINATE	.020
DIETHYLAMINOETHANOL 2	.010
DIETHYLAMINOPHENOL M	.500
DIETHYLAMINOPROPIONITRILE 3	.010
DIETHYLENE GLYCOL ADIPATE	.010
DIETHYLENE GLYCOL DI PELARGONATE	.010
DIETHYLENE GLYCOL DIBENZOATE	.010
DIETHYLENE GLYCOL DIETHYL ETHER	3.000
DIETHYLENE GLYCOL MONOMETHYL ETHER	.010
DIETHYLENE TRIAMINE	.010
DIETHYLENE TRIAMINE PENTAACETIC ACID, PENTASODIUM SALT	4.000
DIFLUORO TETRACHLOROETHANE	1.500
DIFLUROTETRACHLOROETHANE 1,2	1.500
DIHEXYL DIETHYL CARBAMOYL METHYL PHOSPHONATE	.059
DIHEXYL N,N DIETHYL CARBAMOYL METHYL PHOSPHONATE	1.500
DIHYDROFURAN 2,5	.010

Newname	Sum of Kilos
DIHYDROQUERCETIN	.010
DIHYDROQUERCITIN	.010
DIHYDROQUERCITINE	.010
DIHYDROXY 3,3 DIMETHYLDIPHENYL 4,4	.030
DIHYDROXY 3,6 DISULFO 2 NAPHTHYL AZO SALICYLIC ACID 4,1,8	.010
DIHYDROXYACETOPHENONE 2,4	.020
DIHYDROXYPHENYLAZO BENZENE SULFONIC ACID SODIUM SALT P 2	.075
DIHYDROXYPHENYLAZO BENZENE SULFONIC P 2,4	.300
DIISOBUTYLENE	.010
DIISOCTYL ADIPATE	.010
DIISOPROPYL 2,3 DIMETHYBUTANE PURITY-99+% 0-730	.002
DIISOPROPYL ADIPATE	.020
DIMETHOXYBENZENE P	.010
DIMETHYL 1,10 PHENANTHROLINE HEMIHYDRATE 2,9	.015
DIMETHYL 1,3 CYCLOHEXANEDIONE 5,5	.100
DIMETHYL 1,4 CYCLOHEXANE DICARBOXYLATE	.005
DIMETHYL 4 HEPTANONE 2,6	.020
DIMETHYL ACETAMIDE N N	.010
DIMETHYL ADIPATE	.020
DIMETHYL AMINOBENZYLIDENE RHODANINE	.001
DIMETHYL AZELATE	.010
DIMETHYL CARBONATE	.015
DIMETHYL COCOAMINE	.473
DIMETHYL DICHLOROSILANE	.100
DIMETHYL DODECANAMIDE N N	.010
DIMETHYL DODECYLAMINE N N	.010
DIMETHYL ISOPHTHALATE	.020
DIMETHYL ITACONATE	.020
DIMETHYL NAPHTHALENE	.010
DIMETHYL OXALATE	2.110
DIMETHYL PHENOL 3,5	.010
DIMETHYL SEBACATE	.020
DIMETHYL SULFATE	.020
DIMETHYL SULFOLANE	.060
DIMETHYLAMINE HYDROCHLORIDE	.010
DIMETHYLAMINE PROPIONITRILE 3	.010
DIMETHYLAMINO 1 PROPANOL 3	.010
DIMETHYLAMINO 2 PROPANOL 1	.010
DIMETHYLAMINO BENZALDEHYDE	.110
DIMETHYLAMINO BENZALDEHYDE P	.110
DIMETHYLAMINOBENZYLIDENE 5 P	.003
DIMETHYLAMINOBENZYLIDENE RHODANINE 5 P	.014
DIMETHYLAMINOPHENOL M	.010
DIMETHYLBENZYL ALCOHOL D D	.010
DIMETHYLPYRAZOLE 3,5	.010
DIMETHYLUREA 1,3	.010
DIMETHYOXYETHANE 1,2	.010
DIMETHYPIPERIDINE 2,6	.010
DINITRO 1 NAPHTHOL 2,4	.025
DINITROANILINE 2,4	.010
DINITROBENZOYL CHLORIDE 3,5	.010
DINITROPHENYLAMINE 2	.200
DINITROPHENYLHYDRAZINE 2,4	.010
DIOCTYL ISOPHTHALATE	.010
DIOCTYL PHENYL PHOSPHONATE	.100

Newname	Sum of Kilos
DIOCTYL SULFOSUCCINATE SODIUM SALT	2.000
DIPENTENE	.010
DIPHENOXYETHANE 1,2	.010
DIPHENYL 1,10 PHENANTHROLINE 4,7	.090
DIPHENYL 1,3 PROPANEDIONE 1,3	.100
DIPHENYL 3 THIO CARBOHYDRIZIDE 1,5	.010
DIPHENYL ACETIC ACID	.010
DIPHENYL AMINE	1.030
DIPHENYL BENZIDINE N N	.001
DIPHENYL CARBAZONE	.030
DIPHENYL CARBOHYDRAZIDE	.125
DIPHENYL CARBOHYDRAZIDE POWDER	.125
DIPHENYL CARBONATE	.010
DIPHENYL GLYOXIME	.010
DIPHENYL METHANE	.010
DIPHENYL OXAZOLE	.350
DIPHENYL OXAZOLE, 2,5	.350
DIPHENYL PHOSPHITE	.020
DIPHENYL PHTHALATE	.020
DIPHENYL THIOCARBAZONE	.070
DIPHENYLAMINE SULFONIC ACID BARIUM SALT P	.010
DIPHENYLCARBAZONE, SYM	.035
DIPHENYLCARBOHYDRAZIDE 1,5	.100
DIPHOSPHOROUS PENTOXIDE	.200
DIPROPYL SUCCINATE	.010
DIPROPYLENE GLYCOL	.010
DIPROPYLENE GLYCOL DIBENZOATE	.010
DIPROPYLENE GLYCOL DINONANOATE	.010
DIPYRIDYL	.005
DISODIUM ETHYLENEDIAMINE TETRAACETATE	.731
DISODIUM ETHYLENEDINITRILO TETRAACETATE	1.144
DISODIUM TETRAACETATE	.113
DITERTBUTYL HYDROQUINONE 2,5	2.000
DITHIOBISBENZOTHIAZOLE 2,2	.010
DITHIODIBENZOIC ACID 2,2	.010
DITHIODIMORPHOLINE 4,4'	.010
DITHIZONE DIPHENYL THIOCARBAZONE	.030
DL 2,3 DIAMINOPROPIONIC ACID HYDROCHLORIDE	.030
DOCOSENOIC ACID	.010
DODECANETHIOL 1	.020
DODECYL SODIUM SULFATE, 95% SODIUM LAURYL SULFATE	.100
DOW DURSBAN 2E INSECTICIDE	3.785
DOWANOL DE DIETHYLENE GLYCOL ETHYL ETHER	.454
DOWANOL EE ETHYLENE GLYCOL ETHYL ETHER	.454
DUPONT TERSAN 1991 TURF FUNGICIDE	.454
DURENE	.010
DYSPROSIUM CHLORIDE	.010
EHTYLIDENE DIACETATE 493	.010
EICOSANE	.020
EICOSANE 0-732	.020
ENDOSULFAN SULFATE	.002
ENDRIN ALDEHYDE	.002
EPOXY 3 PHENOXYPROPANE 1,2	.010
EPOXYBUTANE 1,2	.072
EPOXYETHYLBENZENE 1,2	.010

Newname	Sum of Kilos
ERUCYLAMIDE	.010
ETHOXY 2 PROPANOL 1	.010
ETHOXYETHOXY ETHANOL	.010
ETHOXYETHOXY ETHYL ACETATE 2,2	.010
ETHOXYETHYL ACETATE	.020
ETHOXYNAPHTHALENE 2	.010
ETHOXYPROPIONITRILE 3	.010
ETHYL 1,3 HEXANEDIOL 2	.010
ETHYL 2 BROMOPROPIONATE	.010
ETHYL 2,3 DIBROMOPROPIONATE	.010
ETHYL 3 BROMOPROPIONATE	.010
ETHYL 3(3 DIMETHYLAMINOPROPYL) CARBO DIIMIDE 1	.010
ETHYL ACETOACETATE	.010
ETHYL BENZOYLACETATE	.010
ETHYL BROMIDE	.010
ETHYL BROMIDE PURITY-99+% 0-640	.010
ETHYL BROMOACETATE	.010
ETHYL CHLOROACETATE	.010
ETHYL CHLOROFORM	.010
ETHYL CHLOROFORMATE	.010
ETHYL CHLOROSULFONATE	.020
ETHYL CINNAMATE	.010
ETHYL CYANOACETATE	.010
ETHYL FORMATE	.020
ETHYL HEXADECYLDIMETHYL AMMONIUM BROMIDE	.010
ETHYL IODIDE	.010
ETHYL MERCAPTOACETATE	.010
ETHYL MORPHOLINE N	.010
ETHYL N BUTYRIC ACID 2	.010
ETHYL O&P TOLUENESULFONAMIDE N	.010
ETHYL OLEATE	.020
ETHYL ORTHOSILICATE	.020
ETHYL OXALATE	3.785
ETHYL P HYDROXYBENZOATE	.010
ETHYL P TOLUENESUFONAMIDE N	.010
ETHYL P-TOLUENESULFONATE	.010
ETHYL PHENYLACETATE	.010
ETHYL PHENYLACETATE 533	.010
ETHYL PHTHALYL ETHYL GLYCOLATE	.010
ETHYL SULFATE	.020
ETHYL TRICHLOROACETATE	.011
ETHYL VINYL ETHER	.010
ETHYLAMINE HYDROCHLORIDE	.010
ETHYLAMINO ETHANOL 2	.010
ETHYLANILINE N	.010
ETHYLENE BROMIDE	.010
ETHYLENE DIACETATE	.030
ETHYLENE DIACETATE 492	.030
ETHYLENE GLYCOL BIS 2 AMINO ETHYLETHER TETRAACETIC	.200
ETHYLENE GLYCOL MONOETHYL ETHER	.010
ETHYLENE GLYCOL MONOLAURATE	.010
ETHYLENE GLYCOL MONOMETHYL ETHER	.010
ETHYLENE GLYCOL MONOOLEATE	.010
ETHYLENE GLYCOL MONORICINOLEATE	.010
ETHYLENE GLYCOL MONOSTEARATE	.010

Newname	Sum of Kilos
ETHYLHEXYL AZELATE D 2	.010
ETHYLHEXYL DIPHENYL PHOSPHATE 2	.010
ETHYLHEXYL ISODECYL PHTHALATE 2	.010
ETHYLHEXYL STEARATE 2	.010
ETHYLHEXYLAMINE 2	.010
ETHYLIDENE DIACETATE	.010
EUROPIUM OXIDE	.035
FENCHONE	.010
FERRIC AMMONIUM OXALATE	.454
FERTI LOME ANT, ROACH, CRICKET, SPIDER & SILVERFISH SPRAY	2.425
FERTILOME ANT,ROACH,CRICKET,SPIDER & SILVERFISH PESTICIDE	2.425
FLUORO BENZENE	.005
FORMAZIN STOCK SUSPENSION	.473
FORMIC ACID THALLOUS SALT	.150
FURFURYL ACETATE	.010
FURILDIOXINE	.050
GADOLINIUM METAL	.018
GADOLINIUM OXIDE	.927
GALLIUM CHLORIDE	1.000
GALLIUM IN 2% NITRIC ACID	1.000
GALLIUM OXIDE	.032
GALLIUM SPLATTER	.005
GALLOCYANINE	.025
GERMANIUM	.010
GERMANIUM DIOXIDE	.002
GLUTARIC ACID BASED MONOMERIC DIESTER	.010
GLUTARIC ACID BASED MONOMERIC ETHER	.010
GLYCINE ETHYL ESTER HYDROCHLORIDE	.010
GLYCOL	1.000
GLYCOLIC ACID	4.510
GLYOXAL	.010
GUANYLUREA SULFATE	.200
HACH CHROMIC ACID	.946
HAFNIUM	.005
HAFNIUM CARBIDE	.237
HEPTYL ALCOHOL N	.010
HEXADECYLAMINE	.010
HEXAFLUORO ISOPROPANOL	.454
HEXAMETHYL DISILAZANE	.100
HEXAMETHYL PHOSPHORAMIDE	.050
HEXAMETHYL PHOSPHORIC TRIAMIDE	.010
HEXAMETHYLENE AMINE, N F	.454
HEXAMETHYLENE TETRAMINE	1.964
HEXANEDIAMINE 1,6	.010
HEXANETHIOL 1	.020
HEXANETRIOL 1,2,6	.010
HEXANIT RODIPHENYLAMINE	.025
HEXANONE 2	.065
HEXANONE, 2	.065
HEXENE 2	.010
HEXYL ALCOHOL N	.010
HEXYL DECYL PHTHALATE N	.010
HEXYL ISODECYL PHTHALATE	.010
HEXYL ISOOCTYL PHTHALATE	.010
HEXYLAMINE N	.010

LIST A

Newname	Sum of Kilos
HOLMIUM CHLORIDE	.010
HOLMIUM METAL	.010
HOLMIUM OXIDE	.010
HYDRACRYLONITRILE	.010
HYDRAZINE DIHYDROCHLORIDE	.610
HYDRAZINE HYDRATE	.100
HYDROABIETHYL ALCOHOL	.010
HYDROCINNAMALDEHYDE	.010
HYDROCINNAMIC ACID	.010
HYDROFLUORIC ACID, 5%	.050
HYDROFLUOSILICIC ACID	.454
HYDROXY 1 NAPHTHYLAZO BENZENE SULFONIC ACID SODIUM SALT P	.025
HYDROXY 2 NAPHTHYLAZO 5 NITRO 2 NAPHTHOL 4 SULFONIC ACID	.075
HYDROXY-4-METHYL-2-PENTANONE	1.000
HYDROXYACETOPHENONE O	.010
HYDROXYAMINE HYDROCHLORIDE	.020
HYDROXYANTHRAQUINONE 1	.120
HYDROXYBENZALDEHYDE P	.010
HYDROXYBENZONITRILE P	.025
HYDROXYETHYL ACETATE 2	.011
HYDROXYETHYL ETHYLENEDIAME TRIACETIC ACID N	.200
HYDROXYETHYL ETHYLENEDIAMINE TRIACETIC ACID	.237
HYDROXYETHYLENE DINITRILO TRIACETIC ACID	1.000
HYDROXYFLAVONE	.005
HYDROXYMETHYL 2 METHYL 1 3 PROPANEDIOL 2	.010
HYDROXYPHENYL ARSONIC ACID P	.500
HYDROXYPHENYL BENZOXAZOLE 2 O	.025
HYDROXYPHENYL GLYCINE N P	.110
HYDROXYPHENYL GLYCINE, N P-	.110
HYDROXYQUINOLINE 8	.010
HYDROXYSTEARIC ACID 12	.010
HYPOPHOSPHOROUS ACID	2.819
HYSOL CURING AGENT B-1 W/ASBESTOS	2.366
HYSOL EA 901 STRUCTURAL ADHESIVE W/ASBESTOS	4.082
IMIDAZOLIDINETHIONE 2	.015
IMIDODIPROPIONITRILE	.010
INDENO(1,2,3,-C,D) PYRENE	.005
INDIGO DISULFONIC ACID DISODIUM SALT 5,5	.200
INDIUM OXIDE	.027
INDIUM POWDER TMI 10	.025
INDIUM WIRE	.010
INDOLE	.010
IODIC ACID	1.025
IODINE PENTOXIDE	.025
IODOBENZENE	.010
IODOFORM	.010
IODOPROPANE 1	.010
IODOPROPANE 2	.010
IODOTOLUENE P	.010
IRIDIC POTASSIUM CHLORIDE	.010
IRIDIUM	.006
IRIDIUM OXIDE	.001
IRIDOUS POTASSIUM CHLORIDE	.010
ISATIN	.010
ISO VALERIC ACID	.010

Newname	Sum of Kilos
ISOAMYL ACETATE	.012
ISOAMYL ALCOHOL	.020
ISOAMYL ALCOHOL 140	.010
ISOAMYL BENZYL ETHER	.010
ISOAMYL ETHER	.011
ISOAMYL NITRITE	.010
ISOBUTRYIC ACID	.010
ISOBUTYL CYCLOHEXYL PHTHALATE	.010
ISOBUTYL NITRILE	.010
ISOBUTYL OLEATE	.010
ISOBUTYL PALMITATE	.010
ISOBUTYL VINYL ETHER	.010
ISOBUTYLAMINE	.010
ISOBUTYRIC ACID	.010
ISODECYL ADIPATE	.010
ISODECYL NONANOATE	.010
ISOHEXYL LAURATE	.010
ISONICOTINIC ACID	.010
ISOOCTYL BENZYL PHTHALATE	.010
ISOOCTYL EPOXYSTEARATE	.010
ISOOCTYL ISODECYL PHTHALATE	.010
ISOOCTYL PALMITATE	.010
ISOPHTHALIC ACID	.010
ISOPRENE	.010
ISOPROPYL ACETATE	.010
ISOPROPYL ETHER	3.785
ISOPROPYL OLEATE	.010
ISOQUINOLINE	.010
ISOSTEARYL NEOPENTYLATE	.010
ITACONIC ACID	4.045
LACTONITRILE	.010
LAUROYL CHLORIDE	.010
LAUROYL CHLORIDE 136	.010
LEAD ACETATE	.927
LEAD CARBONATE	.454
LEAD CHLORIDE	2.288
LEAD CITRATE AR	.100
LEAD DIOXIDE	.113
LEAD FLUOBORATE	.100
LEAD FLUORIDE	.454
LEAD IODIDE	.118
LEAD NITRATE	2.451
LEAD OXIDE	3.710
LEAD OXIDE RED	3.710
LEAD OXIDE, YELLOW	.454
LEAD POWDER	3.000
LEAD SHOT	.050
LEAD SOLUTION 3128	.025
LEAD SULFATE	.454
LEAD WIRE	.050
LECO IODINE PENTOXIDE	.050
LIMONENE D	.010
LITHIUM CARBONATE	1.328
LITHIUM FLUORIDE	3.084
LITHIUM IODIDE	.025

Newname	Sum of Kilos
LITHIUM META BORATE	.554
LITHIUM METAL	.025
LITHIUM NITRATE	.257
LITHIUM PERCHLORATE	.454
LITHIUM SOLUTION 3129	.025
LITHIUM SULFATE	.138
LITHIUM TETRABORATE	2.500
LUMOGALLION	.020
LUTIDINE 2,4	.010
LUTIDINE 2,6	.010
MAGNESIUM	1.287
MAGNESIUM ACETATE	4.292
MAGNESIUM ACETATE 4 HYDRATE REAGENT	4.292
MAGNESIUM CARBONATE	.237
MAGNESIUM CHLORIDE SOLUTION	.100
MAGNESIUM FLUORIDE	2.268
MAGNESIUM HYDROXIDE	2.000
MAGNESIUM IODATE	.118
MAGNESIUM PHTHALATE	.237
MAGNESIUM RODS	.020
MAGNESIUM SILICIDE	.118
MAGNESIUM SILICOFLUORIDE	.454
MAGNESIUM SOLUTION 3131	.025
MAGNESIUM ZIRCONATE	.454
MALEIC ACID	.010
MALKILL INSECTICIDE	3.785
MALONIC ACID	1.600
MALONIC ACID DISODIUM SALT	.700
MANDELIC ACID	.100
MANGANOUS CHLORIDE	.020
MANGANOUS NITRATE	.473
MANGANOUS SULFATE	.060
MANGANOUS SULFATE MONOHYDRATE	.060
MELAMINE	.011
MERCAPTOBENZOIC ACID O	.010
MERCAPTOETHANOL 2	.110
MERCAPTOPROPIONIC ACID 2	.010
MESITYL OXIDE	.020
MESITYLENE	.010
METHACRYLAMIDE	.010
METHACRYLIC ACID,SODIUM SALT	.010
METHANE SULFONIC ACID	.010
METHELPYRAZINE 2	.010
METHENAMINE	.500
METHOXY 1 BUTANOL 3	.010
METHOXY 1 BUTYL ACETATE 3	.010
METHOXY 2 PROPANOL 1	.010
METHOXY METHOXYETHANOL	.010
METHOXYACETIC ACID	.010
METHOXYETHYL ACETATE 2	.015
METHOXYETHYL ACETYL RICINOLEATE	.010
METHOXYETHYL ACRYLATE 2	.010
METHOXYNAPHTHALENE 2	.010
METHOXYPHENOL P	.002
METHOXYPROPIONITRILE 3	.010

Newname	Sum of Kilos
METHOXYPROPYLAMINE 3	.010
METHYL 1 BUTANOL	.500
METHYL 8 QUINOLINOL 2	.025
METHYL ABIETATE	.020
METHYL ACETAMIDE N	.010
METHYL ACETYL RICINOLEATE	.010
METHYL AMINOETHANOL 2	.010
METHYL ANILINE N	.010
METHYL BENZENESULFONATE	.010
METHYL BENZOATE	.010
METHYL BENZOATE 534	.010
METHYL BUTYRATE	.010
METHYL CYCLOHEXYLAMINE N	.010
METHYL CYCLOPENTANE	.010
METHYL DIPHENYL PHOSPHATE	.010
METHYL HYDROQUINONE	.500
METHYL MAGNESIUM BROMIDE, 3M SOLIN IN DIETHYL ETHER	1.000
METHYL MORPHOLINE N	.010
METHYL N NITROSOANILINE N	.010
METHYL OCTANOATE	.010
METHYL ORANGE XYLENE CYANOLE SOLUTION	.500
METHYL P HYDROXYBENZOATE	.010
METHYL P-TOLUENE SULFONATE	.010
METHYL PENTACHLORO STEARATE	.010
METHYL PHTHALYL ETHYLGLYCOLATE	.010
METHYL PIPERIDINE 2	.010
METHYL QUINOLINOL	.005
METHYL SALICILATE	.010
METHYL SULFIDE	.100
METHYL SULFURIC ACID,POTASSIUM SALT	.020
METHYLACETOPHENONE P	.010
METHYLAMINE HYDROCHLORIDE	.060
METHYLAMINO ETHANOL 2	.010
METHYLBENZOTHIAZOLE 2	.010
METHYLCYCLOHEXENE 4	.010
METHYLNAPHTHALENE 1	.510
METHYLNAPHTHALENE 2	.110
METHYLSTYRENE D	.010
MOLYBDENUM BORIDE	.237
MOLYBDENUM CARBIDE	2.268
MOLYBDENUM DISILICIDE	.454
MOLYBDENUM METAL	.200
MOLYBDENUM METAL POWDER	.454
MOLYBDENUM MONOCARBIDE	.454
MOLYBDENUM ROD	.010
MOLYBDENUM SILICIDE	.237
MOLYBDENUM SOLUTION 3134	.025
MOLYBDENUM TRIOXIDE	2.842
MOLYBDIC ACID	.454
MONOCHLORACETIC ACID	.454
MONOCRESYL DIPHENYL PHOSPHATE	.010
MORPHOLINE	.010
MUCIC ACID	.010
MUREXIDE	.040
MUREXIDE, MONOHYDRATE	.040

