SAFETY CLASS II

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**IDAHO CHEMICAL PROCESSING PLANT
SAFETY DOCUMENT**

**ICPP Hazardous Chemical
Evaluation**

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1. EXECUTIVE SUMMARY

This report presents the results of a hazardous chemical evaluation performed for the Idaho Chemical Processing Plant (ICPP). ICPP tracks chemicals on a computerized database, Haz Track, that contains roughly 2000 individual chemicals. The database contains information about each chemical, such as its form (solid, liquid, or gas); quantity, either in weight or volume; and its location. The Haz Track database was used as the primary starting point for the chemical evaluation presented in this report. The chemical data and results presented here are not intended to provide limits, but to provide a starting point for nonradiological hazards analysis.

1.1 HAZARDOUS CHEMICAL RESULTS

Haz Track contains data fields for classification codes used in the Resource Conservation and Recovery Act (RCRA)¹ and the Superfund Amendments and Reauthorization Act (SARA) of 1986.² The SARA codes were used to obtain a list of about 250 chemicals which need to be evaluated. Gasoline, diesel, kerosene, oxygen, and nitrogen outside tanks were considered. Other tanks were assumed to be encompassed by facility chemical lists and included in the evaluation. This list was further pared down to a representative sample by three screening methods discussed in the next few paragraphs.

The first screening method was by weight. If a chemical is stored in quantities of less than one pound, it was eliminated from further evaluation.

The second screening method for the chemicals remaining after the first screening consisted of calculating concentrations resulting from a spilled chemical at 100 m (328 ft) using worst-case meteorology [Class F and 1.5 m/s (5 ft/s)]. The entire stored quantity for solids and gases (in one storage location) is assumed to become airborne in 10 minutes. The evaporation rates for liquids were calculated consistent with the Environmental Protection Agency (EPA) method. The resulting concentrations were compared to occupational exposure limits (OELs).

Chemicals were then eliminated if the calculated concentration was less than one-half of the OEL. One-half the OEL was used as the limit because good occupational health protection recommends evaluation for medical monitoring or controls once the concentration reaches this level.

The third screening method was used on the chemicals remaining after the second screening. An approach similar to the second screening method was used, except the recommended meteorology replaces the worst-case meteorology. Meteorological conditions recommended for hazardous chemical evaluation at ICPP is Class D and 4.3 m/s (14.1 ft/s) wind speed. Both concentration equations (one each for gaseous and liquid chemicals) were modified to account for short averaging time (known as the Hanna equation).

Chemicals that still exceed one-half of the applicable OELs are then evaluated by their storage area. Solid chemicals which are stored in laboratories or in areas where HEPA filtration is normally available have their source terms reduced by 5.0×10^{-3} . This value takes credit for one roughing filter. Those chemicals stored in areas similar to CPP-660 are assumed to be 25% dispersible; i.e., 25% of the chemical stored in that area becomes airborne, leaks to the environment, and is dispersed. Lastly, chemicals stored in areas similar to CPP-608 are assumed to become airborne at 50% and leak to the environment to be dispersed. Liquid chemical source terms have been adjusted only by the size of the pool they form; i.e., the entire amount is spilled and fills the diked area or the laboratory hood. The laboratory hood is assumed to be 0.9 m deep and 1.2 m wide (3 ft by 4 ft).

Table 1-1 presents the chemicals determined to present risk to on-site workers at 100 m (328 ft). The concentrations listed are based on building-dependent release fractions. It is these chemicals which should be evaluated in safety analysis documents in order to assess whether co-location issues are of concern.

Some of these chemicals are not normally considered hazardous, because they can be consumed. The most notable is sodium chloride (table salt). Even though this substance can be consumed, it cannot be inhaled

Table 1-1. Chemicals Hazardous to On-Site Workers

Chemical	Concen. (mg/m ³)	OEL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike Yes/No	Dike Area (ft ²)
Aluminum Nitrate Nanohydrate	1.5E+01	2.0E+00	7.40E+00	375.13	0.0E+00	SOL	NO	0.00E+00
Aluminum Nitrate	8.6E+01	2.0E+00	4.15E+01	375.00	0.0E+00	SOL	NO	0.00E+00
Aluminum Oxide	4.3E+01	1.0E+01	2.10E+01	101.94	0.0E+00	SOL	NO	0.00E+00
Aluminum Sulfate	1.0E+02	2.0E+00	4.86E+01	342.14	0.0E+00	SOL	NO	0.00E+00
Ammonium Nitrate	1.1E+02	1.5E+01	5.16E+01	80.04	0.0E+00	SOL	NO	0.00E+00
Ammonium Sulfide	7.4E+01	1.0E+01	3.60E+01	68.14	0.0E+00	SOL	NO	0.00E+00
Barium Nitrate	6.3E+01	5.0E-01	3.03E+01	216.38	0.0E+00	SOL	NO	0.00E+00
Benzene (IRC)	1.7E+00	3.2E+00	8.80E+00	78.00	7.5E+01	LIQ	NO	0.00E+00
Bismuth Nitrate	4.2E+01	5.0E+00	2.05E+01	395.02	0.0E+00	SOL	NO	0.00E+00
Boric Acid	1.5E+03	1.5E+01	7.25E+02	61.83	0.0E+00	SOL	NO	0.00E+00
Cadmium Nitrate Tetrahydrate	2.8E+01	5.0E-02	1.67E+01	308.47	2.7E+01	LIQ	NO	0.00E+00
Cadmium Sulfate	3.1E+00	2.0E-01	2.39E+01	208.46	2.7E+01	LIQ	YES	1.20E+01
Cadmium	4.8E-01	2.0E-01	2.30E-01	112.41	0.0E+00	SOL	NO	0.00E+00
Calcium Hypochlorite	5.1E+01	5.0E+00	2.48E+01	142.98	0.0E+00	SOL	NO	0.00E+00
Calcium Nitrate Tetrahydrate	2.2E+01	5.0E+00	1.06E+01	236.16	0.0E+00	SOL	NO	0.00E+00
Calcium Nitrate	2.6E+01	5.0E+00	1.27E+01	164.09	0.0E+00	SOL	NO	0.00E+00
Carbon	4.1E+01	3.5E+00	2.00E+01	12.01	0.0E+00	SOL	NO	0.00E+00
Cerium (III) Nitrate	9.5E-01	1.0E+00	4.60E-01	434.23	0.0E+00	SOL	NO	0.00E+00
Cesium Carbonate	4.3E+01	2.0E+00	2.06E+01	325.82	0.0E+00	SOL	NO	0.00E+00

Table 1-1. (Contd.) Chemicals Hazardous to On-Site Workers

Chemical	Concen. (mg/m ³)	OEL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike Yes/No	Dike Area (ft ²)
Chromium (III) Nitrate	8.3E+01	5.0E-01	4.00E+01	400.15	0.0E+00	SOL	NO	0.00E+00
Chromium Oxide	1.1E+02	5.0E-01	5.55E+01	99.99	0.0E+00	SOL	NO	0.00E+00
Citric Acid	4.9E+02	1.0E+00	2.38E+02	192.12	0.0E+00	SOL	NO	0.00E+00
Cobalt Nitrate	3.1E+01	5.0E-02	1.49E+01	182.96	0.0E+00	SOL	NO	0.00E+00
Copper (II) Nitrate	4.8E+01	1.0E+00	2.34E+01	187.55	0.0E+00	SOL	NO	0.00E+00
Copper	1.7E+00	1.0E+00	8.30E-01	63.55	0.0E+00	SOL	NO	0.00E+00
Dodecane	1.1E+01	1.0E+00	5.11E+03	170.34	5.0E-01	LIQ	NO	0.00E+00
Fluoboric Acid	1.8E+01	2.5E+00	2.55E+02	87.82	2.7E+01	LIQ	NO	0.00E+00
Gadolinium Oxide	6.7E+02	1.0E+00	3.25E+02	362.50	0.0E+00	SOL	NO	0.00E+00
Hydrochloric Acid	2.4E+01	7.0E+00	3.85E+02	36.46	4.2E+01	LIQ	NO	0.00E+00
Hydrofluoric Acid	2.9E+02	2.5E+00	2.31E+03	20.01	1.3E+02	LIQ	NO	0.00E+00
Iron (II) Sulfamate	2.7E+01	1.0E+00	1.85E+02	247.80	2.7E+01	LIQ	NO	0.00E+00
Iron (III) Nitrate	9.4E+01	1.0E+00	4.57E+01	241.87	0.0E+00	SOL	NO	0.00E+00
Iron	5.0E+01	1.0E+00	2.44E+01	55.85	0.0E+00	SOL	NO	0.00E+00
Kerosene (Explosive)	1.7E+03	1.0E+02	1.29E+05	212.18	5.0E+00	LIQ	YES	3.50E+04
Lead Nitrate	2.1E+01	1.5E-01	1.00E+01	331.23	0.0E+00	SOL	NO	0.00E+00
Magnesium Nitrate	1.8E+02	1.0E+01	8.50E+01	220.38	0.0E+00	SOL	NO	0.00E+00
Nickel Chloride	1.0E+00	1.0E+00	5.00E-01	237.71	0.0E+00	SOL	NO	0.00E+00
Niobium (V) Oxide	3.1E+01	1.0E+00	1.48E+01	265.81	0.0E+00	SOL	NO	0.00E+00
Niobium	1.0E+02	1.0E+00	5.05E+01	92.91	0.0E+00	SOL	NO	0.00E+00
Nitric Acid	3.1E+01	5.0E+00	3.14E+02	63.00	4.5E+01	LIQ	NO	0.00E+00

Table 1-1. (Contd.) Chemicals Hazardous to On-Site Workers

Chemical	Concen. (mg/m ³)	OEL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike Yes/No	Dike Area (ft ²)
Nitrogen	8.2E+04	3.4E+04	3.98E+04	24.00	2.5E+01	GAS	NO	0.00E+00
Nitrous Oxide	5.3E+01	9.0E+01	2.56E+01	44.00	0.0E+00	GAS	NO	0.00E+00
Oxalic Acid	9.3E+02	1.0E+00	4.50E+02	90.00	0.0E+00	SOL	NO	0.00E+00
Oxygen	4.3E+05	5.2E+04	2.10E+05	32.00	0.0E+00	GAS	NO	0.00E+00
Potassium Iodide	6.8E+00	2.0E+00	3.30E+00	166.01	0.0E+00	SOL	NO	0.00E+00
Potassium Nitrate	1.1E+02	2.0E+00	5.34E+01	101.11	0.0E+00	SOL	NO	0.00E+00
Silver Nitrate	1.1E-02	1.0E-02	5.50E-03	169.87	0.0E+00	SOL	NO	0.00E+00
Sodium Acetate - Trihydrate	2.7E+01	5.0E+00	1.32E+01	136.08	0.0E+00	SOL	NO	0.00E+00
Sodium Carbonate - Anhydrous	1.8E+03	5.0E+00	8.50E+02	105.99	0.0E+00	SOL	NO	0.00E+00
Sodium Chloride	5.2E+00	5.0E+00	2.50E+00	58.44	0.0E+00	SOL	NO	0.00E+00
Sodium Hydroxide	2.1E+03	2.0E+00	1.03E+03	40.00	0.0E+00	SOL	NO	0.00E+00
Sucrose	1.4E+02	1.0E+01	6.96E+01	342.30	0.0E+00	SOL	NO	0.00E+00
Sulfamic Acid	8.3E-01	1.0E+00	4.00E-01	97.16	0.0E+00	SOL	NO	0.00E+00
Sulfurous Acid	2.2E+00	1.0E+00	5.60E+00	82.08	3.4E+01	LIQ	YES	1.20E+01
Tartaric Acid	9.8E+02	1.0E+00	4.75E+02	150.09	0.0E+00	SOL	NO	0.00E+00
Tributyl Phosphate	1.8E+02	2.2E+00	2.25E+03	266.32	1.4E+01	LIQ	NO	0.00E+00
Zirconium Carbonate	1.6E+02	5.0E+00	7.75E+01	431.68	0.0E+00	SOL	NO	0.00E+00
Zirconium Dioxide	1.1E+02	5.0E+00	5.40E+01	123.22	0.0E+00	SOL	NO	0.00E+00
Zirconyl Nitrate	6.0E+02	5.0E+00	2.88E+02	231.23	0.0E+00	SOL	NO	0.00E+00

over certain amounts without having biological effects. Substances which can be ingested can and normally do produce biological effects when inhaled.

All of the hazardous chemicals presented in appendix A were evaluated at the site boundary. None of these chemicals were found to cause concentrations to exceed appropriate limits at the site boundary. Therefore, nonradiological accidents are strictly an on-site, co-location issue.

These chemicals (appendix B) should be reevaluated to ensure that the entire stored amount can become airborne in 10 minutes. If not, their source terms should be reduced as appropriate. A reasonably small reduction in source term should reduce the expected concentration at the site boundary to within acceptable public exposure limits.

1.2 EXPLOSIVE CHEMICAL RESULTS

The second half of this report investigated chemicals which have explosive tendencies such as propane and gasoline. No effort was made to separate chemicals that burn versus those that explode. It was conservatively assumed that if a chemical could burn, it did so violently. All chemicals that could explode were first considered for toxicity and then for flammability.

All explosive chemicals were found to dissipate to concentrations below the lower explosive limit (LEL) within 100 m (328 ft). Diesel fuel did not appear to be at concentrations less than the LEL until realistic meteorology and the dike area were taken into account.

Table 1-2 presents those chemicals included in the explosive chemical portion of this report. All of these chemicals, upon a release, are at both the LEL and the upper explosive limit (UEL) at some distance from the spill. The specific distance is not of concern here; however, if the facility is within 100 m (328 ft) of the storage location of the potentially explosive chemicals, it should receive special attention to ensure adequate safeguards are in place to protect on-site workers.

Table 1-2. ICPP Flammable and Explosive Chemicals

Chemical	LEL (mg/m ³)	UEL (mg/m ³)	Concen. (mg/m ³)
Acetonitrile	7.39E+4	2.69E+5	5.1E+0
Acetylene	3.19E+4	6.92E+5	1.3E+3
Ammonium Hydroxide	2.29E+5	3.87E+5	3.5E+1
Amyl Acetate	> 5.33E+4		2.8E-1
Cyclohexanone	4.51E+4	3.32E+5	1.1E-1
Diesel	2.80E+4	3.5E+5	4.0E+3
Ethanol	6.22E+4	3.58E+5	1.8E+1
Gasoline	6.54E+4	3.55E+5	8.9E+3
Hexane	4.23E+4	2.64E+5	2.6E+1
Hydrogen	3.27E+3	6.13E+4	1.1E+2
Isobutyl Acetate	1.14E+4	4.99E+5	2.6E+0
Kerosene	3.74E+4	2.80E+5	2.9E+4
Methanol	7.86E+4	4.78E+5	3.5E+1
Methyl Isobutyl Ketone	6.31E+4	3.38E+5	1.7E+1
Propane	3.61E+4	1.80E+5	6.8E+1
Propanol	4.98E+4	3.20E+5	8.5E+0
Toluene	4.52E+4	2.64E+5	2.2E+1

Those chemicals which require further evaluation due to either toxicity or flammability have been identified in tables 1-1 and 1-2. Since the ICPP is currently undergoing a mission change, it is very likely that in the near future many of the hazardous chemicals listed in the above tables will be transported off-site for storage or disposal. Therefore, the various safety analysis documents should use the above lists only as a starting point for nonradiological hazards analysis.

2. INTRODUCTION

Safety Analysis Reports (SARs) at the ICPP have generally been written in conformance with USNRC Regulatory Guide 3.26. Section 3 of this guide, "Nearby Industrial, Transportation, and Military Facilities," describes what should be covered in the analysis for "nearby" facilities. Until recently, "nearby" was interpreted to mean facilities other than those at the ICPP. However, new interpretations of "nearby" define it to mean any facility on or off the ICPP. Since there were several operating process buildings at the ICPP, each constitutes a nearby facility to each of the others.

DOE 5480.23³ does not define a nearby facility, but requires both nonradiological and radiological hazards to be presented. Both the USNRC Regulatory Guide 3.26 and DOE Order 5480.23 require information concerning radiological releases from nearby facilities. However, only DOE Order 5480.23 specifically mentions the nonradiological aspects of co-location. Therefore, "nearby" facilities will be interpreted to be any facility on or off of the ICPP reservation.

The ICPP, until 1992, processed nuclear fuels to reclaim usable uranium. This was performed by means of chemical reactions. In some cases, very large amounts of chemicals, both hazardous and nonhazardous, were consumed by the process and in sample analyses. This report will, therefore, focus on the nonradiological aspects of co-location within the ICPP fence. Hazardous chemical releases are expected to have negligible effects off-site, but will be evaluated, should the initial screening of hazardous chemicals indicate a potential area of concern. Effects of a potential nonradiological release to another facility are presented in terms of distance, i.e., whether or not any facility is within a certain distance, for the facility or personnel to be at risk due to potential hazardous chemical releases.

The following sections contain the methodology for analysis of ICPP chemical hazards. Chemicals are identified that surpass recommended exposure limits. Each of the chemicals identified as a problem should be

evaluated in more detail in facility-specific safety documents to identify if any mitigative actions are required.

3. METHOD

The original hazardous chemical analysis was performed in support of the Special Isotope Separator⁴ (SIS). Since that study was completed, hundreds of additional chemicals have been added to the Haz Track database. These additional chemicals will be evaluated after discussion of the SIS report.

There are few limits for hazardous chemicals, and no one set of limits is universally accepted in the United States or among DOE contractors. However, some standard terminology must be defined before describing any analysis. The American Conference of Governmental Industrial Hygienists (ACGIH)⁵ has compiled and issued recommended exposure limits for a few substances. The definitions for these limits are presented since they have been used in previous studies and will be used in this study.

Threshold Limit Value - Time Weighted Average (TLV-TWA) - the time weighted average concentration for a normal 8-hour workday and 40-hour workweek to which nearly all workers may be repeatedly exposed, day-after-day, without suffering adverse effects.

Threshold Limit Value - Short Term Exposure Limit (TLV-STEL) - the concentration to which workers can be exposed continuously for a short period of time provided that the daily TLV-TWA is not exceeded, without suffering irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase likelihood of accidental injury, to impair self-rescue, or to materially reduce work efficiency.

A STEL is defined as a 15-minute TWA exposure which should not be exceeded at any time during a workday, even if the 8-hour TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the STEL should not be longer than 15 minutes and should not occur more than four times a day. There should be at least 60 minutes between successive exposures in this range.

Threshold Limit Value - Ceiling (TLV-C) - the concentration that should not be exceeded during any part of the working exposure.

Immediately Dangerous to Life and Health (IDLH) - the concentration at which workers will immediately suffer irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase likelihood of accidental injury, to impair self-rescue, or to materially reduce work efficiency.

