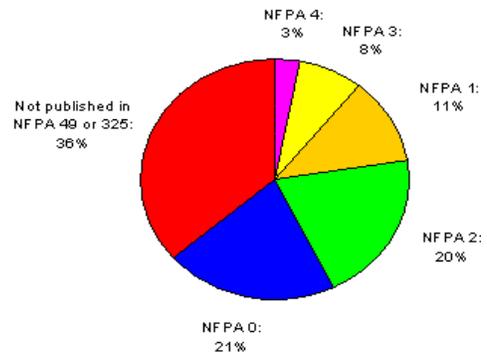
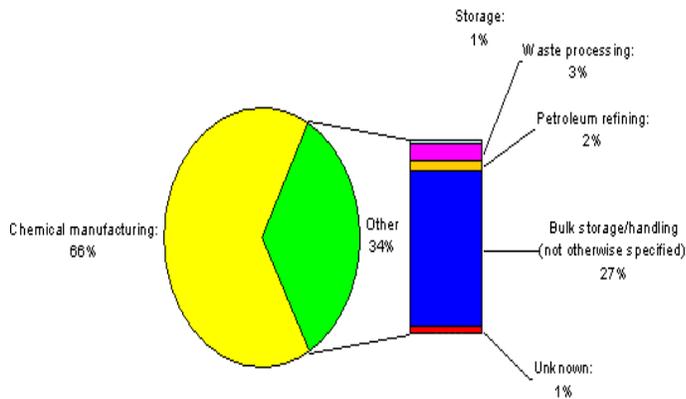
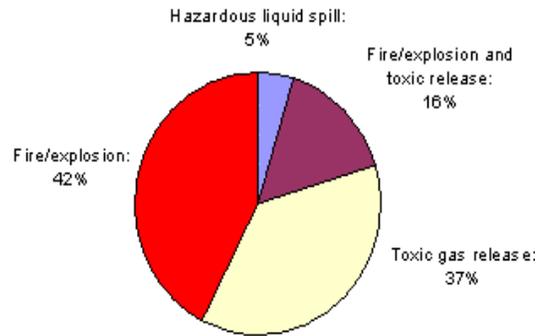
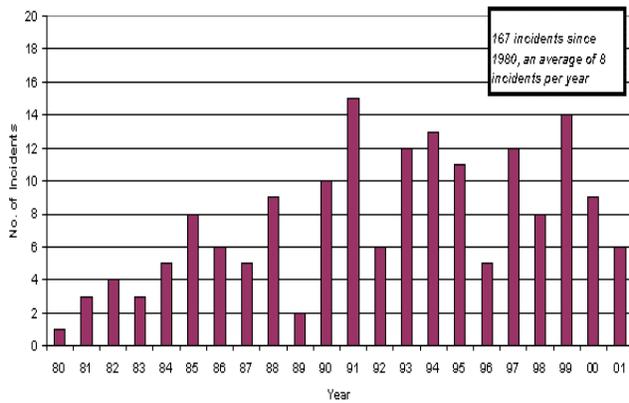


# INCIDENT DATA

## REACTIVE HAZARD INVESTIGATION



**INVESTIGATION DATA RELEASE**

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## Acronyms and Abbreviations

ACC	American Chemistry Council
ANSI	American National Standards Institute
API	American Petroleum Institute
APELL	Awareness and Preparedness for Emergencies at Local Level (UNEP)
ARIP	Accidental Release Information Program (EPA)
CAER	Community Awareness and Emergency Response (ACC Responsible Care)
CCPS	Center for Chemical Process Safety
CDCIR	The Community Documentation Centre on Industrial Risk (MAHB)
Chem. Manufact.	Chemical Manufacturing
CHETAH	Chemical Thermodynamic and Energy Release Evaluation (ASTM)
CHRIS	Chemical Hazards Response Information System (USCG)
CIMAH	Control of Industrial Major Accident Hazards (U.K.)
CIRC	Chemical Incident Reports Center (CSB)
COMAH	Control of Major Accident Hazards Involving Dangerous Substances (U.K., replaced CIMAH in 1999)
CSB	U.S. Chemical Safety and Hazard Investigation Board
DOE	U.S. Department of Energy
EC	European Community
EHS	Environmental health and safety
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EU	European Union
F&E	Fire & Explosion
HA	Hydroxylamine
HarsNet	Hazard Assessment of Highly Reactive Systems Thematic Network

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**Acronyms and Abbreviations (cont'd)**

HASTE	The European Health and Safety Database
HSE	Health and Safety Executive (U.K.)
HSEES	Hazardous Substances Emergency Events Surveillance (MAHB)
IChemE	Institution of Chemical Engineers (U.K.)
Incompat. Matls.	Incompatible Materials
IMIS	Integrated Management Information System (OSHA)
MAHB	Major Accident Hazard Bureau (European Communities)
MARS	Major Accident Reporting System (MAHB)
MHIDAS	Major Hazard Incident Data Service (HSE)
NA	Not Applicable
NAICS	North American Industry Classification System
NFIRS	National Fire Incident Reporting System
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOS	Not Otherwise Specified
NRC	National Response Center (USCG)
NTSB	National Transportation Safety Board
OSHA	Occupational Safety and Health Administration
RMP	Risk Management Program (EPA)
SOCMA	Synthetic Organic Chemical Manufacturers Association
TCPA	Toxic Catastrophe Prevention Act (New Jersey)
TG	Toxic Gas
TGA	Thermogravimetric analysis

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**Acronyms and Abbreviations (cont'd)**

TL	Toxic Liquid
TNO	Netherlands Organisation for Applied Scientific Research
USCG	U.S. Coast Guard

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## 1.0 Background

On September 17, 2002, The U.S. Chemical Safety and Hazard Investigation Board (CSB) unanimously approved a total of 18 recommendations intended to reduce the number of serious industrial accidents caused by uncontrolled chemical reactions. The approval culminated a two-year special CSB investigation, [http://www.csb.gov/completed\\_investigations/docs/DS-Reactives.pdf](http://www.csb.gov/completed_investigations/docs/DS-Reactives.pdf), into hazards at U.S. sites that manufacture, store, or use potentially reactive chemicals. This hazard investigation examined 167 serious chemical accidents in the U.S. over the last 22 years that have involved uncontrolled chemical reactions. These accidents caused 108 deaths as well as hundreds of millions of dollars in property damage.

The investigation prompted the Board to call on government agencies and industry to improve reactive hazard management. In particular, Occupational Safety and Health Administration (OSHA) and the U.S. Environmental Protection Agency (EPA) were asked to extend their process safety regulations — known as the Process Safety Management standard and the Risk Management Program rule — to better control hazards associated with chemical reactivity.

The Board requested that OSHA broaden the application of the PSM standard to cover both individual chemicals and combinations of chemicals that can undergo hazardous reactions under specific process conditions. The standard currently applies to only 137 listed chemicals, plus a class of flammable substances (there are estimated to be thousands of chemicals in common industrial use). Only 38 of these chemicals are currently covered by the PSM standard because of their reactivity. The CSB investigation documented numerous examples where chemicals that were not listed caused reactions resulting in explosions, fires, or toxic gas releases, often with fatal consequences.

EPA currently does not specifically regulate reactive hazards under its RMP rule. The Board

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investigation pointed to numerous examples where reactive accidents had a public or environmental impact. For example, the 1999 Concept Sciences explosion near Allentown, PA, killed a member of the public and damaged nearby businesses. The chemical involved, hydroxylamine, is not covered under the EPA rule.

The Board further called on OSHA to modify the PSM standard by requiring companies to evaluate the potential for hazardous reactions in each covered process. Companies would also be required to consult a wider array of scientific and technical literature on reactivity in compiling process safety information — information that is critical in designing safe processes and in protecting employees from workplace hazards. The Board cited deficiencies in process safety information as a root cause of the 1998 Morton explosion in Paterson, NJ, a reactive accident which injured nine workers and gave rise to the Board's reactive hazard investigation.

EPA and OSHA were also requested to collect additional information on reactive accidents within their respective jurisdictions. CSB staff identified that progress on preventing reactive accidents was hampered by a general lack of reliable data — including information on root causes and lessons learned. They also noted that the tally of 167 reactive incidents was almost certainly an underestimate due to data deficiencies.

Citing inadequacies in existing industry guidance on reactives, the Board called on the American Chemistry Council (ACC), the National Association of Chemical Distributors (NACD), the Synthetic Organic Chemical Manufacturers Association (SOCMA), and the Center for Chemical Process Safety (CCPS) to develop new voluntary codes and standards for controlling reactive hazards. Two of those groups - ACC and SOCMA - were also called on to cooperate with the National Institute of Standards and Technology (NIST) in developing a new national database of reactivity test information. This public database of industrial test data would complement existing knowledge on reactive hazards available from

the published literature.

A critical function of the investigation was the collection and analysis of incident data. This incident data provided the framework for many of the key findings, conclusions, and recommendations of the investigation. After the publication of the report, various stakeholders requested that CSB make the raw data collected as part of the reactive hazard investigation publicly available. The raw data and significant findings from it are presented in this publication.