LIST A

Newname	Sum of Kilos
N, O BIS TRIMETHYLSILYL ACETAMIDE	.075
N,N DIETHYL 1,3 PROPANEDIAMINE	.010
N,N DIETHYL ANILINE	.010
N,N DIETHYL P PHENYLENEDIAMINE HYDROCHLORIDE	.010
N,N DIETHYLENE DIAMINE	.010
N,N DIMETHYL 1,3 PROPANEDIAMINE	.010
N,N DIMETHYL P PHENYLENE DIAMINE	.010
N,N DIMETHYL P PHENYLENE DIAMINE OXALATE	.100
N,N DIMETHYL P PHENYLENE DIAMINE SULFATE	.025
N,N DIMETHYL P TOLUENE SULFONAMIDE	.010
N,N' DIETHYL CARBANILIDE	.005
N,N' DIPHENYL P PHENYLENEDIAMINE	.010
NAPHTHALENE SULFONIC ACID 2	.110
NAPHTHALENE SULFONIC ACID,2-	.110
NAPHTHALENE,ALKYLATED	.010
NAPHTHALENEACETIC ACID 1	.010
NAPHTHALENEDIOL 1,4	.020
NAPHTHALENEDIOL 1,5	.010
NAPHTHOL 1	.010
NAPHTHOL 2	.110
NAPHTHOL 3,6 DISULFONIC ACID, DISODIUM SALT 2	.020
NAPHTHOL BENZOATE 2	.010
NAPHTHOQUINONE 1,4	.010
NAPHTHYL ETHYLENEDIAMINE DIHYDROCHLORIDE N 1	.045
NEODYMIUM METAL	.060
NEODYMIUM NITRATE	.250
NEODYMIUM OXIDE	.500
NEODYMIUM SULFATE	.010
NEODYNIUM OXIDE	.010
NICOTINIC ACID	.010
NIOBIUM BORIDE	.237
NIOBIUM CARBIDE	.907
NIOBIUM DISELENIDE	.118
NIOBIUM METAL	.001
NIOBIUM METAL POWDER	4.536
NIOBIUM OXIDE	.010
NIOBIUM PENTOXIDE	.002
NIOBIUM POWDER	.200
NIOBIUM SILICIDE	.237
NITRILO TRIACETIC ACID	1.600
NITROANILINE M	.010
NITROANILINE O	.010
NITROANILINE P	.110
NITROBARBITURIC ACID 5	.100
NITROBENZOIC ACID M	.010
NITROBENZOIC ACID P	.010
NITROCELLULOSE IN AMYL ACETATE	.355
NITROETHANE	.010
NITROETHANE 853	.010
NITROMETHANE	.591
NITROMETHANE 854	.591
NITRONAPHTHALENE 1	.010
NITROPHENOL O	.010
NITROPHENOL P	.020
NITROPHENYL AZO 1 NAPHTHAL 4 P	.020

Newname	Sum of Kilos
NITROPHENYL GALACTOPYRANOSIDE	.006
NITROPHENYLAZO ORCINOL 4 P	.025
NITROPROPANE 1	.020
NITROQUINOLINE N OXIDE 4	.001
NITROSALICYLALDEHYDE 5	.025
NITROSO 2 NAPHTHOL 1	.120
NITROSO PHENYLAMINE N	.010
NO 112 URANIUM METAL CHIPS	.050
OCTADECYL ACETATE N	.010
OCTANE SULFONIC ACID SODIUM SALT 1	.500
OCTANE SULFONIC ACID, 0.1M	2.366
OCTANETHIOL 1	.020
OCTENE 2	.010
OCTYL DECYL ADIPATE	.010
OCTYL ISO DECYL PHTHALATE	.010
OCTYL N DECYL TRIMELLITATE N	.010
OCTYLAMINE	.500
OLEAMIDE	.010
ORTHO HOME PEST CONTROL	1.656
ORTHO HORNET & WASP KILLER	.887
ORTHOBORIC ACID	.350
OSMIUM SPONGE	.001
OUABAIN	.005
OXALIC ACID DIHYDRATE	.954
OXAMIDE	.010
OXANILIDE	.010
OXYBIS 2 ETHYL ACETATE	.010
OXYBIS(2-ETHYL ACETATE) 506	.010
OXYBIS 2 ETHYLBENZOATE	.010
OXYDIACETIC ACID D D	.010
OXYDIPROPIONITRILE 3,3	.010
P,P' METHYLENE DIANILINE	.010
P,P-DDD	.001
P,P-DDE	.002
P,P-DDT	.001
PALLADIUM	.010
PALLADIUM WIRE	.001
PALMITIC ACID	.010
PAN	.005
PARAFORMALDEHYDE	.907
PARLODION-PURIFIED PYROXYLIN	.030
PENTAERYTHRITOL	.010
PENTAERYTHRITOL MONORICINOLEATE	.010
PENTAERYTHRITOL TETRASTEARATE	.010
PENTANOL 1	3.000
PENTANONE 2	.012
PESTICIDE MIX	.001
PHENANTHRENE	.015
PHENANTHROLINE FERROUS SULFATE, SOLUTION	.059
PHENANTHROLINE MONOHYDRATE 1,10	.075
PHENANTHROLINE MONOHYDRATE, 1.10 ORTHO	.075
PHENANTHROLINE, 1, 10 MONOHYDRATE	.030
PHENELHYDRAZINE HYDROCHLORIDE	.010
PHENOTHIAZINE	.010
PHENOTHIOXIN	.010

Newname	Sum of Kilos
PHENOXYETHANOL	.010
PHENOXYETHANOL 2	.010
PHENYL 1,2 ETHANEDIOL	.010
PHENYL 2 PROPANONE	.010
PHENYL 3 BUTENE 2 ONE 4	.010
PHENYL ACETALDEHYDE	.010
PHENYL ACETONITRILE	.010
PHENYL CYCLOHEXANE	.010
PHENYL ETHER	.010
PHENYL GLYCINE N	.010
PHENYL HYDRAZINE HYDROCHLORIDE	.123
PHENYL ISOCYANATE	.010
PHENYL SALICILATE	.010
PHENYL SULFIDE	.020
PHENYL SULFONE	.020
PHENYLACETAMIDE 2	.010
PHENYLARSENE OXIDE PAO	.946
PHENYLENE DIACETATE M	.010
PHENYLENE DIACETATE P	.010
PHENYLENE DIAMINE DIHYDROCHLORIDE M	.110
PHENYLENE DIAMINE HYDROCHLORIDE	.025
PHENYLENEDIAMINE DIHYDROCHLORIDE P	.510
PHENYLENEDIAMINE P	.510
PHENYLETHYL ACETATE 2	.010
PHENYLPHENOL P	.010
PHOSPHO TUNGSTIC ACID	.120
PHOSPHOMOLYBDIC ACID	.138
PHOSPHORUS SOLUTION 3139	.025
PHTHALALDEHYDE	.005
PHTHALAMIDE	.010
PHTHALIMIDE	.110
PHTHALONITRILE	3.010
PHTHALOYL CHLORIDE	.010
PHTHALOYL CHLORIDE 137	.010
PICOLINE 2	.010
PICOLINE 3	.010
PICOLINE 4	.010
PINENE	.010
PIPERAZINE	.010
PIPERIDINE	.010
PLATINUM CHLORIDE	.001
POLYACRYLAMIDE	.250
POLYIMIDE 2080P	3.785
POLYISOBUTYLENE	.010
POTASIUM PYROSULFATE	.050
POTASSIM THIOCYANATE	.954
POTASSIUM ACID PHTHALATE	4.640
POTASSIUM AMYL XANTHATE Z 6	.100
POTASSIUM BIFLUORIDE	.454
POTASSIUM BROMATE	.932
POTASSIUM CHLORATE	.020
POTASSIUM CHROMATE	4.369
POTASSIUM CYANATE	.474
POTASSIUM ETHYL XANTHATE Z 3	.100
POTASSIUM GOLD CYANIDE	4.968

Newname	Sum of Kilos
POTASSIUM HEXA NIOBATE	.250
POTASSIUM HYDROGEN PHTHALATE	.700
POTASSIUM META PERIODATE	.907
POTASSIUM METAL STICKS	.118
POTASSIUM OXALATE	1.814
POTASSIUM PERCHLORATE	.474
POTASSIUM PERIODATE	.113
POTASSIUM SULFITE	.710
POTASSIUM TARTRATE	.454
PRASEODYMIUM	.050
PRASEODYMIUM OXIDE	.010
PRASEODYMIUM POWDER	.005
PROPANEDIAMINE 1,2	.010
PROPENE 1 SULFONIC ACID SODIUM SALT 2	.050
PROPENYLIDENE DIACETATE 2	.010
PROPENYLIDENE DIACETATE 495 2	.010
PROPIONALDEHYDE	.010
PROPIONAMIDE	.010
PROPIONIC ACID	.010
PROPIONIC ANHYDRIDE	.010
PROPIONIC ANHYDRIDE 129	.010
PROPIONITRILE	.010
PROPYL ACETATE	.012
PROPYL ACETATE N	.012
PROPYL ALCOHOL	.010
PROPYL ALCOHOL N	.010
PROPYL NITRATE N	.010
PROPYLENE DILAURATE 1,2	.010
PROPYLENE DIPROPIONATE 496 1,2	.010
PROPYLENE DISTEARATE 1,2	.010
PYRIDINE 2,6 DICARBOXYLIC ACID	.550
PYRIDINEDICARBOXYLIC ACID, 99% 2,6	.050
PYRIDYLAZO RESORCINOL 4,2	.005
PYRIDYLAZO) 2 NAPHTHOL (PAN) 1 (2	.005
PYRIDYLAZO) RESORCINOL DISODIUM SALT 4 (2-	.020
PYROGALLOL	.010
PYROMELLITIC ACID	.010
PYRROLIDINE	.010
PYRROLIDINE CARBODITHIOIC ACID	.025
QUINHYDRONE	.010
QUINONE P	.020
RESORCINOL	.010
RESORCINOL MONOACETATE	.010
RESORCINOL, YELLOW	.075
RHENIUM	.002
RHENIUM POWDER	.002
RHODIUM	.002
RHODIUM CATALYST PELLETS	1.307
RHODIUM CHLORIDE	.001
RHODIUM METAL	.001
RHODIUM SPONGE	.001
RHODIUM TRICHLORIDE TRIHYDRATE, PURIFIED	.002
RHODIZONIC ACID, DISODIUM DERIVATIVE	.005
RUBIDIUM CARBONATE	.006
RUBIDIUM CHLORIDE	.007

LIST A

Newname	Sum of Kilos
RUBIDIUM CHLORIDE, CP	.007
RUTHENIUM	.005
RUTHENIUM III CHLORIDE; PWDR	.002
RUTHENIUM CHLORIDE	.005
RUTHENIUM IU OXIDE	.098
RUTHENIUM POWDER	.002
RUTHENIUM SPONGE	.001
SALICYLALDEHYDE	.010
SALICYLAMIDE	.010
SAMARIUM OXIDE	.248
SAPONIN	.454
SCANDIUM METAL	.015
SCANDIUM OXIDE	.002
SEC BUTYLAMINE	.010
SEC-BUTYL ALCOHOL	.010
SEMICARBAZIDE HYDROCHLORIDE	.010
SILICO TUNGSTIC ACID	.257
SILICON CRYSTALLINE	2.268
SILICON IN 5% HF(HYDROFLUORIC ACID)	1.500
SILICON NITRIDE POWDER	2.268
SILICON-BORON SILICIDE	.237
SODIUM ALKYLARYLSULFONATE	.454
SODIUM ALUMINATE	3.000
SODIUM AMINOACETATE	.100
SODIUM AMMONIUM PHOSPHATE	.474
SODIUM ARSENATE	.454
SODIUM ARSENITE	.927
SODIUM AZIDE	1.100
SODIUM BICHROMATE	.572
SODIUM BISMUTHATE	1.381
SODIUM BISULFIDE	1.361
SODIUM CHLORATE	2.788
SODIUM CHLORITE FLAKES	.500
SODIUM COBALTINITRITE	.907
SODIUM DITHIONITE	.454
SODIUM ETHYL XANTHATE Z 4	.100
SODIUM FLUOSILICATE	.020
SODIUM FORMATE	1.814
SODIUM HYDROSULFITE	.454
SODIUM HYPOCHLORITE	.473
SODIUM ISOBUTYL XANTHATE Z 14	.100
SODIUM ISOPROPYL XANTHATE Z 11	.100
SODIUM LUMP	.572
SODIUM METAL	.572
SODIUM METATANTALATE N2T2O3	.006
SODIUM MOLYBDATE	.474
SODIUM MOLYBDATE, DIHYDRATE	.474
SODIUM NITROPRUSSIDE	.118
SODIUM OXALATE	1.047
SODIUM PERBORATE	.010
SODIUM PEROXIDE	.454
SODIUM PEROXIDE GRANULAR 20 MESH AND FINER	.454
SODIUM SEC BUTYL XANTHATE Z 12	.100
SODIUM SELENITE	.010
SODIUM SILICOFLUORIDE	.907

Newname	Sum of Kilos
SODIUM STANNATE	.010
SODIUM SULFIDE	3.747
SODIUM SULPHIDE	.100
SODIUM SULPHITE	.100
SODIUM TETRA HYDRIDOBORATE	1.500
SODIUM TETRABORATE	1.000
SODIUM THIOCYANATE	.464
SODIUM TUNGSTATE	4.546
STABILIZED SODIUM HYPOCHLORITE	1.892
STANNIC CHLORIDE 5 HYDRATE	.150
STANNIC OXIDE	.909
STANNOUS OXIDE	.567
STEARIC ACID	.700
STILBENE, TRANS	.010
STROBANE	.001
STRONTIUM CARBONATE	2.501
STRONTIUM CHLORIDE	.123
STRONTIUM FLUORIDE	.942
STRONTIUM NITRATE	1.035
STRONTIUM OXIDE	.118
STRONTIUM SULFIDE	2.268
STRONTIUM ZIRCONATE	.454
SUCCINAMIDE	.010
SUCCINIC ANHYDRIDE	.010
SUCCINIMIDE	.110
SULFANILAMIDE	.010
SULFANILIC ACID	.010
SULFOACETIC ACID	.010
SULFOSALICYCLIC ACID	.010
SULFURATED POTASH, NF	3.175
SULFUROUS	.473
SUNISON REFRIGERANT	3.785
SYNKO TRI-SODIUM PHOSPHATE	2.268
TANNIC ACID	.113
TANTALUM CARBIDE	.237
TANTALUM PENTOXIDE	2.305
TAURINE	.010
TELLURIUM	.020
TELLURIUM METAL	.150
TELLURIUM OXIDE	.002
TELLURIUM POWDER, 200 MESH	.100
TERBIUM PENTOXIDE	.005
TERPHENYL ISOMERIZED	.010
TERPHENYL P	.564
TERTAMYL ALCOHOL	.020
TERTBUTYL ACRYLAMIDE N	.010
TERTBUTYL ALCOHOL	.020
TERTBUTYL BENZENE	.010
TERTBUTYL BENZOIC ACID P	.010
TERTBUTYL DISULFIDE	.020
TERTBUTYL HYDROQUINONE	.010
TERTBUTYL PHENOL P	.010
TERTBUTYL PYROCATECHOL 4	.010
TERTBUTYLAMINE	.010
TETRA ETHYL ORTHO SILICATE	3.000

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Newname	Sum of Kilos
TETRABROMOBUTANE 1,2,3,4	.010
TETRABUTYL AMMONIUM BROMIDE	.025
TETRABUTYL AMMONIUM HYDROXIDE	1.050
TETRABUTYL AMMONIUM HYDROXIDE (40% IN WATER	.100
TETRACHLOROTETRAFLUORO PROPANE	.100
TETRADECANOL 1	.010
TETRAETHYL AMMONIUM BROMIDE	.250
TETRAETHYL AMMONIUM CHLORIDE	.200
TETRAETHYL AMMONIUM HYDROXIDE	.100
TETRAETHYL AMMONIUM PERCHLORATE	.080
TETRAETHYL DIMETHYL AMINO METHYLENE DIPHOSPHONATE	.050
TETRAETHYLENE GLYCOL DI 2 ETHYLHEXANDATE	.010
TETRAHYDRO NAPHTHALENE	.010
TETRAHYDRO THIOPHENE	.010
TETRAHYDRO-2-METHYLFURAN	.010
TETRAHYDROFURFURYL	.005
TETRAHYDROFURFURYL ACETATE	.015
TETRAHYDROFURFURYL ALCOHOL	.010
TETRAHYDROXY BENZOPHENONE 2,2' 4,4'	.020
TETRAHYDROXY QUINONE DISODIUM SALT	.020
TETRAMETHYL AMMONIUM CHLORIDE	.610
TETRAMETHYL AMMONIUM HYDROXIDE	1.075
TETRAPHENYL TIN	.010
TETRAPHOSPHORIC ACID	2.722
TETRAPROPYL AMMONIUM HYDROXIDE	.500
TETRASTEARATE PE	.010
THALLOUS BROMIDE	.100
THALLUS BROMIDE	.050
THIMEROSAL	.010
THIOACETAMIDE	.010
THIOGLYCOLIC ACID	.010
THIONYL CHLORIDE	.500
THIOPHENE	.010
THIOUREA	1.510
THIOUREA THIOCARBAMIDE	.500
THORIUM CHLORIDE	.100
THORIUM NITRATE	3.754
THORIUM OXIDE	.092
THULIUM OXIDE	.005
THULIUM, POWDER	.001
THYMOL	.030
TITANIUM HYDRIDE	.454
TITANIUM HYDRIDE, POWDER	4.536
TITANIUM HYDROXIDE POWDER	.690
TITANIUM METAL	.030
TITANIUM METAL -325 MESH	4.990
TITANIUM NITRIDE	.907
TITANIUM POWDER	.060
TITANIUM ROD	.001
TITANIUM SILICIDE	.473
TITANIUM SPONGE 3-9S PLUS	.100
TITANIUM SULFATE	.010
TITANIUM TRICHLORIDE	1.000
TITANIUM, VP	.454
TITANOUS CHLORIDE 20% SOLN	.250

LIST A

Newname	Sum of Kilos
TOLUALDEHYDE P	.010
TOLUENE SULFONAMIDE, O AND P	.010
TOLUENE SULFONIC ACID P	.010
TOLUENE SULFONYL CHLORIDE P	.010
TOLUENESULFONIC ACID	.200
TOLUENESULFONIC ACID SODIUM SALT	.300
TOLUIC ACID P	.010
TOLUIDINE M	.010
TOLYL ACETATE M	.010
TOLYL ACETATE O	.010
TOLYL ACETATE P	.010
TOLYLENE 2,4 DIISOCYANATE	.010
TRI 2 ETHYLHEXYL PHOSPHATE	.500
TRI N BUTYL ACONITATE	.010
TRI N BUTYRIN	.010
TRI N HEXYL TRIMELLITATE	.010
TRI N OCTYL DECYL ACETYL CITRATE	.010
TRI N OCTYL PHOSPHINE OXIDE	3.375
TRI-N-OCTYL-PHOSPHINE-OXIDE	3.375
TRIOCTYL PHOSPHINE OXIDE	3.375
TRIOCTYLPHOSPHINE OXIDE	3.375
TRI N OCTYL TRIMELLITATE	.010
TRI N OCTYLAMINE	.100
TRIOCTYLAMINE	.100
TRI-N-BUTY ACONITATE 499	.010
TRI-N-BUTYRIN 500	.010
TRIACETIN	.010
TRIACETIN 498	.010
TRIALLYL AMINE	.010
TRIARYL PHOSPHATE	.010
TRIBENZYLAMINE	.010
TRIBUTOXYETHYL PHOSPHATE	.010
TRICAPRYLAMINE	1.000
TRICHLORO ACETONITRILE	.500
TRICHLORO FLUOROMETHANE	.002
TRICHLOROACETIC ACID	.582
TRICHLOROMETHANE SULFONYL CHLORIDE	.010
TRICHLOROTOLUENE A A A	.010
TRICRESYL PHOSPHATE	.020
TRICYCLOHEXYL CITRATE	.010
TRIDODECYLAMINE	.500
TRIETHOXYETHYLSILANE	.010
TRIETHYL ALUMINUM	2.000
TRIETHYL AMINE	.500
TRIETHYL BENZENE	.010
TRIETHYL ORTHO ACETATE	.010
TRIETHYL PHOSPHATE	.020
TRIETHYLENE GLYCO DI 2 ETHYLBUTYRATE	.010
TRIETHYLENE TETRAMINE	.483
TRIETHYLENE TETRAMINE EPON HARDENER	1.419
TRIFLUORO 1,2 THIENYL 1,3 BUTANEDIONE 4,4,4	.675
TRIFLUOROACETIC ANHYDRIDE	.600
TRIFLUOROTOLUENE A A A	.010
TRIISODECYL TRIMELLITATE	.010
TRIISONONYL TRIMELLITATE	.010

LIST A

Newname	Sum of Kilos
TRIISOOCTYL AMINE	.237
TRILAURYLAMINE	.100
TRIMETHYL 1,3 PENTANEDIOL 2,2,4	.010
TRIMETHYL BENZENE 1,2,4	.010
TRIMETHYL BORATE	.010
TRIMETHYL CYCLOHEXANOL 3,3,5	.010
TRIMETHYL ORTHO FORMATE	.010
TRIMETHYL PENTANE 2,2,4	4.010
TRIMETHYLAMINE HYDROCHLORIDE	.010
TRIMETHYLBORATE	.500
TRIMETHYLOLPROPANE	1.814
TRIMETHYLPYRIDINE 2,4,6	.010
TRIMETHYOLPROPANE TRINONANOATE	.010
TRIPHENYL PHOSPHATE	.020
TRIPHENYL PHOSPHITE	.010
TRIPHENYLMETHANE	.010
TRIS 2 CHLOROETHYL PHOSPHATE	.010
TRIS 2 ETHYLHEXYL PHOSPHATE	.010
TRIS 2,3 DIBROMOPROPYL PHOSPHATE	.010
TRIS 2,3 DICHLOROPROPYLENE PHOSPHATE	.010
TRIS HYDROXYMETHYL AMINOMETHANE	.010
TRIS ISOPROPYLPHENYL PHOSPHATE	.010
TRIS PERFLUOROHEPTYL S TRIAZINE	.002
TUNGSTEN CARBIDE	1.814
TUNGSTEN CHLORIDE	.237
TUNGSTEN METAL	.118
TUNGSTEN OXIDE	.100
TUNGSTEN SILICIDE	.237
TUNGSTIC ACID	.120
TUNGSTIC ANHYDRIDE	2.268
URANIUM METAL	.500
URANIUM NITRATE	.118
URANIUM OXIDE NO 95 3 BLACK OXIDE	.025
URANIUM OXIDE NO 95 4 BLACK OXIDE	.025
URANIUM OXIDE NO 95 5 BLACK OXIDE	.025
URANIUM OXIDE NO 95 6 BLACK OXIDE	.025
URANIUM OXIDE NO 95 7 BLACK OXIDE	.025
URANIUM OXIDE NO 98 1 BLACK OXIDE	.025
URANIUM OXIDE NO 98 4 BLACK OXIDE	.025
URANIUM OXIDE NO 98 5 BLACK OXIDE	.025
URANIUM OXIDE NO 98 6 BLACK OXIDE	.025
URANIUM ROD	.050
VALERALDEHYDE N	.010
VALERIC ACID	.010
VINYL BUTYRATE	.010
VINYL CYCLOHEXENE 1 4	.010
VINYL PROPIONATE	.010
VM&P NAPHTHA	3.785
WHITE LEAD BASIC BONATE TYPE B PASTE	.177
WHITE LEAD TPO-143	.454
X2 HYDROXY 5 SULFA PHENYLAZO BENZYLIDENE HYDRAZINO BENZO	.025
XYLENE FLASH CHECK FLUID PARA	3.785
YTTRIUM AQY2	.500
YTTRIUM CHLORIDE	.010
YTTRIUM IN 2% NITRIC ACID	1.000

Newname	Sum of Kilos
YTTRIUM NITRATE	.010
YTTRIUM NITRATE HEXAHYDRATE	.200
ZIRCONIUM CARBIDE	1.144
ZIRCONIUM DIOXIDE	.002
ZIRCONIUM ISOTOPE 91	.001
ZIRCONIUM NITRIDE	.907
ZIRCONIUM NITRIDE POWDER	4.536
ZIRCONIUM ORTHO PHOSPHATE	.454
ZIRCONIUM OXIDE IN ISOPROPANOL	.454
ZIRCONIUM OXYCHLORIDE	.118
ZIRCONIUM ROD	.010
ZIRCONIUM ROD STANDARD	.100
ZIRCONIUM SILICIDE	.237
ZIRCONIUM TUNGSTATE TECH 18782	.250
ZIRCONYL NITRATE	.754
ZIRCONYL NITRATE PURIFIED	.754