Chemical operations at the ICPP are conducted using appropriate protection (e.g., respirators). It should be noted that worker protection changes from respirators to self-contained breathing apparatus when concentrations of a potential chemical release approach the IDLH level.

3.1 PREVIOUS HAZARDOUS CHEMICAL STUDY

The Special Isotope Separation (SIS) study considered three measurements for chemical screening purposes: 1) toxicity, 2) quantity, and 3) volatility. If a chemical was judged to be low in any of these measurements, that chemical was eliminated from further evaluation. Chemicals determined to need further evaluation were evaluated further based on USNRC 1.78 methodology. This methodology assumes that the entire quantity of chemical is spilled, and that all of the spill becomes airborne. It is an ultraconservative approach, since an entire spill normally does not become airborne. However, should this analysis show that, under these circumstances, no problem exists, then it is reasonable to assume that no problem exists.

More detailed calculations were performed for those chemicals determined to need further evaluation. The entire spill for any chemical was assumed to become airborne in two minutes, and the INPUFF code was used for the dispersion analysis. The INPUFF code is a particulate dispersion model and may not reasonably disperse "vapors." Many of the assumptions and criterion used for the SIS study will be used in this analysis. The results of the chemical evaluations were then compared to the TLV-TWA, TLV-STEL, IDLH, or the lower explosive limit (if available).

If the chemical concentration was below the TLV-STEL, TLV-C, and IDLH levels, the concentration was considered acceptable.

The SIS study also eliminated a few other chemicals because they were determined to need special attention in the ICPP method (discussed in the following sections). Diesel fuel, kerosene, and hydrogen are the most notable of those eliminated. Diesel fuel and kerosene were eliminated based on toxicity. Hydrogen was eliminated based on volatility (i.e., quick evaporation and dispersion). These three chemicals have received special attention in the ICPP method because they could potentially lead to an explosion.

3.2 ICPP HAZARDOUS CHEMICAL STUDY

The ICPP currently tracks approximately 2000 chemicals on a computerized database known as Haz Track. These chemicals range in exposure effects to humans from benign to lethal. The following sections discuss the logic followed to screen the 2000 chemicals down to a size that can be presented and analyzed while still remaining representative of the hazardous chemicals at the ICPP.

3.2.1 Occupational Safety and Health Administration Screening and the Environmental Protection Agency Method

Both the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) have adopted different screening methods to determine which of the vast number of chemicals must be evaluated to determine consequences for either on-site workers or members of the public. The following paragraphs describe the differences between these methods.

The OSHA method is similar to the method adopted by the EPA. The OSHA method assumes that the amount of hazardous chemical stored in one area is spilled and becomes completely airborne in one hour. No allowance is made to account for the physical form of the spill (e.g., liquid, powder). The spill and subsequent entrainment are assumed to

occur during meteorological class D conditions with a wind speed of 4.3 m/s (14.1 ft/s).

The EPA method assumes that the amount of a hazardous chemical stored in one location is spilled and becomes completely entrained in the air in 10 minutes. Meteorological conditions are also assumed to be class D and 4.3 m/s (14.1 ft/s). However, in contrast to the OSHA method, the EPA method assumes only solids become airborne in 10 minutes. Evaporation rates are calculated for liquids assuming they form a pool one cm (0.4 in) deep or fill in a diked area.

The differences in the results of the two methods is due primarily to either 1) the time during which the hazardous chemical is assumed to become entrained in the air or 2) whether the hazardous chemical is a liquid. If the hazardous chemical is a liquid, the OSHA method may result in either conservative or nonconservative concentrations. These differences are described in detail in later sections.

The EPA method was chosen by the ICPP because it was determined to best represent real conditions. However, the OSHA method has been used to compare the results of the two methods. This comparison of the results of the two methods is presented in section 4.

3.2.2 Superfund and Reauthorization Act Hazardous Chemical Identification

The ICPP currently tracks approximately 2000 chemicals on a computerized database known as Haz Track. These chemicals range from benign to lethal exposure effects to humans. About 250 of the 2000 chemicals have been classified (according to the SARA Title III list) as extremely hazardous, toxic, acute, and/or fire hazard. Consequences associated with these classifications are, in order of their severity, extremely hazardous, toxic, acute, and fire. Those chemicals that are classified as all four are considered to be the worst.

In an effort to present ICPP co-location chemical hazards, other criteria were used to reduce the 250 chemicals to a representative number. Those criteria are presented below.

- 1) Hazardous chemicals are compared to the EPA SARA Title III list and the Department of Labor OSHA 29 CFR part 1910 to determine that ICPP stores quantities of hazardous chemicals that are considered to have catastrophic consequences if they are released.
- 2) The EPA Technical Guidance for Hazards Analysis⁶ presents a method which is used on the remaining representative hazardous chemicals to determine whether their release could produce concentrations above applicable limits.
- 3) The remaining representative hazardous chemicals are then subjected to the EPA method (item 2) and recommended meteorology (Class D and 4.3 m/s (14.1 ft/s) wind speed) to further reduce the number of potentially hazardous chemicals.
- 4) Chemicals whose forms are readily mitigated by HEPA filtration or are stored in facilities with few or no leak paths to the environment have appropriately modified source terms (see section 4 for details). Liquid hazardous chemicals that can be spilled only within hoods or controlled areas have evaporation rates calculated based upon the surface area of the "dike."
- 5) Explosive gases and materials are handled separately and in accordance with 29 CFR part 1910, except when a potential explosion may lead to the release of radioactive materials to the environment. In the latter case, the EPA method is used and compared with the chemical Lower Explosive Limit (LEL) to determine if further evaluation is necessary.

WINCO and other Westinghouse-managed organizations are currently developing a system to determine hazard classes for nonradiological facilities. This system proposes varying groups of chemical exposure

limits, depending on the hazard classification. However, until this system is complete, the limits used in this analysis are discussed below and are the same as the current M & O effort. The term Threshold Limit Value (TLV) refers to limits from only one recognized and authoritative source; therefore, Occupational Exposure Limits (OELs) will be used as a generic reference to exposure limits that could come from various sources as discussed below.

OELs are obtained from three sources: 1) OSHA,⁷ 2) ACGIH,⁵ and 3) NIOSH.⁸ These sources are listed in order of their preference. Should a limit not be listed in the first, the second is consulted, and so forth. Limited data were derived from the last reference, as shown in appendix A. These limits help to determine whether a hazardous chemical is of concern. If a spilled hazardous chemical results in a concentration at 100 m (328 ft) over one-half of the limits presented in appendix A, it is retained for further evaluation. If the concentration is not over the limits in appendix B, the chemical is eliminated from further consideration.

3.2.3 Environmental Protection Agency Hazardous Chemical Screening - Stage 1

The first stage of hazardous chemical screening uses the EPA method and Class F meteorological conditions with a wind speed of 1.5 m/s (5.0 ft/s). Solid and gaseous hazardous chemicals stored in one area are assumed to become fully entrained in air in 10 minutes. Liquid hazardous chemicals are assumed to evaporate from a non-diked pool 1 cm (0.4 in) deep at 23.9 °C (75 °F). The rate of release is given by equation 1.

$$QR = QS \times (U^{0.78}) \times \left\{ \frac{0.106 \times MW^{2/3} \times VP \times 0.49}{82.05 \times (T1+273)} \right\} \quad 1)$$

where

QR = quantity release rate (lb/min)

U = wind speed (m/s)

MW = molecular Weight (g/g mole)

VP = vapor pressure (mm Hg)

T1 = temperature at which the chemical is stored (i.e., 23.9 °C)

This equation is used to determine the subsequent downwind concentration by use of equation 2.

where

$$C = \frac{QR'}{\pi \times U \times 0.6084 \times (F1 \times d \times (1 + F2 \times d)^{E1} \times (F3 \times d \times (1 + F4 \times d)^{E2}))} \quad 2)$$

C = airborne concentration (g/m³)

QR' = rate of release to the air (g/s)

U = wind speed (m/s)

d = distance downwind (10² < d < 10⁴ m)

If a solid or gas is of interest, QR' is found by dividing the total spilled amount by 10 (i.e., the total amount stored in one area becomes airborne in 10 minutes). It is also recommended that the horizontal dispersion factor be modified to adjust for the typical averaging factor of one hour. This corresponds to a Hanna correction factor of 0.6084. This adjustment is shown in the concentration equation. Note that the dimensions on the variables have changed.

Equation 2 is generic in nature, since it is used for two different types of meteorology (see also EPA method - stage 2). The values for the variables in the denominator are given in table 3-1. The appropriate values need only to be plugged into the above equation to proceed with hazardous chemical screening. Postulated hazardous chemical spills that are calculated to be less than one-half of the recommended OEL are eliminated from further evaluation, and the remainder are used in the next stages of evaluation. One-half of the OEL is used as the limit for elimination of chemicals, since one-half the OEL is the point at which some sort of mitigation action begins.

The release rate and concentration equations were developed based on the assumptions presented below:

Table 3-1. Meteorological Parameters

Open Country (Rural)						
Class	F1	F2	E1	F3	F4	E2
D	8E-2	1E-4	-5E-1	6E-2	1.5E-3	-5E-1
F	4E-2	1E-4	-5E-1	1.6E-2	3E-4	-1
Urban						
Class	F1	F2	E1	F3	F4	E2
D	1.6E-1	4E-4	-5E-1	1.4E-1	3E-4	-5E-1
F	1.1E-1	4E-4	-5E-1	8E-2	1.5E-4	-5E-1

- 1) The terrain is flat with no obstacles that would interfere with the downwind movement of the plume.
- 2) The release is at ground level.
- 3) The release is continuous (consistent with catastrophic loss) rather than a brief puff.
- 4) There is no phase change, and the plume is at ambient temperature (phase changes and temperature changes would cause variations in dispersion and evaporation (volatilization) rates).
- 5) The substance is neutrally buoyant in air. Dense gases are treated the same as neutrally buoyant gases. (The behavior of a dense gas is different.) The concentrations along the centerline of the plume are considered.
- 6) A Gaussian distribution of the plume's spread, in both horizontal and vertical planes, is assumed in the dispersion estimates and are for either rural or urban country, as discussed.

- 7) Powders and gases are released over a 10-minute period.
- 8) Liquids are instantaneously spilled from containment onto a flat, level surface forming a 1-cm (0.4-in) deep pool and are allowed to evaporate at ambient conditions (i.e., 23.9 °C or 75 °F).

The program written to perform the hazardous chemical screening evaluation more efficiently is presented in appendix A. This program was checked against hand calculations to verify that it produced reasonable results for all possible options. The comparison is provided in appendix A prior to the program listing.

3.2.4 Environmental Protection Agency Hazardous Chemical Screening - Stage 2

The EPA hazardous chemical screening, stage 2, uses the same program discussed in the previous section. The only difference is in the parameters chosen for the concentration calculation. For stage 2, recommended meteorology is used. That is, class D meteorological conditions with a wind speed of 4.3 m/s (14.1 ft/s) are assumed. These assumptions are consistent with emergency planning guidelines. Hazardous chemicals that are powders or gases are still assumed to become airborne in 10 minutes, while evaporation rates are calculated for liquids. Those chemicals producing concentrations above one-half the applicable limits then undergo source-term evaluation.

3.2.5 Source Term Evaluation

Chemicals remaining from stage 2 screening are evaluated according to their stored form and storage area. Source re-evaluation was deemed necessary since, in most cases, the entire stored amount of a particular chemical does not or cannot become completely airborne in 10 minutes. Therefore, the following logic was applied to hazardous chemicals that remain after stage 2 screening.

Hazardous chemicals are stored at the ICPP in their original shipping containers inside a structure. Some hazardous chemical storage facilities and areas provide good confinement, while others do not. Table 3-2 presents release fractions that will be applied to hazardous chemical stored amounts at various buildings or storage areas.

Table 3-2. Facility Release Fractions

Storage Area	Release Fraction
CPP-601	5.0 E-3
CPP-602	5.0 E-3
CPP-608	5.0 E-1
CPP-627	5.0 E-3
CPP-637	5.0 E-3
CPP-659	5.0 E-3
CPP-660	2.5 E-1
CPP-663	2.5 E-1
CPP-684	5.0 E-3
CPP-1631	2.5 E-1
TB-B	2.5 E-1
TB-11	2.5 E-1
TB-12	2.5 E-1
Outside	Varies

The release fractions listed in table 3-2 were estimated based on the following assumptions.

- 1) Hazardous chemicals stored in one location are assumed to become airborne in 10 minutes (for solids and gases) or their evaporation rates are calculated (for liquids).
- 2) Liquid hazardous chemicals are evaluated to determine whether a dike is present. If a dike is present, its surface area is used

in the calculation of evaporation rates. Otherwise, the entire amount is assumed to be spilled and to form a pool 1 cm (0.4 in) deep.

- 3) A release fraction of $5.0 \text{ E-}3 = 1 - 0.995$ is assumed where HEPA filtration is available. This release fraction takes credit for one roughing filter.
- 4) If the hazardous chemical is stored in a facility that has few direct and small leak paths to the environment (e.g., CPP-660), a release fraction of $2.5 \text{ E-}1$ is assumed. That is, 25% of the spill becomes airborne, and 100% of the airborne chemical leaks to the environment to be dispersed.
- 5) If the hazardous chemical is stored inside a facility that has direct and large leak paths to the environment (e.g., CPP-608), a release fraction of $5.0 \text{ E-}1$ is assumed. That is, 50% of the spill becomes airborne, and 100% of the airborne chemical leaks to the environment to be dispersed.
- 6) Hazardous chemicals stored outside are evaluated on a case-by-case basis. These chemicals are usually contained in vessels surrounded by dikes. If no dike exists, the entire tank is assumed to be spilled onto the ground, and no credit is taken for a smaller pool size. (No tank was found outside without a surrounding dike.)

As noted in assumption 5, the dike area is used instead of the assumption of a pool 1 cm (0.4 in) deep. However, as of yet, no method has been formulated to calculate the evaporation rate for diked spills. Equation 3 presents the method used by the EPA to calculate such an evaporation rate.

$$QR = \frac{\left\{ \frac{0.052 \times MW^{2/3} \times VP}{82.05 \times (T1 + 273)} \right\} \times Diked Area (ft^2) \times U^{0.78}}{0.49} \quad 3)$$

where

QR = quantity release rate (lb/min)

U = wind speed (m/s)

MW = molecular weight (g/g mole)

VP = vapor pressure (mm Hg)

T1 = temperature at which the chemical is stored (23.9 °C or 75 °F)

After the source terms or the dike areas have been adjusted, the hazardous chemicals are screened again using the same procedure as in EPA screening stage 2. Those chemicals which still remain are listed. These are the chemicals that may cause the worst on-site problems. New facilities, upgrades, and modifications should examine these potential nonradiological releases. In addition, new or larger amounts of chemicals evaluated in this report must be addressed separately or re-evaluated to ensure the results and conclusions presented in this report are still valid.

3.3 ICPP EXPLOSIVE CHEMICAL STUDY

The ICPP uses chemicals that are not necessarily interpreted to be toxic substances. Chemicals such as gasoline and propane are examples of those that do not have toxic effects at low levels. However, at the ICPP, an accidental release of chemicals such as these may not initially present a hazard to workers, but their ensuing ignition may create problems. For example, a propane tank leaks and forms an explosive cloud. The cloud may not be toxic, but should the cloud be ignited (the explosion damages containment), a release of radioactive materials may follow that, potentially, could be much worse. Potentially explosive chemicals are, therefore, treated separately and in accordance with

29 CFR 1910,⁹ as appropriate. These chemicals are evaluated in latter sections of this report by the method presented below.

20 CFR 1910 states that any flammable liquid or gas on-site in a single storage location, in a quantity of 4540 kg (10,000 lb) or more, must, except for hydrocarbon fuels, be used solely for work place consumption (e.g., propane for heating), if the fuels are not a part of a process containing another chemical covered by 29 CFR 1910. Based on this statement, the only potential flammable chemical needing evaluation would be kerosene (NWCF fuel). However, the above release from an explosion may have adverse effects on the environment and workers. Therefore, the more restrictive method described below is used.

Potentially flammable and explosive chemicals that need to be evaluated further are identified by a method similar to that for hazardous chemicals. Instead of comparing a concentration to its effect on humans, the concentration is compared to the chemical LEL, i.e., the lowest concentration at which the chemical will react violently with air (explode). Each chemical has different characteristics when it is consumed by violent reaction. Some produce large amounts of gases (pressure wave), and some produce sound pulses (sound wave). Therefore, the effects of explosions vary greatly from chemical to chemical and should be investigated individually, should a co-location issue arise.

Flammable or explosive chemicals are screened using the program discussed in appendix B and EPA screening stage 1 parameters. Chemicals remaining after stage 1 screening are screened again using stage 2 screening parameters. Should any chemicals remain after these two stages of screening, they are evaluated by source term as discussed. The remaining chemicals are those that may cause explosion co-location hazards.

4. ICPP CHEMICAL EVALUATION

The following sections apply the above method to determine which of the many chemicals at the ICPP require evaluation. Chemicals not discussed or evaluated in this analysis may be evaluated on a case-by-case basis using the same method.

4.1 ICPP HAZARDOUS CHEMICAL EVALUATION

Those hazardous chemicals that present the worst consequences are identified and presented below. Some chemicals are listed as explosive and toxic. Explosive and flammable chemicals are considered first by toxicity and then by flammability. All spills are initially assumed to be unconfined (i.e., no dike).

4.1.1 ICPP Hazardous Chemicals and Occupational Safety and Health Administration Screening and the Environmental Protection Agency Method

As discussed in prior sections, the OSHA method is less conservative than the EPA method. The results of the two methods are presented in table 4-1. The rate of release is presented along with the hazardous chemical vapor pressure. The difference between these two methods is due to one of two things, 1) the time allotted for a spill to become airborne or 2) the fact that the EPA method calculates the rate of evaporation for liquid spills.