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## 2.0 Data Sources and Methods

CSB data collection efforts involved searching over 40 data sources, focusing on incidents where the primary cause was related to chemical reactivity. For the purposes of the investigation, an “incident” was defined as a sudden event involving an uncontrolled chemical reaction—with significant increases in temperature, pressure, and/or gas evolution—that has caused, or has the potential to cause, serious harm to people, property, or the environment.

The data search focused on recent domestic incidents (since 1980) where the primary cause was related to chemical reactivity; however, the 1980 cutoff is not intended to diminish the important lessons learned from prior incidents. The search covered both chemical manufacturing (i.e., raw material storage, chemical processing, and product storage) and other industrial activities involving bulk chemicals, such as storage/distribution, waste processing, and petroleum refining.<sup>1</sup> For purposes of the incident search, only reactive incidents that caused serious consequences<sup>2</sup> were examined.

Sources of incident data included a variety of public-domain databases, technical literature, and news accounts. Appendix A lists the major data sources used to retrieve incident data.

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<sup>1</sup> Incidents involving transportation, pipelines, laboratories, minerals extraction, mining, explosives manufacturing, pyrotechnic manufacturing, or military uses are beyond the scope of this investigation, in addition to events involving simple combustion (i.e., rapid reaction of fuel [liquid, vapor, or dust] with oxygen in air).

<sup>2</sup> Serious consequences are injuries or fatalities, significant property damage, environmental contamination, and offsite evacuation or shelter-in-place.

### 3.0 Data Limitations

CSB believes that most major reactive incidents that have had high public visibility (e.g., government agency investigations, technical literature, national press coverage), over the 22 year period from 1980 to 2001 were captured within the 167 incidents. However, less severe and near-miss reactive incidents were difficult to capture due to data deficiencies. Thus, the tally of 167 reactive incidents is almost certainly an underestimate. Therefore, the results of the CSB incident data analysis were acknowledged as representing only a sampling of recent reactive incident data. This limitation precluded CSB from drawing statistical conclusions on incidence rates or inferring trends in the number or severity of incidents.

The availability of data was limited because of the following:

- No single data source provides a comprehensive collection of chemical incidents from which to retrieve or track reactive incident data.
- Incident data collected by OSHA and EPA provide no functional capability to track the occurrence of reactive incidents with serious worker or public impacts;<sup>3</sup> such data are a valuable resource for analyzing incident trends and developing prevention actions at a national level.
- No one comprehensive data source contains the data needed to adequately understand root causes and lessons learned from reactive incidents or other process safety incidents.<sup>4</sup>

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<sup>3</sup> Research indicates that the OSHA Integrated Management Information System (IMIS) identified 70 percent of the reactive incidents in Section 3.3, but none were tracked as “reactive incidents.” Only 25 percent of the reactive incidents that occurred from June 1994 through June 1999 were reported to EPA. These reports are contained in the RMP 5-year accident histories sent to EPA prior to the June 1999 deadline for initial submissions.

<sup>4</sup> Only one publicly available database is designed to provide such information. The Accident Database from the Institution of Chemical Engineers (ICChemE) contains lessons learned for one-fourth of the 12,000 incidents in the database.

- It is difficult to identify causes and lessons learned in existing sources of process safety incident data because industry associations, government agencies, and academia generally do not collect this information.
- Data sources contained incomplete and sometimes inaccurate incident information—for example, on numbers of injuries and community impacts. Descriptions of incidents and causal information were sometimes vague and incomplete.
- There are limited Federal or state requirements to report incidents unless they involve specific consequences.

However, despite these limitations, the data provided useful insights into the profile and causes of reactive incidents.

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## 4.0 Data Analysis Highlights

The following is a list of findings from the analysis of the data collected by CSB:

1. The limited data analyzed by CSB include 167 serious incidents in the United States involving uncontrolled chemical reactivity from January 1980 to June 2001. Forty-eight of these incidents resulted in a total of 108 fatalities. The data include an average of six injury-related incidents per year, resulting in an average of five fatalities annually.
2. Nearly 50 of the 167 incidents affected the public.<sup>5</sup>
3. Over 50 percent of the 167 incidents involved chemicals not covered by existing OSHA or EPA process safety regulations.<sup>6</sup>
4. Approximately 60 percent of the 167 incidents involved chemicals that either are not rated by NFPA or have “no special hazard” (NFPA “0”).<sup>7</sup> Only 10 percent of the 167 incidents involved chemicals with NFPA published ratings of “3” or “4.”
5. The OSHA PSM Standard lists 137 highly hazardous chemicals—only 38 of which are considered highly reactive based on NFPA instability ratings of “3” or “4.”
6. Reactive hazards are diverse. The reactive incident data analyzed by CSB included:
  - Over 40 different chemical classes (i.e., acids, bases, monomers, oxidizers, etc.), with no single dominating class.

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<sup>5</sup>“Public impact” is defined as known injury, offsite evacuation, or shelter-in-place.

<sup>6</sup> OSHA PSM Standard (29 CFR 1910.119) and EPA Accidental Release Prevention Requirements: Risk Management Programs (RMP) Under the Clean Air Act, Section 112(r)(7) (40 CFR 68).

<sup>8</sup>An NFPA instability rating of “0” means that materials in themselves are normally stable, even under “fire” conditions.

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- Several types of hazardous chemical reactivity, with 36 percent attributed to chemical incompatibility, 35 percent to runaway reactions, and 10 percent to impact-sensitive or thermally sensitive materials.
  - A diverse range of chemical process equipment—including reaction vessels, storage tanks, separation equipment, and transfer equipment. Storage and process equipment (excluding chemical reaction vessels) accounts for over 65 percent of the equipment involved; chemical reaction vessels account for only 25 percent.
7. Reactive incidents can result in a variety of consequences, including fire and explosions (42 percent of incidents) as well as toxic gas emissions (37 percent).
  8. Causes and lessons learned are reported in only 20 percent of the 167 incidents. (Industry associations, government agencies, and academia typically do not collect this information.) However, more than 60 percent of the incidents for which some causal information was available involved inadequate practices for identifying hazards or conducting process hazard evaluations; nearly 50 percent involved inadequate procedures for storage, handling, or processing of chemicals.<sup>11</sup>
  9. Over 90 percent of the incidents analyzed by CSB involved reactive hazards that are documented in publicly available literature accessible to the chemical processing and handling industry.
  10. Approximately 70 percent of the 167 incidents occurred in the chemical manufacturing industry. Thirty percent involved a variety of other industrial sectors that store, handle, or use chemicals in bulk quantities.

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<sup>11</sup>The summation of causal factor statistics exceeds 100 percent because each major incident can, and often does, have more than one cause.

## 5.0 Reactive Incident Data

The reactive incident data collection effort was comprehensive. It took nearly 6 months to complete. As stated in Section 2.0, over 40 data sources were examined. These include a variety of public-domain databases, technical literature, and news accounts. In certain cases, incident investigation reports from companies were requested (voluntary submission) and interviews with OSHA compliance officers were conducted to obtain detailed information (e.g., initiating event, management system deficiencies).

Reactive incidents that met the CSB definition and were within criteria limits (e.g., non-transportation, non-military) were collected. CSB staff ensured that each incident had a unique date and location to minimize double counting of incidents. To further ensure data quality, a contractor was hired to review CSB data collection procedures, collected data and the CSB data analysis.

Table 1 presents the raw reactive incident data collected as part of the reactive hazard investigation.

Table 2 provides a brief description of each data field.

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**Disclaimer:** The contents of this data set are not a comprehensive listing of all reactive incidents that have occurred. This data was compiled from a variety of existing sources, which are inadequate to fully identify the frequency and causes of reactive incidents. Therefore, this data may be of limited usefulness for drawing statistical conclusions on incidence rates or inferring trends in the number or severity of incidents. Although the CSB is committed to gathering and disseminating accurate information, the CSB was unable to independently verify all information contained in the various data sources. These sources, especially those based on initial incident reports, may contain incomplete or inaccurate information. Users of this data are requested to attach this disclaimer to the data and cite the CSB as the source. No CSB endorsement of or agreement with third-parties' analysis or conclusions should be implied from or suggested by those parties' use of this data.