APPENDIX E

REPRODUCTIVE AND DEVELOPMENTAL TOXICANTS

APPENDIX E

REPRODUCTIVE AND DEVELOPMENTAL TOXICANTS

Carbon Disulfide[1]
Carbon Monoxide[1]
Coumarin[2]
Dinitrobenzene[1]
Ethylene Glycol Monoethyl Ether[1]
Ethylene Glycol Monomethyl Ether[1]
Hexachlorobenzene[1]
Lithium[2]
Lead[1,2]
Mercury and Mercury Compounds[1,2]
PCBs[2]
Ethylene Oxide[1]

1 CHWA, 1989
2 Shepard, 1989

0116ALR1

APPENDIX F

LIST A CHEMICALS

Chemical	Kilograms
CYANOETHOXY)PROPANE(TRIS)	.010
HYDROXYACETOPHENONE) CHROMIUM III	.100
PHENYL BUTANEDIONE)OXAVANADIUM IV	.100
1,1-DIMETHOXYMETHANE	.020
1,2,3,4-BUTANETETRACARBOXYLIC ACID	.020
1,2-BIS(2-METHOXYETHOXY)ETHANE	.020
1,2-DIETHOXYETHANE	4.900
1,2-EPOXY-3-PHENOXYPROPANE	.020
1,3-DI-O-TOLYLGUANIDINE	.020
1,3-DIBUTYL-2-THIOUREA	.020
1-ALLY 2 THIOUREA	.600
1-BROMO-2-METHYLPROPANE	.040
1-OCTENE	.020
2 (BENZYLOXY) ETHANOL	.008
2 BENZYL 2 THIOPSEUDOUREA HYDROCHLORIC ACID	.100
2,3-DICHLOROPROPENE	.020
2,5-DI-TERT,-AMYLHYDROQUINONE	.020
2,6-DI-TERT,-BUTYL-P-CRESOL	.020
2-AMINO-5-CHLORO-4-METHYLBENZENESULFONIC ACID	.020
2-BROMO-N-BUTYRIC ACID	.020
2-ETHYLHEXANOIC ACID	1.000
2-METHYLPENTANE	.040
2-METHYLPYRAZINE	.020
2-PHENANTHROLINE	.635
3,3' IMINODIPROPLONITRILE	.020
3-DIMETHYLAMINOPROPIONITRILE	.020
4,AMINO(1-NAPHTHYLAZO)2-2'STILOENEDISULFONIC ACID	.020
5-AMINO-2-CHLOROBENZENESULFONIC ACID	.020
7-AMINO-1,3-NAPHTHALENEDISULFONIC ACID	.020
ACETOIN HYDROXY BUTANONE	.020
ACETYL FLUORIDE	2.000
ACETYLSALICYLIC ACID	.020
ACETYLSALICYLOYL CHLORIDE	.050
ALKYL PHENOXY POLYETHOXY ETHANOL	.500
ALKYLATE SULFONATE	1.000
ALKYLEENZENE SULFONATE	.009
ALUMINUM ISO-PROPOXIDE	.020
AMINO HYDROXY ANTHRAQUINONE	.100
AMINO PHENOL SULFONIC ACID	1.000
AMINOANTIPYRINE	.010
AMINOBENZOIC ACID	.020
AMINOETHANOL	3.000
AMINOHYDROXIMETHYLPROPANEDIOL	.720
AMINOMETHYLALIZARINE N N DIACETIC ACID	.005
AMINOPYRINE	.227
AMMONIUM BENZOATE	.700
AMMONIUM CHROMATE	.960
AMMONIUM DIURANATE	.010
AMMONIUM PHOSPHOMOLYBDATE	.100
AMMONIUM PURPURATE	.143
AMMONIUM TUNGSTATE	.100
AMYL CHLORIDE	.100
AMYL METHYL KETONE	.100
ANILINE HYDROCHLORIDE	.450

LIST A 1974 UNIQUE CHEMICALS

Chemical	Kilograms
ANILINE SULFATE	.450
ANISIC ACID	.050
ANTHRONILIC ACID	.228
ANTIMONY CHLORIDE	1.600
ANTIMONY POTASSIUM TARTRATE	.454
ARSENIOUS IODIDE	.900
AURIN	.020
AZOBISFORMAMIDE	.100
AZODIISOBUTYBONITRILE	.020
AZOXYBENZENE	.020
AZULENE	.025
BARIUM OXALATE	.450
BENZENE ARSENIC ACID	.100
BENZENE SULFONATE	1.000
BENZENE SULFONYL HYDRAZIDE	.100
BENZIDINE DIHYDROCHLORIDE	1.200
BENZIMIDAZOLE	.020
BENZOTRIAZOLE	.550
BENZOYL CHLORIDE	.020
BENZOYLPHENOLHYDROXYLAMINE	.010
BENZYL CARBINOL	.100
BENZYL DIMETHYL AMINE	.250
BIS CYCLOHEXANONE OXALYLDIHYDRAZONE	.002
BIS(2-(METHOXYETHOXY)ETHYL)ETHER	.020
BIS(2-METHOXYETHYL)ETHER	.020
BIS(2-METHOXYETHYL)PHTHALATE	.020
BIS(2-PHENOXYETHYL)ETHER	.020
BIS(ALPHA-METHYLBENZYL)ETHER	.020
BIS(METHOXYPHENYL)CARBONATE	.020
BISMUTH SULFATE	.113
BORIC ANHYDRIDE	.562
BORON TRILUORIDE	4.000
BROMOACETIC ACID	.020
BROMOPENTAFLUROBENZENE	.100
BUTYL AMINE	.080
BUTYL LITHIUM	.450
BUTYL VINYL ETHER	.020
CALCIUM CARBIDE	.950
CALCIUM ETHYLHEXANOATE	.100
CALCIUM HYDRIDE	1.400
CALCIUM PHOSPHIDE	.450
CARBON TETRABROMIDE	.050
CARBON TETRAIODIDE	.015
CERIUM NITRATE	.650
CERIUM POWDER	.635
CEROUS CARBANATE	.200
CESIUM CARBONATE	.550
CESIUM HYDROXIDE	.150
CHLORAL HYDRATE	.454
CHLOROCYCLOHEXANE	.100
CHLOROMANDELIC ACID	.950
CHLORONITROTOLUENE	.100
CHLOROPENTAFLUOROETHANE	.100
CHLOROPHENIRAMINE MALEATE	.044
CHLOROPROPANEDIOL	.020

LIST A 1974 UNIQUE CHEMICALS

Chemical	Kilograms
CHLOROPROPANOL	.100
CHLOROSULFURIC ACID	.500
CHLOROTRIPHENYLMETHANE	.020
COBALT CARBONATE	.225
COPPER BROMIDE	.225
COPPER HYDROXIDE	2.200
COPPER SELENATE	.100
COUMARIN	.800
CRESOLPHTHALEIN	.472
CRYOLITE	.450
CYCLODODECANE	.010
CYCLOHEXANE BUTYRATE, METAL SALTS	1.600
CYCLOHEXENE	.420
CYCLOHEXONEBUTYRIC ACID	.035
CYCLOOCTANE	.100
CYCLOPENTADIENYL METAL SALTS	.480
CYCLOPENTANOL	.100
DECAHYDRONAPHTHALENE(DECALIN)	.020
DECYL AMINE	.100
DEUTEROACETONE	.020
DEUTEROPYRIDINE	.010
DEUTEROTRIFLUOROACETIC ACID	.010
DI(TETRAHYDROFURFURYL)ADIPATE	.020
DI-ISO-BUTYL PHTHALATE	1.000
DI-ISO-PROPANOLAMINE	.500
DIBUTYL OXALATE	.020
DIBUTYL TIN DIACETATE	.020
DIBUTYL TIN DICHLORIDE	1.000
DIBUTYLAMINE	.020
DIBUTYLAMINOETHANOL	.020
DIBUTYLTHIOLATE	.237
DICHLORO PHENOL SULFONIC PHTHALINE	.005
DICHLOROACETYL CHLORIDE	.020
DICHLOROPROPANOL	.040
DICHROMIC ACID	.100
DIDECYL PHTHALATE	.010
DIDEUTEROSULFURIC ACID	.010
DIETHOXYANILINE	.050
DIETHYL BROMONOL	.090
DIETHYL DIHEXYL AMINE	.950
DIETHYL HEXYL SEBACATE	.010
DIETHYL TOLYAMINDE	.475
DIETHYLANILINE	.020
DIETHYLDODECANAMIDE	.020
DIETHYLETHYLENEDIAMINE	.020
DIETHYLPHENYLENEDIAMINE HYDROCHLORIDE	.020
DIETHYLPROPENEDIOL	.020
DIGLYCOL STEARATE	.020
DIHYDROXY PARA SULFOPHENYLAZONAPHALENE DISULFONATE	.125
DIHYDROXYCYCLOBUTENEDIONE	.010
DIISOAMYLOXALATE	.020
DIISOPROPYLAMINE	3.300
DIMERCAPTOPROPANOL	.100
DIMETHOXY PROPANE	1.000
DIMETHYL PHENANTHROLINE HEMIHYDRATE	.065

LIST A 1974 UNIQUE CHEMICALS

Chemical	Kilograms
DIMETHYL PHENYLENEDIAMINE	.020
DIMETHYL PHENYLENEDIAMINE OXALATE	.225
DIMETHYLAMINOETHANOL	.020
DIMETHYLTHIOCARBAMYLDISULFIDE	.020
DINITROSTILBENE	.010
DINONYL PHTHALATE	.050
DINONYL PHTHALATE	4.000
DIPENTYLAMINOETHANOL	.020
DIPHENYL AMINE SULFONATE	.070
DIPHENYL PROPANEDIONE	.100
DIPHENYLCARBAZIDE	.417
DIPHENYLPHENYLENEDIAMINE	.020
DIPROPYLAMINE	.020
DITHENYLOXALATE	.400
DITHIOLOXALIC ACID K SALT	.005
DODECENYL SUCCINIC ANHYDRIDE	.240
DYSPROSIUM	.500
DYSPROSIUM OXIDE	.005
EPOXYNAPHTHALENE	.060
ETHOXY PROPANOL	.020
ETHYL ANISATE	.425
ETHYL CHLORIDE	1.500
ETHYL HEXYL METHYL PHOSPHORAMIDE	.050
ETHYL HEXYL SEBACATE	.500
ETHYL PHENOL KETONE	.200
ETHYL XANTHIC ACID, POTASSIUM SALT	.100
ETHYLAMINE	.100
FERRIC AMMONIUM NITRATE	.450
FERRIC CITRATE	2.300
GALLOYLANINE	.050
GERMANIUM OXIDE	.075
HAFNIUM OXIDE	.010
HAFNIUM OXYCHLORIDE	.013
HEPHYL CHLORIDE	.100
HEPTANOIC ACID	.020
HEPTENE-2	.020
HEXADEUTEROBENZENE	.120
HEXAFLUOROBENZENE	1.000
HEXAMETHYLDISILOXANE	.100
HEXANITRODIPHENYL AMINE	.025
HEXYL ETHER	.020
HYDROGEN BROMIDE GAS	1.600
HYDROGEN SULFIDE	.396
HYDROSULFITE AWC	.020
HYDROXY NAPHTHOIC ACID	.020
HYDROXYAMINOMETHANE	.750
HYDROXYBENZENEARSENIC ACID	.300
HYDROXYBENZOIC ACID	.020
HYDROXYNAPTHAZO NITRO NAPHTHOL	.025
HYDROXYSULFO NAPHTALAZO QUINOLINE SULFUNOIC ACID	.001
IMINODIACETIC AND SODIUM SALT	.350
INDIUM	.054
INDIUM PERCHLORATE	.450
INSECTICIDE, PYRETHRIN	2.200
IODINE MONOCHLORIDE	.454

LIST A 1974 UNIQUE CHEMICALS

Chemical	Kilograms
IODINE PENTAFLUORIDE	.055
IODOBEZOIC ACID	.030
IRON CARBONYL	1.000
IRON CYCLOHEXANE BUTYRATE	.075
IRON POTASSIUM PERCHLORATE	1.000
ISO-BUTYRONITRILE	.040
ISOBUTYLENE	.341
LAURIC ACID	.020
LEAD ARSENATE	.454
LEAD BORATE	.112
LEAD CHLORATE	1.300
LEAD PERCHLORATE	.014
LEAD PEROXIDE	.050
LEAD STYPHANATE	.075
LIMONENE DIPENTANE	.100
LITHIUM BORATE	2.500
LITHIUM BOROHYDRIDE	.015
LITHIUM HYDRIDE	.100
LITHIUM METHOXIDE	.450
LITHIUM NITRIDE	.025
LITHIUM PHENOXIDE	.450
MAGNESIUM HYDRIDE	.025
MAGNESIUM URANIUM SULFATE	.030
MANGANESE PENTOXIDE	4.500
MENTHYL BORATE	.100
MEPROBAMETE	2.200
MERCAPTOACETIC ACID	1.000
MERCAPTOSUCCINIC ACID	.020
METHOXYBENZOIC ACID	.020
METHYL HEPTANE DIONE	.010
METHYL LITHIUM	.450
METHYL PHENYL PYRAZOLINE-ONE	.100
METHYL PYRROLIDINE	.800
METHYLAL	.020
METHYLAMINOPHENYL SULFATE	.900
METHYLBUTANE	3.000
METHYLBUTANOL	.510
METHYLCYCLOHEXANE	.520
METHYLCYCLOHEXANOL	1.100
METHYLENEDIAMINE TETRAACETIC ACID (MDTA)	.025
METHYLFORMATE	.020
METHYLIODIDE	.270
METHYLNAPHTHALENE	.620
METHYLPENTANOL	2.000
METHYLPENTANONE	4.000
METHYLPENTYNOL	1.000
METHYLTRICAPRYL AMMONIUM CHLORIDE	.040
MOLYBDENUM CHLORIDE	.100
MOLYBDENUM HEXACARBONYL	.100
MOLYBDENUM NITRATE	.004
MONOBUTYL PHTHALATE	.020
MONOBUTYRIN	.020
N BUTYL TRIPHENYLPHOSPHONIUM BROMIDE	.100
N,N'-DIETHYLCARBONILIDE	.020
N,N-DIMETHYL-P-TOLUENESULFONAMIDE	.020

LIST A 1974 UNIQUE CHEMICALS

Chemical	Kilograms
N-N-DIETHYLPROPANEDIAMINE	.020
N-N-DIMETHYLPROPANEDIAMINE	.020
NADIC METHYLANHYDRIDE	.227
NAPHTHOL	.340
NAPHTHOLBENZENE	.110
NAPHTHYLAMINE	.550
NICKEL ALUMINIDE	.100
NITRATOCERIC ACID	2.000
NITRILOTRIETHANOL	1.100
NITROANILINE	.150
NITROBENZALDEHYDE	.015
NITROBENZOIC ACID	.180
NITRODIPHENYL AMINE	.200
NITROMETHANE	.040
NITROPHENOL	.270
NITROPHENYLAZORESORCINOL	.125
NITROSONAPHTHOLDISULFONIC ACID NASALT	.350
NITROSORESORCINOL	.125
NITROTRIACETIC ACID	.075
NONANE	1.000
O-BENZOIC SULFAMIDE	.020
OCTAFLUOROTOLUENE	1.000
OXALYL CHLORIDE	.200
OXINE	.020
P-ANILINOPHENOL	.020
P-DIBROMOBENZENE	2.400
P-DIBUTOXYBENZENE	.020
PALLADIUM CHLORIDE	.001
PALLADIUM OXIDE	.225
PENTYL ACETATE	1.600
PERFLUORODECALIN	1.000
PERIODIC ACID	.100
PHENOLDISULFONIC ACID	2.000
PHENOSAFRANINE	.020
PHENOXYACETIC ACID	.020
PHENYL ETHANEDIOL	.020
PHENYL-2-PROPANONE	.020
PHENYLACETIC ACID	.020
PHENYLANTHRANILIC ACID	.020
PHENYLARSINE OXIDE	1.200
PHENYLBENZOHYDROXAMIC ACID	.035
PHENYLPROPANOL	.020
PHENYLSALICYLIC ACID	.025
PHOSPHOROUS	1.100
PICRIC ACID	1.500
PIPERIDINE HYDROCHLORIDE	.100
PLATINUM NITRATE	.002
POLYOXYETHYLENE MONOLEATE	.300
POTASSIUM ARSENATE	.010
PROPANOIC ACID	.025
PROPYLAMINE	.500
PROPYLENE GLYCOL SULFATE	1.000
PURPURIN SULFATE	.020
PYRIBENZAMINE	.400
PYROGALLIC ACID	2.400

LIST A 1974 UNIQUE CHEMICALS

Chemical	Kilograms
PYRROXATE	.720
QUINALDIC ACID	.010
QUINALIZARIN	.040
SALICYLALDOXIME	.010
SILVER PERCHLORATE	.050
SODIUM	3.600
SODIUM 2,4-DIHYDROXYAZORENZENE	.800
SODIUM AMIDE	.100
SODIUM BITARTRATE	.454
SODIUM BOROHYDRIDE	.150
SODIUM CYCLOPENTADINIDE	.020
SODIUM DIETHYLDITHIOCARBONATE	.100
SODIUM DIPHENYLAMINE SULFANATE	.020
SODIUM GLYCEROPHOSPHATE	.100
SODIUM HYDROXY ACETATE	.454
SODIUM HYDROXY MERCURY BENZOATE	.114
SODIUM HYPOBROMITE	.900
SODIUM NITRO FERBICYANIDE	.220
SODIUM PERIODATE	.160
SODIUM PERXENATE	.003
SODIUM PHENYL PHENATE	1.000
SODIUM PYROSULFATE	1.400
SODIUM TEIRAFLUORBORATE	1.000
SODIUM TETRAPHENYLBORON	.028
SODIUM VANADATE	.325
STANNOUS OCTOATE	.020
STRONTIUM	.335
STRONTIUM ACETATE	.450
STRONTIUM HYDROXIDE	.454
STRONTIUM SULFATE	.454
SULFONIC ACID SODIUM SALT	.050
SULFUR MONOCHLORIDE	.500
T-BUTYL HYDROPEROXIDE	.500
TELLURIUM DIOXIDE	.008
TERBIUM OXIDE	.005
TEREPHTHALIC ACID	.010
TERTBUTYL LITHIUM	.100
TERTBUTYL MAGNESIUM CHLORIDE	.100
TETRA BROMOETHANE	.400
TETRABROMOCHRYSAZIN	.020
TETRABROMOCRESOL SULFONE PHTHALEIN	.043
TETRABROMOFLUORESCEIN SODIUM SALT	.100
TETRABROMOPHENOL SULFONE PHTHALEIN	.010
TETRADECANOL	.020
TETRADIMETHYL AMINEDIBORON	.100
TETRAETHYL 1,1,2,2-ETHANE TETRACARBOXYLATE	.020
TETRAETHYL AMMONIUM FLUORIDE	.025
TETRAHYDONAPHTHALENE	.020
TETRAHYDRO-2-METHYLFURAN	.020
TETRAHYDROTHIOPHENE	.020
TETRAHYDROTHIOPHENE DIOXIDE	4.000
TETRAHYDROXYQUINONE	.270
TETRAIODOFLUORESCEIN	.005
TETRAMETHYL AMMONIUM FLUORIDE	.025
TETRAMETHYL AMMONIUM IODIDE	.100

Chemical	Kilograms
TETRAMETHYL HEPTANEDIONE	.001
THIOPHENOL	.100
THIOSEMICARBAZIDE	.020
THORIUM	.837
THORIUM CHLORANILATE	.125
THORIUM HYDROXIDE	.114
THORIUM TETRAIODATE	.008
TOLUENE DIISOCYANATE	.250
TOLUHYDROQUINONE	.500
TOLUIDINE DIHYDROCHLORIDE	.350
TRANS-4-PHENYL-3-BUTENE-2-ONE	.030
TRIBUTYL CHLORIDE	.100
TRIBUTYLAMINE	.010
TRIBUTYRIN	.020
TRICHLOROMETHANESULFONYL CHLORIDE	.020
TRIETHYL PHOSPHITE	.020
TRIFLUOROMETHYL IODINE	.025
TRIHYDROXY PHENYL XANTHENE-ONE	.020
TRIMETHYLPHENYLAMMONIUM IODIDE	.020
TRIMETHYLPHENYLAMMONIUMBENZENESULFONATE	.020
TRINAPHTHYL PHOSPHATE	.030
TRINITROAZOBENZENE	.010
TRIPHENYL PHENYL PHOSPHINE	.100
TRIS (HYDROXYMETHYL) AMINOMETHANE	.120
URANIUM	.152
URANIUM ACETATE	.025
URANIUM TETRAIODIDE	.010
URANYL CHLORIDE	.080
URANYL SULFATE	2.100
VALERALDEHYDE	.020
VINYL ACETATE	.020
VINYL PYRROLIDENE	.100

APPENDIX G

HAZARDOUS CHEMICALS LIST

CARCINOGENS

COMPOUND

ACROLEIN
ACRYLAMIDE
ACRYLONITRILE
ALDRIN
ANILINE
AROCLOR 1016
AROCLOR 1221
AROCLOR 1232
AROCLOR 1242
AROCLOR 1248
AROCLOR 1254
AROCLOR 1260
AROCLOR 1262
AROCLOR 4465
AROCLOR 5460
AROCLOR MIX 1
AROCLOR MIX 2
ARSENIC ACID
ARSENIC IODIDE
ARSENIC METAL
ARSENIC PENTOXIDE
ARSENIC SOLUTION 3103
ARSENIC TRIOXIDE
ASBESTOS
BENZENE
BENZYL CHLORIDE
BERYLLIUM
BERYLLIUM CARBONATE
BERYLLIUM IN 2% HCL(HYDROCHLONC ACID
BERYLLIUM OXIDE
BERYLLIUM SOLUTION 3105
BERYLLIUM SULFATE
BIS 2 CHLOROETHYL ETHER
BIS 2 ETHYLHEXYL PHTHALATE
BROMOFORM
BUTYL BENZYL PHTHALATE
CADMIUM
CADMIUM ACETATE
CADMIUM CHLORIDE
CADMIUM IODIDE
CADMIUM METAL
CADMIUM NITRATE
CADMIUM ORTHOPHOSPHATE
CADMIUM OXIDE
CADMIUM ROD STANDARD
CADMIUM SOLUTION 3108
CADMIUM SULFATE

CARCINOGENS

COMPOUND

CARBAZOLE
CARBON TETRACHLORIDE
CHLORANIL
CHLORDANE
CHLOROANILINE P
CHLORODIBROMOMETHANE
CHLOROFORM
CHROMIUM
CHROMIUM BORIDE
CHROMIUM CARBIDE
CHROMIUM CHLORIDE
CHROMIUM DIOXIDE
CHROMIUM NITRATE
CHROMIUM OXIDE
CHROMIUM PELLETS
CHROMIUM POTASSIUM SULFATE
CHROMIUM POWDER
CHROMIUM SILICIDE
CHROMIUM SOLUTION 3112
CHROMIUM SULFATE
CHROMIUM TOTAL AND TRIVALENT
CHROMIUM TRIOXIDE
CHROMIUM, METAL
CROTONALDEHYDE
DDD 4,4
DDE
DDT
DIBENZO FURAN
DICHLOROBENZENE O
DICHLOROBENZENE P
DICHLOROETHANE 1,2
DICHLOROPROPANE 1,2
DIELDRIN
DIMETHYL HYDRAZINE 1,1
DIOXANE
EPICHLOROHYDRIN
ETHYL ACRYLATE
FLUORENE
FORMALDEHYDE
HEPTACHLOR
HEPTACHLOR EPOXIDE
HEXACHLORO 1,3 BUTADIENE
HEXACHLORO BENZENE
HEXACHLORO ETHANE
HYDRAZINE 95%
HYDRAZINE SULFATE
ISOPHORONE