Careful consideration of the results presented above can show that, in some cases, the OSHA method is both conservative and nonconservative compared to the method recommended by the EPA. Upon further evaluation, it becomes clear that the OSHA method becomes nonconservative when liquid chemicals have a high vapor pressure (evaporate quickly) and conservative when chemicals have a low vapor pressure (oils). Acetates tend to evaporate very quickly, which indicates that the assumption of total suspension in 10 minutes does not realistically model these cases (nonconservative). On the other hand, methyl isobutyl ketone has a very low vapor pressure and will not become airborne in 10 minutes. Thus, the

Table 4-1. OSHA and EPA Release Rates

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Chemical	OSHA (g/s)	Pool (g/s)	VP (mm Hg)
Acetic Acid Anhydride	2.8E-02	1.5E-01	1.1E+01
Acetic Acid, Glacial	1.7E-02	1.4E+00	1.1E+01
Acetonitrile (Explosive)	1.1E-02	4.3E-01	1.0E+02
Acetylene (Explosive)	7.2E-03	4.0E+00	0.0E+00
Aluminum Chloride - Hexahydrate	6.7E-02	1.4E-01	0.0E+00
Aluminum Fluoride - x-hydrate	4.1E-02	6.3E-01	0.0E+00
Aluminum Nitrate Nanohydrate	1.0E-01	3.7E+00	0.0E+00
Aluminum Nitrate	1.0E-01	2.1E+01	0.0E+00
Aluminum Oxide	2.8E-02	5.3E+00	0.0E+00
Aluminum Sulfate	9.5E-02	1.2E+01	0.0E+00
Ammonium Citrate - Dibasic	6.3E-02	4.7E-01	0.0E+00
Ammonium Fluoride	1.0E-02	2.5E+00	0.0E+00
Ammonium Hydroxide (Explosive)	9.7E-03	6.9E-01	4.8E+02
Ammonium Metavanadate	3.2E-02	5.5E-01	0.0E+00
Ammonium Nitrate	2.2E-02	2.6E+01	0.0E+00
Ammonium Persulfate	6.3E-02	1.4E-01	0.0E+00
Ammonium Sulfate	3.7E-02	6.9E-01	0.0E+00
Ammonium Sulfide	1.9E-02	9.1E+00	0.0E+00
Amyl Acetate (Explosive)	3.6E-02	2.8E-01	4.0E+00
Antimony	3.4E-02	1.3E+00	0.0E+00
Barium Hydroxide	8.8E-02	1.4E-01	0.0E+00
Barium Nitrate	6.0E-02	1.5E+01	0.0E+00
Benzene (IRC)	2.2E-02	1.1E+00	7.5E+01
Bismuth Nitrate	1.1E-01	1.0E+01	0.0E+00
Boric Acid	1.7E-02	3.7E+02	0.0E+00
Boron Trioxide	1.9E-02	3.9E-01	0.0E+00
Cadmium Nitrate Tetrahydrate	6.6E-02	2.1E+01	2.7E+01
Cadmium Oxide	3.6E-02	2.5E-01	0.0E+00
Cadmium Sulfate	5.8E-02	3.0E+00	2.7E+01
Cadmium	3.1E-02	5.7E+00	0.0E+00
Calcium Carbonate	2.8E-02	6.3E+00	0.0E+00
Calcium Hypochlorite	4.0E-02	1.3E+01	0.0E+00

Table 4-1. (Contd.) OSHA and EPA Release Rates Page 2 of 5

Chemical	OSHA (g/s)	Pool (g/s)	VP (mm Hg)
Calcium Nitrate Tetrahydrate	6.6E-02	5.4E+00	0.0E+00
Calcium Nitrate	4.6E-02	6.4E+00	0.0E+00
Calcium Sulfate	3.7E-02	2.3E+00	0.0E+00
Carbon Tetrachloride	4.3E-02	2.2E-01	1.0E+02
Carbon	3.3E-03	5.0E+00	0.0E+00
Cerium (III) Nitrate	1.2E-01	1.2E+01	0.0E+00
Cesium Carbonate	9.1E-02	5.2E+00	0.0E+00
Cesium Nitrate	5.4E-02	1.9E+00	0.0E+00
Chloroform	3.3E-02	6.9E-01	1.6E+02
Chromium (III) Nitrate	1.1E-01	2.0E+01	0.0E+00
Chromium Oxide	2.8E-02	2.9E+01	0.0E+00
Citric Acid	5.3E-02	1.2E+02	0.0E+00
Cobalt Nitrate	5.1E-02	7.5E+00	0.0E+00
Copper (II) Nitrate	5.2E-02	1.2E+01	0.0E+00
Copper	1.8E-02	4.2E-01	0.0E+00
Cyclohexanone (Explosive)	2.8E-02	2.6E-01	2.0E+00
Dichlorodifluoromethane	3.4E-02	3.7E+00	0.0E+00
Diesel (Explosive)	5.9E-02	2.1E+05	5.0E+00
Dodecane	4.7E-02	6.4E+02	5.0E-01
EDTA Tetra Sodium Salt Dihydrate	1.1E-01	1.2E+01	0.0E+00
Ethenediol	1.6E-02	2.8E-01	0.0E+00
Ethanol (Explosive)	1.3E-02	2.5E+00	5.9E+01
Ethanolamine	1.7E-02	5.5E-01	1.0E+00
Ethyl Acetate	2.4E-02	1.1E+00	9.0E+01
Fluoboric Acid	2.4E-02	3.2E+01	2.7E+01
Gadolinium Oxide	1.0E-01	1.6E+02	0.0E+00
Gasoline (Explosive)	3.2E-02	7.6E+02	5.0E+01
Glycerol	2.6E-02	1.4E+00	1.9E-01
Hexane (Explosive)	2.4E-02	1.1E+00	1.2E+02
Hydrochloric Acid	1.0E-02	4.9E+01	4.2E+01
Hydrofluoric Acid	5.6E-03	2.9E+02	1.3E+02
Hydrogen Peroxide	9.4E-03	6.0E-01	1.0E+01

Table 4-1. (Contd.) OSHA and EPA Release Rates Page 3 of 5

Chemical	OSHA (g/s)	Pool (g/s)	VP (mm Hg)
Hydrogen (Explosive)	5.6E-04	3.2E-01	0.0E+00
Hydroxylamine Hydrochloride	1.9E-02	1.2E+00	0.0E+00
Iron (II) Sulfamate	7.7E-02	2.3E+01	2.7E+01
Iron (III) Chloride	4.5E-02	2.0E-01	0.0E+00
Iron (III) Nitrate Nanohydrate	1.1E-01	5.6E-01	0.0E+00
Iron (III) Nitrate	6.7E-02	2.3E+01	0.0E+00
Iron (III) Oxide	4.4E-02	2.7E-01	0.0E+00
Iron	1.6E-02	6.1E+00	0.0E+00
Isoamyl Acetate	4.4E-02	2.4E-01	4.0E+00
Isobutyl Acetate (Explosive)	3.2E-02	8.5E-01	1.3E+01
Kerosene (Explosive)	5.9E-02	1.6E+04	5.0E+00
Lead Nitrate	9.2E-02	5.0E+00	0.0E+00
Lithium Nitrate	8.3E-03	1.4E-01	0.0E+00
Magnesium Chloride	2.6E-02	1.4E-01	0.0E+00
Magnesium Nitrate	6.1E-02	4.3E+01	0.0E+00
Magnesium Oxide	1.1E-02	2.8E-01	0.0E+00
Magnesium Perchlorate, Anhydrous	6.2E-02	2.1E-01	0.0E+00
Manganese (II) Nitrate x-hydrate	5.0E-02	6.0E+00	1.0E+00
Mercury	5.6E-02	1.4E+01	1.2E-03
Methanol (Explosive)	8.9E-03	3.5E+00	1.0E+02
Methyl Isobutyl Ketone (Explosive)	3.1E-02	3.8E+00	1.9E+01
Methylene Chloride	2.4E-02	1.1E+00	3.5E+02
Nickel Chloride	6.6E-02	2.5E-01	0.0E+00
Nickel	1.6E-02	2.5E-01	0.0E+00
Niobium (V) Oxide	7.4E-02	3.7E+00	0.0E+00
Niobium	2.6E-02	1.3E+01	0.0E+00
Nitric Acid - Fuming	1.8E-02	2.0E+00	4.5E+01
Nitric Acid	1.8E-02	4.0E+01	4.5E+01
Nitrogen	6.7E-03	5.0E+03	2.5E+01
Nitrous Oxide	1.2E-02	3.2E+00	0.0E+00
Oxalic Acid	2.5E-02	2.3E+02	0.0E+00

Table 4-1. (Contd.) OSHA and EPA Release Rates Page 4 of 5

Chemical	OSHA (g/s)	Pool (g/s)	VP (mm Hg)
Oxygen	8.9E-03	2.6E+04	0.0E+00
Perchloric Acid	2.8E-02	1.6E+00	5.0E-01
Periodic Acid	6.3E-02	1.4E-01	0.0E+00
Phosphoric Acid	2.7E-02	1.2E+00	1.0E-03
Potassium Dichromate	8.2E-02	2.5E-01	0.0E+00
Potassium Fluoride	1.6E-02	6.9E-01	0.0E+00
Potassium Hydroxide	1.6E-02	5.0E-01	0.0E+00
Potassium Iodide	4.6E-02	1.7E+00	0.0E+00
Potassium Nitrate	2.8E-02	2.7E+01	0.0E+00
Potassium Permanganate	4.4E-02	1.8E+00	0.0E+00
Potassium Peroxydisulfate	7.5E-02	9.3E-01	0.0E+00
Potassium Peroxymonosulfate	1.7E-01	1.7E-01	0.0E+00
Propane (Explosive)	1.2E-02	2.6E+00	2.1E+02
Propanol (Explosive)	1.6E-02	3.8E+00	1.5E+01
Silica Gel	1.7E-02	1.6E+00	0.0E+00
Silver Nitrate	4.7E-02	1.4E-01	0.0E+00
Sodium Acetate - Trihydrate	3.8E-02	3.3E+00	0.0E+00
Sodium Borate - Decahydrate	1.1E-01	3.9E-01	0.0E+00
Sodium Bromate	4.2E-02	2.5E-01	0.0E+00
Sodium Carbonate - Anhydrous	2.9E-02	4.3E+02	0.0E+00
Sodium Chloride	1.6E-02	6.3E-01	0.0E+00
Sodium Dichromate Dihydrate	8.3E-02	3.3E+00	0.0E+00
Sodium Hydrogen Sulfate Monohydrate	3.8E-02	2.8E-01	0.0E+00
Sodium Hydrogen Sulfate	3.3E-02	1.4E-01	0.0E+00
Sodium Hydrogen Sulfite	2.9E-02	2.5E-01	0.0E+00
Sodium Hydroxide	1.1E-02	5.2E+02	0.0E+00
Sodium Hypochlorite	2.9E-02	2.6E-01	1.8E+01
Sodium Nitrate	2.4E-02	8.5E-01	0.0E+00
Sodium Phosphate - Tribasic - 12-hydrate	1.1E-01	3.8E+00	0.0E+00
Sodium Sulfate	3.9E-02	4.2E-01	0.0E+00

Table 4-1. (Contd.) OSHA and EPA Release Rates Page 5 of 5

Chemical	OSHA (g/s)	Pool (g/s)	VP (mm Hg)
Sodium Sulfite - Anhydrous	3.5E-02	1.3E+01	0.0E+00
Sodium Tetraborate	5.6E-02	2.5E+00	0.0E+00
Strontium Nitrate	5.9E-02	2.8E-01	0.0E+00
Sucrose	9.5E-02	1.8E+01	0.0E+00
Sulfamic Acid	2.7E-02	1.0E+01	0.0E+00
Sulfur	7.1E-02	2.8E-01	0.0E+00
Sulfurous Acid	2.3E-02	7.1E-01	3.4E+01
Sulfuric Acid	2.7E-02	5.1E+00	1.0E-06
Tartaric Acid	4.2E-02	2.4E+02	0.0E+00
Tin (II) Fluoride	5.4E-02	1.4E-01	0.0E+00
Tin	3.3E-02	5.5E-01	0.0E+00
Titanium (IV) Oxide	2.2E-02	7.5E-01	0.0E+00
Titanium	1.3E-02	1.4E-01	0.0E+00
Toluene (Explosive)	2.6E-02	4.0E+00	2.8E+01
Tributyl Phosphate	1.0E-01	2.8E+02	1.4E+01
Trichloromethane	3.3E-02	1.1E+00	1.6E+02
Tungsten	5.1E-02	6.3E-01	0.0E+00
Urea	1.7E-02	9.4E-01	0.0E+00
Yttrium Nitrate Pentahydrate	1.0E-01	1.6E+00	0.0E+00
Zirconium Carbonate	4.6E-02	2.0E+01	0.0E+00
Zirconium Dioxide	3.4E-02	1.4E+01	0.0E+00
Zirconyl Nitrate	6.4E-02	1.5E+02	0.0E+00

EPA method for calculating evaporation rates was determined to be the most suitable for this analysis.

4.1.2 ICPP Hazardous Chemical Identification

The ICPP tracks over 2000 potentially hazardous chemicals on a computerized data base known as Haz Track. Of these 2000, about 250 have been classified based on the SARA title III classification codes. The classification codes were used as the initial starting point for this analysis. The 250 chemicals were chosen based on their toxicity and frequency of use.

The first criterion presented in section 3 was found to be of very limited value, because the minimum reportable quantities of hazardous chemicals is usually much larger than the quantities the ICPP holds in any given storage area. However, the elimination of most chemicals due to small quantities may not yield an accurate picture of the hazardous chemical postulated release with respect to co-located facilities. Therefore, hazardous chemicals stored in amounts of over 0.45 kg (1 lb) in a single storage location were held for further analysis. Chemicals that met the above criteria are listed in appendix A along with the necessary parameters to complete the ICPP chemical evaluation discussed below.

4.1.3 ICPP Hazardous Chemical Screening - Stage 1

The chemicals listed in appendix A were screened using the program listed in appendix B. The program in appendix B was checked against hand calculations to ensure that it yields reasonable results. The results of this comparison are documented in appendix B.

The following meteorological parameters were assumed and used in the program. Class F meteorology and a wind speed of 1.5 m/s (5.0 ft/s) were assumed to be the prevalent conditions during the postulated release. The total amount stored in one area is assumed to become fully airborne in 10 minutes, if the substance is a solid or gas. If the substance is liquid in nature, its evaporation rate is calculated as discussed in

prior sections. Table 4-2 lists chemicals listed in appendix A that were eliminated because their calculated concentration was one-half or less than the recommended OEL.

4.1.4 ICPP Hazardous Chemical Screening - Stage 2

ICPP hazardous chemical screening, stage 2, changes the meteorology to the recommended conditions. The stage 2 meteorological conditions are Class D and a wind speed of 4.3 m/s (14.1 ft/s). The program presented in appendix B is used to more efficiently process the large number of chemicals. Table 4-3 lists the chemicals remaining after stage 2 screening (i.e., appendix A chemicals not listed in table 4-2).

The chemicals eliminated by the recommended meteorological conditions are listed in table 4-4. Hazardous chemicals which need to be processed through the next phase of evaluation are listed in table 4-5. Many of these chemicals are not normally considered when chemicals are discussed. This is because of the well-known exotic acids that have been used at the ICPP. Many of the chemicals presented in table 4-5 could not be eliminated because of the assumption of 1 mg/m³.

4.1.5 ICPP Hazardous Chemical Source Term Evaluation

All of the above calculations are based on the assumption that the total amount of a hazardous chemical stored in one area is spilled and becomes airborne in 10 minutes. This assumption is re-evaluated in this section to ensure that it is reasonable.

Hazardous chemicals are stored at the ICPP in their original shipping containers, inside some structure. Some hazardous chemical storage facilities and areas are better equipped to handle confinement of materials than others. Table 3-2 presented the release fractions that were applied to hazardous chemical storage amounts at various buildings and storage areas. These release fractions are used for solids only. Gases are assumed to be total releases and become completely airborne in 10 minutes. Liquids are evaluated based on their storage locations.

Table 4-2. Hazardous Chemicals Eliminated by Stage 1

Chemical	Concen. (mg/m ³)	OEL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Acetic Acid Anhydride	3.6E-01	2.5E+02	1.19E+00	102.09	1.1E+01	LIQ	NO	0.00E+00
Acetic Acid, Glacial	2.3E+00	3.7E+01	1.10E+01	60.05	1.1E+01	LIQ	NO	0.00E+00
Acetonitrile (Explosive)	5.1E+00	7.0E+01	3.43E+00	41.05	1.0E+02	LIQ	NO	0.00E+00
Amyl Acetate (Explosive)	2.8E-01	6.5E+02	2.22E+00	130.21	4.0E+00	LIQ	NO	0.00E+00
Carbon Tetrachloride	6.3E+00	6.3E+01	1.75E+00	153.82	1.0E+02	LIQ	NO	0.00E+00
Cyclohexanone (Explosive)	1.1E-01	2.0E+02	2.09E+00	98.15	2.0E+00	LIQ	NO	0.00E+00
Dichlorodifluoromethane	1.2E+03	5.0E+03	2.91E+01	120.91	0.0E+00	GAS	NO	0.00E+00
Ethanol (Explosive)	1.8E+01	1.9E+03	1.96E+01	46.07	5.9E+01	LIQ	NO	0.00E+00
Ethanolamine	8.5E-02	8.0E+00	4.40E+00	61.00	1.0E+00	LIQ	NO	0.00E+00
Ethyl Acetate	1.8E+01	1.4E+03	8.33E+00	88.11	9.0E+01	LIQ	NO	0.00E+00
Glycerol	5.4E-02	1.0E+01	1.11E+01	92.10	1.9E-01	LIQ	NO	0.00E+00
Hexane (Explosive)	2.6E+01	1.8E+03	8.48E+00	86.18	1.2E+02	LIQ	NO	0.00E+00
Hydrogen Peroxide	6.3E-01	1.4E+00	4.77E+00	34.01	1.0E+01	LIQ	NO	0.00E+00
Hydrogen (Explosive)	1.1E+02	2.5E+03	2.50E+00	2.00	0.0E+00	GAS	NO	0.00E+00
Isoamyl Acetate	2.8E-01	5.3E+02	1.91E+00	130.19	4.0E+00	LIQ	NO	0.00E+00
Isobutyl Acetate (Explosive)	2.6E+00	7.0E+02	6.71E+00	116.16	1.3E+01	LIQ	NO	0.00E+00
Manganese (II) Nitrate x-hydrate	1.9E+00	5.0E+00	4.75E+01	178.95	1.0E+00	LIQ	NO	0.00E+00
Mercury	5.5E-03	1.0E-01	1.08E+02	200.61	1.2E-03	LIQ	NO	0.00E+00
Methanol (Explosive)	3.5E+01	3.3E+02	2.79E+01	32.04	1.0E+02	LIQ	NO	0.00E+00
Methyl Isobutyl Ketone (Explosive)	1.7E+01	4.1E+02	3.05E+01	110.16	1.9E+01	LIQ	NO	0.00E+00

Table 4-2. (Contd.) Hazardous Chemicals Eliminated by Stage 1

Chemical	Concen. (mg/m ³)	OEL (mg/m ³)	Amount (lb)	HW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Methylene Chloride	7.4E+01	5.0E+02	8.80E+00	85.00	3.5E+02	LIQ	NO	0.00E+00
Perchloric Acid	1.7E-01	7.0E+00	1.29E+01	100.46	5.0E-01	LIQ	NO	0.00E+00
Phosphoric Acid	2.5E-04	1.0E+00	9.47E+00	98.00	1.0E-03	LIQ	NO	0.00E+00
Propane (Explosive)	6.8E+01	1.8E+03	2.09E+01	44.10	2.1E+02	LIQ	NO	0.00E+00
Propanol (Explosive)	8.5E+00	5.0E+02	3.04E+01	58.00	1.5E+01	LIQ	NO	0.00E+00
Sodium Hypochlorite	1.0E+00	5.0E+00	2.06E+00	106.00	1.8E+01	LIQ	NO	0.00E+00
Sulfuric Acid	1.1E-06	1.0E+00	4.01E+01	98.08	1.0E-06	LIQ	NO	0.00E+00
Toluene (Explosive)	2.2E+01	7.5E+02	3.13E+01	92.14	2.8E+01	LIQ	NO	0.00E+00