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ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 49/325	Chemical 2 Class	Chemical 2 NFPA Number from 49/325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSH List	EPA RHP List	Data Source(s)
1	3/13/2001	Augusta, Georgia	BP Amoco	Polyamides	Organic	Undetermined	NA	NA	Polymerization/Decomposition	Known	Process Tank	Chem Manufact	3	No	Yes	F&E	No	Other (Slow, gassy decomposition)	Inadequate hazard identification	No	No	CSB Case File
2	3/7/2001	Deer Park, Texas	Hempshire Chemical Company (subsidiary of DCW)	Hydrogen cyanide and formaldehyde in a high pH environment	Cyanide salt	2	Aldehyde	0	Unknown	NA	Reactor	Chem Manufact	0	No	No	TG	Yes	Thermal run away - Lack of inhibitor	Unknown	Yes (Listed)	Yes (Toxic)	NRC Report #55837, 03/07/01, Company investigation report
3	2/27/2001	Mesa, Arizona	TRW Inc.	Sodium azide	Sodium azide	Undetermined	NA	NA	Decomposition	Known	Storage area	Other	0	Yes	Yes	F&E	No	Thermal/Mechanical Shock (NOS)	Unknown	No	No	Associated Press, 02/25/2001
4	2/7/2001	Lexington, South Carolina	Tin Products, Inc.	Tri-n-butyl aluminum, water, and air	Organometallic	3	NA	NA	Water reactive / Pyrophoric	Known	Process Tank	Chem Manufact	0	Yes	Yes	F&E	Yes	Incompat. Mells. - (NOS)	Unknown	Yes (Flammable)	No	Associated Press, 2/7/2001
5	2/1/2001	Kansas City, Missouri	Phillips Service Corporation	Aluminum paste and of solvents	Inorganic-Metal	Unknown	Hydrocarbon	0	Unknown	NA	Unknown	Waste	0	Yes	Yes	F&E and TL	No	Unknown	Unknown	No	No	KSHB, KCTV 5, KMBC (TV stations), 02/01/2001
6	1/28/2001	Columbus, Georgia	Eastman Chemical (Formerly McWhorter Technologies)	Organic peroxide	Organic peroxide	Unknown	NA	NA	Decomposition	Known	Process Tank	Chem Manufact	0	Yes	Yes	F&E	No	Thermal run away - Excess heating	Inadequate operating procedures, and inadequate hazard evaluation during management of change	Yes (Flammable)	No	Associated Press, Company Incident Report
7	12/18/2000	Port Neches, Texas	Huntsman Corp.	Ethylene oxide and oxygen	Ethylene oxide	3	Oxidizer	0	Oxidation / Decomposition	Known	Reactor	Chem Manufact	0	No	Yes	F&E	No	Thermal run away - incorrect operating conditions	Unknown	Yes (Listed)	Yes (Toxic)	Beaumont Enterprise 12/19/00, NRC Report
8	10/3/2000	West Chester, Ohio	Three Bond USA	Unknown	NA	Unknown	NA	NA	Unknown	NA	Process Tank	Other	0	Yes	No	TG	Unknown	Unknown	Unknown	Unknown	Associated Press, 10/3/2000	
9	7/5/2000	Pasadena, Texas	Dole Chemical Company	Glycidol and methanol	Alcohol	0	Alcohol	0	Polymerization/Decomposition	Known	Reactor	Chem Manufact	0	Yes	Yes	F&E and TG	No	Thermal run away - (NOS)	Unknown	Yes (Flammable)	No	Houston Chronicle 07/06/2000, 07/19/2000
10	4/12/2000	Muskegon, Michigan	Lomac LLC	Tetrahydrofuran and hydrocarbon fuel	Oxidizer	Undetermined	Hydrocarbon	0	Oxidation	Known	Waste System	Chem Manufact	0	Yes	Yes	F&E and TG	No	Thermal/Mechanical Shock - Excess Heating	Inadequate understanding of process chemistry	No	Yes (toxic)	WoodTV5 News website The Muskegon Chronicle, Jul 03, 2000
11	3/29/2000	Deer Park, Texas	Rohm and Haas Texas Inc.	Acrylic acid	Monomer	2	NA	NA	Polymerization	Known	Storage Tank	Chem Manufact	0	No	No	TG	Yes	Thermal run away (near miss) - Contamination	Unknown	No	No	Reuters Online, 03/29/2000, Company investigation report.

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 49/525	Chemical 2 Class	Chemical 2 NFPA Number from 49/525	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)	
12	3/27/2000	Pasadena, Texas	Phillips Chemical	Butadiene and styrene copolymer, butadiene polyperoxide	Organic peroxide	Undetermined	NA	NA	Decomposition	Known	Storage Tank	Chem Manufact	1	Yes	\$20,000,000	F&E	No	Thermal/ Mechanical Shock - (NOS)	Unknown	Yes (Harmful)	Yes (Harmful)	The Oil Daily, April 2000, Industrial Fire World Magazine, 03/27/2000, Chem Week 04/25/2000, OSHA National News release 05/21/2000, Marsh Loss Control Newsletter, #1, 2000	
13	3/29/2000	Lily, Kentucky	AISIN Automotive	Unknown	NA	Unknown	NA	NA	Unknown	NA	Unknown	Other	0	Yes	No	TG	Unknown	Incompat. Mixt - Inadvertent Mixing	Unknown	Unknown	Unknown	Associated Press, 03/29/2000	
14	3/29/2000	Nashville, Tennessee	Metro Water Services	Ferric chloride and sodium hypochlorite	Acid	Undetermined	Sodium hypochlorite	Undetermined	Acid/base	Known	Storage Tank	Other	0	Yes	No	TG	No	Incompat. Mixt - Inadvertent Mixing	Unknown	No	No	Associated Press, 2/25/2000	
15	1/13/2000	Pasadena, Texas	Goodyear Tire and Rubber Company	Mercaptan polymer and methacrylate, and/or possible other chemicals	NA	Unknown	NA	NA	Unknown	NA	Process Tank	Chem Manufact	0	No	No	TG	Unknown	Unknown	Unknown	Unknown	Unknown	Houston Chronicle, 01/13/2000	
16	12/9/1999	Oak Ridge, Tennessee	DOE Y-12 Plant	Potassium superoxide and mineral oil	Oxidizer	1	Hydrocarbon	0	Oxidation	Known	Unknown	Chem Manufact	0	Yes	Yes	F&E	No	Thermal/ Mechanical Shock - Inadvertent Mixing	Inadequate hazard identification and evaluation, inadequate procedures and training for controls to prevent the loss of control resulting in a spill or to preclude the addition of mineral oil and impact in the presence of potassium superoxide during spill recovery	Unknown	No	No	DOE Type A Accident Investigation of the NAK explosion in building 5001-5 at the Y-12 plant in Oak Ridge
17	11/2/1999	West Paterson, New Jersey	CCP Inc.	Various chemicals, including potassium compounds	NA	Unknown	NA	NA	Unknown	NA	Unknown	Chem Manufact	0	Yes	No	TG	Yes	Unknown	Unknown	Unknown	Unknown	Bergen Record, 11/03/1999 and 11/15/1999	
18	10/25/1999	Livonia, Michigan	McGraw-Hill/COHCO Inc.	Water and chromium oxide	Oxidizer	1	Water	NA	Unknown	NA	Process Tank	Chem Manufact	0	Yes	Yes	F&E and TG	Yes (Injury)	Unknown	Unknown	No	No	Detroit Free Press 10/30/1999, National Response Center Incident Report #041511	
19	9/4/1999	Bucks, Alabama	Celanese Chemicals Inc.	Sodium hydroxide and water	Sodium hydroxide	2	Water	NA	Water reactive	Known	Separation Equipment	Chem Manufact	1	Yes	No	TG	No	Incompat. Mixt - Opening procedure	Inadequate identification and evaluation chemical reactivity hazards, inadequate communication and training on chemical hazards	No	No	Chemical Process Safety Report 500, Associated Press 09/06/99, OSHA Incident Summary Interview	

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 491325	Chemical 2 Class	Chemical 2 NFPA Number from 491325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
20	9/2/1999	El Dorado, Arkansas	Con-Agra Poultry Co.	Chlorine dioxide and ferric chloride	Oxidizer	Undetermined	Inorganic-salt	Undetermined	Acid/base	Known	Storage Tank	Other	0	Yes	Yes	F&E and TG	Unknown	Incompat. Mixts - Inadvertent Mixing	Unknown	Yes (Listed)	Yes (toxic)	National Response Center Incident Report # 497529
21	8/11/1999	Rahoboth Beach, Delaware	City of Rehoboth Beach Waste Water Treatment Plant	Sodium hypochlorite and ferric chloride	Sodium hypochlorite	Undetermined	Acid	Undetermined	Acid/base	Known	Storage tank	Waste	0	Yes	No	TG	Unknown	Incompat. Mixts - Inadvertent Mixing	Unknown	No	No	National Response Center Incident Report # 494744
22	8/6/1999	Alamogordo, New Mexico	Alamogordo waste water pump station (Professional Services Group, Inc.)	Sodium hypochlorite and urea	Sodium hypochlorite	Undetermined	Amine	Undetermined	Redox / Decomposition	Known	Storage tank	Waste	1	Yes	Yes	F&E	No	Incompat. Mixts - Inadvertent Mixing	Unknown	No	No	Albuquerque Journal, 08/10/1999
23	8/2/1999	Pasadena, Texas	Akzo Nobel	Peroxy-dicarbonate	Organic peroxide	Undetermined	NA	NA	Decomposition	Known	Transfer	Chem Manufact	0	Yes	Yes	F&E	Unknown	Thermal run away - (NOS)	Unknown	No	No	Marsh Quarterly Loss Report, 11/1/99, Chem Week, 08/11/1999
24	7/13/1999	Azusa, California	Reichold Chemicals	Unknown	Monomer	Unknown	NA	NA	Polymerization	Known	Reactor	Chem Manufact	0	Yes	No	TG	Yes	Thermal run away - Control system failure	Unknown	Unknown	Unknown	City News Service, 07/13/1999
25	8/23/1999	Pasadena, Texas	Phillips Chemical	Butadiene	Monomer	2	NA	NA	Polymerization	Known	Reactor	Chem Manufact	2	Yes	Yes	F&E	No	Thermal run away - Mixture	Inadequate hazard evaluation during management of change, inadequate procedural training, inadequate process hazards analysis, inadequate emergency relief design	Yes (flammable)	Yes (flammable)	OSHA Incident Summary Interview
26	8/4/1999	Whitehall, Michigan	Whitehall Leather Company	Sodium hydrosulfide and ferrous sulfate	Base	Undetermined	Acid	Undetermined	Acid/base	Known	Storage Tank	Other	1	Yes	No	TG	No	Incompat. Mixts - Inadvertent Mixing	Inadequate procedures to prevent inadvertent mixing of incompatible chemicals, practices and management controls to ensure safe delivery of chemicals	No	No	NTSB report
27	2/19/1999	Allentown, Pennsylvania	Concept Sciences Inc.	Hydroxylamine	Hydroxylamine	3	NA	NA	Decomposition	Known	Separation Equipment	Chem Manufact	5	Yes	Yes	F&E	Yes (Fatality)	Thermal/ Mechanical Shock - Incorrect operating conditions	Inadequate safe operating limits and inadequate hazard evaluation during design	Yes (listed)	No	Hazard Research Corporation Report 8034 to Department of Labor 7/2/99; OSHA Incident Summary Interview, IChemE