CARCINOGENS

COMPOUND

LEAD
LINDANE
METHYLENE CHLORIDE
NICKEL ACETATE
NICKEL CHLORIDE
NICKEL CYANIDE
NICKEL METAL
NICKEL METAL POWDER
NICKEL NITRATE
NICKEL OXIDE
NICKEL SOLUTION 3136
NICKEL SULFAMATE
NICKEL SULFATE
NICKELOUS ACETATE
NICKELOUS CARBONATE
NICKELOUS CHLORIDE
NICKELOUS FLUORIDE
NICKELOUS NITRATE
NICKELOUS OXIDE
NICKELOUS SULFATE
NITROPROPANE 2
NITROSO DI N PROPYLAMINE N
NITROSO DIPHENYLAMINE N
PHENYLENE DIAMINE O
QUINOLINE
SODIUM DIETHYLDITHIOCARBAMATE
STYRENE
TETRACHLOROETHANE 1,1,2,2
TETRACHLOROETHANE PURITY-99+% 0-651 5
TETRACHLOROETHANE, S
TETRACHLOROETHYLENE
TOLUIDINE O
TOLUIDINE P
TOXAPHENE
TRICHLOROETHANE 1,1,2
TRICHLOROETHENE
TRICHLOROPHENOL 2,4,6
VAPONITE 2 INSECTICIDE
VINYL CHLORIDE
VINYLIDENE CHLORIDE

CARCINOGENS

COMPOUND

AZOBENZENE
BENZIDINE
BERYLLIUM ACETATE
BERYLLIUM CHLORIDE
BERYLLIUM DUST AND MASSIVE
BERYLLIUM FLUORIDE
BERYLLIUM NITRATE
BERYLLIUM OXYCHLORIDE
BUTADIENE
CADMIUM CARBONATE
CHLOROMETHYLANILINE
ETHYLENE OXIDE
NICKEL AMMONIUM SULFATE
NICKEL BROMIDE
NICKEL CARBONATE
NICKEL FLUORIDE
PROPYLENE OXIDE
ZINC CADMIUM SULFIDE PHOSPHOR

NONCARCINOGENS WITH REFERENCE DOSE

COMPOUND

ACENAPHTHENE
ACETONE
ACETONITRILE
ACETOPHENONE
ACROLEIN
ACRYLAMIDE
ACRYLIC ACID
ALDRIN
ALLYL CHLORIDE
AMINOPHENOL M
AMMONIA
ANTHRACENE
ANTIMONY IN 20% HCL HYDROCHLORIC ACID
ANTIMONY IODIDE
ANTIMONY OXIDE
ANTIMONY PENTACHLORIDE
ANTIMONY POWDER
ANTIMONY SOLUTION 3102
ANTIMONY TRICHLORIDE
ANTIMONY TRIOXIDE
ARSENIC ACID
ARSENIC IODIDE
ARSENIC METAL
ARSENIC PENTOXIDE
ARSENIC SOLUTION 3103
ARSENIC TRIOXIDE
ATRAZINE
BARIUM ACETATE
BARIUM CARBONATE
BARIUM CHLORANILATE
BARIUM CHLORIDE
BARIUM CHROMATE
BARIUM DIOXIDE
BARIUM DIPHENYLAMINE SULFONATE
BARIUM FLUORIDE
BARIUM HYDROXIDE
BARIUM METAL
BARIUM NITRATE
BARIUM OXIDE
BARIUM PERCHLORATE
BARIUM PERCHLORATE DESSICCHLORA
BARIUM ROD 99.5%
BARIUM SOLUTION 3104
BARIUM SULFATE
BARIUM THIOCYANATE
BARIUM ZIRCONATE
BENZALDEHYDE

NONCARCINOGENS WITH REFERENCE DOSE

COMPOUND

BERYLLIUM
BERYLLIUM CARBONATE
BERYLLIUM IN 2% HCL(HYDROCHLONC ACID
BERYLLIUM OXIDE
BERYLLIUM SOLUTION 3105
BERYLLIUM SULFATE
BIPHENYL
BIS 2 ETHYLHEXYL PHTHALATE
BORON CARBIDE
BORON CRYSTALLINE
BORON ISOTOPE 10
BORON ISOTOPE 11
BORON ISOTOPE 11 B2O3
BORON METAL
BORON NITRIDE
BORON OXIDE
BORON SOLUTION 3107
BROMOFORM
BUTYL BENZYL PHTHALATE
BUTYL PHTHALATE N
CADMIUM
CADMIUM ACETATE
CADMIUM CHLORIDE
CADMIUM IODIDE
CADMIUM METAL
CADMIUM NITRATE
CADMIUM ORTHOPHOSPHATE
CADMIUM OXIDE
CADMIUM ROD STANDARD
CADMIUM SOLUTION 3108
CADMIUM SULFATE
CAPROLACTAM
CARBON DISULFIDE
CARBON TETRACHLORIDE
CAUSTIC POTASH DRY FLAKE
CAUSTIC SODA FLAKE
CAUSTIC, POTASH FLAKE
CHLORDANE
CHLOROACETIC ACID
CHLOROANILINE P
CHLOROBENZENE
CHLOROBENZOIC ACID P
CHLOROBUTANE 0-621 1
CHLORODIBROMOMETHANE
CHLOROFORM
CHLOROPHENOL O
CHLOROPROPANE 3110 2

NONCARCINOGENS WITH REFERENCE DOSE

COMPOUND

CHLOROTOLUENE 0-672 O
CHROMIUM
CHROMIUM BORIDE
CHROMIUM CARBIDE
CHROMIUM CHLORIDE
CHROMIUM DIOXIDE
CHROMIUM NITRATE
CHROMIUM OXIDE
CHROMIUM PELLETS
CHROMIUM POTASSIUM SULFATE
CHROMIUM POWDER
CHROMIUM SILICIDE
CHROMIUM SOLUTION 3112
CHROMIUM SULFATE
CHROMIUM TOTAL AND TRIVALENT
CHROMIUM TRIOXIDE
CHROMIUM, METAL
COPPER CYANIDE
CRESOL M
CRESOL O
CRESOL P
CUMENE
CYCLOHEXYL AMINE
DDT
DI N BUTYL PHTHALATE
DI N OCTYL PHTHALATE
DIAZINON
DICHLOROBENZENE O
DICHLOROBENZENE P
DICHLOROETHANE 1,1
DICHLOROETHYLENE CIS 1,2
DICHLOROPHENOL 2,4
DICHLOROPHENOXYACETIC ACID 2,4
DICYCLOPENTANDIENE
DIELDRIN
DIETHYL PHTHALATE
DIETHYLENE GLYCOL MONOETHYL ETHER
DIMETHYL PHENOL 3,4
DIMETHYL PHTHALATE
DIMETHYL TEREPHTHALATE
DIMETHYLPHENOL 2,6
DINITROBENZENE M
ENDOSULFAN
ENDRIN
EPICHLOROHYDRIN
ETHOXYETHANOL 2
ETHYL ACETATE

NONCARCINOGENS WITH REFERENCE DOSE

COMPOUND

ETHYL BENZENE
ETHYL ETHER
ETHYL METHACRALATE
ETHYLENE DIAMINE
ETHYLENE GLYCOL
ETHYLENE GLYCOL MONOBUTYL ETHER
FLUORANTHENE
FLUORENE
FLUORIDE STANDARD
FLUORIDE STANDARD 940907
FORMIC ACID
FREON 11
FREON 12
FURFURAL
HEPTACHLOR
HEXACHLORO 1,3 BUTADIENE
HEXACHLORO BENZENE
HEXACHLORO CYCLOPENTADIENE
HEXACHLORO ETHANE
HEXANE
HYDROQUINONE
ISOBUTYL ALCOHOL
ISOPHORONE
LEAD
LINDANE
MALEIC ACID HYDRAZIDE
MALEIC ANHYDRIDE
MANGANESE
MANGANESE CARBONATE
MANGANESE CHIPS
MANGANESE DIOXIDE
MANGANESE FLAKE
MANGANESE II OXIDE
MANGANESE METAL (325)
MANGANESE MONOXIDE
MANGANESE POWDER
MERCURIC ACETATE
MERCURIC CHLORANILATE
MERCURIC CHLORIDE
MERCURIC IODIDE
MERCURIC NITRATE
MERCURIC OXIDE
MERCURIC POTASSIUM THIOCYANATE
MERCURIC THIOCYANATE
MERCUROUS CHLORIDE
MERCUROUS NITRATE
MERCURY

NONCARCINOGENS WITH REFERENCE DOSE

COMPOUND

MERCURY (METAL)
MERCURY II NITRATE
METHANOL
METHOXYCHLOR
METHOXYETHANOL 2
METHYL ACETATE
METHYL ACRYLATE
METHYL ETHYL KETONE
METHYL ISOBUTYL KETONE
METHYL METHACRYLATE
METHYLENE CHLORIDE
N,N DIMETHYL ANILINE
N,N DIMETHYL FORMAMIDE
NAPHTHALENE
NICKEL ACETATE
NICKEL CHLORIDE
NICKEL CYANIDE
NICKEL METAL
NICKEL METAL POWDER
NICKEL NITRATE
NICKEL OXIDE
NICKEL SOLUTION 3136
NICKEL SULFAMATE
NICKEL SULFATE
NICKELOUS ACETATE
NICKELOUS CARBONATE
NICKELOUS CHLORIDE
NICKELOUS FLUORIDE
NICKELOUS NITRATE
NICKELOUS OXIDE
NICKELOUS SULFATE
NITRIC OXIDE
NITROBENZENE
NITROGEN DIOXIDE
NITROTOLUENE 859 M
NITROTOLUENE O
NITROTOLUENE P
PENTACHLOROPHENOL
PHENOL
PHENYL MERCURIC ACETATE
PHTHALIC ACID
PHTHALIC ANHYDRIDE
POTASSIUM CYANIDE
PROPYLENE GLYCOL
PROPYLENE GLYCOL ANTI FREEZE
PYRENE
PYRIDINE

NONCARCINOGENS WITH REFERENCE DOSE

COMPOUND

SELENIUM DIOXIDE
SELENIUM OXIDE
SELENIUM PELLETS
SELENIUM POWDER
SEVIN INSECTICIDE
SILVER CHLORIDE/LITHIUM FLUORIDE
SILVER CYANIDE
SILVER NITRATE
SILVER OXIDE
SILVER PEROXIDE
SILVER VANADATE
SODIUM CYANIDE
SODIUM DIETHYLDITHIOCARBAMATE
STYRENE
SULFURIC ACID
TETRACHLOROBENZENE 1,2,4,5
TETRACHLOROETHYLENE
THALLIC OXIDE
THALLIUM
THIRAM
TIN
TIN IN 20% HCL
TIN METAL
TIN POWDER
TIN, METAL SHOT
TOLUENE
TOLUENE T-324
TORDON 22K WEED KILLER
TRICHLORO 1,2,2 TRIFLUOROETHANE 1,1,2
TRICHLOROBENZENE 1,2,4
TRICHLOROETHANE 1,1,1
TRICHLOROETHANE 1,1,2
TRICHLOROPHENOL 2,4,5
TRICHLOROPHENOXYACETIC ACID 2,4,5
TRICHLOROPROPANE 1,2,3
VANADIUM
VANADIUM CARBIDE
VANADIUM METAL
VANADIUM NITRIDE
VANADIUM PENTOXIDE
VANADIUM SILICIDE
VANADIUM SULFATE
VINYLIDENE CHLORIDE
XYLENE
XYLENE M
XYLENE O
XYLENE P

NONCARCINOGENS WITH REFERENCE DOSE

COMPOUND

ZINC
ZINC ACETATE
ZINC BROMIDE
ZINC CARBONATE
ZINC CHLORIDE
ZINC CHROMATE PRIMER 154-00
ZINC CHROMATE YELLOW PRIMER
ZINC CYANIDE
ZINC FLUORIDE
ZINC METAL POWDER
ZINC MOSSY
ZINC NITRATE
ZINC OXIDE
ZINC SILICOFLUORIDE
ZINC SULFIDE
ZINC SULFIDE POWDER
ZINC SULPHATE

NONCARCINOGENS WITH REFERENCE DOSE

COMPOUND

A-METHYLSTYRENE
BENZIDINE
BERYLLIUM ACETATE
BERYLLIUM CHLORIDE
BERYLLIUM DUST AND MASSIVE
BERYLLIUM FLUORIDE
BERYLLIUM NITRATE
BERYLLIUM OXYCHLORIDE
CADMIUM CARBONATE
CHLORAL T
MANGANESE CARBONYL
MANGANESE NITRATE
MANGANESE PHOSPHOLINE
MANGANOUS CARBONATE
MANGANOUS PENTOXIDE
MERCURIC CYANIDE
MERCURIC SULFATE
MERCURY BROMIDE
NICKEL AMMONIUM SULFATE
NICKEL BROMIDE
NICKEL CARBONATE
NICKEL FLUORIDE
SELENIUM
SELENIUM CHLORIDE
SILVER CARBONATE
SILVER DIETHYL DITHIO CARBAMATE
SILVER ETHYLHEXANOATE
SILVER FLUORIDE
THALLIUM BROMIDE
THALLIUM DICYCLOPENTADIENE
THALLIUM ETHOXIDE
THALLIUM FORMATE
THALLIUM MALONATE
THALLIUM NITRATE
THALLIUM OXIDE
THALLIUM PERCHLORATE
THALLIUM SULFATE
TIN OXIDE
TRINITROBENZENE
VANADIUM NITRATE
ZINC CADMIUM SULFIDE PHOSPHOR

NONCARCINOGENS WITHOUT REFERENCE DOSE, > 5 KG

COMPOUND

ALUMINIUM NITRATE
ALUMINUM HYDROXIDE
ALUMINUM NITRATE SOLUTION
ALUMINUM SULFIDE
AMMONIUM BIFLUORIDE
AMMONIUM FLUORIDE
AMMONIUM HYDROXIDE
AMMONIUM OXALATE
AMMONIUM THIOCYANATE
AMWEST KEROSENE
BIS(2-METHOXYETHYL) ETHER
BROMOBENZENE,M-
CALCIUM HYDROCHLORITE
CALCIUM HYPOCHLORITE
CELLULOSE NITRATE
CERIC AMMONIUM NITRATE
CERIC SULFATE
COBALTOUS SULFATE
CORROSIVE LIQUID, POISONOUS N.O.S. 2922
CUPRIC CHLORIDE
CUPRIC SULFATE
CYCLOHEXANE
D/DICAMBA MIXTURE 2,4
DEUTERIUM SULFIDE
DI 2 ETHYLHEXYL PHOSPHORIC ACID
DIALLYL PHTHALATE
DIBUTYL PHOSPHATE
DIETHYL BENZENE
DIETHYL CARBAMOYL METHYLENE PHOSPHONATE
DIHEXYL N,N DIETHYL CARBAMOYL METHYLENE PHOSPHONAT
DIISOPROPYL BENZENE
DIXICHLOR-SODIUM HYPOCHLORITE
DMA 4 HERBICIDE
FERROUS AMMONIUM SULFATE
FERROUS SULFAMATE
FERRSUS SULFAMATE 50% SOLN
FLUOSILICIC ACID
HEXAMETAPHOSPHATE
HYDRIODIC ACID
HYDROCHLORIC ACID
HYDROFLUORIC ACID
HYDROGEN FLUORIDE, ANHYDROUS
HYDROXYLAMINE HYDROCHLORIDE
HYVAR X-L HERBICIDE
INCO S-ROUNDS ELECTROLYTIC NICKEL
IODINE
ISOPROPYL ALCOHOL

NONCARCINOGENS WITHOUT REFERENCE DOSE, > 5 KG

COMPOUND

KATHENE SOLUTION TYPE D-LITHIUM CHLORIDE
LACOLENE-PETROLEUM NAPHTHA
LEAD METAL
LEAD METAL POWDER
LITHIUM ALUMINUM HYDRIDE
LITHIUM BROMIDE INHIBITIVE BRINE
LITHIUM CHLORIDE
LITHIUM CHROMATE
MAGNESIUM CHLORIDE
MAGNESIUM METAL
MAGNESIUM METAL CHIPS
MAGNESIUM NITRATE
MAGNESIUM OXIDE
MAGNESIUM PERCHLORATE
METHYL 2 HEXANONE 5
METHYL SULFOXIDE
MOLYBDENUM DISULFIDE
NITRIC ACID
NITROUS OXIDE
NORBIDE BORON CARBIDE
OXALIC ACID
PENTYL ALCOHOL
PERCHLORIC ACID
PHOSPHORIC ACID
POTASSIUM DICHROMATE
POTASSIUM FLUORIDE
POTASSIUM HYDROXIDE
POTASSIUM PERMANGANATE
POTASSIUM PERSULFATE
POTASSIUM PYROSULFATE
POTASSIUM STANNATE
PROPANOL 2
QUINOLINOL,8-
RED LEAD
ROUNDUP HERBICIDE
SODA ASH
SODA LIME
SODIUM BORATE
SODIUM BROMIDE
SODIUM CHROMATE
SODIUM DICHROMATE
SODIUM HYDROXIDE
SODIUM HYPOCHLORITE SOLUTION
SODIUM NITRITE
SODIUM PERCHLORATE
SODIUM SILICON SOL
STANNOUS CHLORIDE

NONCARCINOGENS WITHOUT REFERENCE DOSE, > 5 KG

COMPOUND

SULFAMIC ACID
SULFUR DIOXIDE
TARTARIC ACID
TDI/TOLUENE/ACETONE MIXTURE
TETRAHYDROFURAN
TITANIUM, METAL POWDER
TRI N BUTYL PHOSPHATE
TRIETHANOLAMINE
TRIFLUOROACETIC ACID
TRIFLUOROETHANE
TUNGSTEN
TUNGSTEN, POWDER
WHITE LEAD
YTTRIUM OXIDE

NONCARCINOGENS WITHOUT REFERENCE DOSE, > 5 KG

COMPOUND

ACETYL IODIDE
BISMUTH
CHLORINE
COPPER AMMONIUM CHLORIDE
COPPER NITRATE
CYANIDES
DEUTERIUM HYDRIDE
DIETHYL AMINE
DIETHYLHEXYLPHOSPHORIC ACID
DIMETHYL AMINE
ETHYL HEXANOL
FLUORINE
GALLIUM NITRATE
HEXAFLUORPROPENE
HYDROGEN CHLORIDE GAS
HYDROGEN FLUORIDE GAS
HYDRORODIC ACID
HYDROXYLAMINE NITRATE
NITROGEN TRIOXIDE
OCTANAL
PETROLEUM ETHER
PHOSGENE
PHOSPHOROUS ACID
PROPYLENE
PVC(POLYVINYL CHLORIDE)
TETRA SODIUM PYROPHOSPHATE
THORIUM DIOXIDE
TRIMETHYLAMINE
XENON

APPENDIX H

LIST B CHEMICALS

COMPOUND

ALUMINUM SULFIDE
AMMONIUM BIFLUORIDE
AMMONIUM IODIDE
AMMONIUM OXALATE
AMWEST KEROSENE
BIS(2-METHOXYETHYL) ETHER
CALCIUM HYDROCHLORITE
CELLULOSE NITRATE
CERIC AMMONIUM NITRATE
CERIC SULFATE
CERIUM CHIPS
CERIUM OXIDE
DEUTERIUM SULFIDE
DI 2 ETHYLHEXYLADIPATE
DIETHYL BENZENE
DIETHYL CARBAMOYL METHYLENE PHOSPHONATE
DIHEXYL N,N DIETHYL CARBAMOYL METHYLENE PHOSPHONATE
DIMETHYLGLYOXIME
ETHYL CARBAMATE
FERROUS AMMONIUM SULFATE
FERROUS SULFAMATE
FERROUS SULFAMATE 50% SOLN
FERROUS SULFIDE
FLUOBORIC ACID
FLUOSILICIC ACID
GALLIUM METAL
HYDRIODIC ACID
HYDROBROMIC ACID
HYDROFLUORIC ACID
HYDROGEN FLUORIDE, ANHYDROUS
HYDROXYLAMINE SULFATE
KATHENE SOLUTION TYPE D-LITHIUM CHLORIDE
LACOLENE-PETROLEUM NAPHTHA
MERCAPTOBENZYLTHIOZOLE 2
MINERAL SPIRITS
MOLYBDENUM DISULFIDE
NITRIC ACID
NORBIDE BORON CARBIDE
PETROLEUM DISTALLATE
PHOSPHORUS PENTOXIDE
POTASSIUM BIPHTHALATE
POTASSIUM BROMIDE

COMPOUND

POTASSIUM PYROSULFATE
SODA LIME
SODIUM BIFLUORIDE
SODIUM HYPOPHOSPHITE
SODIUM SILICON SOL
SULFUR DIOXIDE
SULFURIC ACID
SULFUROUS ACID
TARTARIC ACID
THENOYLTRIFLUOROACETONE
TITANIUM DIOXIDE
TITANIUM, METAL POWDER
TRIFLUOROETHANE
TUNGSTEN, POWDER
URANIUM OXIDE
URANYL NITRATE
XYLENE CYANOLE
YTTRIUM OXIDE
ZIRCONIUM OXIDE

COMPOUND
ACETYL IODIDE
CHLORINE
COPPER AMMONIUM CHLORIDE
DEUTERIUM HYDRIDE
HEXAFLUORPROPENE
HYDROGEN CHLORIDE GAS
HYDROGEN FLUORIDE GAS
HYDRORODIC ACID
HYDROXYLAMINE NITRATE
NITROGEN TRIOXIDE
PETROLEUM ETHER
PHOSGENE
PHOSPHOROUS ACID
POLYMETHYLMETHACRYLATE
PROPYLENE
PVC (POLYVINYL CHLORIDE)
SULFUR MONOCHLORIDE
TRIMETHYLAMINE
XENON

APPENDIX I

ADJUSTMENTS TO INVENTORY QUANTITIES

ADJUSTMENTS TO CHEMICAL QUANTITIES - 1988/89 INVENTORY

COMPOUND		QUANTITY (KG)
ALUMINUM COMPOUNDS		
ALUMINUM NITRATE	2097.459	
ALUMINUM NITRATE 60% SOLUTION	2602.000	
	TOTAL:	4699.459
ANTIMONY COMPOUNDS		
ANTIMONY IN 20% HCL HYDROCHLORIC ACID		0.100
ANTIMONY IODIDE		0.454
ANTIMONY OXIDE		0.002
ANTIMONY PENTACHLORIDE		1.020
ANTIMONY POWDER		1.861
ANTIMONY SOLUTION 3102		0.025
ANTIMONY TRICHLORIDE		1.891
ANTIMONY TRIOXIDE		3.194
	TOTAL:	**8.546**
AROCLORS		
AROCLOR 1016		0.006
AROCLOR 1221		0.016
AROCLOR 1232		0.007
AROCLOR 1242		0.017
AROCLOR 1248		0.007
AROCLOR 1254		0.017
AROCLOR 1260		0.018
AROCLOR 1262		0.012
AROCLOR 4465		0.010
AROCLOR 5460		0.010
AROCLOR MIX 1		0.001
AROCLOR MIX 2		0.001
	TOTAL:	**0.122**
ARSENIC COMPOUNDS		
ARSENIC ACID		0.454
ARSENIC IODIDE		0.118
ARSENIC METAL		0.005
ARSENIC PENTOXIDE		0.454
ARSENIC SOLUTION 3103		0.025
ARSENIC TRIOXIDE		2.006
	TOTAL:	**3.062**

ADJUSTMENTS TO CHEMICAL QUANTITIES - 1988/89 INVENTORY

COMPOUND	QUANTITY (KG)
BARIUM COMPOUNDS	
BARIUM ACETATE	1.391
BARIUM CARBONATE	3.348
BARIUM CHLORANILATE	0.325
BARIUM CHLORIDE	9.597
BARIUM CHROMATE	0.907
BARIUM DIOXIDE	0.355
BARIUM DIPHENYLAMINE SULFONATE	0.050
BARIUM FLUORIDE	0.454
BARIUM HYDROXIDE	3.416
BARIUM METAL	0.030
BARIUM NITRATE	1.494
BARIUM OXIDE	6.990
BARIUM PERCHLORATE	0.454
BARIUM PERCHLORATE DESSICCHLORA	3.000
BARIUM ROD 99.5%	0.454
BARIUM SOLUTION 3104	0.025
BARIUM SULFATE	0.030
BARIUM THIOCYANATE	0.118
BARIUM ZIRCONATE	0.454
TOTAL:	**32.890**
BERYLLIUM COMPOUNDS	
BERYLLIUM	0.085
BERYLLIUM CARBONATE	0.030
BERYLLIUM IN 2% HCL(HYDROCHLONC ACID	0.500
BERYLLIUM OXIDE	0.149
BERYLLIUM SOLUTION 3105	0.025
BERYLLIUM SULFATE	0.474
TOTAL:	**1.262**
BORON COMPOUNDS	
BORON CARBIDE	3.431
BORON CRYSTALLINE	0.237
BORON ISOTOPE 10	0.010
BORON ISOTOPE 11	0.006
BORON ISOTOPE 11 B2O3	0.002