Table 4-3. Stage 2 Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	PM	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Acetylene (Explosive)	2.7E+03	3.16E+01	26.02	0.0E+00	GAS	NO	0.00E+00
Aluminum Chloride - Hexahydrate	2.0E+00	1.10E+00	241.43	0.0E+00	SOL	NO	0.00E+00
Aluminum Fluoride - x-hydrate	2.0E+00	5.00E+00	147.03	0.0E+00	SOL	NO	0.00E+00
Aluminum Nitrate Nanohydrate	2.0E+00	2.97E+01	375.13	0.0E+00	SOL	NO	0.00E+00
Aluminum Nitrate	2.0E+00	1.66E+02	375.00	0.0E+00	SOL	NO	0.00E+00
Aluminum Oxide	1.0E+01	4.20E+01	101.94	0.0E+00	SOL	NO	0.00E+00
Aluminum Sulfate	2.0E+00	9.72E+01	342.14	0.0E+00	SOL	NO	0.00E+00
Ammonium Citrate - Dibasic	1.7E+01	3.75E+00	226.19	0.0E+00	SOL	NO	0.00E+00
Ammonium Fluoride	1.0E+01	1.98E+01	37.04	0.0E+00	SOL	NO	0.00E+00
Ammonium Hydroxide (Explosive)	2.4E+01	5.50E+00	35.05	4.8E+02	LIQ	NO	0.00E+00
Ammonium Metavanadate	1.7E+01	4.40E+00	116.99	0.0E+00	SOL	NO	0.00E+00
Ammonium Nitrate	1.5E+01	2.07E+02	80.04	0.0E+00	SOL	NO	0.00E+00
Ammonium Persulfate	1.0E+01	1.10E+00	228.20	0.0E+00	SOL	NO	0.00E+00
Ammonium Sulfate	2.4E+01	5.51E+00	132.14	0.0E+00	SOL	NO	0.00E+00
Ammonium Sulfide	1.0E+01	7.20E+01	68.14	0.0E+00	SOL	NO	0.00E+00
Antimony	5.0E-01	1.00E+01	121.75	0.0E+00	SOL	NO	0.00E+00
Barium Hydroxide	5.0E-01	1.10E+00	315.50	0.0E+00	SOL	NO	0.00E+00
Barium Nitrate	5.0E-01	1.21E+02	216.38	0.0E+00	SOL	NO	0.00E+00
Benzene (IRC)	3.2E+00	8.80E+00	78.00	7.5E+01	LIQ	NO	0.00E+00
Bismuth Nitrate	5.0E+00	8.19E+01	395.02	0.0E+00	SOL	NO	0.00E+00
Boric Acid	1.5E+01	2.90E+03	61.83	0.0E+00	SOL	NO	0.00E+00
Boron Trioxide	1.5E+01	3.10E+00	69.62	0.0E+00	SOL	NO	0.00E+00

Table 4-3. (Contd.) Stage 2 Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	MM	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Cadmium Nitrate Tetrahydrate	5.0E-02	1.67E+02	236.16	2.7E+01	LIQ	NO	0.00E+00
Cadmium Oxide	2.0E-01	1.96E+00	128.40	0.0E+00	SOL	NO	0.00E+00
Cadmium Sulfate	2.0E-01	2.39E+01	208.46	2.7E+01	LIQ	NO	0.00E+00
Cadmium	2.0E-01	4.50E+01	112.41	0.0E+00	SOL	NO	0.00E+00
Calcium Carbonate	5.0E+00	5.00E+01	100.09	0.0E+00	SOL	NO	0.00E+00
Calcium Hypochlorite	5.0E+00	9.91E+01	142.98	0.0E+00	SOL	NO	0.00E+00
Calcium Nitrate Tetrahydrate	5.0E+00	4.24E+01	308.47	0.0E+00	SOL	NO	0.00E+00
Calcium Nitrate	5.0E+00	5.06E+01	164.09	0.0E+00	SOL	NO	0.00E+00
Calcium Sulfate	5.0E+00	1.80E+01	132.14	0.0E+00	SOL	NO	0.00E+00
Carbon	3.5E+00	4.00E+01	12.01	0.0E+00	SOL	NO	0.00E+00
Cerium (III) Nitrate	1.0E+00	9.17E+01	434.23	0.0E+00	SOL	NO	0.00E+00
Cesium Carbonate	2.0E+00	4.12E+01	325.82	0.0E+00	SOL	NO	0.00E+00
Cesium Nitrate	2.0E+00	1.49E+01	194.92	0.0E+00	SOL	NO	0.00E+00
Chloroform	9.8E+00	5.50E+00	119.00	1.6E+02	LIQ	NO	0.00E+00
Chromium (III) Nitrate	5.0E-01	1.60E+02	400.15	0.0E+00	SOL	NO	0.00E+00
Chromium Oxide	5.0E-01	2.30E+02	99.99	0.0E+00	SOL	NO	0.00E+00
Citric Acid	1.0E+00	9.50E+02	192.12	0.0E+00	SOL	NO	0.00E+00
Cobalt Nitrate	5.0E-02	5.94E+01	182.96	0.0E+00	SOL	NO	0.00E+00
Copper (II) Nitrate	1.0E+00	9.36E+01	187.55	0.0E+00	SOL	NO	0.00E+00
Copper	1.0E+00	3.30E+00	63.55	0.0E+00	SOL	NO	0.00E+00
Diesel (Explosive)	3.7E+04	1.68E+06	212.18	5.0E+00	LIQ	NO	0.00E+00
Dodecane	1.0E+00	5.11E+03	170.34	5.0E-01	LIQ	NO	0.00E+00

Table 4-3. (Contd.) Stage 2 Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
EDTA Tetra Sodium Salt Dihydrate	5.0E+00	9.40E+01	394.22	0.0E+00	SOL	NO	0.00E+00
EthanedioI	6.0E+00	2.20E+00	62.07	0.0E+00	SOL	NO	0.00E+00
Fluoboric Acid	2.5E+00	2.55E+02	87.82	2.7E+01	LIQ	NO	0.00E+00
Gadolinium Oxide	1.0E+00	1.30E+03	362.50	0.0E+00	SOL	NO	0.00E+00
Gasoline (Explosive)	9.0E+02	6.05E+03	114.23	5.0E+01	LIQ	NO	0.00E+00
Hydrochloric Acid	7.0E+00	3.85E+02	36.46	4.2E+01	LIQ	NO	0.00E+00
Hydrofluoric Acid	2.5E+00	2.31E+03	20.01	1.3E+02	LIQ	NO	0.00E+00
Hydroxylamine Hydrochloride	7.5E+00	9.40E+00	69.49	0.0E+00	SOL	NO	0.00E+00
Iron (II) Sulfamate	1.0E+00	1.85E+02	246.80	2.7E+01	LIQ	NO	0.00E+00
Iron (III) Chloride	1.0E+00	1.56E+00	162.20	0.0E+00	SOL	NO	0.00E+00
Iron (III) Nitrate Nanohydrate	1.0E+00	4.41E+00	404.02	0.0E+00	SOL	NO	0.00E+00
Iron (III) Nitrate	1.0E+00	1.83E+02	241.87	0.0E+00	SOL	NO	0.00E+00
Iron (III) Oxide	1.0E+01	2.18E+00	159.69	0.0E+00	SOL	NO	0.00E+00
Iron	1.0E+00	4.87E+01	55.85	0.0E+00	SOL	NO	0.00E+00
Kerosene (Explosive)	1.0E+02	1.29E+05	212.18	5.0E+00	LIQ	NO	0.00E+00
Lead Nitrate	1.5E-01	3.99E+01	331.23	0.0E+00	SOL	NO	0.00E+00
Lithium Nitrate	2.5E-02	1.10E+00	68.95	0.0E+00	SOL	NO	0.00E+00
Magnesium Chloride	1.0E+01	1.10E+00	95.22	0.0E+00	SOL	NO	0.00E+00
Magnesium Nitrate	1.0E+01	3.40E+02	220.38	0.0E+00	SOL	NO	0.00E+00
Magnesium Oxide	1.5E+01	2.20E+00	40.31	0.0E+00	SOL	NO	0.00E+00
Magnesium Perchlorate Anhydrous	5.0E+00	1.70E+00	223.23	0.0E+00	SOL	NO	0.00E+00
Nickel Chloride	1.0E+00	2.00E+00	237.71	0.0E+00	SOL	NO	0.00E+00

Table 4-3. (Contd.) Stage 2 Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Nickel	1.0E+00	1.98E+00	58.70	0.0E+00	SOL	NO	0.00E+00
Niobium (V) Oxide	1.0E+00	2.95E+01	265.81	0.0E+00	SOL	NO	0.00E+00
Niobium	1.0E+00	1.01E+02	92.91	0.0E+00	SOL	NO	0.00E+00
Nitric Acid - Fuming	5.0E+00	1.62E+01	63.01	4.5E+01	LIQ	NO	0.00E+00
Nitric Acid	5.0E+00	3.14E+02	63.00	4.5E+01	LIQ	NO	0.00E+00
Nitrogen	3.4E+04	3.98E+04	28.00	2.5E+01	GAS	NO	0.00E+00
Nitrous Oxide	9.0E+01	2.56E+01	44.00	0.0E+00	GAS	NO	0.00E+00
Oxalic Acid	1.0E+00	1.80E+03	90.00	0.0E+00	SOL	NO	0.00E+00
Oxygen	5.2E+04	2.10E+05	32.00	0.0E+00	GAS	NO	0.00E+00
Periodic Acid	1.0E+00	1.10E+00	227.94	0.0E+00	SOL	NO	0.00E+00
Potassium Dichromate	2.0E+00	1.98E+00	294.19	0.0E+00	SOL	NO	0.00E+00
Potassium Fluoride	2.0E+00	5.50E+00	58.10	0.0E+00	SOL	NO	0.00E+00
Potassium Hydroxide	2.0E+00	3.96E+00	56.11	0.0E+00	SOL	NO	0.00E+00
Potassium Iodide	2.0E+00	1.32E+01	166.01	0.0E+00	SOL	NO	0.00E+00
Potassium Nitrate	2.0E+00	2.13E+02	101.11	0.0E+00	SOL	NO	0.00E+00
Potassium Permanganate	2.0E+00	1.40E+01	158.04	0.0E+00	SOL	NO	0.00E+00
Potassium Peroxydisulfate	2.0E+00	7.35E+00	270.33	0.0E+00	SOL	NO	0.00E+00
Potassium Peroxymonosulfate	2.0E+00	1.31E+00	614.78	0.0E+00	SOL	NO	0.00E+00
Silica Gel	1.0E+01	1.27E+01	60.09	0.0E+00	SOL	NO	0.00E+00
Silver Nitrate	1.0E-02	1.10E+00	169.87	0.0E+00	SOL	NO	0.00E+00
Sodium Acetate - Trihydrate	5.0E+00	2.65E+01	136.08	0.0E+00	SOL	NO	0.00E+00
Sodium Borate - Decahydrate	5.0E+00	3.10E+00	381.37	0.0E+00	SOL	NO	0.00E+00

Table 4-3. (Contd.) Stage 2 Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Sodium Bromate	1.0E+00	1.98E+00	150.90	0.0E+00	SOL	NO	0.00E+00
Sodium Carbonate - Anhydrous	5.0E+00	3.40E+03	105.99	0.0E+00	SOL	NO	0.00E+00
Sodium Chloride	5.0E+00	5.00E+00	58.44	0.0E+00	SOL	NO	0.00E+00
Sodium Dichromate Dihydrate	1.0E+01	2.64E+01	298.00	0.0E+00	SOL	NO	0.00E+00
Sodium Hydrogen Sulfate Monohydrate	1.0E+01	2.20E+00	138.07	0.0E+00	SOL	NO	0.00E+00
Sodium Hydrogen Sulfate	1.0E+01	1.10E+00	120.06	0.0E+00	SOL	NO	0.00E+00
Sodium Hydrogen Sulfite	1.0E+01	2.00E+00	104.06	0.0E+00	SOL	NO	0.00E+00
Sodium Hydroxide	2.0E+00	4.10E+03	40.00	0.0E+00	SOL	NO	0.00E+00
Sodium Nitrate	5.0E+00	6.72E+00	84.99	0.0E+00	SOL	NO	0.00E+00
Sodium Phosphate - Tribasic - 12-hydrate	5.0E+00	3.00E+01	380.12	0.0E+00	SOL	NO	0.00E+00
Sodium Sulfate	1.0E+01	3.30E+00	142.04	0.0E+00	SOL	NO	0.00E+00
Sodium Sulfite - Anhydrous	1.0E+01	1.00E+02	126.04	0.0E+00	SOL	NO	0.00E+00
Sodium Tetraborate	5.0E+00	2.00E+01	201.22	0.0E+00	SOL	NO	0.00E+00
Strontium Nitrate	1.0E+00	2.20E+00	211.63	0.0E+00	SOL	NO	0.00E+00
Sucrose	1.0E+01	1.39E+02	342.30	0.0E+00	SOL	NO	0.00E+00
Sulfamic Acid	1.0E+00	7.93E+01	97.16	0.0E+00	SOL	NO	0.00E+00
Sulfur	1.0E+01	2.20E+00	256.48	0.0E+00	SOL	NO	0.00E+00
Sulfurous Acid	1.0E+00	5.62E+00	82.08	3.4E+01	LIQ	NO	0.00E+00
Tartaric Acid	1.0E+00	1.90E+03	150.09	0.0E+00	SOL	NO	0.00E+00
Tin (II) Fluoride	2.0E+00	1.10E+00	156.69	0.0E+00	SOL	NO	0.00E+00
Tin	2.0E+00	4.40E+00	118.69	0.0E+00	SOL	NO	0.00E+00

Table 4-3. (Contd.) Stage 2 Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Titanium (IV) Oxide	1.5E+01	5.97E+00	79.90	0.0E+00	SOL	NO	0.00E+00
Titanium	1.0E+01	1.10E+00	47.90	0.0E+00	SOL	NO	0.00E+00
Tributyl Phosphate	2.2E+00	2.25E+03	266.32	1.4E+01	LIQ	NO	0.00E+00
Trichloroethane	9.8E+00	8.96E+00	119.38	1.6E+02	LIQ	NO	0.00E+00
Tungsten	1.0E+01	5.00E+00	183.85	0.0E+00	SOL	NO	0.00E+00
Urea	2.0E-01	7.49E+00	60.06	0.0E+00	SOL	NO	0.00E+00
Yttrium Nitrate Pentahydrate	1.0E+00	1.23E+01	365.00	0.0E+00	SOL	NO	0.00E+00
Zirconium Carbonate	5.0E+00	1.55E+02	431.68	0.0E+00	SOL	NO	0.00E+00
Zirconium Dioxide	5.0E+00	1.08E+02	123.22	0.0E+00	SOL	NO	0.00E+00
Zirconyl Nitrate	5.0E+00	1.15E+03	231.23	0.0E+00	SOL	NO	0.00E+00

Table 4-4. Hazardous Chemicals Eliminated by Stage 2

Chemical	Concen (mg/m ³)	REL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Acetylene (Explosive)	6.5E+01	2.7E+03	3.16E+01	26.02	0.0E+00	GAS	NO	0.00E+00
Ammonium Citrate - Dibasic	7.8E+00	1.7E+01	3.75E+00	226.19	0.0E+00	SOL	NO	0.00E+00
Ammonium Hydroxide (Explosive)	3.8E+00	2.4E+01	5.50E+00	35.05	4.8E+02	LIQ	NO	0.00E+00
Ammonium Persulfate	2.3E+00	1.0E+01	1.10E+00	228.20	0.0E+00	SOL	NO	0.00E+00
Ammonium Sulfate	1.1E+01	2.4E+01	5.51E+00	132.14	0.0E+00	SOL	NO	0.00E+00
Boron Trioxide	6.4E+00	1.5E+01	3.10E+00	69.62	0.0E+00	SOL	NO	0.00E+00
Chloroform	2.9E+00	9.8E+00	5.50E+00	119.00	1.6E+02	LIQ	NO	0.00E+00
Iron (III) Oxide	4.5E+00	1.0E+01	2.18E+00	159.69	0.0E+00	SOL	NO	0.00E+00
Magnesium Chloride	2.3E+00	1.0E+01	1.10E+00	95.22	0.0E+00	SOL	NO	0.00E+00
Magnesium Oxide	4.5E+00	1.5E+01	2.20E+00	40.31	0.0E+00	SOL	NO	0.00E+00
Nitric Acid - Fuming	1.6E+00	5.0E+00	1.62E+01	63.01	4.5E+01	LIQ	NO	0.00E+00
Sodium Hydrogen Sulfate Monohydrate	4.5E+00	1.0E+01	2.20E+00	138.07	0.0E+00	SOL	NO	0.00E+00
Sodium Hydrogen Sulfate	2.3E+00	1.0E+01	1.10E+00	120.06	0.0E+00	SOL	NO	0.00E+00
Sodium Hydrogen Sulfite	4.1E+00	1.0E+01	2.00E+00	104.06	0.0E+00	SOL	NO	0.00E+00
Sulfur	4.5E+00	1.0E+01	2.20E+00	256.48	0.0E+00	SOL	NO	0.00E+00
Titanium	2.3E+00	1.0E+01	1.10E+00	47.90	0.0E+00	SOL	NO	0.00E+00
Trichloromethane	4.8E+00	9.8E+00	8.96E+00	119.38	1.6E+02	LIQ	NO	0.00E+00