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 490325	Chemical 2 Class	Chemical 2 NFPA Number from 490325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
28	2/15/1999	Clymers, Indiana	Esroc Cement Corporation	Toluene diisocyanate	Monomer	3	NA	NA	Polymerization	Known	Storage Tank	Other	0	No	Yes	F&E	Yes	Thermal run away - Excess heating	Inadequate procedures for offloading railcars resulting in excess heating of a polyisocyanate material	No	Yes (Toxic)	NTSB Report H2M-0101
29	1/29/1999	Beaumont, Texas	Arch Chemicals, Inc (Din Corporation)	Unknown	NA	Unknown	NA	NA	Unknown	NA	Storage Tank	Chem Manufact	0	No	No	TG	Unknown	Unknown	Unknown	Unknown	Unknown	EPA RMP #1000 0015 2416; ERNS Report # 611084
30	11/19/1998	Louisville, Kentucky	Ford Motor Co.	Nickel nitrate and phosphoric acid solution (CHEMPCOS 700), sodium nitrate solution (CHEMPCOS LIQ)	Oxidizer	Undetermined	Inorganic	Undetermined	Redox	Known	Storage Tank	Other	0	Yes	Yes	TG	Yes	Incompat. Mixts - Inadvertent Mixing	Inadequate training on procedures for unloading chemicals, inadequate design to prevent human error	No	No	NTSB report DCA 98M2003, NRC #32-98
31	11/6/1998	Crosby, Texas	Alfina Chemicals, Inc.	Sulfated isobutylene intermediate	Organic peroxide	Unknown	NA	NA	Decomposition	Known	Process Tank	Chem Manufact	0	No	Yes	TG	Yes	Thermal run away - (NOS)	Unknown	Unknown	Unknown	RMP Submission Facility ID 1000 00124457; Houston Chronicle, 10/7/98
32	10/13/1998	Baltimore, Maryland	Condea Viata	Aluminum, aluminum chloride, water	Inorganic-metal	1	Inorganic-metalhalide	2	Water reactive	Known	Reactor	Chem Manufact	0	No	\$14,400,000	F&E	No	Thermal run away - Operating procedure	Inadequate hazard identification and assessment, inadequate communication of hazards, and inadequate management of change	No	No	CSB Case File; RMP Submission Facility ID 1000 00040261
33	8/20/1998	Philadelphia, Pennsylvania	Ashland Chemical Company	Dicyclopentadiene, (and other chemicals including maleic anhydride, ethylene glycol, diethylene glycol)	Monomer	1	NA	NA	Polymerization/Decomposition	Known	Reactor	Chem Manufact	0	No	No	TG	Yes	Thermal run away - Excess heating	Inadequate design to prevent human error, inadequate Safe Operating Limits	Yes (Flammable)	No	NRC incident summary 23-98, Ashland Chemical Investigation Report
34	7/29/1998	Covington, Virginia	Westvaco	Sodium hydrosulfide and sulfuric acid	Base	Undetermined	Acid	2	Acid/base	Known	Storage Tank	Chem Manufact	0	Yes	No	TG	No	Incompat. Mixts - Operating procedure	Unknown	No	No	National Response Center Incident Report #449369, 07/29/1998, Label from Westvaco company describing the incident 04/28/2001
35	7/21/1998	Holland, Michigan	Holland Public Works	Sodium hypochlorite and aluminum sulfate	Sodium hypochlorite	Undetermined	Inorganic-salt	Undetermined	Acid/base	Known	Storage tank	Other	0	Yes	No	TG	Unknown	Incompat. Mixts - Inadvertent mixing	Unknown	No	No	National Response Center #447365

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 480325	Chemical 2 Class	Chemical 2 NFPA Number from 480325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
36	4/8/1998	Paterson, New Jersey	Morton International	Ortho-nitrochlorobenzene (o-NCB) and 2-ethylhexylamine (2-EHA)	Nitro compound	0	Amine	0	Amination / Decomposition	Known	Reactor	Chem Manufact	0	Yes	Yes	F&E and TG	Yes	Thermal runaway - Incorrect Operating Conditions	Inadequate communication of chemical hazards, inadequate management of change, inadequate hazard assessment	No	No	CSB Morton Incident Report 1998-05-14J
37	1/14/1998	Freeport, Texas	Dow Chemical Co.	Unknown	NA	Unknown	NA	NA	Unknown	NA	Reactor	Chem Manufact	0	Yes	No	TG	No	Unknown	Unknown	Unknown	Unknown	National Response Center Incident Report # 419781
38	12/19/1997	Marcus Hook, Pennsylvania	Sun Oil	Sodium hypochlorite and an acid	Sodium hypochlorite	Undetermined	Acid	Unknown	Acidbase	Known	Storage Tank	Refinery	0	Yes	No	TG	Unknown	Incompat. Mixts - Inadvertent mixing	Unknown	No	No	National Response Center Incident Report #416599, 12/19/1997
39	10/4/1997	Houston, Texas	Cook Composites and Polymers	n-butyl acrylate, di-tertiary-butyl peroxide (catalyst)	Monomer	2	Organic peroxide	Undetermined	Polymerization	Known	Reactor	Chem Manufact	0	No	Yes	F&E and TG	No	Thermal runaway - Mischarge	Inadequate operating procedural training, inadequate hazard evaluation, inadequate human factors engineering, inadequate near miss reporting and incident investigation	No	No	CCPS Conference - Michael Cromaki October 2000
40	9/10/1997	Columbus, Ohio	Georgia Pacific Resins	Phenol-formaldehyde	Alcohol	0	Aldehyde	0	Polymerization	Known	Reactor	Chem Manufact	1	Yes	Yes	F&E	Yes	Thermal runaway - Mischarge	Inadequate hazard assessment, inadequate human factors engineering, inadequate emergency relief system design	Yes (listed)	Yes (toxic)	EPA Case Study "How to Prevent Runaway Reactions," EPA 550-F99-004, August 1999, Chem Week 02/05/1999, US Dept. Labor News Release, 95-5A, 03/02/1995
41	8/21/1997	Bennettsville, South Carolina	Willamette Industries, Inc.	Chlorine dioxide and an acid	Oxidizer	Undetermined	Acid	Unknown	Acidbase	Known	Process Tank	Chem Manufact	0	Yes	Yes	TG	Unknown	Incompat. Mixts - (NDS)	Unknown	Yes (listed)	Yes (toxic)	EPA RMP #1000 0007 7418
42	7/30/1997	Cedar City, Utah	Western Electro Chemical, a division of American Pacific	Ammonium perchlorate	Oxidizer	4	NA	NA	Decomposition	Known	Process Tank	Chem Manufact	1	Yes	Yes	F&E	No	Thermal/ Mechanical Shock Operating Procedure	Inadequate hazard evaluation, inadequate safety work procedures and training for clearing of equipment with reactive chemical	Yes (listed)	No	Las Vegas Review Journal, Chemical Week, 07/31/1997, OSHA Inspection 126775008