COMPOUND	QUANTITY (KG)
BORON COMPOUNDS (CONTINUED)	
BORON METAL	0.120
BORON NITRIDE	2.268
BORON OXIDE	0.100
BORON SOLUTION 3107	0.025
SODIUM BORATE	10.615
SODIUM TETRABORATE	0.066
TOTAL:	**16.880**
CADMIUM COMPOUNDS	
CADMIUM	0.907
CADMIUM ACETATE	0.287
CADMIUM CHLORIDE	1.437
CADMIUM IODIDE	0.118
CADMIUM METAL	14.480
CADMIUM NITRATE	0.148
CADMIUM ORTHOPHOSPHATE	0.100
CADMIUM OXIDE	25.642
CADMIUM ROD STANDARD	0.454
CADMIUM SOLUTION 3108	0.025
CADMIUM SULFATE	0.479
TOTAL:	**42.883**
CHROMIUM COMPOUNDS	
CHROMIUM	0.947
CHROMIUM BORIDE	0.454
CHROMIUM CARBIDE	0.237
CHROMIUM CHLORIDE	2.752
CHROMIUM DIOXIDE	0.010
CHROMIUM NITRATE	72.606
CHROMIUM OXIDE	3.969
CHROMIUM PELLETS	0.010
CHROMIUM POTASSIUM SULFATE	0.954
CHROMIUM POWDER	0.075
CHROMIUM SILICIDE	0.454
CHROMIUM SOLUTION 3112	0.025
CHROMIUM SULFATE	2.268

ADJUSTMENTS TO CHEMICAL QUANTITIES - 1988/89 INVENTORY

COMPOUND		QUANTITY (KG)
CHROMIUM COMPOUNDS		
CHROMIUM TOTAL AND TRIVALENT		0.002
CHROMIUM TRIOXIDE		647.239
CHROMIUM, METAL		0.454
LITHIUM CHROMATE		56.774
POTASSIUM DICHROMATE		8.166
SODIUM CHROMATE		46.787
SODIUM DICHROMATE		5.581
	TOTAL:	**849.763**
HYDRAZINE COMPOUNDS		
HYDRAZINE 95%		0.500
HYDRAZINE SULFATE		1.335
	TOTAL:	**1.835**
LEAD COMPOUNDS		
LEAD		2.000
LEAD METAL		92.917
LEAD METAL POWDER		30.391
RED LEAD		1217.916
WHITE LEAD		6.744
	TOTAL:	**1349.968**
LITHIUM COMPOUNDS		
LITHIUM ALUMINUM HYDRIDE		6.850
LITHIUM BROMIDE INHIBITIVE BRINE		227.098
LITHIUM CHLORIDE		5.933
	TOTAL:	**239.881**
MAGNESIUM COMPOUNDS		
MAGNESIUM CHLORIDE		305.024
MAGNESIUM METAL		113.967
MAGNESIUM METAL CHIPS		58.968
MAGNESIUM NITRATE		16.649
MAGNESIUM OXIDE		25.316
MAGNESIUM PERCHLORATE		8.618
	TOTAL:	**528.542**

ADJUSTMENTS TO CHEMICAL QUANTITIES - 1988/89 INVENTORY

COMPOUND	QUANTITY (KG)
MANGANESE	
MANGANESE	0.050
MANGANESE CARBONATE	0.002
MANGANESE CHIPS	1.000
MANGANESE DIOXIDE	0.203
MANGANESE FLAKE	0.050
MANGANESE II OXIDE	0.020
MANGANESE METAL (325)	4.536
MANGANESE MONOXIDE	0.275
MANGANESE POWDER	0.118
POTASSIUM PERMANGANATE	12.050
TOTAL:	**18.305**
MERCURY COMPOUNDS	
MERCURIC ACETATE	0.020
MERCURIC CHLORANILATE	0.025
MERCURIC CHLORIDE	2.078
MERCURIC IODIDE	0.907
MERCURIC NITRATE	0.927
MERCURIC OXIDE	0.002
MERCURIC POTASSIUM THIOCYANATE	0.118
MERCURIC THIOCYANATE	0.454
MERCUROUS CHLORIDE	1.361
MERCUROUS NITRATE	0.927
MERCURY	3.632
MERCURY COMPOUNDS (CONTINUED)	
MERCURY (METAL)	0.118
MERCURY II NITRATE	0.454
TOTAL:	**11.023**
NICKEL COMPOUNDS	
NICKEL ACETATE	2.268
NICKEL CHLORIDE	1.954
NICKEL CYANIDE	0.907
NICKEL METAL	15.097
NICKEL METAL POWDER	2.801

COMPOUND	QUANTITY (KG)
NICKEL COMPOUNDS (CONTINUED)	
NICKEL NITRATE	1.907
NICKEL OXIDE	1.128
NICKEL SOLUTION 3136	0.025
NICKEL SULFAMATE	4.250
NICKEL SULFATE	74.704
NICKELOUS ACETATE	0.474
NICKELOUS CARBONATE	2.722
NICKELOUS CHLORIDE	4.302
NICKELOUS FLUORIDE	0.454
NICKELOUS NITRATE	4.556
NICKELOUS OXIDE	0.687
NICKELOUS SULFATE	10.571
TOTAL:	**128.806**
POLYAROMATIC HYDROCARBONS (TOTAL)	
ACENAPHTHENE	0.015
ANTHRACENE	0.115
BENZO(A)PYRENE	0.002
CHRYSENE	0.005
FLUORANTHENE	0.015
FLUORENE	0.015
NAPHTHALENE	0.992
PYRENE	0.017
TOTAL:	**1.176**
SELENIUM COMPOUNDS	
SELENIUM DIOXIDE	0.118
SELENIUM OXIDE	0.002
SELENIUM PELLETS	0.100
SELENIUM POWDER	0.907
TOTAL:	**1.127**

COMPOUND	QUANTITY (KG)
SILVER COMPOUNDS (EXCLUDING SILVER CYANIDE)	
SILVER CHLORIDE/LITHIUM FLUORIDE	0.100
SILVER NITRATE	6.742
SILVER OXIDE	0.534
SILVER PEROXIDE	0.473
SILVER VANADATE	0.040
TOTAL:	**7.889**
1,1,2,2-TETRACHLOROETHANE	
1,1,2,2-TETRACHLOROETHANE	0.005
TETRACHLOROETHANE PURITY-99+% 0-651 5	0.005
TETRACHLOROETHANE S	0.015
TOTAL:	**0.025**
TIN COMPOUNDS	
TIN	1.574
TIN IN 20% HCL	0.100
TIN METAL	0.500
TIN POWDER	0.040
TIN, METAL SHOT	0.907
POTASSIUM STANNATE	13.608
STANNOUS CHLORIDE	9.407
TOTAL:	**26.136**
TOLUENE	
TOLUENE	93.182
TOLUENE T-324	19.785
TOTAL:	**112.967**
VANADIUM COMPOUNDS (WITHOUT VANADIUM PENTOXIDE)	
VANADIUM	0.500
VANADIUM CARBIDE	0.907
VANADIUM METAL	0.917
VANADIUM NITRIDE	0.907

COMPOUND	QUANTITY (KG)
VANADIUM COMPOUNDS (CONTINUED)	
VANADIUM SILICIDE	0.118
VANADIUM SULFATE	0.089
TOTAL:	**3.439**
ZINC COMPOUNDS (WITHOUT ZINC CYANIDE)	
ZINC	7.612
ZINC ACETATE	0.360
ZINC BROMIDE	0.454
ZINC CARBONATE	0.454
ZINC CHLORIDE	50.550
ZINC CHROMATE PRIMER 154-00	3.785
ZINC CHROMATE YELLOW PRIMER	0.384
ZINC FLUORIDE	0.100
ZINC METAL POWDER	6.150
ZINC MOSSY	2.268
ZINC NITRATE	2.845
ZINC OXIDE	6.960
ZINC SILICOFLUORIDE	0.454
ZINC SULFIDE	0.454
ZINC SULFIDE POWDER	2.268
ZINC SULPHATE	0.118
TOTAL:	**85.214**

ADJUSTMENTS TO CHEMICAL QUANTITIES - 1974 INVENTORY

COMPOUND	QUANTITY (KG)
ANTIMONY COMPOUNDS	
ANTIMONY IODIDE	0.227
ANTIMONY OXIDE	2.400
TOTAL:	**2.627**
ARSENIC COMPOUNDS	
ARSENIC ACID	0.450
ARSENIC PENTOXIDE	3.000
ARSENOUS ACID	0.614
TOTAL:	**4.064**
BARIUM COMPOUNDS	
BARIUM ACETATE	1.800
BARIUM CARBONATE	1.900
BARIUM CHLORANILATE	0.475
BARIUM CHLORIDE	23.000
BARIUM CHROMATE	1.400
BARIUM DIPHENYLAMINE SULFONATE	0.026
BARIUM FLUORIDE	1.300
BARIUM HYDROXIDE	3.900
BARIUM NITRATE	0.760
BARIUM OXIDE	1.000
BARIUM PERCHLORATE	1.000
TOTAL:	**36.561**
BERYLLIUM COMPOUNDS	
BERYLLIUM	9000.000
BERYLLIUM CARBONATE	0.084
BERYLLIUM OXIDE	141.000
BERYLLIUM SULFATE	0.976
TOTAL:	**9142.060**

ADJUSTMENTS TO CHEMICAL QUANTITIES - 1974 INVENTORY

COMPOUND	QUANTITY (KG)
BORON COMPOUNDS	
BORON CARBIDE	6.500
BORON METAL	20.700
SODIUM BORATE	250.000
SODIUM TETRABORATE	0.400
TOTAL:	**277.600**
CADMIUM COMPOUNDS	
CADMIUM	57.000
CADMIUM ACETATE	0.402
CADMIUM CHLORIDE	3.800
CADMIUM IODIDE	0.225
CADMIUM NITRATE	34.000
CADMIUM OXIDE	2.800
CADMIUM SULFATE	1.800
TOTAL:	**100.027**
CHROMIUM COMPOUNDS	
CHROMIC ACID	0.870
CHROMIUM	7.500
CHROMIUM CHLORIDE	48.500
CHROMIUM NITRATE	8.900
CHROMIUM OXIDE	3.300
CHROMIUM POTASSIUM SULFATE	0.450
CHROMIUM SULFATE	4.500
CHROMIUM TRIOXIDE	23.000
POTASSIUM CHROMATE	2.700
SODIUM CHROMATE	110.000
SODIUM DICHROMATE	0.938
TOTAL:	**210.658**
LEAD COMPOUNDS	
LEAD	504000.000
LEAD ACETATE	0.620
LEAD CARBONATE	0.002
LEAD CHLORIDE	1.800

COMPOUND	QUANTITY (KG)
LEAD COMPOUNDS (CONTINUED)	
LEAD CITRATE AR	0.100
LEAD FLUORIDE	0.200
LEAD NITRATE	1.800
LEAD OXIDE	38.100
LEAD SULFATE	2.300
TOTAL:	**504044.922**
LITHIUM COMPOUNDS	
LITHIUM ALUMINUM HYDRIDE	0.200
LITHIUM CARBONATE	4.200
LITHIUM CHLORIDE	14.500
LITHIUM FLUORIDE	1.900
LITHIUM HYDROXIDE	7.300
LITHIUM IODIDE	0.100
LITHIUM METAL	1.100
LITHIUM NITRATE	1.400
LITHIUM PERCHLORATE	1.500
LITHIUM SULFATE	0.204
TOTAL:	**32.404**
MAGNESIUM COMPOUNDS	
MAGNESIUM	95.700
MAGNESIUM ACETATE	5.400
MAGNESIUM CARBONATE	13.400
MAGNESIUM CHLORIDE	195.000
MAGNESIUM FLUORIDE	5.000
MAGNESIUM HYDROXIDE	4.500
MAGNESIUM IODATE	0.113
MAGNESIUM NITRATE	10.300
MAGNESIUM OXIDE	1280.000
MAGNESIUM PERCHLORATE	17.500
MAGNESIUM SILICOFLUORIDE	0.450
MAGNESIUM ZIRCONATE	180.000
TOTAL:	**1807.363**

ADJUSTMENTS TO CHEMICAL QUANTITIES - 1974 INVENTORY

COMPOUND	QUANTITY (KG)
MANGANESE COMPOUNDS	
MANGANESE	13.800
MANGANESE DIOXIDE	1.100
MANGANOUS CHLORIDE	5.000
MANGANOUS NITRATE	0.594
MANGANOUS SULFATE	2560.000
POTASSIUM PERMANGANATE	38.000
TOTAL:	**2618.494**
MERCURY COMPOUNDS	
MERCURIC ACETATE	0.212
MERCURIC CHLORANILATE	0.010
MERCURIC CHLORIDE	7.100
MERCURIC IODIDE	1.300
MERCURIC NITRATE	2.400
MERCURIC OXIDE	1.100
MERCURIC POTASSIUM THIOCYANATE	0.114
MERCURY	442.000
TOTAL:	**454.236**
NICKEL COMPOUNDS	
NICKEL ACETATE	4.100
NICKEL CYANIDE	1.200
NICKEL METAL	133.000
NICKEL OXIDE	0.351
NICKEL SULFAMATE	0.260
NICKEL SULFATE	22.400
NICKELOUS CHLORIDE	31.500
NICKELOUS NITRATE	5.700
TOTAL:	**198.511**
POLYAROMATIC HYDROCARBONS (TOTAL)	
ACENAPHTHENE	0.020
ANTHRACENE	0.520
FLUORANTHENE	0.120
FLUORENE	0.020

COMPOUND	QUANTITY (KG)
POLYAROMATIC HYDROCARBONS (CONTINUED)	
NAPHTHALENE	1.800
PYRENE	0.020
TOTAL:	**2.500**
SILVER COMPOUNDS (WITHOUT SILVER CYANIDE)	
SILVER NITRATE	20.300
SILVER OXIDE	0.680
SILVER PEROXIDE	0.454
SILVER VANADATE	0.030
TOTAL:	**21.464**
TIN COMPOUNDS	
TIN	97.100
SODIUM STANNATE	0.454
STANNIC OXIDE	2.400
STANNOUS CHLORIDE	52.900
TOTAL:	**152.854**
VANADIUM COMPOUNDS	
VANADIUM	0.530
VANADIUM PENTOXIDE	11.800
VANADIUM SULFATE	0.256
TOTAL:	**12.586**
ZINC COMPOUNDS (WITHOUT ZINC CYANIDE)	
ZINC	1251.000
ZINC ACETATE	1.200
ZINC BROMIDE	1.400
ZINC CARBONATE	1.100
ZINC CHLORIDE	350.000
ZINC NITRATE	1.400
ZINC OXIDE	0.814
ZINC SILICOFLUORIDE	0.454

COMPOUND	QUANTITY (KG)
ZINC COMPOUND (CONTINUED)	
ZINC SULFIDE	1.454
ZINC SULPHATE	5.200
TOTAL:	**1614.022**

ADJUSTMENTS TO CHEMICAL QUANTITIES - 1974 UNIQUE INVENTORY

COMPOUND	QUANTITY (KG)
BERYLLIUM COMPOUNDS	
BERYLLIUM ACETATE	0.210
BERYLLIUM CHLORIDE	0.090
BERYLLIUM DUST AND MASSIVE	9000.000
BERYLLIUM FLUORIDE	0.200
BERYLLIUM NITRATE	0.028
BERYLLIUM OXYCHLORIDE	0.454
TOTAL:	**9000.982**
CADMIUM COMPOUNDS	
CADMIUM CARBONATE	0.400
ZINC CADMIUM SULFIDE	0.450
TOTAL:	**0.850**
MANGANESE	
MANGANESE CARBONYL	0.010
MANGANESE NITRATE	0.006
MANGANESE PHOSPHOLINE	0.500
MANGANESE CARBONATE	0.454
MANGANESE PENTOXIDE	0.005
TOTAL:	**0.975**
MERCURY COMPOUNDS	
MERCURIC CYANIDE	0.112
MERCURIC SULFATE	1.200
MERCURY BROMIDE	0.224
TOTAL:	**1.536**
NICKEL COMPOUNDS	
NICKEL AMMONIUM SULFATE	0.454
NICKEL BROMIDE	0.110
NICKEL CARBONATE	10.000
NICKEL FLUORIDE	0.750
TOTAL:	**11.314**

COMPOUND	QUANTITY (KG)
SELENIUM COMPOUNDS	
SELENIUM	1.600
SELENIUM CHLORIDE	0.007
TOTAL:	**1.607**
SILVER COMPOUNDS	
SILVER CARBONATE	0.080
SILVER DIETHYL DITHIO CARBAMATE	0.005
SILVER ETHYLHEXANOATE	0.005
SILVER FLUORIDE	0.150
TOTAL:	**0.240**
THALLIUM COMPOUNDS	
THALLIUM BROMIDE	0.300
THALLIUM DICYCLOPENTADIENE	0.011
THALLIUM ETHOXIDE	0.050
THALLIUM FORMATE	0.400
THALLIUM MALONATE	0.055
THALLIUM NITRATE	0.162
THALLIUM OXIDE	0.030
THALLIUM PERCHLORATE	0.454
THALLIUM SULFATE	0.010
TOTAL:	**1.472**

APPENDIX J

SCREEN MODEL PRINTOUT

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

Rocky Flats-scenario#1

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	1.52
STK EXIT VELOCITY (M/S)	=	.00
STK GAS EXIT TEMP (K)	=	293.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = .00 M**4/S**3; MOM. FLUX = .00 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1524.	351.4	6	1.0	1.0	5000.0	.0	49.7	18.2	NO
1600.	326.0	6	1.0	1.0	5000.0	.0	52.0	18.8	NO
1700.	296.9	6	1.0	1.0	5000.0	.0	54.9	19.5	NO
1800.	271.9	6	1.0	1.0	5000.0	.0	57.9	20.2	NO
1900.	250.1	6	1.0	1.0	5000.0	.0	60.8	20.9	NO
2000.	231.1	6	1.0	1.0	5000.0	.0	63.7	21.6	NO
2100.	215.3	6	1.0	1.0	5000.0	.0	66.6	22.2	NO
2200.	201.3	6	1.0	1.0	5000.0	.0	69.4	22.8	NO
2300.	188.7	6	1.0	1.0	5000.0	.0	72.3	23.3	NO
2400.	177.4	6	1.0	1.0	5000.0	.0	75.1	23.9	NO
2500.	167.2	6	1.0	1.0	5000.0	.0	77.9	24.4	NO
2600.	158.0	6	1.0	1.0	5000.0	.0	80.8	25.0	NO
2700.	149.5	6	1.0	1.0	5000.0	.0	83.6	25.5	NO
2800.	141.9	6	1.0	1.0	5000.0	.0	86.4	26.0	NO
2900.	134.8	6	1.0	1.0	5000.0	.0	89.1	26.5	NO
3000.	128.4	6	1.0	1.0	5000.0	.0	91.9	27.0	NO
3500.	104.0	6	1.0	1.0	5000.0	.0	105.7	29.0	NO
4000.	86.62	6	1.0	1.0	5000.0	.0	119.2	30.8	NO
4500.	73.75	6	1.0	1.0	5000.0	.0	132.5	32.6	NO
5000.	63.88	6	1.0	1.0	5000.0	.0	145.7	34.2	NO
5500.	56.10	6	1.0	1.0	5000.0	.0	158.7	35.8	NO
6000.	49.83	6	1.0	1.0	5000.0	.0	171.6	37.2	NO
6500.	44.68	6	1.0	1.0	5000.0	.0	184.3	38.6	NO
7000.	40.40	6	1.0	1.0	5000.0	.0	197.0	40.0	NO
7500.	36.90	6	1.0	1.0	5000.0	.0	209.5	41.2	NO

APPENDIX K

RESULTS OF STAGE 2 SCREENING

RESULTS OF STAGE 2 SCREENING

Chemical (based on Newname)	Toxicity Criteria		Allowable Quantitiy (KG)	Actual Quantity (KG)	Ratio
BERYLLIUM COMPOUNDS	Slope Factor (o)	4.3	0.056	9142.060	1.63E+05
CHROMIUM COMPOUNDS	Slope Factor (i)	41	0.016	792.526	4.95E+04
CARBON TETRACHLORIDE	Slope Factor (o)	0.13	0.56	12502.000	2.23E+04
DIBENZOFURAN	Slope Factor (o)	15000	0.0000056	0.020	3.57E+03
TRICHLOROETHENE	Slope Factor (o)	0.011	5.6	15300.000	2.73E+03
PAHs	Slope Factor (o)	11.5	0.0056	6.000	1.07E+03
LEAD COMPOUNDS	RfD (o)	0.0014	560	504044.992	9.00E+02
TETRACHLOROETHYLENE	Slope Factor (o)	0.051	5.6	4462.000	7.97E+02
CADMIUM COMPOUNDS	Slope Factor (i)	6.1	0.16	100.027	6.25E+02
HYDRAZINE 95%	Slope Factor (o)	3	0.056	30.000	5.36E+02
CHLOROFORM	Slope Factor (i)	0.081	16	5513.000	3.45E+02
QUINOLINE	Slope Factor (o)	12	0.0056	1.600	2.86E+02
SODIUM HYDROXIDE	LD50/100,000	0.0004	56	15577.007	2.78E+02
ARSENIC COMPOUNDS	Slope Factor (i)	50	0.016	4.060	2.54E+02
POTASSIUM HYDROXIDE	LD50/100,000	0.00273	560	92200.907	1.65E+02
METHYLENE CHLORIDE	Slope Factor (i)	0.014	16	2095.000	1.31E+02
NICKEL COMPOUNDS	Slope Factor (i)	0.84	1.6	198.511	1.24E+02
ACRYLAMIDE	Slope Factor (o)	4.5	0.056	6.000	1.07E+02
MERCURY COMPOUNDS	RfD (i)	0.000086	16	454.231	2.84E+01
FORMALDEHYDE	Slope Factor (o)	0.03	5.6	146.303	2.61E+01
HEXACHLOROBENZENE	Slope Factor (o)	1.6	0.056	1.015	1.81E+01
DIAZINON	RfD (o)	0.0009	5.6	96.022	1.71E+01
MANGANESE COMPOUNDS	RfD (i)	0.0003	160	2618.494	1.64E+01
PERCHLORIC ACID	LD50/100,000	0.004	560	8581.000	1.53E+01
VAPONITE 2 INSECTICIDE	Slope Factor (i)	0.29	1.6	18.925	1.18E+01
TOLUIDINE O	Slope Factor (o)	0.24	0.56	4.400	7.86E+00
BENZENE	Slope Factor (o)	0.029	5.6	42.500	7.59E+00
AMMONIA	RfD (i)	0.1	160000	996000.000	6.23E+00
DIOXANE P	Slope Factor (o)	0.011	5.6	31.523	5.63E+00
BROMACIL	LD50/100,000	0.00641	560	2700.000	4.82E+00
TRICHLOROETHANE 1,1,1	RfD (o)	0.09	5600	22763.000	4.06E+00
POTASSIUM CYANIDE	LD50/100,000	0.00005	5.6	20.592	3.68E+00
VINYL CHLORIDE	Slope Factor (o)	2.3	0.056	0.200	3.57E+00
HYDROCHLORIC ACID	LD50/100,000	0.009	560	1300.000	2.32E+00
AROCLORS	Slope Factor (o)	7.7	0.056	0.122	2.18E+00