Table 4-5. Source Term Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	HM	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Aluminum Chloride - Hexahydrate	2.0E+00	1.10E+00	241.43	0.0E+00	SOL	NO	0.00E+00
Aluminum Fluoride - x-hydrate	2.0E+00	5.00E+00	147.03	0.0E+00	SOL	NO	0.00E+00
Aluminum Nitrate Nanohydrate	2.0E+00	2.97E+01	375.13	0.0E+00	SOL	NO	0.00E+00
Aluminum Nitrate	2.0E+00	1.66E+02	375.00	0.0E+00	SOL	NO	0.00E+00
Aluminum Oxide	1.0E+01	4.20E+01	101.94	0.0E+00	SOL	NO	0.00E+00
Aluminum Sulfate	2.0E+00	9.72E+01	342.14	0.0E+00	SOL	NO	0.00E+00
Ammonium Fluoride	1.0E+01	1.98E+01	37.04	0.0E+00	SOL	NO	0.00E+00
Ammonium Metavanadate	1.7E+01	4.40E+00	116.99	0.0E+00	SOL	NO	0.00E+00
Ammonium Nitrate	1.5E+01	2.07E+02	80.04	0.0E+00	SOL	NO	0.00E+00
Ammonium Sulfide	1.0E+01	7.20E+01	68.14	0.0E+00	SOL	NO	0.00E+00
Antimony	5.0E-01	1.00E+01	121.75	0.0E+00	SOL	NO	0.00E+00
Barium Hydroxide	5.0E-01	1.10E+00	315.50	0.0E+00	SOL	NO	0.00E+00
Barium Nitrate	5.0E-01	1.21E+02	216.38	0.0E+00	SOL	NO	0.00E+00
Benzene (IRC)	3.2E+00	8.80E+00	78.00	7.5E+01	LIQ	NO	0.00E+00
Bismuth Nitrate	5.0E+00	8.19E+01	395.02	0.0E+00	SOL	NO	0.00E+00
Boric Acid	1.5E+01	2.90E+03	61.83	0.0E+00	SOL	NO	0.00E+00
Cadmium Nitrate Tetrahydrate	5.0E-02	1.67E+02	308.47	2.7E+01	LIQ	NO	0.00E+00
Cadmium Oxide	2.0E-01	1.96E+00	128.40	0.0E+00	SOL	NO	0.00E+00
Cadmium Sulfate	2.0E-01	2.39E+01	208.46	2.7E+01	LIQ	NO	0.00E+00
Cadmium	2.0E-01	4.50E+01	112.41	0.0E+00	SOL	NO	0.00E+00
Calcium Carbonate	5.0E+00	5.00E+01	100.09	0.0E+00	SOL	NO	0.00E+00
Calcium Hypochlorite	5.0E+00	9.91E+01	142.98	0.0E+00	SOL	NO	0.00E+00

Table 4-5. (Contd.) Source Term Hazardous Chemicals

Chemical	OEI (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Calcium Nitrate Tetrahydrate	5.0E+00	4.24E+01	236.16	0.0E+00	SOL	NO	0.00E+00
Calcium Nitrate	5.0E+00	5.06E+01	164.09	0.0E+00	SOL	NO	0.00E+00
Calcium Sulfate	5.0E+00	1.80E+01	132.14	0.0E+00	SOL	NO	0.00E+00
Carbon	3.5E+00	4.00E+01	12.01	0.0E+00	SOL	NO	0.00E+00
Cerium (III) Nitrate	1.0E+00	9.17E+01	434.23	0.0E+00	SOL	NO	0.00E+00
Cesium Carbonate	2.0E+00	4.12E+01	325.82	0.0E+00	SOL	NO	0.00E+00
Cesium Nitrate	2.0E+00	1.49E+01	194.92	0.0E+00	SOL	NO	0.00E+00
Chromium (III) Nitrate	5.0E-01	1.60E+02	400.15	0.0E+00	SOL	NO	0.00E+00
Chromium Oxide	5.0E-01	2.30E+02	99.99	0.0E+00	SOL	NO	0.00E+00
Citric Acid	1.0E+00	9.50E+02	192.12	0.0E+00	SOL	NO	0.00E+00
Cobalt Nitrate	5.0E-02	5.94E+01	182.96	0.0E+00	SOL	NO	0.00E+00
Copper (II) Nitrate	1.0E+00	9.36E+01	187.55	0.0E+00	SOL	NO	0.00E+00
Copper	1.0E+00	3.30E+00	63.55	0.0E+00	SOL	NO	0.00E+00
Diesel (Explosive)	3.7E+04	1.68E+06	212.18	5.0E+00	LIQ	NO	0.00E+00
Dodecane	1.0E+00	5.11E+03	170.34	5.0E-01	LIQ	NO	0.00E+00
EDTA Tetra Sodium Salt Dihydrate	5.0E+00	9.40E+01	394.22	0.0E+00	SOL	NO	0.00E+00
Ethanediol	6.0E+00	2.20E+00	62.07	0.0E+00	SOL	NO	0.00E+00
Fluoboric Acid	2.5E+00	2.55E+02	87.82	2.7E+01	LIQ	NO	0.00E+00
Gadolinium Oxide	1.0E+00	1.30E+03	362.50	0.0E+00	SOL	NO	0.00E+00
Gasoline (Explosive)	9.0E+02	6.05E+03	114.23	5.0E+01	LIQ	NO	0.00E+00
Hydrochloric Acid	7.0E+00	3.85E+02	36.46	4.2E+01	LIQ	NO	0.00E+00
Hydrofluoric Acid	2.5E+00	2.31E+03	20.01	1.3E+02	LIQ	NO	0.00E+00

Table 4-5. (Contd.) Source Term Hazardous Chemicals

Chemical	OEI (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Hydroxylamine Hydrochloride	7.5E+00	9.40E+00	69.49	0.0E+00	SOL	NO	0.00E+00
Iron (II) Sulfamate	1.0E+00	1.85E+02	247.80	2.7E+01	LIQ	NO	0.00E+00
Iron (III) Chloride	1.0E+00	1.56E+00	162.20	0.0E+00	SOL	NO	0.00E+00
Iron (III) Nitrate Nanohydrate	1.0E+00	4.41E+00	404.02	0.0E+00	SOL	NO	0.00E+00
Iron (III) Nitrate	1.0E+00	1.83E+02	241.87	0.0E+00	SOL	NO	0.00E+00
Iron	1.0E+00	4.87E+01	55.85	0.0E+00	SOL	NO	0.00E+00
Kerosene (Explosive)	1.0E+02	1.29E+05	212.18	5.0E+00	LIQ	NO	0.00E+00
Lead Nitrate	1.5E-01	3.99E+01	331.23	0.0E+00	SOL	NO	0.00E+00
Lithium Nitrate	2.5E-02	1.10E+00	68.95	0.0E+00	SOL	NO	0.00E+00
Magnesium Nitrate	1.0E+01	3.40E+02	220.38	0.0E+00	SOL	NO	0.00E+00
Magnesium Perchlorate Anhydrous	5.0E+00	1.70E+00	223.23	0.0E+00	SOL	NO	0.00E+00
Nickel Chloride	1.0E+00	2.00E+00	237.71	0.0E+00	SOL	NO	0.00E+00
Nickel	1.0E+00	1.98E+00	58.70	0.0E+00	SOL	NO	0.00E+00
Niobium (V) Oxide	1.0E+00	2.95E+01	265.81	0.0E+00	SOL	NO	0.00E+00
Niobium	1.0E+00	1.01E+02	92.91	0.0E+00	SOL	NO	0.00E+00
Nitric Acid	5.0E+00	3.14E+02	63.00	4.5E+01	LIQ	NO	0.00E+00
Nitrogen	3.4E+04	3.98E+04	28.00	2.5E+01	GAS	NO	0.00E+00
Nitrous Oxide	9.0E+01	2.56E+01	44.00	0.0E+00	GAS	NO	0.00E+00
Oxalic Acid	1.0E+00	1.80E+03	90.00	0.0E+00	SOL	NO	0.00E+00
Oxygen	5.2E+04	2.10E+05	32.00	0.0E+00	GAS	NO	0.00E+00
Periodic Acid	1.0E+00	1.10E+00	227.94	0.0E+00	SOL	NO	0.00E+00
Potassium Dichromate	2.0E+00	1.98E+00	294.19	0.0E+00	SOL	NO	0.00E+00

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Table 4-5. (Contd.) Source Term Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	HM	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Potassium Fluoride	2.0E+00	5.50E+00	58.10	0.0E+00	SOL	NO	0.00E+00
Potassium Hydroxide	2.0E+00	3.96E+00	56.11	0.0E+00	SOL	NO	0.00E+00
Potassium Iodide	2.0E+00	1.32E+01	166.01	0.0E+00	SOL	NO	0.00E+00
Potassium Nitrate	2.0E+00	2.13E+02	101.11	0.0E+00	SOL	NO	0.00E+00
Potassium Permanganate	2.0E+00	1.40E+01	158.04	0.0E+00	SOL	NO	0.00E+00
Potassium Peroxydisulfate	2.0E+00	7.35E+00	270.33	0.0E+00	SOL	NO	0.00E+00
Potassium Peroxymonosulfate	2.0E+00	1.31E+00	614.78	0.0E+00	SOL	NO	0.00E+00
Silica Gel	1.0E+01	1.27E+01	60.09	0.0E+00	SOL	NO	0.00E+00
Silver Nitrate	1.0E-02	1.10E+00	169.87	0.0E+00	SOL	NO	0.00E+00
Sodium Acetate - Trihydrate	5.0E+00	2.65E+01	136.08	0.0E+00	SOL	NO	0.00E+00
Sodium Borate - Decahydrate	5.0E+00	3.10E+00	381.37	0.0E+00	SOL	NO	0.00E+00
Sodium Bromate	1.0E+00	1.98E+00	150.90	0.0E+00	SOL	NO	0.00E+00
Sodium Carbonate - Anhydrous	5.0E+00	3.40E+03	105.99	0.0E+00	SOL	NO	0.00E+00
Sodium Chloride	5.0E+00	5.00E+00	58.44	0.0E+00	SOL	NO	0.00E+00
Sodium Dichromate Dihydrate	1.0E+01	2.64E+01	298.00	0.0E+00	SOL	NO	0.00E+00
Sodium Hydroxide	2.0E+00	4.10E+03	40.00	0.0E+00	SOL	NO	0.00E+00
Sodium Nitrate	5.0E+00	6.72E+00	84.99	0.0E+00	SOL	NO	0.00E+00
Sodium Phosphate - Tribasic - 12 - hydrate	5.0E+00	3.00E+01	380.12	0.0E+00	SOL	NO	0.00E+00
Sodium Sulfate	1.0E+01	3.30E+00	142.04	0.0E+00	SOL	NO	0.00E+00
Sodium Sulfite - Anhydrous	1.0E+01	1.00E+02	126.04	0.0E+00	SOL	NO	0.00E+00
Sodium Tetraborate	5.0E+00	2.00E+01	201.22	0.0E+00	SOL	NO	0.00E+00

Table 4-5. (Contd.) Source Term Hazardous Chemicals

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Chemical	OEL (mg/m ³)	Amount (lb)	MI	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Strontium Nitrate	1.0E+00	2.20E+00	211.63	0.0E+00	SOL	NO	0.00E+00
Sucrose	1.0E+01	1.39E+02	342.30	0.0E+00	SOL	NO	0.00E+00
Sulfamic Acid	1.0E+00	7.93E+01	97.16	0.0E+00	SOL	NO	0.00E+00
Sulfurous Acid	1.0E+00	5.62E+00	82.08	3.4E+01	LIQ	NO	0.00E+00
Tartaric Acid	1.0E+00	1.90E+03	150.09	0.0E+00	SOL	NO	0.00E+00
Tin (II) Fluoride	2.0E+00	1.10E+00	156.69	0.0E+00	SOL	NO	0.00E+00
Tin	2.0E+00	4.40E+00	118.69	0.0E+00	SOL	NO	0.00E+00
Titanium (IV) Oxide	1.5E+01	5.97E+00	79.90	0.0E+00	SOL	NO	0.00E+00
Tributyl Phosphate	2.2E+00	2.25E+03	266.32	1.4E+01	LIQ	NO	0.00E+00
Tungsten	1.0E+01	5.00E+00	183.85	0.0E+00	SOL	NO	0.00E+00
Urea	2.0E-01	7.49E+00	60.06	0.0E+00	SOL	NO	0.00E+00
Yttrium Nitrate Pentahydrate	1.0E+00	1.23E+01	365.00	0.0E+00	SOL	NO	0.00E+00
Zirconium Carbonate	5.0E+00	1.55E+02	431.68	0.0E+00	SOL	NO	0.00E+00
Zirconium Dioxide	5.0E+00	1.08E+02	123.22	0.0E+00	SOL	NO	0.00E+00
Zirconyl Nitrate	5.0E+00	1.15E+03	231.23	0.0E+00	SOL	NO	0.00E+00

Those chemicals stored in laboratory facilities are assumed to generate a pool 0.9 m deep and 1.2 m wide (3 ft by 4 feet). These dimensions are roughly the size of a laboratory hood. No other adjustment is made for liquids.

The results of the above assumed release fractions and dike areas are presented in table 4-6. Table 4-6 lists the data used to evaluate those hazardous chemicals remaining after ICPP stage 2 screening. Some of the data has been left off the table since it has not changed and is presented in full in appendix A.

The chemicals that have been eliminated based on the source term adjustment just described are listed in table 4-7. Table 4-8 lists the chemicals that should be deemed of primary importance when performing safety analysis. The chemicals listed in table 4-8 present the most risk to ICPP on-site workers and, therefore, should be given careful consideration. However, should any new facilities or new chemicals be used, they must be evaluated on their own merits. The methodology presented should help analysts determine if any precautions need to be taken to ensure on-site worker safety.

All of the chemicals presented in appendix A were evaluated at the site boundary. None of the chemicals had concentrations above appropriate limits at the site boundary.

4.2 ICPP EXPLOSIVE CHEMICAL EVALUATION

As stated in previous sections, flammable or explosive chemicals were first evaluated based on their toxicity. In this section, those chemicals listed as flammable or explosive are evaluated to determine if, upon release, they can generate a flammable or explosive cloud. No distinction is made between flammable and explosive chemicals in this report. If a chemical can burn over a certain concentration, it was assumed to do so in a violent manner.

As previously discussed, the evaluation method is similar in nature to the hazardous chemicals, except the limit is the LEL. The following

Table 4-6. Source Term Adjusted Hazardous Chemicals

Chemical	QEL (mg/m ³)	Amount (lb)	Form	Storage Location	Dike Area (ft ²)
Aluminum Chloride - Hexahydrate	2	5.5 E-3	SOL	CPP-627	0
Aluminum Fluoride - x-hydrate	2	2.5 E-2	SOL	CPP-602	0
Aluminum Nitrate	2	41.5	SOL	TB-11	0
Aluminum Nitrate Nanohydrate	2	7.4	SOL	TB-11	0
Aluminum Oxide	10	21.0	SOL	CPP-608	0
Aluminum Sulfate	2	48.6	SOL	CPP-608	0
Ammonium Fluoride	10	9.9 E-2	SOL	CPP-637	0
Ammonium Metavanadate	17	2.2 E-2	SOL	CPP-637	0
Ammonium Nitrate	15	51.6	SOL	TB-11	0
Ammonium Sulfide	10	36.0	SOL	CPP-608	0
Antimony	0.5	5.0 E-2	SOL	CPP-637	0
Barium Hydroxide	0.5	5.5 E-3	SOL	CPP-637	0
Barium Nitrate	0.5	30.3	SOL	TB-11	0
Benzene	3.2	8.8	LIQ	IRC	0
Bismuth Nitrate	5	20.5	SOL	TB-11	0
Boric Acid	15	725.0	SOL	CPP-660	0
Cadmium	0.2	2.3 E-1	SOL	CPP-637	0
Cadmium Nitrate Tetrahydrate	5.0E-2	1.7 E+2	LIQ	CPP-637	0
Cadmium Oxide	0.2	1.0 E-2	SOL	CPP-637	0
Cadmium Sulfate	0.2	2.4 E+1	LIQ	CPP-637	12
Calcium Carbonate	5	2.5 E-1	SOL	CPP-637	0
Calcium Hypochlorite	5	24.8	SOL	CPP-663	0

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Table 4-6. (Contd.) Source Term Adjusted Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	Form	Storage Location	Bike Area (ft ²)
Calcium Nitrate	5	12.7	SOL	TB-B	0
Calcium Nitrate Tetrahydrate	5	10.6	SOL	TB-B	0
Calcium Sulfate	5	9.0 E-2	SOL	CPP-637	0
Carbon	3.5	20.0	SOL	CPP-608	0
Cerium (III) Nitrate	1	4.6 E-1	SOL	CPP-637	0
Cesium Carbonate	2	20.6	SOL	CPP-608	0
Cesium Nitrate	2	7.5 E-2	SOL	CPP-637	0
Chromium (III) Nitrate	0.5	40.0	SOL	TB-11	0
Chromium Oxide	0.5	55.5	SOL	TB-12	0
Citric Acid	1	237.5	SOL	CPP-660	0
Cobalt Nitrate	5.0E-2	14.9	SOL	TB-11	0
Copper (II) Nitrate	1	23.4	SOL	TB-11	0
Copper	1	8.3 E-1	SOL	TB-11	0
Diesel (Explosive)	37380	1.7E+6	LIQ	Outside	8.0E+4
Dodecane	1	5114.1	LIQ	CPP-660	0
EDTA Tetra Sodium Salt Dihydrate	5	4.7 E-1	SOL	CPP-601	0
Ethanedial	6	1.1 E-2	SOL	CPP-602	0
Fluoboric Acid	2.5	4.7	LIQ	CPP-660	0
Gadolinium Oxide	1	325.0	SOL	CPP-660	0
Gasoline (Explosive)	900	6050.00	LIQ	Outside	605
Hydrochloric Acid	7	385.0	LIQ	CPP-637	0
Hydrofluoric Acid	2.5	2308.8	LIQ	CPP-660	0

Table 4-6. (Contd.) Source Term Adjusted Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	Form	Storage Location	Dike Area (ft ²)
Hydroxylamine Hydrochloride	7.5	4.7 E-2	SOL	CPP-602	0
Iron (II) Sulfamate	1	184.6	LIQ	CPP-601	0
Iron (III) Nitrate	1	45.7	SOL	TB-11	0
Iron (III) Chloride	1	8.0 E-3	SOL	CPP-637	0
Iron (III) Nitrate Nanohydrate	1	2.2 E-2	SOL	CPP-602	0
Iron	1	24.4	SOL	CPP-608	0
Kerosene (Explosive)	100	1.3E+5	LIQ	Outside	3.5E+4
Lead Nitrate	0.15	10.0	SOL	TB-11	0
Lithium Nitrate	2.5E-2	6.0 E-3	SOL	CPP-637	0
Magnesium Nitrate	10	85.0	SOL	TB-11	0
Magnesium Perchlorate Anhydrous	5	9.0 E-3	SOL	CPP-602	0
Nickel Chloride	1	5.0 E-1	SOL	CPP-1631	0
Nickel	1	1.0 E-2	SOL	CPP-602	0
Niobium (V) Oxide	1	14.8	SOL	CPP-608	0
Niobium	1	50.5	SOL	CPP-608	0
Nitric Acid	5	313.9	LIQ	CPP-637	0
Nitrogen	34350	39795	GAS	Outside	0
Nitrous Oxide	90	25.59	GAS	CPP-684	0
Oxalic Acid	1	450.0	SOL	CPP-660	0
Oxygen	5.2E+4	2.1 E+5	GAS	Outside	0
Periodic Acid	1	5.5 E-3	SOL	CPP-602	0
Potassium Dichromate	2	1.0 E-2	SOL	CPP-602	0