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 490325	Chemical 2 Class	Chemical 2 NFPA Number from 490325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
43	5/14/1997	Richland, Washington	US DOE Hanford Site Plutonium Reclamation Facility	Hydroxylamine nitrate and nitric acid	Hydroxylamine	Undetermined	Acid	0	Decomposition	Known	Storage Tank	Other	0	No	Unknown	F&E	No	Thermal run away - Incorrect Operating Conditions	Inadequate hazard evaluation inadequate existing of safety management systems, inadequate training for personnel on reactive hazards	Yes (listed)	No	US DOE/RL-97-59
44	5/8/1997	West Helena, Arkansas	BPS, Inc.	Azinphos methyl (AZM 50 W)	Organo-phosphate	Undetermined	NA	NA	Decomposition	Known	Storage Area	Storage	3	Yes	Yes	F&E and TG	Yes (Fatality)	Thermal run away - Incorrect Storage Conditions	Lack of knowledge of all the hazards posed by the chemicals stored on-site (inadequate hazard identification) Inadequate hazard evaluation Lack of procedures for material storage and handling	No	No	EPA/OSHA Joint Chemical Accident Investigation Report, EPA-550-R-99-003 4/1999
45	3/26/1997	Haskell, Oklahoma	Chief Supply Corporation	Chlorates, perchlorate nitrates, and fuels (special solvents and cleaners)	Oxidizer	3	Hydrocarbon	0	Oxidation	Known	Process Tank	Waste	1	Yes	Yes	F&E and TL	Yes	Incompat. Mixture - Operating procedure	Inadequate hazard identification and hazard evaluation inadequate communication of hazards to operators, no controls to prevent human error.	Yes (flammable)	No	CEPRC-Chemical Case Study EPA 550-PDC-001, 4/2000
46	3/25/1997	Newark, New Jersey	Fairmount Chemical	4,4 diazido stilbene disodium sulfonate	Sulfonated compound	Undetermined	NA	NA	Decomposition	Undetermined	Process Tank	Chem Manufact	0	No	Yes	F&E	No	Thermal run away - Incorrect Operating Conditions	Inadequate knowledge of process chemistry hazards (inadequate hazard identification).	No	No	OSHA Incident Summary Interview
47	2/20/1997	Hammond, Indiana	Rhode Inc.	Hydrochloric acid and chloroform	Acid	Undetermined	Chloroform	0	Unknown	NA	Storage Tank	Chem Manufact	0	Yes	No	TG	Yes (Injury)	Unknown	Unknown	No	Yes (toxic)	RMP Submission Facility ID 1000 0009 0536
48	1/23/1997	Bloomington, Minnesota	EF Alchem North America, Inc.	Acetic acid, hydrogen peroxide, water	Acid	0	Peroxide	3	Unknown	NA	Transfer	Chem Manufact	1	Yes	Yes	F&E	Unknown	Unknown	Unknown	Maybe (concentration)	No	OSHA IMIS, Chemical Marketing Reporter 2/11/97
49	1/21/1997	Martinez, California	Toaco Avon Refinery	Light oils, hydrogen, and catalysts	Hydrocarbon	0	Hydrogen	0	Catalytic cracking	Known	Reactor	Refinery	1	Yes	\$20,000,000	F&E	Yes	Thermal run away - Incorrect Operating Conditions	Inadequate hazard assessment, inadequate human factors design, inadequate operating procedural training, and inadequate maintenance of safety critical devices	Yes (flammable)	Yes (flammable)	EPA Investigation Report 550-R-98-006, Mans and McLerran, 18th Edition, RMP Summary Facility ID 1000 0014 5104

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 48/325	Chemical 2 Class	Chemical 2 NFPA Number from 48/325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
50	11/17/1996	Bessemer City, North Carolina	FMC Corporation	Lithium and water	Inorganic-metal	2	Water	NA	Water reactive	Known	Reactor	Chem Manufact	0	No	Yes	F&E	Yes	Incompat. Mixts - Operating Procedure	Unknown	No	No	Gaston Observer, 04/21/1997; The Charlotte Observer, 09/25/1996.
51	8/28/1996	North Adams, Massachusetts	Modern Aluminum Anodizing Co	Mix of chemicals	NA	Unknown	NA	NA	Unknown	NA	Waste System	Other	2	No	No	TG	No	Incompat. Mixts. - (NOS)	Unknown	Unknown	Unknown	Associated Press
52	9/27/1996	Victoria, Texas	Lyondal Polymers	Ethylene	Hydrocarbon	2	NA	NA	Decomposition	Known	Reactor	Chem Manufact	0	No	Yes	F&E	No	Thermal run away-incorrect Operating Conditions	Equipment design and operating conditions promoted an uncontrolled reaction	Yes (Flammable)	Yes (Flammable)	Ethylene decomposition event Daniel E. Black CCPS International Conference Oct. 1997
53	9/9/1996	Newton, Illinois	Central Illinois Publ Service Company	Sodium hydroxide and sulfuric acid	Base	1	Acid	2	Acidbase	Known	Storage tank	Other	0	Yes	Yes	F&E and TL	Unknown	Incompat. Mixts - Inadvertent Mixing	Unknown	No	No	OSHA IMIS
54	4/12/1996	Toccoa, Georgia	Aerquip Corp. Aerospace Marine Group Clamp Prod.	Nitric acid and unknown chemical	NA	Undetermined	NA	NA	Unknown	NA	Process Tank	Other	0	Yes	No	TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	Maybe (concentration)	Maybe (concentration)	OSHA IMIS
55	12/5/1996	Nitro, West Virginia	FMC Corporation	Phosphorus and chlorine	Inorganic	1	Halogen	0	Chlorination	Known	Reactor	Chem Manufact	0	No	No	TG	Yes	Thermal run away-incorrect operating conditions	Unknown	Yes (leaked)	Yes (toxic)	FMC Nitro incident report to Responsible Care Coordinator at Great Lakes Nitro, WV.; Charleston Daily Mail, Herley vs. FMC Corp
56	11/3/1996	Auburn, Washington	Boeing Co. dba Boeing Commercial Airline Group	Acids and unknown chemical	Acid	Unknown	NA	Unknown	Redox	Known	Storage Tank	Other	0	Yes	No	TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	Unknown	Unknown	OSHA IMIS
57	10/23/1995	Bogalusa, Louisiana	Gaylord Chemical Corp.	Nitrogen trioxide	Oxidizer	Undetermined	Water	NA	Water reactive	Known	Storage area	Chem Manufact	0	Yes	No	TG	Yes (Injury)	Incompat. Mixts - Inadvertent Mixing	Inadequate procedures to prevent or detect the contamination of nitrogen trioxide with water	Yes (leaked)	No	NTSB Report DCA-95-MZ-001; Chemica Week, July 10, 1996
58	10/7/1995	Cincinnati, Ohio	Spring Grove Resource Recovery	Sodium azide and an acidic aqueous solution	Sodium azide	Undetermined	Acid	Unknown	Decomposition	Known	Drum	Chem Manufact	1	No	Yes	F&E	No	Thermal/Mechanical Shock - (NOS)	Unknown	No	No	OSHA IMIS, Cincinnati Enquirer
59	9/14/1995	Danbury, Connecticut	Bedoukian Research, Inc	Lithium aluminum hydride (LAH) and water.	Reductant	2	Water	NA	Water reactive	Known	Reactor	Chem Manufact	0	Yes	Yes	F&E	Unknown	Incompat. Mixts - Inadvertent Mixing	Unknown	No	No	OSHA IMIS
60	8/16/1995	Tonawanda, New York	FMC Corporation	Ammonium persulfate	Inorganic-persulfate	Undetermined	NA	NA	Decomposition	Unknown	Storage area	Chem Manufact	1	Yes	Yes	F&E	No	Thermal run away - (NOS)	Unknown	No	No	NFPA Report, Chem Week, Sept 6, 1995. ICHENE Sedgewick Loss Control Newsletter, Issue 4, 1995
61	5/26/1995	Sulphur, Louisiana	Westlake Polymers Corp	Ethylene	Hydrocarbon	2	NA	NA	Decomposition	Known	Transfer	Chem Manufact	0	Yes	Yes	F&E	Unknown	Thermal run away - (NOS)	Unknown	Yes (Flammable)	Yes (Flammable)	RMP Submission Facility ID 1000-0014-4471