RESULTS OF STAGE 2 SCREENING

Chemical (based on Newname)	Toxicity Criteria		Allowable Quantitiy (KG)	Actual Quantity (KG)	Ratio
DICHLOROETHANE 1,2	Slope Factor (o)	0.091	5.6	11.868	2.12E+00
PHOSPHORIC ACID	LD50/100,000	0.0153	5600	10100.000	1.80E+00
CHLORANIL	Slope Factor (o)	0.4	0.56	1.000	1.79E+00
METHYLENE DIANALINE	Slope Factor (o)	0.25	0.56	1.000	1.79E+00
COBALT OXIDE	LD50/100,000	0.002	560	677	1.21E+00
SODIUM NITRITE	LD50/100,000	0.00085	56	63.000	1.13E+00
OXALIC ACID	LD50/100,000	0.00375	560	557.000	9.95E-01
ACRYLONITRILE	Slope Factor (o)	0.54	0.56	0.520	9.29E-01
STYRENE	Slope Factor (o)	0.03	5.6	4.900	8.75E-01
AMMONIUM HYDROXIDE	LD50/100,000	0.0035	560	479.000	8.55E-01
BENZYL CHLORIDE	Slope Factor (o)	0.17	0.56	0.470	8.39E-01
ALUMINUM NITRATE	LD50/100,000	0.03654	5600	4699.100	8.39E-01
CUPRIC CHLORIDE	LD50/100,000	0.00031	56	36.874	6.58E-01
ALDRIN	Slope Factor (o)	17	0.0056	0.003	5.36E-01
DIELDRIN	Slope Factor (o)	16	0.0056	0.003	5.36E-01
CALCIUM HYPOCHLORITE	LD50/100,000	0.0085	560	261.552	4.67E-01
METHOXYETHANOL 2	RfD (o)	0.001	560	246.000	4.39E-01
SODIUM DIETHYLDITHIOCARBAMATE	Slope Factor (o)	0.27	0.56	0.237	4.22E-01
DISODIUM METHANEARSENATE	LD50/100,000	0.018	5600	2100.000	3.75E-01
CROTONALDEHYDE	Slope Factor (o)	1.9	0.056	0.020	3.57E-01
DIMETHYL HYDRAZINE 1,1	Slope Factor (o)	8.7	0.056	0.020	3.57E-01
MAGNESIUM COMPOUNDS	LD50/100,000	0.028	5600	1797.073	3.21E-01
FREON 11	RfD (o)	0.3	56000	11351.000	2.03E-01
CYCLOHEXANE	LD50/100,000	0.00813	560	108.364	1.94E-01
POTASSIUM FLUORIDE	LD50/100,000	0.00245	560	100.710	1.80E-01
BIS 2 CHLOROETHYL ETHER	Slope Factor (o)	1.1	0.056	0.010	1.79E-01
NITROPROPANE 2	Slope Factor (o)	9.5	0.056	0.010	1.79E-01
AMMONIUM THIOCYANATE	TD(lo)/10,000	0.043	5600	875.000	1.56E-01
ANTIMONY COMPOUNDS	RfD (o)	0.0004	56	8.547	1.53E-01
SODIUM HYPOCHLORITE SOLUTION	LD50/100,000	0.089	5600	851.616	1.52E-01
ETHANOLAMINE	LD50/100,000	0.0062	560	83.020	1.48E-01
SODA ASH	LD50/100,000	0.0409	5600	771.574	1.38E-01
ISOPROPYL ALCOHOL	LD50/100,000	0.05054	5600	691.119	1.23E-01
DIXICHLOR-SODIUM HYPOCHLORITE	LD50/100,000	0.058	5600	658.583	1.18E-01
THALLIUM	RfD (o)	0.00007	5.6	0.625	1.12E-01

RESULTS OF STAGE 2 SCREENING

Chemical (based on Newname)	Toxicity Criteria		Allowable Quantitiy (KG)	Actual Quantity (KG)	Ratio
COBALT CHLORIDE	LD50/100,000	0.00055	56	5.6	1.00E-01
BROMOFORM	Slope Factor (o)	0.0079	56	5.515	9.85E-02
CUPRIC SULFATE	LD50/100,000	0.003	560	50.073	8.94E-02
HEXACHLORO 1,3 BUTADIENE	Slope Factor (o)	0.078	5.6	0.469	8.38E-02
FREON 12	RfD (i)	0.05	16000	1311.832	8.20E-02
NITROBENZENE	RfD (o)	0.0005	56	4.000	7.14E-02
SULFAMIC ACID	LD50/100,000	0.0105	5600	378.960	6.77E-02
BORON COMPOUNDS	RfD (o)	0.09	5600	332.500	5.94E-02
HYDROXYLAMINE HYDROCHLORIDE	LD50/100,000	0.00408	560	32.014	5.72E-02
CHLORDANE	Slope Factor (o)	1.3	0.056	0.003	5.36E-02
HEPTACHLOR	Slope Factor (o)	4.5	0.056	0.003	5.36E-02
TOXAPHENE	Slope Factor (o)	1.1	0.056	0.003	5.36E-02
TORDON 22K WEED KILLER	RfD (o)	0.07	5600	283.872	5.07E-02
PROPANOL 2	LD50/100,000	0.08	5600	280.715	5.01E-02
PHENYLENE DIAMINE O	Slope Factor (o)	0.047	5.6	0.275	4.91E-02
COPPER CYANIDE	RfD (o)	0.005	560	27.216	4.86E-02
TETRACHLOROETHANE 1,1,2,2	Slope Factor (o)	0.2	0.56	0.025	4.46E-02
ETHYLENE GLYCOL	RfD (o)	2	560000	22349.000	3.99E-02
SILVER COMPOUNDS	RfD (o)	0.003	560	20.300	3.63E-02
LINDANE	Slope Factor (o)	1.3	0.056	0.002	3.57E-02
PENTYL ALCOHOL	LD50/100,000	0.002	560	19.925	3.56E-02
VINYLIDENE CHLORIDE	Slope Factor (i)	1.2	0.16	0.005	3.13E-02
ZINC COMPOUNDS	RfD (o)	0.2	56000	1614.000	2.88E-02
ACETONE	RfD (o)	0.1	56000	1562.000	2.79E-02
AMMONIUM FLUORIDE	LD50/100,000	0.0035	560	14.712	2.63E-02
COPPER SULFATE	LD50/100,000	0.003	560	14.7	2.63E-02
COBALTOUS SULFATE	LD50/100,000	0.00434	560	14.194	2.53E-02
DIALLYL PHTHALATE	LD50/100,000	0.0077	560	13.500	2.41E-02
BUTOXYETHANOL 2	LD50/100,000	0.003	560	13.000	2.32E-02
ACETONITRILE	RfD (o)	0.006	560	12.966	2.32E-02
BARIUM COMPOUNDS	RfD (i)	0.001	1600	36.561	2.29E-02
VANADIUM PENTOXIDE	RfD (o)	0.009	560	11.800	2.11E-02
ANILINE	Slope Factor (o)	0.0057	56	1.000	1.79E-02
HEPTACHLOR EPOXIDE	Slope Factor (o)	9.1	0.056	0.001	1.79E-02
NITROSO DI N PROPYLAMINE N	Slope Factor (o)	7	0.056	0.001	1.79E-02

RESULTS OF STAGE 2 SCREENING

Chemical (based on Newname)		Toxicity Criteria		Allowable Quantitiy (KG)	Actual Quantity (KG)	Ratio
TOLUIDINE P		Slope Factor (o)	0.19	0.56	0.010	1.79E-02
CHLOROACETIC ACID		RfD (o)	0.002	560	8.300	1.48E-02
ATRAZINE		RfD (o)	0.005	560	7.570	1.35E-02
POTASSIUM PERSULFATE		LD50/100,000	0.0082	560	7.259	1.30E-02
TRIFLUOROACETIC ACID		LD50/100,000	0.002	560	7.010	1.25E-02
ACETOPHENONE		RfD (i)	0.000005	1.6	0.020	1.25E-02
METHYL ETHYL KETONE		RfD (o)	0.05	5600	68.445	1.22E-02
PYRIDINE	MEX	RfD(i))	0.03	160.000	68.445	4.28E-4
POTASSIUM THIOCYANATE		LD50/100,000	0.006	560	6	1.07E-02
TRI N BUTYL PHOSPHATE		LD50/100,000	0.01189	5600	58.047	1.04E-02
COBALT SULFATE		LD50/100,000	0.00424	560	5.8	1.04E-02
POTASSIUM NITRITE		LD50/100,000	0.002	560	5.7	1.02E-02
METHANOL		RfD (o)	0.5	56000	568.646	1.02E-02
TRICHLOROBENZENE 1,2,4		RfD (i)	0.003	1600	16.016	1.00E-02
CUPFERRON		LD50/100,000	0.002	560	5.1	9.11E-03
PHENYL MERCURIC ACETATE		RfD (o)	0.00008	5.6	0.050	8.93E-03
INCO S-ROUNDS ELECTROLYTIC NICKEL		LD50/100,000	0.1	56000	500.000	8.93E-03
THIRAM		RfD (o)	0.006	560	4.731	8.45E-03
D/DICAMBA MIXTURE 2,4		LD50/100,000	0.0104	5600	45.360	8.10E-03
HEXAMETAPHOSPHATE		LD50/100,000	0.0725	5600	45.360	8.10E-03
XYLENE		RfD (i)	0.086 (MIXED)	16000	128.010	8.00E-03
DICHLOROPROPANE 1,2		Slope Factor (o)	0.068	5.6	0.040	7.14E-03
LAURYL SULFATE		LD50/100,000	0.013	5600	39.110	6.98E-03
DIETHYLENE GLYCOL		LD50/100,000	0.033	5600	36.7	6.55E-03
METHYL ISOBUTYL KETONE		RfD (o)	0.05	5600	35.891	6.41E-03
VANADIUM COMPOUNDS		RfD (o)	0.007	560	3.438	6.14E-03
TOLUENE		RfD (o)	0.3	56000	300.000	5.36E-03
NITRIC OXIDE		RfD (o)	0.1	56000	254.000	4.54E-03
HEXACHLORO ETHANE		Slope Factor (o)	0.014	5.6	0.025	4.46E-03
SODIUM CYANIDE		RfD (o)	0.04	5600	24.927	4.45E-03
TRIISOCTYLAMINE		LD50/100,000	0.016	5600	24.4	4.36E-03
HEXANE		RfD (i)	0.057	16000	66.375	4.15E-03
DIMETHYLPHENOL 2,6		RfD (o)	0.0006	56	0.225	4.02E-03
PHTHALIC ANHYDRIDE		RfD (o)	0.003	560	2.200	3.93E-03
CHLOROBENZENE		RfD (i)	0.005	1600	6.000	3.75E-03

RESULTS OF STAGE 2 SCREENING

Chemical (based on Newname)	Toxicity Criteria		Allowable Quantitiy (KG)	Actual Quantity (KG)	Ratio
PROPYLENE GLYCOL	LD50/100,000	0.185	56000	208.183	3.72E-03
CARBON DISULFIDE	RfD (i)	0.0029	1600	5.912	3.70E-03
FERRIC NITRATE	LD50/100,000	0.033	5600	20.1	3.59E-03
ETHYL ACRYLATE	Slope Factor (o)	0.048	5.6	0.020	3.57E-03
DDT	Slope Factor (o)	0.34	0.56	0.002	3.57E-03
TETRAHYDROFURAN	LD50/100,000	0.023	5600	19.634	3.51E-03
TIN COMPOUNDS	RfD (o)	0.6	56000	163.608	2.92E-03
TRICHLOROETHANE 1,1,2	Slope Factor (o)	0.057	5.6	0.016	2.86E-03
DIBUTYL CARBITOL	LD50/100,000	0.039	5600	13.1	2.34E-03
DINITROBENZENE M	RfD (o)	0.0001	56	0.120	2.14E-03
ROUNDUP HERBICIDE	LD50/100,000	0.0405	5600	11.355	2.03E-03
SELENIUM COMPOUNDS	RfD (o)	0.003	560	1.127	2.01E-03
TRICHLOROPHENOL 2,4,6	Slope Factor (o)	0.011	5.6	0.011	1.96E-03
QUINOLINOL,8-	LD50/100,000	0.012	5600	10.454	1.87E-03
BIS 2 ETHYLHEXYL PHTHALATE	Slope Factor (o)	0.014	5.6	0.010	1.79E-03
CARBAZOLE	Slope Factor (o)	0.02	5.6	0.010	1.79E-03
CHLOROANILINE P	Slope Factor (o)	0.035	5.6	0.010	1.79E-03
DICHLOROBENZENE P	Slope Factor (o)	0.024	5.6	0.010	1.79E-03
DDD 4,4	Slope Factor (o)	0.24	0.56	0.001	1.79E-03
DDE	Slope Factor (o)	0.24	0.56	0.001	1.79E-03
TRICHLORO-1,2,2-TRIFLUOROETHANE 1,1,2	RfD (o)	30	5600000	9406.000	1.68E-03
DIMETHYL SULFOXIDE	LD50/100,000	0.079	5600	9.2	1.64E-03
FORMAMIDE	LD50/100,000	0.0315	5600	9.200	1.64E-03
SODIUM PERCHLORATE	LD50/100,000	0.021	5600	9.000	1.61E-03
DI 2 ETHYLHEXYL PHOSPHORIC ACID	LD50/100,000	0.0494	5600	8.516	1.52E-03
BROMOBENZENE,M-	LD50/100,000	0.017	5600	7.600	1.36E-03
DIISOPROPYL BENZENE	LD50/100,000	0.065	5600	7.570	1.35E-03
TRIETHANOLAMINE	LD50/100,000	0.022	5600	7.200	1.29E-03
BUTYL ACETATE	LD50/100,000	0.032	5600	7.02	1.25E-03
DICYCLOPENTANDIENE	RfD (i)	0.00006	16	0.020	1.25E-03
EPICHLOROHYDRIN	RfD (i)	0.000086	16	0.020	1.25E-03
METHYL SULFOXIDE	LD50/100,000	0.0792	5600	6.055	1.08E-03
METHYL-2-HEXANONE, 5	LD50/100,000	0.025	5600	6.000	1.07E-03
ZIRCONIUM NITRATE	LD50/100,000	0.023	5600	6	1.07E-03
DIETHYLENE TRIAMINEPENTAACETIC ACID	LD50/100,000	0.048	5600	5.8	1.04E-03

RESULTS OF STAGE 2 SCREENING

Chemical (based on Newname)	Toxicity Criteria		Allowable Quantitiy (KG)	Actual Quantity (KG)	Ratio
SODIUM BROMIDE	LD50/100,000	0.035	5600	5.745	1.03E-03
DIBUTYL PHOSPHATE	LD50/100,000	0.032	5600	5.285	9.44E-04
ETHYLENE DIAMINE	RfD (o)	0.02	5600	5.259	9.39E-04
CHLORODIBROMOMETHANE	Slope Factor (o)	0.02	5.6	0.005	8.93E-04
HYDROQUINONE	RfD (o)	0.04	5600	4.860	8.68E-04
METHYL METHACRYLATE	RfD (o)	0.08	5600	4.500	8.04E-04
XYLENE P	RfD (i)	0.086	16000	12.010	7.51E-04
ETHOXYETHANOL 2	RfD (i)	0.05	16000	8.201	5.13E-04
ETHYL ACETATE	RfD (o)	0.9	56000	26.7	4.77E-04
N,N DIMETHYL FORMAMIDE	RfD (o)	0.1	56000	23.203	4.14E-04
DIMETHYL FORMAMIDE	RfD (i)	0.03	16000	6.500	4.06E-04
THALLIC OXIDE	RfD (o)	0.00007	5.6	0.002	3.57E-04
ISOPHORONE	Slope Factor (o)	0.0039	56	0.020	3.57E-04
NITROSO DIPHENYLAMINE N	Slope Factor (o)	0.0049	56	0.020	3.57E-04
TETRACHLOROBENZENE 1,2,4,5	RfD (o)	0.0003	56	0.020	3.57E-04
ETHYL ETHER	RfD (o)	0.5	56000	18.212	3.25E-04
HEXACHLORO CYCLOPENTADIENE	RfD (i)	0.00002	16	0.005	3.13E-04
DICHLOROBENZENE O	RfD (o)	0.09	5600	1.600	2.86E-04
FLUORIDE STANDARD	RfD (o)	0.06	5600	1.475	2.63E-04
SEVIN INSECTICIDE	RfD (o)	0.1	56000	13.608	2.43E-04
CHLOROPHENOL O	RfD (o)	0.005	560	0.120	2.14E-04
CHLOROTOLUENE 0-672 O	RfD (o)	0.02	5600	1.200	2.14E-04
DI N OCTYL PHTHALATE	RfD (o)	0.02	5600	1.135	2.03E-04
IODINE	LD50/100,000	0.1	56000	10.811	1.93E-04
SILVER CYANIDE	RfD (o)	0.1	56000	10.731	1.92E-04
ALUMINUM HYDROXIDE	TD(lo)/100,000	0.79	56000	10.572	1.89E-04
ENDOSULFAN	RfD (o)	0.00005	5.6	0.001	1.79E-04
ZINC CYANIDE	RfD (o)	0.05	5600	1.000	1.79E-04
PHENOL	RfD (o)	0.6	56000	7.500	1.34E-04
ETHYL BENZENE	RfD (o)	0.1	56000	7.000	1.25E-04
CRESOL M	RfD (o)	0.05	5600	0.520	9.29E-05
PROPYLENE CARBONATE	LD50/100,000	0.2	56000	5.000	8.93E-05
DIMETHYLANILINE 2,4	LD50/100,000	0.0025	560	0.040	7.14E-05
ENDRIN	RfD (o)	0.0003	56	0.004	7.14E-05
DICHLOROPHENOL 2,4	RfD (o)	0.003	560	0.020	3.57E-05

RESULTS OF STAGE 2 SCREENING

Chemical (based on Newname)	Toxicity Criteria		Allowable Quantitiy (KG)	Actual Quantity (KG)	Ratio
FURFURAL	RfD (o)	0.003	560	0.020	3.57E-05
TRICHLOROPROPANE 1,2,3	RfD (o)	0.006	560	0.014	2.50E-05
DIMETHYL PHENOL 3,4	RfD (o)	0.001	560	0.010	1.79E-05
N,N DIMETHYL ANILINE	RfD (o)	0.002	560	0.010	1.79E-05
BENZALDEHYDE	RfD (o)	0.1	56000	0.770	1.38E-05
FORMIC ACID	RfD (o)	2	560000	7.319	1.31E-05
CUMENE	RfD (i)	0.0026	1600	0.020	1.25E-05
TDI/TOLUENE/ACETONE MIXTURE	LD50/100,000	0.058	5600	7.570	1.04E-05
ISOBUTYL ALCOHOL	RfD (o)	0.3	56000	0.493	8.81E-06
DIMETHYL PHTHALATE	RfD (o)	1	560000	4.830	8.62E-06
DICHLOROETHYLENE CIS 1,2	RfD (o)	0.01	5600	0.040	7.14E-06
TRICHLORO 1,2,2 TRIFLUOROETHANE 1,1,2	RfD (o)	30	5600000	35.140	6.28E-06
BENZOIC ACID	RfD (o)	4	560000	2.900	5.18E-06
PENTACHLOROPHENOL	RfD (o)	0.03	5600	0.022	3.93E-06
ACRYLIC ACID	RfD (o)	0.08	5600	0.020	3.57E-06
BIPHENYL	RfD (o)	0.050	5600	0.020	3.57E-06
ETHYL METHACRALATE	RfD (o)	0.09	5600	0.020	3.57E-06
METHYL ACRYLATE	RfD (o)	0.03	5600	0.020	3.57E-06
NITROTOLUENE 859 M	RfD (o)	0.01	5600	0.020	3.57E-06
CRESOL O	RfD (o)	0.05	5600	0.015	2.68E-06
CRESOL P	RfD (o)	0.05	5600	0.015	2.68E-06
AMINOPHENOL M	RfD (o)	0.07	5600	0.010	1.79E-06
DICHLOROPHENOXYACETIC ACID 2,4	RfD (o)	0.01	5600	0.010	1.79E-06
NITROTOLUENE O	RfD (o)	0.01	5600	0.010	1.79E-06
NITROTOLUENE P	RfD (o)	0.01	5600	0.010	1.79E-06
TRICHLOROPHENOXYACETIC ACID 2,4,5	RfD (o)	0.01	5600	0.010	1.79E-06
ETHYLENE GLYCOL MONOBUTYL ETHER	RfD (i)	0.02	16000	0.020	1.25E-06
DIETHYL PHTHALATE	RfD (o)	0.8	56000	0.040	7.14E-07
TRICHLOROPHENOL 2,4,5	RfD (o)	0.1	56000	0.040	7.14E-07
CHLOROPROPANE 3110 2	RfD (i)	0.09	16000	0.010	6.25E-07
PHTHALIC ACID	RfD (o)	1	560000	0.260	4.64E-07
BUTYL PHTHALATE N	RfD (o)	0.1	56000	0.020	3.57E-07
CAPROLACTAM	RfD (o)	0.5	56000	0.020	3.57E-07
CHLOROBENZOIC ACID P	RfD (o)	0.2	56000	0.020	3.57E-07
CHLOROBUTANE 0-621 1	RfD (o)	0.4	56000	0.020	3.57E-07

RESULTS OF STAGE 2 SCREENING

Chemical (based on Newname)	Toxicity Criteria		Allowable Quantitiy (KG)	Actual Quantity (KG)	Ratio
DI N BUTYL PHTHALATE	RfD (o)	0.1	56000	0.015	2.68E-07
DICHLOROETHANE 1,1	RfD (o)	0.1	56000	0.015	2.68E-07
CYCLOHEXYL AMINE	RfD (o)	0.2	56000	0.010	1.79E-07
DIMETHYL TEREPHTHALATE	RfD (o)	0.1	56000	0.010	1.79E-07
MALEIC ACID HYDRAZIDE	RfD (o)	0.5	56000	0.010	1.79E-07
MALEIC ANHYDRIDE	RfD (o)	0.1	56000	0.010	1.79E-07
BUTYL BENZYL PHTHALATE	RfD (o)	0.2	56000	0.005	8.93E-08
XYLENE M	RfD (i)	0.2	160000	0.010	6.25E-08
XYLENE O	RfD (i)	0.2	160000	0.010	6.25E-08
METHOXYCHLOR	RfD (o)	0.1	56000	0.002	3.57E-08
METHYL ACETATE	RfD (o)	1	560000	0.020	3.57E-08
DIETHYLENE GLYCOL MONOETHYL ETHER	RfD (o)	2	560000	0.010	1.79E-08

RESULTS OF STAGE 2 SCREENING - UNIQUE 1974 INVENTORY

CHEMICAL	TOXICITY CRITERIA		ALLOWABLE QUANTITY (KG)	ACTUAL QUANTITY (KG)	QUANTITY RATIO
BERYLLIUM COMPOUNDS	Slope Factor (o)	4.3	0.056	9000.982	1.61E+05
ETHYLENE OXIDE	Slope Factor (i)	0.35	1.6	192400.000	1.20E+05
BUTADIENE	Slope Factor (i)	1.8	0.16	113.000	7.06E+02
BENZIDINE	Slope Factor (o)	230	0.00056	0.025	4.46E+01
NICKEL COMPOUNDS	Slope Factor (i)	0.84	1.6	11.314	7.07E+00
CADMIUM COMPOUNDS	Slope Factor (i)	6.1	0.16	0.450	2.81E+00
PROPYLENE OXIDE	Slope Factor (o)	0.24	0.56	1.500	2.68E+00
THALLIUM COMPOUNDS	RfD (o)	0.00007	5.6	1.472	2.63E-01
GALLIUM NITRATE	LD50/100000	0.0436	5600	540.000	9.64E-02
MERCURY COMPOUNDS	RfD (i)	0.000086	16	1.536	9.60E-02
AZOBENZENE	Slope Factor (o)	0.11	0.56	0.020	3.57E-02
CHLOROMETHYLANILINE	Slope Factor (o)	0.58	0.56	0.020	3.57E-02
COPPER NITRATE	LD50/100000	0.0094	560	14.200	2.54E-02
DIETHYL AMINE	LD50/100,000	0.005	560	7.300	1.30E-02
DIMETHYL AMINE	LD50/100000	0.0024	560	6.800	1.21E-02
FLUORINE	RfD (o)	0.06	5600	57.000	1.02E-02
CYANIDES	RfD (o)	0.02	5600	48.200	8.61E-03
MANGANESE COMPOUNDS	RfD (i)	0.0003	160	0.975	6.09E-03
TRINITROBENZENE	RfD (o)	0.00005	5.6	0.020	3.57E-03
ETHYL HEXANOL	LD50/100000	0.032	5600	19.100	3.41E-03
SELENIUM COMPOUNDS	RfD (o)	0.004	560	1.607	2.87E-03
HYDROGEN SULFIDE	RfD (i)	0.0009	160	0.396	2.48E-03
TETRASODIUM PYROPHOSPHATE	LD50/100000	0.0298	5600	9.900	1.77E-03
THORIUM DIOXIDE	LD50/100000	0.0114	5600	9.000	1.61E-03
DIETHYLHEXYLPHOSPHORIC ACID	LD50/100,000	0.0494	5600	8.200	1.46E-03
POTASSIUM FERRICYANIDE	LD50/100000	0.0297	5600	7.900	1.41E-03
OCTANOL	LD50/100000	0.0179	5600	7.600	1.36E-03
BISMUTH	LD50/100000	0.05	5600	5.500	9.82E-04
PHENYLPHENOL, 2	Slope Factor (o)	0.0019	56	0.040	7.14E-04
CHLOROANILINE	RfD (o)	0.004	560	0.350	6.25E-04
SILVER COMPOUNDS	RfD (o)	0.003	560	0.247	4.41E-04
METHYLSTYRENE, A	RfD (o)	0.07	5600	0.220	3.93E-05
VANADIUM NITRATE	RfD (o)	0.007	560	0.002	3.57E-06