CHEM-TAB.WPD/ABM/OSA

Table 4-6. (Contd.) Source Term Adjusted Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	Form	Storage Location	Dike Area (ft ²)
Potassium Fluoride	2	2.8 E-2	SOL	CPP-602	0
Potassium Hydroxide	2	2.0 E-2	SOL	CPP-602	0
Potassium Iodide	2	3.3	SOL	CPP-663	0
Potassium Nitrate	2	53.4	SOL	'B-11	0
Potassium Permanganate	2	7.0 E-2	SOL	CPP-601	0
Potassium Peroxydisulfate	2	3.7 E-2	SOL	CPP-602	0
Potassium Peroxymonosulfate	2	7.0 E-3	SOL	CPP-637	0
Silica Gel	10	6.4 E-2	SOL	CPP-637	0
Silver Nitrate	1.0E-3	5.5 E-3	SOL	CPP-637	0
Sodium Acetate - Trihydrate	5	13.2	SOL	CPP-608	0
Sodium Borate - Decahydrate	5	1.6 E-2	SOL	CPP-602	0
Sodium Bromate	1	1.0 E-2	SOL	CPP-602	0
Sodium Carbonate - Anhydrous	5	850.0	SOL	CPP-660	0
Sodium Chloride	5	2.5	SOL	CPP-608	0
Sodium Dichromate Dihydrate	10	1.3 E-1	SOL	CPP-627	0
Sodium Hydroxide	2	1025.0	SOL	CPP-660	0
Sodium Nitrate	5	3.0 E-2	SOL	CPP-637	0
Sodium Phosphate - Tribasic - 12-hydrate	5	1.5 E-1	SOL	CPP-601	0
Sodium Sulfate	10	1.7 E-2	SOL	CPP-602	0
Sodium Sulfite - Anhydrous	10	5.0 E-1	SOL	CPP-602	0
Sodium Tetraborate	5	1.0 E-1	SOL	CPP-602	0
Strontium Nitrate	1	1.1 E-2	SOL	CPP-637	0

Table 4-6. (Contd.) Source Term Adjusted Hazardous Chemicals

Chemical	OEL (mg/m ³)	Amount (lb)	Form	Storage Location	Dike Area (ft ²)
Sucrose	10	69.6	SOL	CPP-608	0
Sulfamic Acid	1	4.0 E-1	SOL	CPP-659	0
Sulfurous Acid	1	5.6	LIQ	CPP-637	12
Tartaric Acid	1	475.0	SOL	CPP-660	0
Tin (II) Fluoride	2	6.0 E-3	SOL	CPP-637	0
Tin	2	2.2 E-2	SOL	CPP-637	0
Titanium (IV) Oxide	15	3.0 E-2	SOL	CPP-637	0
Tributyl Phosphate	2.2	2250.0	LIQ	CPP-660	0
Tungsten	10	2.5 E-2	SOL	CPP-602	0
Urea	0.2	3.7 E-2	SOL	CPP-637	0
Yttrium Nitrate Pentahydrate	1	6.2 E-2	SOL	CPP-637	0
Zirconium Carbonate	5	77.5	SOL	CPP-608	0
Zirconium Dioxide	5	54.0	SOL	CPP-608	0
Zirconyl Nitrate	5	288.0	SOL	TB-11	0

Table 4-7. Hazardous Chemicals Eliminated by Source Term Evaluation

Chemical	Concen. (mg/m ³)	OEL (mg/m ³)	Amount (lb)	HW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Aluminum Chloride - Hexahydrate	1.1E-02	2.0E+00	5.50E-03	241.43	0.0E+00	SOL	NO	0.00E+00
Aluminum Fluoride - x-hydrate	5.2E-02	2.0E+00	2.50E-02	147.03	0.0E+00	SOL	NO	0.00E+00
Ammonium Fluoride	2.0E-01	1.0E+01	9.90E-02	37.04	0.0E+00	SOL	NO	0.00E+00
Ammonium Metavanadate	4.5E-02	1.7E+01	2.20E-02	116.99	0.0E+00	SOL	NO	0.00E+00
Antimony	1.0E-01	5.0E-01	5.00E-02	121.75	0.0E+00	SOL	NO	0.00E+00
Barium Hydroxide	1.1E-02	5.0E-01	5.50E-03	315.50	0.0E+00	SOL	NO	0.00E+00
Cadmium Oxide	2.1E-02	2.0E-01	1.0E-02	128.40	0.0E+00	SOL	NO	0.00E+00
Calcium Carbonate	5.2E-01	5.0E+00	2.50E-01	100.09	0.0E+00	SOL	NO	0.00E+00
Calcium Sulfate	1.9E-01	5.0E+00	9.00E-02	132.14	0.0E+00	SOL	NO	0.00E+00
Cesium Nitrate	1.6E-01	2.0E+00	7.50E-02	194.92	0.0E+00	SOL	NO	0.00E+00
Diesel	4.0E+03	3.7E+04	1.68E+06	212.18	5.0E+00	LIQ	YES	8.00E+04
EDTA Tetra Sodium Salt Dihydrate	9.7E-01	5.0E+00	4.70E-01	394.22	0.0E+00	SOL	NO	0.00E+00
Ethanedio	2.3E-02	6.0E+00	1.10E-02	62.07	0.0E+00	SOL	NO	0.00E+00
Gasoline	2.0E+02	9.0E+02	6.05E+03	114.23	5.0E+01	LIQ	YES	6.05E+02
Hydroxylamine Hydrochloride	9.7E-02	7.5E+00	4.70E-02	69.49	0.0E+00	SOL	NO	0.00E+00
Iron (III) Chloride	1.7E-02	1.0E+00	8.00E-03	162.20	0.0E+00	SOL	NO	0.00E+00
Iron (III) Nitrate Nanohydrate	4.5E-02	1.0E+00	2.20E-02	404.02	0.0E+00	SOL	NO	0.00E+00
Lithium Nitrate	1.2E-02	2.5E-02	6.00E-03	68.95	0.0E+00	SOL	NO	0.00E+00
Magnesium Perchlorate Anhydrous	1.9E-02	5.0E+00	9.00E-03	223.23	0.0E+00	SOL	NO	0.00E+00
Nickel	2.1E-02	1.0E+00	1.0E-02	58.70	0.0E+00	SOL	NO	0.00E+00
Periodic Acid	1.1E-02	1.0E+00	5.50E-03	227.94	0.0E+00	SOL	NO	0.00E+00
Potassium Dichromate	2.1E-02	2.0E+00	1.0E-02	294.19	0.0E+00	SOL	NO	0.00E+00

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Table 4-7. (Contd.) Hazardous Chemicals Eliminated by Source Term Evaluation

Chemical	Concn. (mg/m ³)	OEL (mg/m ³)	Amount (lb)	HM	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Potassium Fluoride	5.8E-02	2.0E+00	2.80E-02	58.10	0.0E+00	SOL	NO	0.00E+00
Potassium Hydroxide	4.1E-02	2.0E+00	2.00E-02	56.11	0.0E+00	SOL	NO	0.00E+00
Potassium Permanganate	1.4E-01	2.0E+00	7.00E-02	158.04	0.0E+00	SOL	NO	0.00E+00
Potassium Peroxydisulfate	7.6E-02	2.0E+00	3.70E-02	279.33	0.0E+00	SOL	NO	0.00E+00
Potassium Peroxymonosulfate	1.4E-02	2.0E+00	7.00E-03	614.78	0.0E+00	SOL	NO	0.00E+00
Silica Gel	1.3E-01	1.0E+01	6.40E-02	60.09	0.0E+00	SOL	NO	0.00E+00
Sodium Borate - Decahydrate	3.3E-02	5.0E+00	1.60E-02	381.37	0.0E+00	SOL	NO	0.00E+00
Sodium Bromate	2.1E-02	1.0E+00	1.0E-02	150.90	0.0E+00	SOL	NO	0.00E+00
Sodium Dichromate Dihydrate	2.7E-01	1.0E+01	1.30E-01	298.00	0.0E+00	SOL	NO	0.00E+00
Sodium Nitrate	6.2E-02	5.0E+00	3.00E-02	84.99	0.0E+00	SOL	NO	0.00E+00
Sodium Phosphate - Tribasic - 12-hydrate	3.1E-01	5.0E+00	1.50E-01	380.12	0.0E+00	SOL	NO	0.00E+00
Sodium Sulfate	3.5E-02	1.0E+01	1.70E-02	142.04	0.0E+00	SOL	NO	0.00E+00
Sodium Sulfite - Anhydrous	1.0E+00	1.0E+01	5.00E-01	126.04	0.0E+00	SOL	NO	0.00E+00
Sodium Tetraborate	2.1E-01	5.0E+00	1.00E-01	201.22	0.0E+00	SOL	NO	0.00E+00
Strontium Nitrate	2.3E-02	1.0E+00	1.10E-02	211.63	0.0E+00	SOL	NO	0.00E+00
Tin (II) Fluoride	1.2E-02	2.0E+00	6.00E-03	156.69	0.0E+00	SOL	NO	0.00E+00
Tin	4.5E-02	2.0E+00	2.20E-02	118.69	0.0E+00	SOL	NO	0.00E+00
Titanium (IV) Oxide	6.2E-02	1.5E+01	3.00E-02	79.90	0.0E+00	SOL	NO	0.00E+00
Tungsten	5.2E-02	1.0E+01	2.50E-02	183.85	0.0E+00	SOL	NO	0.00E+00
Urea	7.6E-02	2.0E-01	3.70E-02	60.06	0.0E+00	SOL	NO	0.00E+00
Yttrium Nitrate Pentahydrate	1.3E-01	1.0E+00	6.20E-02	365.00	0.0E+00	SOL	NO	0.00E+00

Table 4-8. Chemicals Hazardous to On-Site Workers

Chemical	Concen. (mg/m ³)	OEL (mg/m ³)	Amount (lb)	MM	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Aluminum Nitrate Nanohydrate	1.5E+01	2.0E+00	7.40E+00	375.13	0.0E+00	SOL	NO	0.00E+00
Aluminum Nitrate	8.6E+01	2.0E+00	4.15E+01	375.00	0.0E+00	SOL	NO	0.00E+00
Aluminum Oxide	4.3E+01	1.0E+01	2.10E+01	101.94	0.0E+00	SOL	NO	0.00E+00
Aluminum Sulfate	1.0E+02	2.0E+00	4.86E+01	342.14	0.0E+00	SOL	NO	0.00E+00
Ammonium Nitrate	1.1E+02	1.5E+01	5.16E+01	80.04	0.0E+00	SOL	NO	0.00E+00
Ammonium Sulfide	7.4E+01	1.0E+01	3.60E+01	68.14	0.0E+00	SOL	NO	0.00E+00
Barium Nitrate	6.3E+01	5.0E-01	3.03E+01	216.38	0.0E+00	SOL	NO	0.00E+00
Benzene (IRC)	1.7E+00	3.2E+00	8.80E+00	78.00	7.5E+01	LIQ	NO	0.00E+00
Bismuth Nitrate	4.2E+01	5.0E+00	2.05E+01	395.02	0.0E+00	SOL	NO	0.00E+00
Boric Acid	1.5E+03	1.5E+01	7.25E+02	61.83	0.0E+00	SOL	NO	0.00E+00
Cadmium Nitrate Tetrahydrate	2.8E+01	5.0E-02	1.67E+01	308.47	2.7E+01	LIQ	NO	0.00E+00
Cadmium Sulfate	3.1E+00	2.0E-01	2.39E+01	208.46	2.7E+01	LIQ	YES	1.20E+01
Cadmium	4.8E-01	2.0E-01	2.30E-01	112.41	0.0E+00	SOL	NO	0.00E+00
Calcium Hypochlorite	5.1E+01	5.0E+00	2.48E+01	142.98	0.0E+00	SOL	NO	0.00E+00
Calcium Nitrate Tetrahydrate	2.2E+01	5.0E+00	1.06E+01	236.16	0.0E+00	SOL	NO	0.00E+00
Calcium Nitrate	2.6E+01	5.0E+00	1.27E+01	164.09	0.0E+00	SOL	NO	0.00E+00
Carbon	4.1E+01	3.5E+00	2.00E+01	12.01	0.0E+00	SOL	NO	0.00E+00
Cerium (III) Nitrate	9.5E-01	1.0E+00	4.60E-01	434.23	0.0E+00	SOL	NO	0.00E+00
Cesium Carbonate	4.3E+01	2.0E+00	2.06E+01	325.82	0.0E+00	SOL	NO	0.00E+00
Chromium (III) Nitrate	8.3E+01	5.0E-01	4.00E+01	400.15	0.0E+00	SOL	NO	0.00E+00
Chromium Oxide	1.1E+02	5.0E-01	5.55E+01	99.99	0.0E+00	SOL	NO	0.00E+00
Citric Acid	4.9E+02	1.0E+00	2.38E+02	192.12	0.0E+00	SOL	NO	0.00E+00

Table 4-8. (Contd.) Chemicals Hazardous to On-Site Workers

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Chemical	Concen. (mg/m ³)	REL (mg/m ³)	Amount (lb)	PM	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Aluminum Nitrate Nanohydrate	1.5E+01	2.0E+00	7.40E+00	375.13	0.0E+00	SOL	NO	0.00E+00
Cobalt Nitrate	3.1E+01	5.0E-02	1.49E+01	182.96	0.0E+00	SOL	NO	0.00E+00
Copper (II) Nitrate	4.8E+01	1.0E+00	2.34E+01	187.55	0.0E+00	SOL	NO	0.00E+00
Copper	1.7E+00	1.0E+00	8.30E-01	63.55	0.0E+00	SOL	NO	0.00E+00
Dodecane	1.1E+01	1.0E+00	5.11E+03	170.34	5.0E-01	LIQ	NO	0.00E+00
Fluoboric Acid	1.8E+01	2.5E+00	2.54E+02	87.82	2.7E+01	LIQ	NO	0.00E+00
Gadolinium Oxide	6.7E+02	1.0E+00	3.25E+02	362.50	0.0E+00	SOL	NO	0.00E+00
Hydrochloric Acid	2.4E+01	7.0E+00	3.85E+02	36.46	4.2E+01	LIQ	NO	0.00E+00
Hydrofluoric Acid	2.9E+02	2.5E+00	2.31E+03	20.01	1.3E+02	LIQ	NO	0.00E+00
Iron (II) Sulfamate	2.7E+01	1.0E+00	1.85E+02	247.80	2.7E+01	LIQ	NO	0.00E+00
Iron (III) Nitrate	9.4E+01	1.0E+00	4.57E+01	241.87	0.0E+00	SOL	NO	0.00E+00
Iron	5.0E+01	1.0E+00	2.44E+01	55.85	0.0E+00	SOL	NO	0.00E+00
Kerosene (Explosive)	1.7E+03	1.0E+02	1.29E+05	212.18	5.0E+00	LIQ	YES	3.50E+04
Lead Nitrate	2.1E+01	1.5E-01	1.00E+01	331.23	0.0E+00	SOL	NO	0.00E+00
Magnesium Nitrate	1.8E+02	1.0E+01	8.50E+01	220.38	0.0E+00	SOL	NO	0.00E+00
Nickel Chloride	1.0E+00	1.0E+00	5.00E-01	237.71	0.0E+00	SOL	NO	0.00E+00
Niobium (V) Oxide	3.1E+01	1.0E+00	1.48E+01	265.81	0.0E+00	SOL	NO	0.00E+00
Niobium	1.0E+02	1.0E+00	5.05E+01	92.91	0.0E+00	SOL	NO	0.00E+00
Nitric Acid	3.1E+01	5.0E+00	3.14E+02	63.00	4.5E+01	LIQ	NO	0.00E+00
Nitrogen	8.2E+04	3.4E+04	3.98E+04	28.00	2.5E+01	GAS	NO	0.00E+00
Nitrous Oxide	5.3E+01	9.0E+01	2.56E+01	44.00	0.0E+00	GAS	NO	0.00E+00
Oxalic Acid	9.3E+02	1.0E+00	4.50E+02	90.00	0.0E+00	SOL	NO	0.00E+00

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Table 4-8. (Contd.) Chemicals Hazardous to On-Site Workers

Chemical	Concen. (mg/m ³)	OEL (mg/m ³)	Amount (lb)	MW	VP (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Aluminum Nitrate Nanohydrate	1.5E+01	2.0E+00	7.40E+00	375.13	0.0E+00	SOL	NO	0.00E+00
Oxygen	4.3E+05	5.2E+04	2.10E+05	32.00	0.0E+00	GAS	NO	0.00E+00
Potassium Iodide	6.8E+00	2.0E+00	3.30E+00	166.01	0.0E+00	SOL	NO	0.00E+00
Potassium Nitrate	1.1E+02	2.0E+00	5.34E+01	101.11	0.0E+00	SOL	NO	0.00E+00
Silver Nitrate	1.1E-02	1.0E-02	5.50E-03	169.87	0.0E+00	SOL	NO	0.00E+00
Sodium Acetate - Trihydrate	2.7E+01	5.0E+00	1.32E+01	136.08	0.0E+00	SOL	NO	0.00E+00
Sodium Carbonate - Anhydrous	1.8E+03	5.0E+00	8.50E+02	105.99	0.0E+00	SOL	NO	0.00E+00
Sodium Chloride	5.2E+00	5.0E+00	2.50E+00	58.44	0.0E+00	SOL	NO	0.00E+00
Sodium Hydroxide	2.1E+03	2.0E+00	1.03E+03	40.00	0.0E+00	SOL	NO	0.00E+00
Sucrose	1.4E+02	1.0E+01	6.96E+01	342.30	0.0E+00	SOL	NO	0.00E+00
Sulfamic Acid	8.3E-01	1.0E+00	4.00E-01	97.16	0.0E+00	SOL	NO	0.00E+00
Sulfurous Acid	2.2E+00	1.0E+00	5.60E+00	82.08	3.4E+01	LIQ	YES	1.20E+01
Tartaric Acid	9.8E+02	1.0E+00	4.75E+02	150.09	0.0E+00	SOL	NO	0.00E+00
Tributyl Phosphate	1.8E+02	2.2E+00	2.25E+03	266.32	1.4E+01	LIQ	NO	0.00E+00
Zirconium Carbonate	1.6E+02	5.0E+00	7.75E+01	431.68	0.0E+00	SOL	NO	0.00E+00
Zirconium Dioxide	1.1E+02	5.0E+00	5.40E+01	123.22	0.0E+00	SOL	NO	0.00E+00
Zirconyl Nitrate	6.0E+02	5.0E+00	2.88E+02	231.23	0.0E+00	SOL	NO	0.00E+00

paragraph describes the logic which lead to the choice of the LEL instead of the upper explosive limit (UEL) for comparison.