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 MFPA Number from 49/325	Chemical 2 Class	Chemical 2 NFPA Number from 49/325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
62	5/16/1995	Marion, Illinois	Reichold Chemicals	Maleic anhydride and water	Anhydride	1	Water	NA	Water reactive	Known	Reactor	Chem Manufact	0	Yes	Unknown	TL	Unknown	Incompat. Matls. - (NOS)	Unknown	No	No	Chemical Week, May 31, 1995, July 12, 1995
63	5/9/1995	Fountain Inn, South Carolina	Holly Oak Chemical Co.	2-ethylhexano-1, phosphoric anhydride (powder form) and hydrogen peroxide	NA	Unknown	Peroxide	3	Unknown	NA	Reactor	Chem Manufact	0	Yes	Yes	F&E	Unknown	Unknown	Unknown	Maybe (concentration)	No	OSHA IMIS
64	5/6/1995	Bennettsville, South Carolina	Willamette Industries, Inc.	Hydrogen and chlorine dioxide	Hydrogen	0	Oxidizer	Undetermined	Decomposition	Known	Process Tank	Chem Manufact	0	No	Yes	TG	No	Incompat. Matls. - (NOS)	Unknown	Yes (listed)	Yes (Toxic)	EPA RMP #1000 0007 T418, ERMS report 442055
65	4/21/1995	Lodi, New Jersey	Napp Technologies	A gold precipitating agent identified as AC29031 GFA, composed of sodium hydrosulfite, aluminum powder, potassium carbonate and benzaldehyde	Sodium hydrosulfite	2	Inorganic-metal	1	Water reactive / Decomposition	Known	Process Tank	Chem Manufact	5	Yes	\$30,000,000	F&E and TG	Yes	Incompat. Matls. - Mechanical Failure	Inadequate hazard evaluation, inadequate procedural training, inadequate communication between vendor/supplier, improper equipment design	No	No	EPA/OSHA Joint Accident Investigation Report, 550-86 97-002, 10/1/97, OSHA Investigation Report, Marsh & McLennan 30 Year Review, 10th Ed.
66	12/00/1994	Riceboro, Georgia	SNF Holding Company	Monomer, methyl chloride and iron (catalyst)	NA	0	NA	NA	Polymerization	NA	Reactor	Chem Manufact	0	Yes	No	TG	Yes (Injury)	Thermal run-away Contamination	Unknown	Yes (listed)	Yes (toxic)	RMP Submission EPA ID 1000 0002 9774
67	12/16/1994	Dublin, California	Trox	Activated carbon and ozone	Carbon	Undetermined	Oxidizer	Undetermined	Oxidation	Known	Process Tank	Other	0	No	Yes	F&E	Unknown	Incompat. Matls. - (NOS)	Unknown	Yes (listed)	No	OSHA IMIS
68	12/13/1994	Port Neal, Iowa	Terra Industries	Ammonium nitrate and nitric acid	Oxidizer	3	Acid	0	Decomposition	Known	Reactor	Chem Manufact	4	Yes	\$120,000,000	F&E	Yes	Thermal/ Mechanical Shock - Incorrect Operating Conditions	Inadequate standard operating procedures, inadequate hazard evaluation	No	No	EPA Chemical Accident Investigation Report, Terra Industries, Marsh & McLennan 30 Year Review, 10th ed, Chem Week 7/28/95, 12/21/94, 1/3/96, Wilfred Baker Engineering Emergent Events Publication
69	9/16/1994	Mesa, Arizona	TRW	Sodium azide	Sodium azide	Undetermined	NA	NA	Decomposition	Known	Transfer	Other	1	Yes	Yes	F&E	No	Thermal/ Mechanical Shock - (NOS)	Unknown	No	No	Crane's Cleveland Business, 11/27/1995, Automotive News, 11/20/1995
70	8/17/1994	Columbus, Ohio	Capital Resins Corp	Pheno-Formaldehyde	Alcohol	0	Aldehyde	0	Polymerization	Known	Reactor	Chem Manufact	0	No	Unknown	TL	Yes	Thermal run-away - Insufficient Cooling	Inadequate human factors engineering, inadequate procedures and training	Yes (listed)	Yes (toxic)	EPA How to Prevent Runaway Reaction, August 1999, EPA Region 5 Chemical Safety Audit

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 49325	Chemical 2 Class	Chemical 2 NFPA Number from 49325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
71	07/01/94	San Diego, California	Toppen West Inc.	Ammonium hydroxide and hydrogen peroxide	Base	Undetermined	Peroxide	3	Decomposition	Known	Drum	Other	0	Yes	Yes	F&E	Unknown	Incompat. Mixts - Inadvertent mixing	Unknown	Maybe (concentration)	No	OSHA IMS
72	6/21/1994	Bristol, Pennsylvania	United Chemical Technologies	Trichloroethylene and styrene	Chloroethylene	2	Monomer	2	Polymerization	Known	Drum	Chem Manufact	0	Yes	Yes	F&E and TG	Yes	Thermal run-away - Excess Heating	Unknown	Yes (labeled)	Yes (flammable)	Chemical Week, 6/25/94, Waste Environment Today, 1994, 7
73	5/31/1994	Enfield, Connecticut	Town of Enfield Water Pollution Control Plant	Ferric chloride and sodium hypochlorite	Acid	Undetermined	Sodium hypochlorite	Undetermined	Acidbase	Known	Storage tank	Waste	0	Yes	No	TG	Unknown	Incompat. Mixts - Inadvertent mixing	Unknown	No	No	OSHA IMS
74	5/27/1994	Belpre, Ohio	Shell Chemical	Isobutylene	Monomer	2	NA	NA	Polymerization	Known	Reactor	Chem Manufact	3	No	\$100,000,000	F&E and TG	Yes	Thermal run-away - Mischarge	Inadequate process controls, inadequate training, inadequate inspection/maintenance program for pressure relief devices, the reaction "kill system" was inadequate, emergency relief system sizing was inadequate, inadequate piping/separation of the process from the control room and the tank farm	Yes (flammable)	Yes (flammable)	Marsh & McLennan 30 Year Review, 15th Ed., Risk Management Program Handbook, 1994 Vol 1, IChemE Accident Database, OSHA Incident Summary Interview.
75	5/8/1994	Hagerstown, Maryland	C.M. Offway & Sons, Inc.	Thiourea and sulfuric acid	Amine	Undetermined	Acid	2	Acidbase	Known	Process Tank	Other	0	Yes	No	TG	Unknown	Thermal run-away - Mischarge	Unknown	No	No	OSHA IMS
76	3/23/1994	Philadelphia, Pennsylvania	Unknown	Sodium hydroxide and water	Sodium hydroxide	2	Water	NA	Water reactive	Known	Drum	Unknown	0	Yes	No	TG	Unknown	Incompat. Mixts - Inadvertent mixing	Unknown	No	No	Appendix of EPA/OSHA Joint Accident Investigation Report (EPA 550-R-97-002)
77	3/19/1994	Taft, Louisiana	Occidental Chemical Corporation	Nitrogen trichloride	Nitrogen trichloride	Undetermined	NA	NA	Decomposition	Known	Separation Equipment	Chem Manufact	0	Yes	Yes	F&E and TG	No	Thermal/Mechanical Shock - Incorrect Operating Conditions	Inadequate process understanding led to equipment design and operating conditions which promoted accumulation of nitrogen trichloride and uncontrolled reaction	No	No	Nitrogen trichloride, a collection of papers, Pamphlet 21, edition 4, 1977.
78	1/12/1994	Caldon, California	Londa Corporation	Sodium chlorite and sodium borohydride	Oxidizer	1	Inorganic-hydride	Undetermined	Unknown	NA	Process Tank	Chem Manufact	0	Yes	Yes	F&E	Unknown	Incompat. Mixts - (NOS)	Unknown	No	No	OSHA IMS
79	12/2/1993	Abingdon, Maryland	Alcoa	Aluminum and water	Inorganic-metal	1	Water	NA	Water reactive	Known	Drum	Other	0	Yes	Yes	F&E	Unknown	Incompat. Mixts - Inadvertent mixing	Unknown	No	No	OSHA IMS