APPENDIX L

USAGE AND ESTIMATES OF RELEASE OF GROUP ONE CHEMICALS

APPENDIX L

USAGE AND ESTIMATES OF RELEASE OF GROUP ONE CHEMICALS

Building	Room	Chemical	Usage	1988/1989 Inventory Quantity (kg)	Estimated Annual Usage (kg)	Disposal Method	Comments
B559	101	Acenapthene	Standard, Not Used	0.01	0	NA	
BT452B	NA	Acenapthene		0.005			
B559	101	Anthracene	Standard, Not Used	0.01	0	NA	
BT452B	NA	Anthracene		0.005			
B881	267	Anthracene, Scintillation Grade	No information	0.1	NA	NA	
T452F	NA	Benzo-a-pyrene	Not Used in years	0.002	<0.005	No release	No longer used
BT452B	NA	Chrysene		0.005			
BT452B	NA	Fluoranthene		0.005			
B559	101	Fluoranthrene	Standard, Not Used	0.01	0	NA	
B559	101	Fluorene	Standard, Not Used	0.01	0	NA	
BT452B	NA	Fluorene		0.005			
B559	101	Pyrene	Standard, Not Used	0.01	0	NA	
B881	212	Pyrene	Lab Standard	0.002	<10x qty on hand	minimal to no release	
BT452B	NA	Pyrene		0.005			
B881	224	Naphthalene	Lab Standard	0.45	<10x qty on hand	minimal to no release	No longer used
BT452B	NA	Naphthalene		0.005			
B559	101	Naphthalene	Standard, Not Used	0.01	0	NA	
B881	255	Naphthalene	Lab Standard	0.45	<10x qty on hand	minimal to no release	No longer used

APPENDIX L

USAGE AND ESTIMATES OF RELEASE OF GROUP ONE CHEMICALS

Building	Room	Chemical	Usage	1988/1989 Inventory Quantity (kg)	Estimated Annual Usage (kg)	Disposal Method	Comments
B559	101	Naphthalene, Alkylate	Standard, Not Used	0.01	0	NA	
B559	101	Acrylamide	Standard, Not Used	0.01	0	NA	
B881	266	Aroclor	Lab Standard	0.016	used in minute quantities (µl)	minimal to no release	
BT452B	NA	Aroclor		0.005			
B881	262	Aroclor Mix	Lab Standard	0.002	<1ml	minimal to no release	
B881	139	Arsenic 100 ppm	Lab Standard	0.11	NA	minimal to no release	
B881	137	Arsenic Acid	Lab Standard	0.45	NA	minimal to no release	
B559	129	Arsenic Iodide		0.11	<1x qty on hand	minimal to no release	
B559	103E	Arsenic Metal	Standard, Not Used	0.005	<1x qty on hand	minimal to no release	
B881	137	Arsenic Pentoxide	Lab Standard	0.45	NA	minimal to no release	
B559	101D	Arsenic Plas 2X	Standard, Rarely used	0.5	<5x qty on hand	minimal to no release	10% solution
B881	227	Arsenic Solution	Lab Standard	0.025	NA	minimal to no release	
B444	212A	Arsenic Trioxide	Not Used	0.46	0	NA	
B444	245C	Arsenic Trioxide	Not Used	0.5	0	NA	

APPENDIX L

USAGE AND ESTIMATES OF RELEASE OF GROUP ONE CHEMICALS

Building	Room	Chemical	Usage	1988/1989 Inventory Quantity (kg)	Estimated Annual Usage (kg)	Disposal Method	Comments
B559	101D	Arsenic Trioxide		0.002	1x qty on hand	minimal to no release	
B559	129	Arsenic Trioxide	Stock supply	0.45	1x qty on hand	minimal to no release	
B779	131 137	Arsenic Trioxide Arsenic Trioxide	Not used in years Lab Standard	0.11 0.45	0 NA	minimal to no release	
B881	227	Arsenic Trioxide	Lab Standard	0.45	NA	minimal to no release	
B881	227	Arsenic Trioxide Standard	Lab Standard	0.15	NA	minimal to no release	
B559	101	Dibenzofuran	Standard, Not Used	0.01	0	NA	
B881	137	Hexachlorobenzene	Lab Standard	1	0	minimal to no release	
BT452B	NA	Hexachlorobenzene		0.005			
B779	137	Hydrazine 95%	Not used in years	0.5	0	minimal to no release	
B881	137	Hydrazine Sulfate	No information	1.2	0	NA	
B881	227	Hydrazine Sulfate	No information	0.125	0	NA	
B881	283	Methylene Dianiline	Lab Standard	1	<10x qty on hand	minimal to no release	
B559	101	O-Toluidine	Standard, Not Used	0.01	0	NA	
BT452B	NA	p-Dioxane		0.002			
B559	101	p-Dioxane	Standard, Not Used	0.01	<1x qty on hand	minimal to no release	

APPENDIX L

USAGE AND ESTIMATES OF RELEASE OF GROUP ONE CHEMICALS

Building	Room	Chemical	Usage	1988/1989 Inventory Quantity (kg)	Estimated Annual Usage (kg)	Disposal Method	Comments
B444	201	p-Dioxane	Not Used	1	0	NA	
B559	101	p-Dioxane		0.516	0	NA	
B771	137	p-Dioxane	Not used in years	0.5	0	NA	
B771	137	p-Dioxane	Not used in years	1	0	NA	
B881	224	p-Dioxane	No longer used	2	0	NA	
B559	101	Quinoline	Standard, Not Used	0.01	0	NA	
B771	137	Quinoline	Not used in years	0.9	0	NA	
B771	156A	Quinoline	Not used in years	0.11	0	NA	
B881	266	Vinyl Chloride	Lab Standard	0.004	<10x qty on hand	minimal to no release	

APPENDIX M

USE OF POTASSIUM HYDROXIDE, SODIUM HYDROXIDE AND SULFURIC ACID AT ROCKY FLATS FACILITY

APPENDIX M

USE OF POTASSIUM HYDROXIDE, SODIUM HYDROXIDE, AND SULFURIC ACID AT ROCKY FLATS

Tradename	Location	Room	Workplace	Operation	Pres_quant	Units
CAUSTIC FLAKE	B443	R101	EQUIPMENT ROOM	REGENERATE DEMENERALIZER	770	LB
CAUSTIC FLAKE	B774	R322	NUL	DO NOT USE	100	GL
CAUSTIC POTASH DRY FLAKE	B551	R101	WAREHOUSE		2800	LB
CAUSTIC SODA FLAKE	B124	R001	BASEMENT	WATER TREATMENT	750	LB
CAUSTIC SODA FLAKE	B551	R101	WAREHOUSE		1600	LB
CAUSTIC, POTASH FLAKE	B559	R127	NUL	CLEAN TUBES OF CHILLERS	100	LB
POTASSIUM HYDROXIDE	B123	R158	RECEIVING		5	LB
POTASSIUM HYDROXIDE	B371	R3412	LAB		5	LB
POTASSIUM HYDROXIDE	B371	R3412	LAB		5	LB
POTASSIUM HYDROXIDE	B371	R3412	LAB		10	LB
POTASSIUM HYDROXIDE	B374	OUTSIDE	TANK-NORTH	CHEMICAL PREPARATION, NEUTRALIZATION	18000	GL
POTASSIUM HYDROXIDE	B374	R4101	CHEM-PREP	PRECIPITATION	400	LB
POTASSIUM HYDROXIDE	B444	R212A	PRODUCTION LAB	PLATING	8	KG
POTASSIUM HYDROXIDE	B444	R245	PLATING LAB	PLATING	12	KG
POTASSIUM HYDROXIDE	B444	R245C	CHEMISTRY LAB	PLATING	5	LB
POTASSIUM HYDROXIDE	B559	R101	LAB		10	GM
POTASSIUM HYDROXIDE	B559	R101	LAB		10	GM
POTASSIUM HYDROXIDE	B559	R101	PU SPECT LAB		5	LB
POTASSIUM HYDROXIDE	B701	R101	NUL		2	LB
POTASSIUM HYDROXIDE	B701	R101	NUL	R & D	4	LB
POTASSIUM HYDROXIDE	B707	R135	MODULE-H	N/A	5	LT
POTASSIUM HYDROXIDE	B771	OUTSIDE	TANK-SOUTHEAST	NUMEROUS	5000	GL
POTASSIUM HYDROXIDE	B771	R164	LAB		500	GM
POTASSIUM HYDROXIDE	B771	R187	LAB		5	LB
POTASSIUM HYDROXIDE	B771	R246	NUL	NOT USED	20	LB
POTASSIUM HYDROXIDE	B771	R247	NUL	VACUUM SYSTEM, FUME SCRUBBER, FLOOR, INC.	1130	LT
POTASSIUM HYDROXIDE	B771	R247	NUL		665	LT
POTASSIUM HYDROXIDE	B771	R247	NUL	VACUUM SYSTEM, FUME SCRUBBER, FLOOR, INC.	635	LT
POTASSIUM HYDROXIDE	B779	R222	NUL		5	LB
POTASSIUM HYDROXIDE	B865	R106	LAB-METALLOGRA		5	LB
POTASSIUM HYDROXIDE	B881	245	LAB-R+D		4	LT
POTASSIUM HYDROXIDE	B881	R267	LAB-PROC DEV		7	KG
POTASSIUM HYDROXIDE	B883	R139	UTILITY RM	NEUTRALIZING NITRIC ACID	220	GL
POTASSIUM HYDROXIDE PELLETS	B123	R112	LAB		1	LB

APPENDIX M

USE OF POTASSIUM HYDROXIDE, SODIUM HYDROXIDE, AND SULFURIC ACID AT ROCKY FLATS

Tradename	Location	Room	Workplace	Operation	Pres_quant	Units
POTASSIUM HYDROXIDE PELLETS	B881	R227	LAB-STANDARDS		5	LB
POTASSIUM HYDROXIDE SOLID	B991	R110	LAB-GENERAL-ME		8	LB
POTASSIUM HYDROXIDE SOLUTION	B443	R202	WATER-TEST-LAB	DISPOSED OF	4	OZ
POTASSIUM HYDROXIDE SOLUTION (45%)	B883	R139	UTILITY RM	NEUTRALIZING NITRIC ACID	660	LB
POTASSIUM HYDROXIDE, PELLETS	B559	R101D	CHEM PREP/SPEC		5	LB
POTASSIUM HYDROXIDE, PELLETS	B559	R129	UTILITY RM		3	KG
POTASSIUM HYDROXIDE, PELLETS	B881	R131C	LAB-GEN-CHEM		5	LB
POTASSIUM HYDROXIDE, PELLETS	B881	R255	NUL		3	KG
SODIUM HYDROXIDE	B123	R112	LAB		2	KG
SODIUM HYDROXIDE	B123	R156	LAB		1	KG
SODIUM HYDROXIDE	B124	R101	WATER-TREATMEN	REMOVE FROM AREA	1000	ML
SODIUM HYDROXIDE	B371	R2117	TEST-AREA	TOWER WATER TEST FOR PHOSPHATE	20	OZ
SODIUM HYDROXIDE	B371	R3179	LAB		15	KG
SODIUM HYDROXIDE	B371	R3179	LAB		1	QT
SODIUM HYDROXIDE	B371	R3412	LAB		2	KG
SODIUM HYDROXIDE	B443	OUTSIDE	TANK-EAST	BOILER AND TO REGENERATE DEMINERALIZER	750	GL
SODIUM HYDROXIDE	B443	R202	WATER-TEST-LAB	DISPOSED OF	1	OZ
SODIUM HYDROXIDE	B443	R202	WATER-TEST-LAB	DISPOSED OF	32	OZ
SODIUM HYDROXIDE	B444	R109	WATER TREAMENT	CLEANING PRODUCTION PARTS	550	LB
SODIUM HYDROXIDE	B444	R109B	LAB	CLEAN COATING FIXTURE	5	LB
SODIUM HYDROXIDE	B444	R201	PLATING STORAG	ALUMINUM ETCHING	25	LB
SODIUM HYDROXIDE	B559	R101	LAB		10	GM
SODIUM HYDROXIDE	B559	R101	LAB		10	GM
SODIUM HYDROXIDE	B559	R101D	CHEM PREP/SPEC		500	GM
SODIUM HYDROXIDE	B559	R103	MS LAB		5	LB
SODIUM HYDROXIDE	B559	R103	MS LAB		500	GM
SODIUM HYDROXIDE	B701	R100	NUL	R & D	500	GM
SODIUM HYDROXIDE	B701	R107	NUL	R & D	12	LB
SODIUM HYDROXIDE	B771	R158	LAB-		5	LB
SODIUM HYDROXIDE	B771	R164	LAB		10	KG
SODIUM HYDROXIDE	B771	R180F	LAB		3	KG
SODIUM HYDROXIDE	B771	R180F	LAB		5	LB
SODIUM HYDROXIDE	B774	OUTSIDE	LIQ-WASTE-OPS-	FIRST STAGE NEUTRALIZATION	2800	GL
SODIUM HYDROXIDE	B779	R223	LAB-COATINGS		4	LB
SODIUM HYDROXIDE	B779	R234B	LAB-PHYSICAL-M		500	GM

APPENDIX M

USE OF POTASSIUM HYDROXIDE, SODIUM HYDROXIDE, AND SULFURIC ACID AT ROCKY FLATS

Tradename	Location	Room	Workplace	Operation	Pres_quant	Units
SODIUM HYDROXIDE	B865	R145	HIGH BAY		760	LB
SODIUM HYDROXIDE	B881	245	LAB-R+D		20	LT
SODIUM HYDROXIDE	B881	245	LAB-R+D		10	LT
SODIUM HYDROXIDE	B881	R227	LAB-STANDARDS		5	LB
SODIUM HYDROXIDE	B881	R266	LAB-GEN-CHEM		1000	GM
SODIUM HYDROXIDE	B881	R267	LAB-PROC DEV		10	KG
SODIUM HYDROXIDE	B881	R283	PRODUCT LAB	ETCHING METAL	1	LB
SODIUM HYDROXIDE STANDARD SOLUTION	B443	R202	WATER-TEST-LAB	DISPOSED OF	32	OZ
SODIUM HYDROXIDE, CAUSTIC SODA FLAKE	B883	R139	UTILITY RM	NEUTRALIZING - NITRIC ACID	400	LB
SODIUM HYDROXIDE, CAUSTIC SODA FLAKE	B883	R139	UTILITY RM	NEUTRALIZING - NITRIC ACID	400	LB
SODIUM HYDROXIDE, FLAKE	B910	NUL	NUL	WATER TREATMENT	175	LB
SODIUM HYDROXIDE, FLAKE	B910	R2	NUL	WATER TREATMENT	100	LB
SODIUM HYDROXIDE, PELLETS	B123	R127	LAB		5	LB
SODIUM HYDROXIDE, PELLETS	B444	R109B	LAB	CLEAN PRODUCTION PARTS	10	LB
SODIUM HYDROXIDE, PELLETS	B444	R201	PLATING STORAG	PH ADJUSTING	5	LB
SODIUM HYDROXIDE, PELLETS	B444	R204	BULK STORAGE C	PLATING	110	LB
SODIUM HYDROXIDE, PELLETS	B559	R102	PU CHEM LAB		5	KG
SODIUM HYDROXIDE, PELLETS	B779	R155	NUL	ETCHING METALLURGICAL SAMPLES	150	GM
SODIUM HYDROXIDE, RGT	B701	R107	NUL	R & D		LB
SULFURIC ACID	B119	OUTSIDE	WEST SIDE BLDG	BATTERY ELETROLYTE	1	QT
SULFURIC ACID	B123	R103	LAB		9	LB
SULFURIC ACID	B123	R112	LAB		2	QT
SULFURIC ACID	B123	R112	LAB		9	LB
SULFURIC ACID	B123	R127	LAB		36	LB
SULFURIC ACID	B373	NUL	COOLING TOWER	TOWER WATER TREATMENT FOR P.H. CONTROL	22	LB
SULFURIC ACID	B443	OUTSIDE	TANK-EAST	REGENERATE DEMINERALIZER	1400	GL
SULFURIC ACID	B443	R202	WATER-TEST-LAB	CHEMICAL-TEST	56	OZ
SULFURIC ACID	B444	R10	WATER TREATMEN		220	LB
SULFURIC ACID	B444	R10	WATER TREATMEN	WATER TREATMENT COOLING TOWER	220	LB
SULFURIC ACID	B444	R203	ACID ROOM	PLATING	45	LB
SULFURIC ACID	B444	R212A	PRODUCTION LAB	PLATING	4	LB
SULFURIC ACID	B444	R245	PLATING LAB	PLATING	50	LB
SULFURIC ACID	B551	R101	WAREHOUSE		180	LB
SULFURIC ACID	B551	R101	WAREHOUSE		360	LB

APPENDIX M

USE OF POTASSIUM HYDROXIDE, SODIUM HYDROXIDE, AND SULFURIC ACID AT ROCKY FLATS

Tradename	Location	Room	Workplace	Operation	Pres_quant	Units
SULFURIC ACID	B551	R101	WAREHOUSE		90	LB
SULFURIC ACID	B559	129	NUL	TREATMENT OF COOLING WATER	100	LB
SULFURIC ACID	B559	R101D	CHEM PREP/SPEC		9	KG
SULFURIC ACID	B559	R102	PU CHEM LAB		90	LB
SULFURIC ACID	B559	R102	PU CHEM LAB		4400	ML
SULFURIC ACID	B559	R103A	LAB-PHOTOGRAPH		1000	ML
SULFURIC ACID	B559	R103D	LAB-		18	LB
SULFURIC ACID	B559	R103E	LAB-ANNEX		500	ML
SULFURIC ACID	B559	R129	UTILITY RM		126	LB
SULFURIC ACID	B701	R101	NUL	R & D	6	GL
SULFURIC ACID	B701	R107	NUL	R & D	9	LB
SULFURIC ACID	B703	NUL	NUL	COOLING WATER PH CONTROL	440	LB
SULFURIC ACID	B708	R100	UTILITIES	TOWER WATER TREATMENT	20	GL
SULFURIC ACID	B771	R180F	LAB		9	LB
SULFURIC ACID	B771	R180F	LAB		9	LB
SULFURIC ACID	B771	R247	NUL	PRECIPITATION, PART V DISSOLUTION	306	LB
SULFURIC ACID	B779	R155	NUL	ETCHING METALLURGICAL SAMPLES	700	ML
SULFURIC ACID	B783	NUL	NUL	COOLING WATER PH CONTROL	150	LB
SULFURIC ACID	B865	R145	HIGH BAY		36	LB
SULFURIC ACID	B881	R131C	LAB-GEN-CHEM		9	LB
SULFURIC ACID	B881	R227	LAB-STANDARDS		18	LB
SULFURIC ACID	B881	R227	LAB-STANDARDS		1	LT
SULFURIC ACID	B881	R267	LAB-CHEM-PROC-		18	LB
SULFURIC ACID	B881	R299	LAB-CORROSION		18	LB
SULFURIC ACID STANDARDIZED CONCENTRATE 1/10	B779	R137	LAB-AQ-REC-TEC		100	ML
SULFURIC ACID, TECH	B551	R101	WAREHOUSE		540	LB
SULFURIC ACID, TECH	B771	R249	NUL	COOLING TOWER WATER TREATMENT (NOT IN SERV	440	LB
SULFURIC ACID,STANDARD SOLUTION	B124	R101	WATER-TREATMEN	REMOVE FROM AREA	800	ML
SULFURIC ACID,STANDARD SOLUTION	B371	R2117	TEST-AREA	TOWER WATER TEST FOR PHOSPHATE & ALKALINIT	36	OZ

APPENDIX N

USAGE, ENVIRONMENTAL FATE, ACUTE AND CHRONIC TOXICITY OF THE CHEMICALS OF CONCERN

Chemical name: Benzene

Common names: Benzol or cyclohexatriene

Nature of Use and Presence in the Environment

From the 1930s to 1960s, benzene was widely used as an organic solvent in shoe, rubber and artificial leather industries. The use of benzene has significantly decreased over the last twenty years after the recognition that it is a human carcinogen. It is found in gasoline in amount ranging from approximately 2-5%. It is relatively soluble in water (1700 mg/l at 25 C) and has been found in some contaminated groundwater systems. However, due to the high volatility of benzene, it does not stay in exposed water and tends to evaporate into the atmosphere. Also, as it moves through the surface water and groundwater systems, a significant amount of benzene is expected to be retained by the organic materials in the sediments and soils. Benzene can be potentially biodegraded by microorganisms in the soil or water systems.

Acute and Chronic Toxicity

The most common route of benzene exposure is inhalation. It was estimated that exposure to concentrations of 19,000 to 20,000 ppm in air for 10 minutes may be fatal. The acute toxic effect is caused by respiratory arrest, central nervous system depression, or cardiac arrest. An 8 hr no observable effect level in humans is estimated to be 25 ppm.

Chronic low level exposures to benzene is associated with blood and bone marrow disorders, the most serious of which is leukemia. The toxic effects on the blood forming system can be separated into 3 stages. The first stage is reversible, is characterized by blood clotting defects and a decrease in the production of all blood components. The second stage is associated with internal hemorrhage, disruption of iron metabolism and abnormality of the bone marrow. The final stage is the development of leukemia.

Chemical name: Benzidine

Common names: [1,1-Biphenyl]-4,4-diamine, p-diaminodiphenyl

Nature of Use and Presence in the Environment

Benzidine can be formed in the environment by the breakdown of benzidine-based dyes. Benzidine may be further degraded in natural waters to simpler compounds, which may be fairly persistent. The physical and chemical properties of benzidine suggest that direct degradation of this compound by radiant energy from sunlight probably occurs in aquatic systems. Adsorption to clay minerals and metallic compounds in sediments is very rapid and may be the most important environmental transport process for this compound. Benzidine does not appear to accumulate to any significant degree in living organisms (Clement, 1985).

Acute and Chronic Toxicity

Relatively little information is available concerning the noncarcinogenic effects of benzidine. Acute exposure by ingestion may result in nausea, vomiting, and possibly liver and kidney damages.

Benzidine is considered a human carcinogen. Epidemiological studies show a strong association between occupational exposure to benzidine and development of bladder cancer. Exposure can occur through ingestion, inhalation, or dermal absorption. Benzidine is also carcinogenic in experimental animals, producing liver and bladder tumors (Clement, 1985).

Chemical name: Beryllium compounds

Common names: Beryllium compounds include: beryllium acetate, beryllium carbonate, beryllium chloride, beryllium fluoride, beryllium hydride, beryllium hydroxide, beryllium nitrate, beryllium oxide, beryllium sulfate

Nature of Use and Presence in the Environment

Beryllium is a hard, brittle metallic element. It is used in ceramics, electron tubes, and high temperature reaction systems. It enters the environment primarily through coal combustion. It is estimated that the human daily intake of beryllium is in the range of 20 ug/day. Beryllium has a natural abundance in the earth's crust of about 6 ug/g. It is accumulated and enriched in several plant species, including cultivated potatoes, tomatoes, and head lettuce.