First, the mechanism of release was examined. It was assumed that a tank leaks or undergoes catastrophic failure. The gas or liquid is initially at its stored concentration, which is normally much higher than the UEL. Upon release, the chemical is dispersed by atmospheric conditions and concentration gradients. The chemical is initially at a concentration much higher than the UEL. Shortly after the release, the chemical cloud begins to dissipate and eventually reaches the UEL. At some point in time and distance from the release, its concentration will decrease to less than the LEL.

Regardless of the type of release, the concentration near the spill or leak would be very near or greater than the UEL. The volume of gases near the UEL would be small and would probably cause little damage. Therefore, because of the small amount of damage expected and the fact that every explosive substance release would be at or above the UEL at some distance (normally close to the release point), the UEL was not used. The LEL, on the other hand, requires more dilution and, therefore, a larger volume is involved. This large volume could produce catastrophic damage to a co-located facility, even though the energy output at the LEL concentration is low compared to the UEL.

Therefore, the LEL is used as the limit below which no explosion is possible. Table 4-9 presents those chemicals, their LELs, UELs, and concentrations at 100 m (328 ft) in terms of mg/m^3 .

New calculations are not required, since only the limit used for comparison is changed. Therefore, previous calculations were used and compared to the LELs. All the chemicals listed in table 4-9 are below the LEL at 100 m (328 ft) from the release as shown, except for diesel fuel. However, diesel fuel drops below the LEL at 100 m (328 ft) when recommended meteorology and the containment dike are considered.

Table 4-9. ICPP Flammable and Explosive Chemicals

Chemical	LEL (mg/m ³)	UEL (mg/m ³)	Concen. (mg/m ³)
Acetonitrile	7.39E+4	2.69E+5	5.1E+0
Acetylene	3.19E+4	6.92E+5	1.3E+3
Ammonium Hydroxide	2.29E+5	3.87E+5	3.5E+1
Amyl Acetate	> 5.33E+4		2.8E-1
Cyclohexanone	4.51E+4	3.32E+5	1.1E-1
Diesel	2.80E+4	3.5E+5	4.0E+3
Ethanol	6.22E+4	3.58E+5	1.8E+1
Gasoline	6.54E+4	3.55E+5	8.9E+3
Hexane	4.23E+4	2.64E+5	2.6E+1
Hydrogen	3.27E+3	6.13E+4	1.1E+2
Isobutyl Acetate	1.14E+4	4.99E+5	2.6E+0
Kerosene	3.74E+4	2.80E+5	2.9E+4
Methanol	7.86E+4	4.78E+5	3.5E+1
Methyl Isobutyl Ketone	6.31E+4	3.38E+5	1.7E+1
Propane	3.61E+4	1.80E+5	6.8E+1
Propanol	4.98E+4	3.20E+5	8.5E+0
Toluene	4.52E+4	2.64E+5	2.2E+1

All the explosive chemicals are at both the LEL and UEL at a specific distance from the postulated spill. It is not the object of this report to determine that distance, but to describe those chemicals that could pose a co-location problem. However, even in the event of a catastrophic failure of the storage container, no chemical presents an explosive hazard past 100 m (328 ft). Therefore, careful consideration should be given to those chemicals whose storage locations are within 100 m (328 ft) of the facility under consideration.

5. RESULTS AND CONCLUSIONS

Approximately 2000 potentially hazardous chemicals were evaluated by the methods and screening criteria presented in this evaluation. The screening methods used a simple form of dispersion analysis and some realistic assumptions regarding release amounts.

The screening methodology and source term assumptions resulted in a list of about 60 potentially hazardous releases, which are presented in table 4-8. The more exotic acids are included in this list. The most notable is hydrofluoric acid. These acids should be evaluated in more detail in the appropriate ICPP safety documents to ensure adequate on-site-worker safety.

All exposures to hazardous chemicals discussed here are strictly inhalation exposures. Exposure limits for eyes, skin, etc., are not included. Table 4-8 also lists some chemicals that can exceed exposure limits if they are inhaled, but may not have any effect if ingested. The best example of this is table salt (sodium chloride). Even though a human can ingest salt without suffering ill effects, a human cannot inhale salt above a certain level for very long. If sodium chloride at 5 mg/m^3 is inhaled for an eight-hour work day, the recommended exposure limit is reached.

Many of the chemicals listed as potentially hazardous are listed as such because of the assumption of 1 mg/m^3 as the OEL. This assumption was made for chemicals that could not be found in any of the exposure lists. Additionally, all concentrations are for a person at a distance of 100 m (328 ft). Should a facility be further away than 100 m (328 ft), the concentration would be less. Likewise, facilities closer than 100 m (328 ft) would experience higher concentrations than those listed.

Table 4-8 lists those chemicals stored at the ICPP which should receive evaluation first. Other chemicals that may be new, stored differently, or in larger quantities must be evaluated separately to

ensure the results of this evaluation are valid. The method and screening criteria used for this evaluation are simple and conservative due to the large dispersion parameters used. The chemicals shown in table 4-8 should be used as a starting point when evaluating any facility for nonradiological hazards. Of those chemicals at the ICPP that are flammable or explosive, none remains above the LEL for over 100 m (328 ft) as shown in table 4-9. Facilities located closer than 100 m (328 ft) to storage areas for potentially flammable or explosive substances should be evaluated separately.

All the chemicals presented in appendix A were evaluated at the site boundary, $1.4\text{E}+4$ m ($4.6\text{E}+4$ ft) away. None was found to present concentrations above the applicable OELs as presented in appendix A.

6. REFERENCES

1. Code of Federal Regulations - Title 40, Parts 199-300, Resource Conservation and Recovery Act (RCRA).
2. Code of Federal Regulations - Title 10, Part 40, Section 302, Superfund Amendments and Reauthorization Act (SARA) of 1986.
3. U. S. Department of Energy, DOE Order 5480.23, Nuclear Safety Analysis Reports, April 13, 1992.
4. Rood, A. S., ltr ASR-07-89 to Franz Jr., W. A., "SIS Chemical Safety Report," April 5, 1989.
5. American Conference of Governmental Industrial Hygienists (ACGIH), 1990. 1990-1991 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, ISBN: 0-936712-86-4, 1990, Cincinnati, Ohio.
6. U. S. Environmental Protection Agency, "Technical Guidance for Hazards Analysis, Emergency Planning for Extremely Hazardous Substances," December 1987.
7. Code of Federal Regulations - Title 29, Part 1910, Subpart Z, "Toxic and Hazardous Substances," July 1, 1981.
8. National Institute for Occupational Safety and Health, "NIOSH Pocket Guide to Chemical Hazards," September 1985.
9. Code of Federal Regulations (CFR) - Title 29, Part 1910, Part II, Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents; Final Rule, February 1992.

APPENDIX A
INITIAL HAZARDOUS CHEMICAL DATA

Appendix A

Initial Hazardous Chemical Data

The initial data for this hazardous chemical study came directly from Haz Track, an ICPP computerized hazardous chemical data base. This data base contains the amount, location, and form, as well as a few more parameters, for over 2000 chemicals presently stored or used at the ICPP. Approximately 250 of these chemicals were classified according to SARA Title III guidelines, their toxicity, frequency of use and delivery, and experience. Chemicals were then eliminated if they are stored in amounts of less than 0.45 kg (1 lb).

The resulting list of chemicals is shown in table A-1, together with chemical specific parameters required for analysis as discussed in the report. The various parameters were obtained mainly from Haz Track, with the remainder obtained from several references noted in the table. An occupational exposure limit (OEL) of 1 mg/m^3 was assumed where no data could be found, and this is noted in the table. Other OELs were taken from a more general form of the chemical and were assumed to apply. Where no vapor pressure data are available, 100 mm Hg was assumed.

Gasoline was assumed to have a molecular weight equivalent to octane. Diesel and kerosene fuels were assumed to have a molecular weight of the heaviest carbon chain in the kerosene mixture. The C-16 chain was chosen and equates to a molecular weight of about 212 g/g mole.

All of the above parameters are reevaluated as part of the iteration method of determining chemical hazards for a facility or nearby facility. The body of this report provides the details.

Table A-1. Initial Hazardous Chemical Data

Chemical	OEL (mg/m ³)	Amount Spilled (lb)	Molecular Weight (g/g mole)	Vapor Press. (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Acetic Acid Anhydride	250.0 ^{1(TWA)}	1.2	102.09	11.0	LIQ	NO	0.0
Acetic Acid, Glacial	37.0 ^{2(TWA)}	11.0	60.05	11.0	LIQ	NO	0.0
Acetonitrile (Explosive)	70.0 ^{1(TWA)}	3.4	41.05	100.0	LIQ	NO	0.0
Acetylene (Explosive)	2660.0 ^{4(TWA)}	31.6	26.02	0.0	GAS	NO	0.0
Aluminum Chloride - Hexahydrate	2.0 ^{2(TWA)}	1.1	241.43	0.0	SOL	NO	0.0
Aluminum Nitrate	2.0 ^{2(TWA)}	165.8	375.0	0.0	SOL	NO	0.0
Aluminum Nitrate Nanohydrate	2.0 ^{2(TWA)}	29.7	375.13	0.0	SOL	NO	0.0
Aluminum Sulfate	2.0 ^{2(TWA)}	97.2	342.14	0.0	SOL	NO	0.0
Aluminum Fluoride - x-hydrate	2.0 ^{2(TWA)}	5.0	147.03	0.0	SOL	NO	0.0
Aluminum Oxide	10.0 ^{2(TWA)}	42.0	101.94	0.0	SOL	NO	0.0
Ammonium Metavanadate	17.0 ^{5(TWA)}	4.4	116.99	0.0	SOL	NO	0.0
Ammonium Sulfide	10.0 ^{5(TWA)}	72.0	68.14	0.0	SOL	NO	0.0
Ammonium Fluoride	10.0 ^{5(TWA)}	19.8	37.04	0.0	SOL	NO	0.0
Ammonium Nitrate	24.0 ^{5(STEL)}	206.6	80.04	0.0	SOL	NO	0.0
Ammonium Persulfate	10.0 ^{5(TWA)}	1.1	228.2	0.0	SOL	NO	0.0
Ammonium Hydroxide (Explosive)	24.0 ^{5(STEL)}	5.5	35.05	475.00	LIQ	NO	0.0
Ammonium Sulfate	24.0 ^{5(STEL)}	5.5	132.14	0.0	SOL	NO	0.0
Ammonium Citrate - Dibasic	17.0 ^{5(TWA)}	3.8	226.19	0.0	SOL	NO	0.0

Table A-1. (Contd.) Initial Hazardous Chemical Data

Chemical	DEL (mg/m ²)	Amount Spilled (lb)	Molecular Weight (g/g mole)	Vapor Press. (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Amyl Acetate (Explosive)	650.0 ^{1(TWA)}	2.2	130.21	4.0	LIQ	NO	0.0
Antimony	0.5 ^{1(TWA)}	10.0	121.75	0.0	SOL	NO	0.0
Barium Nitrate	0.5 ^{2(TWA)}	121.0	216.38	0.0	SOL	NO	0.0
Barium Hydroxide	0.5 ^{2(TWA)}	1.1	315.5	0.0	SOL	NO	0.0
Bismuth Nitrate	5.0 ^{5(TWA)}	81.9	395.02	0.0	SOL	NO	0.0
Boric Acid	15.0 ^{1(TWA)}	124.2	61.83	0.0	SOL	NO	0.0
Boron Trioxide	15.0 ^{1(TWA)}	3.1	69.62	0.0	SOL	NO	0.0
Cadmium Nitrate Tetrahydrate	0.05 ^{5(TWA)}	167.1	308.47	26.6	LIQ	NO	0.0
Cadmium	0.2 ^{1(TWA)}	45.0	112.41	0.0	SOL	NO	0.0
Cadmium Oxide	0.2 ^{1(TWA)}	2.0	128.4	0.0	SOL	NO	0.0
Cadmium Sulfate	0.2 ^{1(TWA)}	23.9	208.46	26.6	LIQ	NO	0.0
Calcium Nitrate	5.0 ^{1(TWA)}	50.6	164.09	0.0	SOL	NO	0.0
Calcium Nitrate Tetrahydrate	5.0 ^{1(TWA)}	42.4	236.16	0.0	SOL	NO	0.0
Calcium Hypochlorite	5.0 ^{1(TWA)}	99.1	142.98	0.0	SOL	NO	0.0
Calcium Sulfate	5.0 ^{1(TWA)}	18.0	132.14	0.0	SOL	NO	0.0
Calcium Carbonate	5.0 ^{1(TWA)}	50.0	100.09	0.0	SOL	NO	0.0
Carbon	3.5 ^{1(TWA)}	40.0	12.01	0.0	SOL	NO	0.0
Carbon Tetrachloride	63.0 ^{4(TWA)}	1.8	153.82	100.0	LIQ	NO	0.0
Cerium (III) Nitrate	1.0 ⁰	91.7	434.23	0.0	SOL	NO	0.0
Cesium Nitrate	2.0 ^{5(TWA)}	14.9	194.92	0.0	SOL	NO	0.0

Table A-1. (Contd.) Initial Hazardous Chemical Data

Chemical	OEL (mg/m ³)	Amount Spilled (lb)	Molecular Weight (g/g mole)	Vapor Press. (mm Hg)	Form	Bike YES/NO	Bike Area (ft ²)
Cesium Carbonate	2.0 ^{5(TWA)}	41.2	325.82	0.0	SOL	NO	0.0
Chromium (N) Oxide	0.5 ^{1(TWA)}	230.0	99.99	0.0	SOL	NO	0.0
Chromium (III) Nitrate	0.5 ^{2(TWA)}	160.0	400.15	0.0	SOL	NO	0.0
Citric Acid	1.0 ⁶	950.0	192.12	0.0	SOL	NO	0.0
Cobalt Nitrate	0.05 ^{5(TWA)}	59.4	182.96	0.0	SOL	NO	0.0
Copper (II) Nitrate	1.0 ^{5(TWA)}	93.6	187.55	0.0	SOL	NO	0.0
Copper	1.0 ^{2(TWA)}	3.3	63.55	0.0	SOL	NO	0.0
Cyclohexanone (Explosive)	200.0 ^{1(TWA)}	2.1	98.15	2.0	LIQ	NO	0.0
Dichlorodifluoromethane	4950.0 ^{1(TWA)}	29.1	120.91	0.0	GAS	NO	0.0
Diesel (Explosive)	3.7E+4 ^{LEL}	1.7E+6	212.18	5.0	LIQ	YES	8.0E+4
Dodecane	1.0 ⁶	5114.1	170.34	0.5	LIQ	NO	0.0
EDTA Tetra Sodium Salt Dihydrate	5.0 ^{5(TWA)}	94.0	394.22	0.0	SOL	NO	0.0
Ethanedio1	6.0 ³	2.2	62.07	0.0	SOL	NO	0.0
Ethanol (Explosive)	1880.0 ^{2(TWA)}	19.6	46.07	58.5	LIQ	NO	0.0
Ethyl Acetate	1440.0 ^{1(TWA)}	8.3	88.11	89.6	LIQ	NO	0.0
Fluoboric Acid	2.5 ^{5(TWA)}	254.7	87.82	26.6	LIQ	NO	0.0
Gasoline (Explosive)	900.0 ^{4(TWA)}	6050.0	114.23	50.0	LIQ	YES	605
Gadolinium Oxide	1.0 ⁶	1300.0	362.5	0.0	SOL	NO	0.0
Glycerol	10.0 ^{5(TWA)}	11.1	92.1	1.9E-1	LIQ	NO	0.0

Table A-1. (Contd.) Initial Hazardous Chemical Data

Chemical	QEL (mg/m ³)	Amount Spilled (lb)	Molecular Weight (g/g mole)	Vapor Press. (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Hexane (Explosive)	1800.0 ^{1(TWA)}	8.5	86.18	124.0	LIQ	NO	0.0
Hydrochloric Acid	7.0 ^{1(TWA)}	385.3	36.46	41.6	LIQ	NO	0.0
Hydrofluoric Acid	2.5 ^{1(TWA)}	2308.8	20.01	125.0	LIQ	NO	0.0
Hydrogen (Explosive)	2450.0 ^{Asphyx}	2.5	2.00	0.0	GAS	NO	0.0
Hydrogen Peroxide	1.4 ^{1(TWA)}	4.8	34.01	10.1	LIQ	NO	0.0
Hydroxylamine Hydrochloride	7.5 ^{2(TWA)}	9.4	69.49	0.0	SOL	NO	0.0
Iron (II) Sulfamate	1.0 ^{2(TWA)}	184.6	247.80	26.6	LIQ	NO	0.0
Iron	1.0 ^{2(TWA)}	48.7	55.85	0.0	SOL	NO	0.0
Iron (III) Nitrate Nanohydrate	1.0 ^{2(TWA)}	4.4	404.02	0.0	SOL	NO	0.0
Iron (III) Nitrate	1.0 ^{2(TWA)}	182.6	241.87	0.0	SOL	NO	0.0
Iron (III) Chloride	1.0 ^{2(TWA)}	1.6	162.2	0.0	SOL	NO	0.0
Iron (III) Oxide	10.0 ^{1(TWA)}	2.2	159.69	0.0	SOL	NO	0.0
Isoamyl Acetate	525.0 ^{1(TWA)}	1.9	130.19	4.0	LIQ	NO	0.0
Isobutyl Acetate (Explosive)	700.0 ^{1(TWA)}	6.7	116.16	13.0	LIQ	NO	0.0
Kerosene (Explosive)	100.0 ^{4(TWA)}	1.3E+5	114.23	5.0	LIQ	YES	3.5E+4
Lead Nitrate	0.15 ^{5(TWA)}	39.9	331.23	0.0	SOL	NO	0.0
Lithium Nitrate	2.5E-2 ^{5(TWA)}	1.1	68.95	0.0	SOL	NO	0.0
Magnesium Nitrate	10.0 ^{5(TWA)}	339.9	220.38	0.0	SOL	NO	0.0
Magnesium Perchlorate, Anhydrous	5.0 ³	1.7	223.23	0.0	SOL	NO	0.0