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 MFPA Number from 490325	Chemical 2 Class	Chemical 2 NFPA Number from 490325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
80	04/19/93	Pittsburgh, Pennsylvania	Unknown	Aluminum powder	NA	1	NA	NA	Unknown	NA	Process Tank	Other	1	No	Yes	F&E	Unknown	Unknown	Unknown	No	No	Appendix of EPA/OSHA Joint Accident Investigation Report (EPA 550-R-97-002)
81	02/27/1993	Elyria, Ohio	Aztec Chemical Co. (division of Phillips petroleums)	Organic peroxide	Organic peroxide	Unknown	NA	NA	Decomposition	Known	Transfer	Chem Manufact	0	No	Yes	F&E and TG	Yes	Thermal run away - Incorrect Operating conditions	Unknown	Unknown	Unknown	Chemical Process Safety Report January 1994, Chem Week 82593, MHIDAS
82	01/16/1993	Institute, West Virginia	Rhone Poulenc	Insoluble by-products of the reaction between acetyl oxide and chlorine primarily dichloro-nitrosocethane (DCNE)	Unknown	Undetermined	Unknown	Undetermined	Decomposition	Known	Reactor	Chem Manufact	1	Yes	Yes	F&E and TL	No	Thermal/ Mechanical Shock - Incorrect Operating Conditions	Modifications to process operation without a adequate assessment of reactivity hazards, inadequate investigation of previous incidents	Yes (labeled)	Yes (toxic)	Chemical Week, 02/17/1994, OSHA Incident Summary Interview
83	7/16/1993	Laporte, Texas	Akzo Chemicals	Organic peroxides	Organic peroxide	Unknown	NA	NA	Decomposition	Known	Drum	Chem Manufact	0	No	Yes	F&E	Unknown	Thermal run away - Insufficient Cooling	Unknown	Unknown	Unknown	Chemical Week, 7/28/93, NRC # 18936
84	7/21/1993	Crosby, Texas	EF Atochem, Inc.	Organic peroxides	Organic peroxide	Unknown	NA	NA	Decomposition	Known	Storage area	Chem Manufact	0	Yes	No	TG	Yes (Injury)	Unknown	Unknown	Unknown	Unknown	Chemical Week, 03/04/1993, NRC 187670
85	5/28/1993	Kansas City, Missouri	Cook Composites and Polymers	Styrene	Monomer	2	NA	NA	Polymerization	Known	Process Tank	Chem Manufact	0	Yes	No	TG	Yes (Injury)	Unknown	Unknown	Yes (flammable)	No	NRC #177100, 05/29/1993
86	5/27/1993	Fort Mill, South Carolina	R-M Industries, Inc.	Unknown (solvent)	NA	Unknown	NA	NA	Unknown	NA	Reactor	Chem Manufact	0	Yes	Yes	F&E	Unknown	Unknown	Unknown	Unknown	Unknown	OSHA IMIS
87	4/26/1993	Baton Rouge, Louisiana	Formosa Plastics Corp.	Sulfuric acid, polyglyco	Acid	2	Alcohol	Undetermined	Unknown	NA	Transfer	Chem Manufact	1	No	Unknown	TL	No	Incompat. Mixts - Inadvertent mixing	Unknown	Maybe (concentration)	Maybe (concentration)	OSHA IMIS
88	3/5/1993	Hammond, Indiana	American Maze	Water and phosphorus oxychloride	Water	Undetermined	Phosphorus halide	2	Water reactive	Known	Drum	Other	0	Yes	No	TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	Yes (labeled)	Yes (toxic)	National Response Center Incident Report, #160304, 03/06/1993
89	1/26/1993	Phoenix, Arizona	Dolphin Inc.	Hydrofluoric acid and sodium hydroxide	Acid	Undetermined	Base	1	Acid/base	Known	Drum	Other	0	Yes	Unknown	TL	Unknown	Incompat. Mixts. - (NOS)	Unknown	No	No	OSHA IMIS
90	1/14/1993	Charleston, South Carolina	Albright & Wilson	Chloroalkyl phosphite	Organo-phosphate	Undetermined	NA	NA	Unknown	NA	Reactor	Chem Manufact	0	Yes	No	TG	Unknown	Thermal run away - Mischarge	Unknown	No	No	OSHA IMIS
91	11/9/1992	Morristown, New Jersey	Allied Signal Inc.	Dimethyl sulfate and dimethyl-hydroxylamine	NA	0	Hydroxylamine	Undetermined	Unknown	NA	Reactor	Chem Manufact	0	Yes	Yes	F&E and TG	No	Unknown	Unknown	No	No	National Response Center Incident Report #144035
92	7/21/1992	Ventura, California	Applied Silicone Corporation	Sodium hydroxide, cyanopyridine	Base	1	None	Undetermined	Redox	Known	Reactor	Chem Manufact	1	No	Unknown	TL	Unknown	Unknown	Unknown	No	No	OSHA IMIS
93	8/22/1992	Martinez, California	Unknown	Sulfuric and acid sludge containing hydrocarbons, metal	Acid	2	NA	Unknown	Redox	Known	Waste System	Chem Manufact	1	Yes	Yes	F&E	Unknown	Unknown	Unknown	No	No	NFPA Journal, July/Aug 93

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 49325	Chemical 2 Class	Chemical 2 NFPA Number from 49325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
94	3/29/1992	Vienna, Georgia	Georgia Pacific	Phenol-formaldehyde and unknown catalyst	Alcohol	0	Aldehyde	0	Polymerization	Known	Reactor	Chem Manufact	0	Yes	Yes	F&E and TL	Yes	Thermal run away - (NOS)	Unknown	Yes (listed)	Yes (toxic)	EPA How to Prevent Runaway Reactions, August 1999, EPA Region 4 compliance inspection report
95	1/13/1992	Akin, Texas	Monsanto Company	Glyphosate herbicide (trade name Roundup herbicide)	Organo-phosphate	Undetermined	NA	NA	Decomposition	Undetermined	Process Tank	Chem Manufact	0	No	\$32,000,000	F&E and TG	Unknown	Thermal run away - Excess Heating	Unknown	No	No	Marsh & McLennan 30 Year Review, 18th Ed., Chemical Week, V-158, No. 15, P. 18
96	1/10/1992	Newark, New Jersey	Rohm and Haas	n-butyl acrylate and initiator (Vaso 64)	Monomer	2	NA	Unknown	Polymerization/Decomposition	Known	Process Tank	Chem Manufact	0	Yes	Yes	F&E	Unknown	Thermal run away - (NOS)	Unknown	No	No	NRC Report #102412, EPA ARIIP, Associated Press, 1/12/92
97	12/11/1991	South Charleston West Virginia	Union Carbide	Acetic anhydride, water	Anhydride	1	Water	NA	Water reactive	Known	Process Tank	Chem Manufact	1	No	Yes	F&E	Unknown	Incompat. Matls. - (NOS)	Unknown	No	No	OSHA IMIS
98	12/17/1991	Romeo, Michigan	TRW Inc.	Sodium azide	Sodium azide	Undetermined	NA	NA	Decomposition	Known	Storage area	Other	0	Yes	Yes	F&E	Unknown	Thermal/Mechanical Shock - (NOS)	Unknown	No	No	Detroit Free Press, 12/18/1991, Automotive News, 5/22/1995
99	8/16/1991	Newark, New Jersey	Crompton-Kelco Colors Inc.	Nitrosylsulfuric acid	NA	Undetermined	NA	NA	Unknown	NA	Reactor	Chem Manufact	0	Yes	Yes	F&E	Unknown	Thermal run away - (NOS)	Unknown	No	No	OSHA IMIS
100	7/26/1991	Sacramento, California	Aerjet Industries	Potassium perchlorate aluminum powder	Oxidizer	Undetermined	Inorganic-metal	1	Oxidation	Known	Unknown	Other	0	Yes	Yes	F&E	Unknown	Unknown	Unknown	No	No	EPA/OSHA Joint Chemical Accident Investigation Report Napp Tech—EPA 550-R-97-026
101	7/26/1991	Trion, Georgia	Mount Vernon Mills Inc.	Chemicals forming hydrogen sulfide gas.	NA	Unknown	NA	NA	Unknown	NA	Waste System	Other	0	Yes	No	TG	Unknown	Unknown	Unknown	Unknown	Unknown	OSHA IMIS
102	7/19/1991	Bowling Green, Kentucky	Guardmark, Inc. and Eaton Corp. Cutter Hammer Products	Chromic acid bright dip (chromic acid and sulfuric acid 1%)	NA	Unknown	NA	NA	Unknown	NA	Drum	Other	0	Yes	No	TG	Unknown	Unknown	Unknown	No	No	OSHA IMIS
103	8/17/1991	Charleston, South Carolina	Albright and Wilson	Organophosphate (flame retardant chemical)	Organo-phosphate	Undetermined	NA	NA	Decomposition	Unknown	Reactor	Chem Manufact	0	Yes	\$10,000,000	F&E	Yes	Thermal run away - Inefficient Cooling	Inadequate hazard identification	No	No	Marsh & McLennan 30 Year Review, 14th Ed., OSHA IMIS, Company Investigation Report, Charleston Post and Courier, 8/18/91, 12/20/91, 8/11/94, 2/16/95, 7/23/98.

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 49/325	Chemical 2 Class	Chemical 2 NFPA Number from 49/325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
104	5/1/1991	Sterlington, Louisiana	Angus Chemical, BMC Fertilizers (operating company)	Nitro methane	Nitroparaffins	4	NA	NA	Decomposition	Known	Transfer	Chem Manufact	8	Yes	\$105,000,000	F&E	Yes (Injury)	Thermal/Mechanical Shock-Excess Heating	Inadequate design and inadequate hazard evaluation management of change to address reactivity hazards	Yes (Flammable)	No	Marsh & McLennan 20 Year Review, 15th ed. Chemical Week 10/27/03, OSHA Settlement Agreement 10/31/01, OCFPS Guidance to Chemical Incident Investigation, p250, OSHA Incident Summary Interview, OSHA IMIS
105	4/26/1991	Rossville, Georgia	Klean A Mattic	Muriatic acid and sodium hypochlorite	Acid	Undetermined	Sodium hypochlorite	Undetermined	Acid/base	Known	Storage Tank	Other	0	Yes	No	TG	Unknown	Incompat. Mixts - Inadvertent Mixing	Unknown	No	No	National Response Center, Incident Report #09627, 04/26/91
106	4/24/1991	Newark, Ohio	Wiley Organics Technologies, Inc dba Organic Technology	Alcohol, cumene hydroperoxide, and methylene chloride	Organic peroxide	4	Organic chloride	0	Decomposition	Known	Reactor	Chem Manufact	1	No	Yes	F&E	Unknown	Unknown	Unknown	Yes (listed)	No	OSHA Review Commission and Admin Law Judge Decisions - Wiley Organics - Docket Number 91-3275, OSHA IMIS
107	4/8/1991	Milpitas, California	Lite-On Inc.	Propanol, concentrated hydrofluoric and nitric acids	Alcohol	0	Acid	0	Oxidation	Known	Process Tank	Other	0	Yes	No	TG	Unknown	Incompat. Mixts - Inadvertent Mixing	Unknown	Yes (Flammable)	Yes (toxic)	OSHA IMIS
108	4/5/1991	Titusville, Florida	PB&S Chemical	Sodium hypochlorite and acid	Sodium hypochlorite	Undetermined	Acid	Unknown	Acid/base	Known	Storage Tank	Chem Manufact	0	Yes	No	TG	Unknown	Incompat. Mixts - Inadvertent Mixing	Unknown	No	No	National Response Center, Incident Report #06791
109	3/12/1991	Seadrift, Texas	Union Carbide	Ethylene oxide	Ethylene oxide	3	NA	NA	Decomposition	Unknown	Separation Equipment	Chem Manufact	1	Yes	\$80,000,000	F&E	No	Thermal runaway Unexpected Catalytic Activity	Previously unknown reactive hazard caused by processing conditions and presence of catalyst	Yes (Flammable)	Yes (Flammable)	Lees, Loss Prev. Symposium March 29 - April 1, 1993, Chem Week, Jan 15, 1992, Chemical Engineering Progress, Aug 1993, IChemE Accident Database
110	2/18/1991	South Corneleville, Pennsylvania	Unknown	Hydrazide oil, soybean oil (Vikolite)	NA	Unknown	NA	NA	Unknown	NA	Drum	Other	0	Yes	Yes	F&E and TG	Unknown	Unknown	Unknown	Unknown	MHIDAS	