Acute and Chronic Toxicity

The major toxicological effects of beryllium are to the lungs. In workers occupationally exposed to beryllium, chronic pulmonary beryllium disease, or berylliosis, has been observed. Chronic berylliosis is characterized by severe shortness of breath, while the acute form causes inflammation of the respiratory tract and a chemical pneumonitis. Allergic, contact dermatitis is the most common effect of dermal exposure to beryllium. It is not clear if exposure to beryllium compounds is associated with an increase in the incidence of carcinomas in humans.

Chemical name: Butadiene

Common names: biethylene, vinylethylene, erythrene, pyrrolylene, bivinyl, divinyl

Nature of Use and Presence in the Environment

1,3-Butadiene is a gas at ambient temperature. It is released to the atmosphere from motor vehicles, burning of fossil fuels, plastic and rubber manufacturing industries. Butadiene may also enter the air as a natural emission from forest fires. The primary source of human exposure to butadiene is through inhalation in urban areas and around manufacturing plants which use the chemical. Liquid butadiene spilled on land or water will rapidly volatilize to the atmosphere. Once in the atmosphere, butadiene will be broken down by radiant energy from sunlight and will react with radicals, including ozone (Howard, 1989). It is very soluble in water and is likely to leach through soil to groundwater. Exposure from water is probably minor, although butadiene has been detected in drinking water. Butadiene may also be subject to biodegradation in water.

Acute and Chronic Toxicity

Information on the acute toxicity of butadiene is limited. The major acute toxic effect are irritation of the respiratory tract, mucous membranes, and eyes.

Effects observed during chronic exposure of experimental animals to butadiene include excessive secretion of the eyes and nose, adverse effects on the liver, testes, and ovaries. Exposure of rodents to butadiene has resulted in ovarian tumors. Adequate evidence of the carcinogenicity of butadiene in humans is not available. Based on the data available from animal studies, the USEPA classifies butadiene as a "probable" human carcinogen (USEPA, 1985b and 1990).

Chemical name: Cadmium compounds

Common names: Cadmium compounds include: cadmium acetate, cadmium bis(2-ethylhexyl) phosphate, cadmium chlorate, cadmium chloride, cadmium fluoride, cadmium nitrate, cadmium oxide, cadmium phosphate, cadmium sulfate, cadmium sulfide

Nature of Use and Presence in the Environment

Cadmium is a naturally occurring element which is most often encountered in the environment as oxide, chloride, or sulfide. Cadmium is present at relatively low concentrations in various environmental media except where it has been concentrated due to human activities. Most cadmium metal in the United States is obtained as a by-product from zinc, lead, or copper ore smelting. It is used mainly in metal plating, pigments, batteries, and plastics. Cadmium enters the environment from discarded metal-containing products, phosphate fertilizer, and fuel combustion. High acidity favors cadmium release from soil and uptake by plants. Consumption of food normally represents the greatest source of human exposure to cadmium since many edible plants and tobacco contain cadmium.

Acute and Chronic Toxicity

Ingestion of high levels of cadmium compounds produces irritation of the stomach, leading to vomiting and diarrhea. Acute exposure to cadmium in air may result in delayed (4 to 10 hours) breathing distress, cough and tightness of the chest, pulmonary edema (fluid in the lungs), and possibly bronchopneumonia. Other tissues which exhibit a toxic response to cadmium include the liver and testes. Cadmium is well absorbed from the lungs but is quite poorly absorbed from the gastrointestinal tract. Acute lethality is primarily the result of pulmonary edema. It was estimated that inhalation exposure to 2500 mg/m^3 for 1 minute is fatal. Exposure to 1 mg/m^3 for 8 hours can adversely affect human health.

Chronic exposure to low levels of cadmium in the air has been reported to result in emphysema and kidney lesions. Chronic exposure to cadmium also produces a variety of skeletal effects like painful joints and bones. There is adequate evidence from animal studies to conclude that chronic inhalation exposure to cadmium chloride is associated with an increased incidence of lung tumors. Epidemiological studies in humans exposed to cadmium provide limited evidence that inhaled cadmium is a lung carcinogen.

Chemical name: Carbon tetrachloride

Common names: perchloromethane, tetrachloromethane

Nature of Use and Presence in the Environment

Carbon tetrachloride has a wide range of industrial and chemical applications. It is a clear, colorless, nonflammable liquid with a distinctive odor. Carbon tetrachloride may be emitted into the environment through production, use of the chemical or through other chemicals that contain carbon tetrachloride, such as chlorofluorocarbons. The primary source of emissions is solvent applications. There are no known natural sources of carbon tetrachloride. Releases of carbon tetrachloride are associated with human activities. Volatilization is expected to be the primary process for removal of carbon tetrachloride from surface waters. Due to its high volatility and relatively low solubility and mobility in soil, carbon tetrachloride is not easily transported to groundwater. Contamination of surface water and soil is unlikely to present long-term hazards due to the rapid volatilization of carbon tetrachloride.

Acute and Chronic Toxicity

Uptake from air is considered the major source of exposure to carbon tetrachloride. Adverse effects recorded for humans following ingestion or inhalation of large quantities of carbon tetrachloride are damage to the liver, kidney, lungs and central nervous system. Low levels of exposure may cause headaches, nausea, and biochemical alterations.

Prolonged or repeated dermal exposure to carbon tetrachloride may cause skin irritation. Chronic exposure by ingestion may lead to liver toxicity. Carbon tetrachloride is classified as an animal carcinogen and probable human carcinogen. No evidence was located to indicate carbon tetrachloride is teratogenic.

Chemical name: Chloroform

Common names: trichloromethane

Nature of Use and Presence in the Environment

Chloroform is a dense, colorless, volatile liquid used primarily in the production of chlorodifluoromethane. It is also a common byproduct in chlorinated drinking water and municipal sewage. It is used in floor polishes, resins, vitamins, penicillin, and as a dry cleaning agent. Chloroform is ubiquitous in the environment and is found in both urban and nonurban environments. The dominant fate of chloroform in an aquatic environment is volatilization into the atmosphere.

Acute and Chronic Toxicity

Dermal exposure to chloroform may cause skin irritation. However, toxicity from dermal exposure is not considered significant compared to inhalation exposure. A study of human exposures to chloroform via ingestion did not appear to adversely affect liver or kidney function.

Data on long-term inhalation exposures to chloroform is limited. Exposure to chloroform in chlorinated drinking water has been linked to an increased number of colon/ rectal cancers in humans. It is classified by USEPA (1990) as a "probable" human carcinogen. Chloroform is also considered a potential developmental toxicant based on animal studies.

Chemical name: Chromium compounds

Common names: Chromium compounds include: chromic acetate, chromic acid, chromic chromate, chromium chloride, chromium nitride, chromium oxychloride, chromium pentafluoride

Nature of Use and Presence in the Environment

Chromium is a naturally occurring, environmentally pervasive element. It is an essential nutrient with a Recommended Daily Allowance (RDA) for adults of 0.05-0.2 mg/day. The valence states of chromium of toxicological concern which are frequently encountered are III (trivalent chromium) and VI (hexavalent chromium). Trivalent chromium is the common stable form found in nature. Hexavalent chromium is almost exclusively produced as the result of manufacturing activities. Elemental chromium does not occur in nature. There is much data to support the conclusion that reduction of hexavalent chromium to trivalent chromium has been commonly observed under natural conditions, and that the reverse process, oxidation of trivalent chromium to hexavalent chromium, is not likely to occur. Hexavalent chromium is soluble in water and can be transported via surface water, runoff and groundwater.

Acute and Chronic Toxicity

Systemic effects have been demonstrated in the kidneys, liver, gastrointestinal tract, and circulatory system as a result of acute high dose exposure to trivalent and hexavalent chromium. High doses of chromate may lead to kidney damage.

The chronic effects of chromium include changes in the skin and mucous membranes. Long-term high dose inhalation exposure to hexavalent chromium is associated with lesions of the mucous membranes of the respiratory tract in humans. Increased lung cancers among chromate workers in the United States have been reported. Inhalation studies in animals indicate that calcium chromate and sodium dichromate may be weak carcinogens. Long-term inhalation or ingestion of trivalent chromium compounds suggest minimal adverse health effects. Indications are that trivalent chromium is not a carcinogen and that it is effectively non-toxic to humans at doses which would be encountered in environmental situations. Inhalation exposure to hexavalent chromium has been associated with increase of lung cancer risks.

Chemical name: Ethylene Oxide

Common names: oxirane, anprolene

Nature of Use and Presence in the Environment

More than 99% of the ethylene oxide produced in the United States is used as a chemical intermediate in the syntheses of glycols and other related compounds. Ethylene oxide is also used as a fumigant and sterilizing agent in hospitals. In addition, ethylene oxide is produced during the combustion of hydrocarbon fuels, and has been identified in automobile exhaust and tobacco smoke. Epoxides such as ethylene oxide are not persistent in the environment due to their highly reactive chemical and biological properties. Evaporation and degradation in water appear to be the dominant fate processes for ethylene oxide. Microorganisms in water do not appear to rapidly degrade ethylene oxide. In the atmosphere, ethylene oxide is attacked by hydroxyl radicals to form acetaldehyde and other related compounds.

Acute and Chronic Toxicity

Ethylene oxide is an irritant and causes central nervous system depression at concentrations higher than 1000 ppm. Acute inhalation exposure to ethylene oxide has resulted in headache, nausea, vomiting, difficulty in breathing and/or respiratory irritation. Aqueous solutions of ethylene oxide can be extremely irritating to the skin, with symptoms appearing 1-5 hours after exposure. Ethylene oxide is also very irritating to the eyes of both humans and animals.

Chronic exposure to ethylene oxide in experimental animals has been shown to increase the incidence of ovarian, lymphoid, and pulmonary tumors, as well as leukemia. Studies of workers occupationally exposed to ethylene oxide have found statistically significant increases in mortality from leukemia, stomach cancer, pancreatic cancer, and Hodgkin's disease (USEPA, 1985c).

Chemical name: Formaldehyde

Common names: methanal, oxomethane, oxymethylene, formic aldehyde, methyl aldehyde, methylene glycol, methylene oxide

Nature of Use and Presence in the Environment

Formaldehyde is a gas at ambient temperatures. Thus, the air is a major route of transport. In the atmosphere, degradation of formaldehyde by radiant energy from sunlight occurs. The estimated half-life of formaldehyde in sunlight is about 75 minutes. Degradation also occurs in water, primarily due to the activities of microorganisms. Formaldehyde binds readily to clay particles in soils and sediments.

Acute and Chronic Toxicity

Formaldehyde is a respiratory irritant and has been found to produce localized effects in the nose, throat, and lung of exposed individuals. Irritation of the skin has also been reported. In addition, an allergic dermatitis has been produced in some people exposed to formaldehyde.

Formaldehyde has been shown to produce nasal tumors in rats, and there is evidence that suggests it produces the same type of tumor in humans. It has been shown that formaldehyde is a "weak" mutagen producing gene mutations in a variety of laboratory test systems. Formaldehyde is identified as a "probable" human carcinogen by USEPA (1990). Formaldehyde has not been shown to cause developmental malformations in fetuses or to cause toxicity to the reproductive system (Clement, 1985).

Chemical name: Hydrazine

Common names: diamide, diamine, hydrazyna

Nature of Use and Presence in the Environment

Hydrazine is used as a reducing agent and a rocket fuel.

Acute and Chronic Toxicity

Acute exposure to hydrazine can cause corrosive damage to the eyes, skin, and mucous membranes. Chronic exposure to hydrazine and some of its derivatives may cause damage to the liver and destruction of red blood cells. In experimental animals, hydrazine has produced tumors of the lung, liver, kidney, hematopoietic (blood-forming) system, breast, and subcutaneous tissue (Sax, 1989).

Chemical name: Lead compounds

Common names: Lead compounds include: lead acetate, lead carbonate, lead chloride, lead chromate, lead dioxide, Lead(II) fluoride, lead monoxide, Lead(II) phosphate, Lead(II) sulfate

Nature of Use and Presence in the Environment

Lead is a naturally occurring metal found in small quantities in the earth's crust. It is ubiquitous in the environment, primarily due to the past extensive use of leaded gasoline as a fuel. Lead is extremely persistent in both water and soil. It binds strongly to organic materials present in soil, so that very little lead is transported in surface waters or groundwater. Lead is not easily taken up by plants, and therefore its availability to humans and animals via plant consumption is limited.

Acute and Chronic Toxicity

Symptoms of acute lead poisoning in humans include fatigue, disturbance of sleep, and constipation, followed by colic, anemia, and inflammation of nerves. Target organs are the central nervous system, the peripheral nervous system, the kidneys, and the blood-forming system.

Chronic exposure to lead has been reported to cause permanent brain damage. Permanent clinically undetectable learning disabilities in children may be due to low level exposure to lead. Extended exposure to extremely high concentrations of lead can result in progressive kidney damage and possibly kidney failure. Common symptoms of chronic toxicity are loss of appetite, metallic taste, constipation, anemia, pallor, weakness, nervous irritability, fine tremors, and colic. Results of published studies regarding the carcinogenicity of lead in humans are not definitive, although in animal studies, lead has resulted in an increased incidence of kidney tumors. USEPA (1990) identified lead as a "probable" human carcinogen.

Chemical name: Mercury compounds

Common names: Mercury compounds include: mercuric acetate, mercuric oxide, mercuric salicylate, mercurous chloride, methyl mercury

Nature of Use and Presence in the Environment

Mercury is a naturally occurring element that is ubiquitous in the environment. Mercury and its compounds have numerous uses in many industries, including textile printing, photography, and the manufacture of scientific instruments (barometers, thermometers, etc.), electrical equipment, dry batteries, electric lamps, and x-ray tubes. Mercury is fairly mobile in the environment. Elemental mercury readily volatilizes at room temperature and can be released into the atmosphere by degassing of the element from soils. Once in the atmosphere, it can be transported long distances before returning to soil and water. Many forms of inorganic mercury may be transformed into the more toxic methylated organic mercury by bacteria in soil or water. Certain marine fish also transform inorganic mercury to methyl mercury. Routes of entry into the human body include inhalation of dust and absorption through the skin. Uptake of mercury in food is usually the largest source of human intake from the environment.

Acute and Chronic Exposure

In general, methyl (organic) mercury is more toxic than inorganic mercury. Methyl mercury compounds are absorbed into human tissue very rapidly in contrast to inorganic mercury compounds. Major target organs are the central nervous system and the kidney, although the liver, heart, pancreas, endocrine, and reproductive systems may be affected. Elemental mercury is not highly toxic as an acute poison, although inhalation of high concentrations may cause pneumonia, bronchitis, chest pains, inflammation of the gums, nausea, vomiting, and diarrhea.

Methyl mercury tends to accumulate in the kidney, brain, and blood. In addition, methyl mercury may pass through the placental wall into the fetus, concentrating in the brain tissue. Chronic mercury exposures are associated with behavioral and neurological disturbances of the central nervous system.

Chemical name: Methylene chloride

Common names: dichloromethane (DCM), methylene dichloride, methylene bichloride

Nature of Use and Presence in the Environment

Methylene chloride (also known as dichloromethane, or DCM) is a common laboratory solvent. The major source of DCM in the environment is industrial releases. Chlorination of drinking water also produces DCM. DCM has no known natural sources that significantly contribute to environmental concentrations. Due to its moderate solubility in water, DCM will leach from soil to groundwater and surface water. DCM is found in drinking water, surface water, and groundwater throughout the United States. However, because of its high volatility, DCM is not expected to be retained in exposed water. Once in the atmosphere, DMC reacts with free radicals to form carbon dioxide, carbon monoxide and some phosgene. Phosgene is readily hydrolyzed into hydrochloric acid and carbon dioxide (USEPA, 1979). Most estimates for the lifetime of DCM in the atmosphere are less than a year.

Acute and Chronic Toxicity

The primary route of exposure to humans is inhalation. The major targets following DCM exposure are the central nervous system and the liver. Inhalation of high levels of DCM has caused irritation to the eyes, nose and throat. Based on experimental animal data, DCM is considered a probable human carcinogen to the lung and liver.

Chemical name: Nickel compounds

Common names: Nickel compounds include: nickel acetate, nickel carbonate, nickel carbonyl, nickel hydroxide, nickel monoxide, nickel nitrate, nickel subsulfide, nickel sulfide

Nature of Use and Presence in the Environment

Nickel has a variety of physical and chemical properties due to the many potential chemical complexes which it can form. These various complexes can cause nickel to occur in soluble or insoluble form. Insoluble inorganic nickel compounds are metallic nickel, nickel oxide, and nickel subsulfide. Soluble nickel compounds include acetate, sulfate, hexahydrate, nitrate hexahydrate, and chloride. Due to their solubility, these compounds can pose a water pollution problem. Nickel is found in many soils in a generally insoluble form, but acidification may render it soluble, causing plant injury or death. It now appears that the toxicity of nickel for plants may be caused by a decrease in the oxygen exchange capacity of the roots.

Acute and Chronic Toxicity

The major organ affected by nickel inhalation is the lung. The immune system, kidney, and blood forming systems may also be affected. Nickel has been known to cause contact dermatitis, due primarily to occupational exposure, but also due to exposure to nickel in jewelry, coinage, tools, cooking utensils, etc.

Chronic exposure to low levels of nickel has been associated with emphysema, anosmia (loss or impairment of the sense of smell), and severe nasal injuries such as septal perforation, chronic rhinitis, and sinusitis. Some nickel compounds like nickel dust and nickel subsulfide are identified by USEPA as human carcinogens (USEPA, 1990).

Chemical name: Nitric acid

Common names: azotic acid, hydrogen nitrate

Nature of Use and Presence in the Environment

Nitric acid is both a strong acid and a strong oxidizing agent. It is usually found in conjunction with nitrogen dioxide, which appears to be more hazardous. Nitric acid is used to dissolve metals, for etching and cleaning metals, and to make nitrates and nitrogen compounds for fertilizers, dye intermediates and explosives.

Acute and Chronic Toxicity

The primary site of toxic action of nitric acid vapor and mist is the terminal respiratory bronchi and alveoli. Acute exposure to nitric acid vapor or mist may cause pulmonary congestion and edema. Continued exposure to nitric acid vapor may result in chronic bronchitis or emphysema. More severe exposure may cause a chemical pneumonitis.

Chemical name: Propylene oxide

Common names: methyloxirane, propene oxide

Nature of Use and Presence in the Environment

Propylene oxide is used as a chemical intermediate in the preparation of polyethers to form polyurethanes. It is also used in the preparation of lubricants, surfactants, and oil demulsifiers. Propylene oxide may also be found in automobile exhaust and combustion exhausts at stationary sources which burn hydrocarbons. There are no known natural sources of propylene oxide. When released to soil or water, propylene oxide is expected to volatilize rapidly. Propylene oxide is also expected to leach through soils to groundwater due to its high water solubility. In the atmosphere, propylene oxide is destroyed by radicals produced by the radiant energy of sunlight. Propylene oxide is not expected to bind to a significant degree with soils or sediments (Howard, 1989).

Acute and Chronic Toxicity

Ingestion exposure by experimental animals to acute levels of propylene oxide has resulted in gastric disturbances and liver damage. Inhalation exposure has resulted in respiratory difficulty, pneumonia, gasping, and hyperactivity. In humans, acute exposure to propylene oxide has caused temporary corneal injury and contact dermatitis.

Chronic exposure of experimental animal to propylene oxide vapor has caused eye and nose irritation, including nasal lesions, and pulmonary congestion. Animal studies have also shown increases in the number of tumors in the stomach and respiratory tract. Based on animal data, propylene oxide is considered a "probable" human carcinogen by the USEPA (USEPA, 1985a and 1990).

Chemical name: Tetrachloroethylene

Common names: perchloroethylene (PCE), ethylene tetrachloride, tetrachloroethene

Nature of Use and Presence in the Environment

Tetrachloroethylene (also known as perchloroethylene, or PCE) is a nonflammable liquid solvent. Its primary commercial applications are in dry cleaning and degreasing of fabricated metal parts. PCE rapidly volatilizes from water to the atmosphere. It also rapidly leaches into groundwater from soil. PCE is generally found in surface and drinking water at levels between 1 and 2 ppb. PCE will bind to soils high in organic content. In natural water and soil systems, biodegradation and hydrolysis may be the most important transformation processes. However, since neither of these processes occur at a rapid rate, most PCE in surface waters will evaporate to the atmosphere. Once in the atmosphere, it reacts with hydroxyl radicals at the double bond, resulting in the formation of trichloroacetyl chloride and phosgene. The lifetime of TCE in the atmosphere is estimated to be about 10 days (USEPA, 1979).

Acute and Chronic Toxicity

The most likely route of human exposure to PCE is inhalation. The main target organs are the central nervous system, liver and kidney. Acute exposures to high concentrations will cause central nervous depression effects such as loss of coordination and impaired judgement, cardiovascular effects and adverse effects on the lung, kidney, and liver. Dermal irritation has also been observed.

Excluding carcinogenicity as an endpoint, toxicity testing in animals and human data suggest that long term exposure of humans to environmental levels of 10 ppb or less of PCE is not likely to present a health concern. In some experimental animal studies, PCE has increased the incidence of spontaneously occurring tumors. However, evidence of the carcinogenicity of PCE in humans is limited. USEPA (1990) classifies PCE as a "probable" human carcinogen.

Chemical name: 1,1,1-Trichloroethane

Common names: methyl chloroform, chlorothene

Nature of Use and Presence in the Environment

1,1,1-Trichloroethane (1,1,1-TCA) is one of the most frequently used cleaning solvents in industry. 1,1,1-TCA disperses from surface water primarily by volatilization. Several studies have indicated that 1,1,1-TCA may be adsorbed onto organic materials in the sediment, but this is probably not an important route of elimination from surface water. 1,1,1-TCA can be transported in the groundwater, but the speed of transport depends on the composition of the soil. Photooxidation by reaction with hydroxyl radicals in the atmosphere is probably the principal fate process for this chemical.

Acute and Chronic Toxicity

The most notable toxic effects of 1,1,1-TCA in humans and animals are central nervous system depression, including anesthesia at very high concentrations and impairment of coordination, equilibrium, and judgement at lower concentrations. Cardiovascular effects, and adverse effects to the lungs, liver, and kidneys have also been reported.

There is evidence that 1,1,1-TCA is mutagenic in some bacterial culture systems. No evidence is available from human epidemiological or animal studies which demonstrates that 1,1,1-TCA is a carcinogen.

Chemical name: Trichloroethene

Common name: trichloroethylene, ethinyl trichloride

Nature of Use and Presence in the Environment

Tricloroethene (TCE) is a commonly used solvent in the manufacture of organic chemicals and pharmaceuticals. Volatilization is probably the most important transport mechanism for TCE. Due to its high vapor pressure, TCE rapidly volatilize from surface water and upper layer of soil into the atmosphere. Once in the atmosphere, TCE reacts with hydroxyl radicals to form hydrochloric acid, carbon monoxide, carbon dioxide and carboxylic acid. TCE adsorbs to organic materials and can be bioaccumulated to some degree. There is some evidence that higher organisms can metabolize TCE. TCE is fairly soluble in water and leaches into the groundwater; it is a common contaminant of groundwater around hazardous waste sites.

Acute and Chronic Toxicity

Acute toxicity data indicate that TCE is relatively nontoxic by the inhalation and oral routes. The bone marrow, central nervous system, and kidney are the target organs for TCE exposure. Central nervous system effects are related to narcosis, while liver and kidney effects include enlargement with histological effects of damage. The use of TCE as an anaesthetic agent has been associated with cardiac arrhythmias.

Effects following chronic exposure to TCE were renal toxicity, liver toxicity, neurotoxicity, and dermatological reactions. Epidemiological studies have not shown a relationship between exposure to TCE and increased cancer risk. However, chronic inhalation exposure to TCE has produced lung and liver tumors in mice and in rats. Chronic oral exposure produced increased incidence of liver tumors in mice and kidney tumors in rats. TCE does not appear to cause reproductive toxicity or teratogenicity.

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