Table A-1. (Contd.) Initial Hazardous Chemical Data

Chemical	OEL (mg/m ³)	Amount Spilled (lb)	Molecular Weight (g/g mole)	Vapor Press. (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Magnesium Oxide	15.0 ^{1(TWA)}	2.2	40.31	0.0	SOL	NO	0.0
Magnesium Chloride	10.0 ^{5(TWA)}	1.1	95.22	0.0	SOL	NO	0.0
Manganese (II) Nitrate x-hydrate	5.0 ^{5(TWA)}	47.5	178.95	1.0	LIQ	NO	0.0
Mercury	0.1 ^{1(C)}	107.6	200.61	1.2 E-3	LIQ	NO	0.0
Methanol (Explosive)	328.0 ^{2(STEL)}	27.9	32.04	100.0	LIQ	NO	0.0
Methyl Isobutyl Ketone (Explosive)	410.0 ^{1(TWA)}	30.9	110.16	19.1	LIQ	NO	0.0
Nickel	1.0 ^{1(TWA)}	2.0	58.7	0.0	SOL	NO	0.0
Nickel Chloride	1.0 ^{1(TWA)}	2.0	237.71	0.0	SOL	NO	0.0
Niobium (V) Oxide	1.0 ⁶	20.5	265.81	0.0	SOL	NO	0.0
Niobium	1.0 ⁶	101.0	92.91	0.0	SOL	NO	0.0
Nitric Acid	5.0 ^{1(TWA)}	313.9	63.0	45.0	LIQ	NO	0.0
Nitric Acid - Fuming	5.0 ^{1(TWA)}	16.2	63.01	45.0	LIQ	NO	0.0
Nitrogen	34350 ^{Asphyx}	4.0E+4	28.0	24.7	GAS	NO	0.0
Nitrous Oxide	90.0 ^{2(TWA)}	25.6	44.0	0.0	GAS	NO	0.0
Oxalic Acid	1.0 ^{1(TWA)}	1800.0	90.0	0.0	SOL	NO	0.0
Oxygen	52350 ^{Asphyx}	2.1E+5	32.0	5.3	GAS	NO	0.0
Perchloric Acid	7.0 ^{5(STEL)}	12.9	100.46	0.5	LIQ	NO	0.0
Periodic Acid	1.0 ⁶	1.1	227.94	0.0	SOL	NO	0.0
Phosphoric Acid	1.0 ^{1(TWA)}	9.5	98.0	1.0E-3	LIQ	NO	0.0

Table A-1. (Contd.) Initial Hazardous Chemical Data

Chemical	DEL (mg/m ³)	Amount Spilled (lb)	Molecular Weight (g/g mole)	Vapor Press. (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Potassium Peroxydisulfate	2.0 ^{5(C)}	7.4	270.33	0.0	SOL	NO	0.0
Potassium Nitrate	2.0 ^{5(C)}	213.5	101.11	0.0	SOL	NO	0.0
Potassium Permanganate	2.0 ^{5(C)}	14.0	158.04	0.0	SOL	NO	0.0
Potassium Peroxymonosulfate	2.0 ^{5(C)}	1.3	614.78	0.0	SOL	NO	0.0
Potassium Hydroxide	2.0 ^{2(C)}	4.0	56.11	0.0	SOL	NO	0.0
Potassium Dichromate	2.0 ^{5(C)}	2.0	294.19	0.0	SOL	NO	0.0
Potassium Iodide	2.0 ^{5(C)}	13.2	166.01	0.0	SOL	NO	0.0
Potassium Fluoride	2.0 ^{5(C)}	5.5	58.1	0.0	SOL	NO	0.0
Propane (Explosive)	1800.0 ^{1(TWA)}	20.0	44.1	208.0	LIQ	NO	0.0
Propanol (Explosive)	500.0 ^{1(TWA)}	30.4	58.0	15.0	LIQ	NO	0.0
Silica Gel	10.0 ^{2(TWA)}	12.7	60.09	0.0	SOL	NO	0.0
Silver Nitrate	0.01 ^{1(TWA)}	1.1	169.87	0.0	SOL	NO	0.0
Sodium Carbonate - Anhydrous	5.0 ^{5(TWA)}	3400.0	105.99	0.0	SOL	NO	0.0
Sodium Borate - Decahydrate	5.0 ^{5(TWA)}	3.1	381.37	0.0	SOL	NO	0.0
Sodium Chloride	5.0 ^{5(TWA)}	5.0	58.44	0.0	SOL	NO	0.0
Sodium Dichromate Dihydrate	10.0 ^{2(TWA)}	26.4	298.0	0.0	SOL	NO	0.0
Sodium Acetate - Trihydrate	5.0 ^{5(TWA)}	26.5	136.08	0.0	SOL	NO	0.0
Sodium Hydrogen Sulfate Monohydrate	10.0 ^{5(TWA)}	2.2	138.07	0.0	SOL	NO	0.0
Sodium Tetraborate	5.0 ^{5(TWA)}	20.0	201.22	0.0	SOL	NO	0.0

Table A-1. (Contd.) Initial Hazardous Chemical Data

Chemical	QEL (mg/m ³)	Amount Spilled (lb)	Molecular Weight (g/g mole)	Vapor Press. (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Sodium Nitrate	5.0 ^{5(TWA)}	6.7	84.99	0.0	SOL	NO	0.0
Sodium Sulfate	10.0 ^{2(TWA)}	3.3	142.04	0.0	SOL	NO	0.0
Sodium Sulfite - Anhydrous	10.0 ^{5(TWA)}	100.0	126.04	0.0	SOL	NO	0.0
Sodium Hypochlorite	5.0 ^{5(TWA)}	2.1	106.0	17.5	LIQ	NO	0.0
Sodium Hydroxide	2.0 ^{1(TWA)}	1500.0	40.0	0.0	SOL	NO	0.0
Sodium Bromate	1.0 ⁶	2.0	150.9	0.0	SOL	NO	0.0
Sodium Hydrogen Sulfate	10.0 ^{5(TWA)}	1.1	120.06	0.0	SOL	NO	0.0
Sodium Hydrogen Sulfite	10.0 ^{5(TWA)}	2.0	104.06	0.0	SOL	NO	0.0
Sodium Phosphate - Tribasic - 12-hydrate	5.0 ^{5(TWA)}	30.0	380.12	0.0	SOL	NO	0.0
Strontium Nitrate	1.0 ⁶	2.2	211.63	0.0	SOL	NO	0.0
Sucrose	10.0 ^{2(TWA)}	139.2	342.3	0.0	SOL	NO	0.0
Sulfamic Acid	1.0 ^{5(TWA)}	79.3	97.16	0.0	SOL	NO	0.0
Sulfur	10.0 ^{4(TWA)}	2.2	256.48	0.0	SOL	NO	0.0
Sulfurous Acid	1.0 ^{5(TWA)}	5.6	82.08	34.4	LIQ	NO	0.0
Sulfuric Acid	1.0 ^{1(TWA)}	40.1	98.08	1.0 E-6	LIQ	NO	0.0
Tartaric Acid	1.0 ⁶	1900.0	150.09	0.0	SOL	NO	0.0
Tin	2.0 ^{1(TWA)}	4.4	118.69	0.0	SOL	NO	0.0
Tin (II) Fluoride	2.0 ^{1(TWA)}	1.1	156.69	0.0	SOL	NO	0.0
Titanium	10.0 ^{4(TWA)}	1.1	47.9	0.0	SOL	NO	0.0

Table A-1. (Contd.) Initial Hazardous Chemical Data

Chemical	OEL (mg/m ³)	Amount Spilled (lb)	Molecular Weight (g/g mole)	Vapor Press. (mm Hg)	Form	Dike YES/NO	Dike Area (ft ²)
Titanium (IV) Oxide	15.0 ^{4(TWA)}	6.0	79.9	0.0	SOL	NO	0.0
Toluene (Explosive)	754.0 ^{4(TWA)}	31.3	92.14	28.0	LIQ	NO	0.0
Tributyl Phosphate	2.2 ^{2(TWA)}	2250.0	266.32	13.7	LIQ	NO	0.0
Trichloromethane	240.0 ^{1(TWA)}	9.0	119.38	192.5	LIQ	NO	0.0
Tungsten	10.0 ^{2(STEL)}	5.0	183.85	0.0	SOL	NO	0.0
Urea	0.2 ^{5(TWA)}	7.5	60.06	0.0	SOL	NO	0.0
Yttrium Nitrate Pentahydrate	1.0 ^{1(TWA)}	12.3	365.0	0.0	SOL	NO	0.0
Zirconium Carbonate	5.0 ^{1(TWA)}	155.0	431.68	0.0	SOL	NO	0.0
Zirconium Dioxide	5.0 ^{1(TWA)}	108.0	123.22	0.0	SOL	NO	0.0
Zirconyl Nitrate	5.0 ^{1(TWA)}	1151.7	231.23	0.0	SOL	NO	0.0

- 1) Code of Federal Regulations - Title 29, Part 1910, Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents; Final Rule, February 24, 1992.
- 2) American Conference of Governmental Industrial Hygienists. 1991 - 1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Indices, ISBN: 0-936712-92-9, 1990, Cincinnati, Ohio.
C ≡ Threshold Limit Value - Ceiling.
TWA ≡ Threshold Limit Value - Time Weighted Average.
STEL ≡ Threshold Limit Value - Short Term Exposure Limit.
- 3) National Institute for Occupational Safety and Health, "NIOSH Pocket Guide to Chemical Hazards," September 1985.

Table A-1. (Contd.) Initial Hazardous Chemical Data

Footnotes Contd.

4) "Material Safety Data Sheets Collection, Volume I Inorganic and Organic Materials," Genium Publishing Corporation, April 1986.

5) Limit presented is for the more general form of the chemical.

C $\equiv$ Threshold Limit Value - Ceiling.

TWA $\equiv$ Threshold Limit Value - Time Weighted Average.

STEL $\equiv$ Threshold Limit Value - Short Term Exposure Limit.

6) Permissible Exposure Limit (PEL) is assumed to be 1 mg/m³.

APPENDIX B
PROGRAM AND COMPARISON

Appendix B Program and Comparison

The program listed after the following discussion was written in Turbo-Basic at WINCO for screening hazardous chemicals. The discussion below describes the program and shows that the program produces good results when compared to hand calculations. Four substances were chosen and used for example calculations. The chemicals and their parameters which were chosen are listed in table B-1. They also represent chemical substances in all three physical forms (i.e., solids, liquids, and gases).

Table B-1. Hazardous Chemicals and Properties for Example Calculations

Chemical	Spilled Amount (lb)	Molecular Weight (g/g mole)	Vapor Pressure (mm Hg)	Form	Dike (ft ²) YES/NO
Aluminum Chloride Hexahydrate	1.10	241.43	---	Solid	No
Hydrogen Fluoride (HF)	2308.76	20.01	125.0	Liquid	No
Diesel	1.7 E+6	212.18	5.0	Liquid	Yes 8.0E+4
Nitrous Oxide	29.59	44.0	---	Gas	No

The above-listed specific chemical parameters were used with the program and in hand calculations. The program can perform four variations of calculations. Those four variations consist of Class D and F meteorological conditions for both open country and urban areas. The program was written so that if Class D meteorology is chosen, the code automatically utilizes a wind speed of 4.3 m/s (14.1 ft/s). Likewise, if Class F meteorology is chosen, a wind speed of 1.5 m/s (5.0 ft/s) is used. OSHA calculations (section 3, ICPP Hazardous Chemical Evaluation) are not specifically named in the program, but they can be obtained by choosing the appropriate parameters. Those parameters consist of Class D

meteorology and a wind speed of 4.3 m/s (14.1 ft/s) in an urban area. The code assumes a distance of 100 m (328 ft) for all calculations. Table B-2 and B-3 show the results of the program and the hand calculations in terms of concentration (mg/m³) for the variations described above.

Table B-2. Results of Program and Hand Calculations for Open Country

Chemical	Open Country					
	Class D Concentration (mg/m ³)			Class F Concentration (mg/m ³)		
	Program	Hand- Calc.	% Δ	Program	Hand- Calc.	% Δ
Aluminum Chloride Hexahydrate	2.3	2.2	4.3	4.7E+1	4.6E+1	2.1
Hydrogen Fluoride (HF)	2.9E+2	2.9E+2	0.0	2.7E+3	2.7E+3	0.0
Diesel	4.0E+3	4.0E+3	0.0	3.6E+4	3.6E+4	0.0
Nitrous Oxide	5.3E+1	6.1E+1	13.1	1.1E+3	1.3E+3	0.0

Table B-3. Results of Program and Hand Calculations for Urban Areas

Chemical	Urban Area					
	Class D Concentration (mg/m ³)			Class F Concentration (mg/m ³)		
	Program	Hand- Calc.	% Δ	Program	Hand- Calc.	% Δ
Aluminum Chloride Hexahydrate	4.7E-1	4.6E-1	2.1	3.4	3.4	0.0
Hydrogen Fluoride (HF)	6.0E+1	6.0E+1	0.0	1.9E+2	1.9E+2	0.0
Diesel	8.2E+2	8.2E+2	0.0	2.6E+3	2.6E+3	0.0
Nitrous Oxide	1.1E+1	1.3E+1	15.3	7.9E+1	9.1E+1	13.2

As shown in the above tables, the program yields good results. The fifteen percent variation in results for nitrous oxide can be attributed

to round-off and compiler number reproduction error. Because large uncertainty is inherent in these dispersion calculations, the fifteen percent error is not unreasonable or unacceptable.

```

DIM CD$(500,3),CD(500,5)
INPUT "Data file name? ",DATANAME$
INPUT "File name for chemicals eliminated? ",ELIM$
INPUT "File name for chemicals needing further evaluation? ",NEED$
INPUT "Save release rates (OSHA vs Pool Calc.)? (Y/N) ",ANS$
IF (ANS$ = "Y") OR (ANS$ = "y") THEN
INPUT "File name for OSHA vs Pool Calc? ",OSHA$
END IF
OPEN DATANAME$ FOR INPUT AS #1
OPEN ELIM$+".RES" FOR OUTPUT AS #2
OPEN NEED$+".RES" FOR OUTPUT AS #3
OPEN NEED$+".DAT" FOR OUTPUT AS #4
IF (ANS$ = "Y") OR (ANS$ = "y") THEN OPEN OSHA$+".RES" FOR OUTPUT AS #5
PRINT #2,"Chemical Concen. (mg/m3) OEL (mg/m3) Amount (lb) MW VP Form_
Diked? Dike Area (ft2)"
PRINT #3,"Chemical Concen. (mg/m3) OEL (mg/m3) Amount (lb) MW VP Form_
Diked? Dike Area (ft2)"
IF (ANS$ = "Y") OR (ANS$ = "y") THEN PRINT #5,"Chemical OSHA (g/s) Pool_
(g/s) VP (mm Hg)"
CNT=1
WHILE NOT EOF(1)
INPUT #1,CD$(CNT,1),CD(CNT,1),CD(CNT,2),CD(CNT,3),CD(CNT,4),_
CD$(CNT,2),CD$(CNT,3),CD(CNT,5)
CNT=CNT + 1
WEND
CLOSE #1
INPUT "Is OSHA dispersion required? (Y/N) ",OSHAMET$
IF (OSHAMET$ = "Y") OR (OSHAMET$ = "y") THEN
F1 = 0.16 : F2 = 4.0E-4 : E1 = -0.5
F3 = 0.14 : F4 = 3.0E-4 : E2 = -0.5 : U = 4.3
GOTO 1
END IF
INPUT "Is the dispersion to be in an urban area? (Y/N) ",URBAN$
INPUT "Is the dispersion meteorology class F? (Y/N) ",METE$
IF (URBAN$ = "Y")OR(URBAN$ = "y")AND(METE$ = "Y") OR (METE$ = "y") THEN
F1 = 0.11 : F2 = 4.0E-4 : E1 = -0.5
F3 = 8.0E-2 : F4 = 1.5E-4 : E2 = -0.5 : U = 1.5

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END IF
IF (URBAN$ = "Y")OR(URBAN$ = "y")AND(METE$ = "N") OR (METE$ = "n") THEN
F1 = 0.16 : F2 = 4.0E-4 : E1 = -0.5
F3 = 1.4E-1 : F4 = 3.0E-4 : E2 = -0.5 : U = 4.3
END IF
IF (URBAN$ = "N")OR(URBAN$ = "n")AND(METE$ = "Y") OR (METE$ = "y") THEN
F1 = 4.0E-2 : F2 = 1.0E-4 : E1 = -0.5
F3 = 1.6E-2 : F4 = 3.0E-4 : E2 = -1.0 : U = 1.5
END IF
IF (URBAN$ = "N")OR(URBAN$ = "n")AND(METE$ = "N") OR (METE$ = "n") THEN
F1 = 8.0E-2 : F2 = 1.0E-4 : E1 = -0.5
F3 = 6.0E-2 : F4 = 1.5E-3 : E2 = -0.5 : U = 4.3
END IF
1 INPUT "Distance other than 100 m? (Y/N) ",DIST$
IF (DIST$ = "N") OR (DIST$ = "n") THEN
DIST=100.0
ELSE
INPUT "Distance in meters. ",DIST
END IF
I = 1
WHILE CD$(I,1) <> ""
PRINT "Processing Chemical" TAB(21) CD$(I,1)+ "..."
IF (CD$(I,2) = "SOL")OR(CD$(I,2) = "GAS") THEN QR=(454.0/600.0)*CD(I,2)
IF (OSHAMET$ = "Y") OR (OSHAMET$ = "y") THEN
QR = CD(I,2) * (454.0 / 3600.0)
GOTO 2
END IF
IF (CD$(I,3) = "YES") THEN
QR=(0.106*CD(I,3)^(2/3)*0.49*CD(I,4))/(82.05*(23.9+273))*CD(I,5)
QR=454.0/60.0*QR*U^0.78/0.49
END IF
IF (CD$(I,3) = "NO") AND (CD$(I,2) = "LIQ") THEN
QR=454.0/60.0*CD(I,2)*U^0.78*(0.106*CD(I,3)^(2/3)*0.49*CD(I,4))/_
(82.05*(23.9+273))
END IF
2 HANNA=0.6084
D1=HANNA*(F1*DIST*(1+F2*DIST)^E1)

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D2=(F3*DIST*(1+F4*DIST)^E2)
C=(QR/(3.1416*U*D1*D2))*1000
IF (C < .5*CD(I,1)) THEN
PRINT #2, USING "& #.##### #.##### #.##### ###.## #.##### & _
#.#####";CD$(I,1);C;CD(I,1);CD(I,2);CD(I,3);CD(I,4);CD$(I,2);_
CD$(I,3);CD(I,5)
ELSEIF (C > .5*CD(I,1)) THEN
PRINT #3, USING "& #.##### #.##### #.##### ###.## #.##### & _
#.#####";CD$(I,1);C;CD(I,1);CD(I,2);CD(I,3);CD(I,4);CD$(I,2);_
CD$(I,3);CD(I,5)
END IF
IF (C > .5*CD(I,1)) THEN WRITE #4,CD$(I,1);CD(I,1);CD(I,2);CD(I,3);_
CD(I,4);CD$(I,2);CD$(I,3);CD(I,5)
IF (ANS$ = "Y")OR(ANS$ = "y") THEN PRINT #5, USING "& #.##### #.##### _
#.#####";CD$(I,1);CD(I,3)/3600.0;QR;CD(I,4)
I = I + 1
WEND
CLOSE #2 : CLOSE #3 : CLOSE #4
IF (ANS$ = "Y") OR (ANS$ = "y") THEN CLOSE #5
PRINT "Finished!"

```

END

**DATE
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9/17/93