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 49/325	Chemical 2 Class	Chemical 2 NFPA Number from 49/325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
111	2/16/1991	Madawaska, Maine	Paxer Paper Limited	Sodium hypochlorite and acid	Sodium hypochlorite	Undetermined	Acid	Unknown	Acid/base	Known	Storage tank	Other	0	Yes	Yes	TG	Yes	Incompat. Mixts - Inadvertent Mixing	Unknown	No	No	National Response Center Incident Report #5824, 02/16/1991
112	12/25/1990	Kearns, Utah	SPS Technologies	Freon TP	Chloro-fluorocarbon	Undetermined	NA	NA	Decomposition	Known	Separation Equipment	Other	0	Yes	No	TG	Unknown	Thermal run away - Excess Heating	Unknown	No	No	OSHA IMIS
113	11/6/1990	Madawaska, Maine	Paxer Paper Limited	Sodium hydroxide	Sodium hydroxide	2	NA	NA	Decomposition	Known	Unknown	Other	0	Yes	No	TG	Unknown	Unknown	Unknown	No	No	EPA/OSHA Joint Chemical Accident Investigation Report Napp Tech—EPA 550-R-97-028 NRC-49599, ARIP
114	10/22/1990	Tonawanda, New York	FMC Corporation	Potassium persulfate	Oxidizer	Undetermined	NA	NA	Decomposition	Known	Transfer	Chem Manufact	1	No	Yes	F&E	Unknown	Unknown	Unknown	No	No	OSHA IMIS
115	10/3/1990	Rosamont, Illinois	Redi Cut Foods	Sodium metabisulfite and acid	NA	Undetermined	Acid	Unknown	Oxidation	Known	Unknown	Other	0	Yes	No	TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	No	No	OSHA IMIS
116	7/5/1990	Channahon, Texas	ARCO Chemical Company	Organic peroxide	Organic peroxide	Unknown	NA	NA	Decomposition	Known	Process Tank	Chem Manufact	17	No	\$12,000,000	F&E	No	Thermal run away - Incorrect Operating Conditions	Inadequate safe operating procedures for the peroxide decomposition, inadequate redundant controls to monitor tank contents, inadequate design to prevent human error, use of equipment unsuitable for oxygen enriched atmosphere	No	No	OSHA Report (The ARCO Chemical Company Channahon Complex Explosion and Fire), December 1990
117	5/29/1990	Freeport, Texas	DOW Chemical Co.	Amino-ethyl-ethanolamine and 1,3-dichloropropane	Amine	Undetermined	Chlorinated hydrocarbon	0	Polymerization/Decomposition	Known	Storage Tank	Chem Manufact	0	No	No	TG	Yes	Incompat. Mixts - Inadvertent Mixing	Inadequate procedural controls to prevent human error	Yes (Flammable)	No	Loss Prevention Symposium, Management of reactive chemicals incident, ICHERM Accident Database, NRC Report #24343
118	4/22/1990	Muskegon, Michigan	Lomac Inc.	Phosphorus oxychloride and limestone	Phosphorus halide	2	Base	Undetermined	Redox	Known	Unknown	Chem Manufact	0	Yes	No	TG	Yes (Injury)	Incompat. Mixts. - (NOS)	Unknown	Yes (listed)	Yes (toxic)	ICHERM Accident Database, Detroit Free Press, 4/22/90
119	4/21/1990	Valdosta, Georgia	Chemical Conservation of Georgia, Inc.	3,4 dichloro-1-butene	Chlorinated hydrocarbon	2	NA	NA	Polymerization	Known	Storage Tank	Chem Manufact	0	Yes	Unknown	TL	Unknown	Unknown	Unknown	Yes (Flammable)	No	OSHA IMIS
120	4/16/1990	Barberton, Ohio	PPG Industries	Herbicide	NA	Unknown	NA	NA	Unknown	NA	Separation Equipment	Chem Manufact	1	Yes	Yes	F&E	Unknown	Thermal run away - (NOS)	Unknown	Unknown	Unknown	OSHA IMIS
121	1/20/1990	Lima, Ohio	BP Chemicals	Acrylonitrile and caustic	Monomer	2	Base	1	Polymerization	Known	Process Tank	Chem Manufact	0	Yes	Yes	F&E and TG	Unknown	Thermal run away - contamination	Unknown	Yes (Flammable)	Yes (toxic)	NRC Report #1451, ICHERM Accident Database
122	9/25/1989	West Helena, Arkansas	Cedar Chemical Corporation	Methyl thioacetone	NA	Undetermined	NA	NA	Decomposition	Undetermined	Process Tank	Chem Manufact	0	Yes	Yes	F&E	Unknown	Unknown	Unknown	No	No	OSHA IMIS

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 49/025	Chemical 2 Class	Chemical 2 NFPA Number from 49/025	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
123	6/25/1989	Rocky Mountain, North Carolina	Unknown	Sodium hydroxide and water	Sodium hydroxide	2	Water	NA	Water reactive	Known	Drum	Chem Manufact	0	Yes	No	TG	Unknown	Incompat. Mixts - Inadvertent mixing	Unknown	No	No	EPA/OSHA Joint Chemical Accident Investigation Report Napp Tech—EPA 550-R-97-028
124	10/17/1985	Wilmington, California	US Borax	Hydrochloric acid and sodium chloride	Acid	Undetermined	Oxidizer	1	Oxidation	Known	Drum	Chem Manufact	0	Yes	Yes	F&E	Unknown	Incompat. Mixts - (NOS)	Unknown	No	No	EPA ARIP
125	9/3/1988	Commerce, California	Unknown	Trichloroacetic acid and water	Acid	2	Water	NA	Water reactive	Known	Unknown	Storage	0	Yes	Yes	TG	Yes	Incompat. Mixts - (NOS)	Unknown	No	No	MFEDAS; IChemE Accident Database
126	7/21/1988	Deer Park, Texas	Rohm and Haas	Methylacrylic acid (TMAA)	Monomer	2	NA	NA	Polymerization	Known	Storage Tank	Chem Manufact	0	No	Yes	F&E	Unknown	Thermal runaway - Lack of inhibitor	Inadequate administrative/procedural controls for inhibitor level, lack of adequate procedures to prevent contamination	No	No	Annual Loss Prevention Symposium, 8/23/91
127	6/28/1988	Auburn, Indiana	Bastian Plating Company	Zinc cyanide and nitric acid	Cyanide salt	0	Acid	Undetermined	Redox	Known	Unknown	Other	5	Yes	No	TG	No	Incompat. Mixts - Operating Procedure	Inadequate procedures and training on chemical hazards (includes operators and emergency responders)	No	No	Charleston Gazette, 8/23/89; Indianapolis Star 8/4/91; IChemE Accident Database; IMS, US DCE Occupational Safety Observer, Sept. 1994
128	5/23/1988	Sterling, Virginia	Automata, Inc.	Sodium chlorite, sulfuric acid	Oxidizer	1	Acid	2	Oxidation	Known	Transfer	Other	1	Yes	Yes	F&E	Unknown	Incompat. Mixts - Inadvertent mixing	Unknown	No	No	OSHA IMS
129	5/13/1988	Willow Island, West Virginia	American Cyanamid Company	Sulfur dioxide, toluene, and iron chloride (catalyst)	Non-metal halide	Undetermined	Organic	0	Chlorination / Oxidation	Unknown	Reactor	Chem Manufact	1	Yes	Yes	F&E and TG	Unknown	Thermal runaway - Unexpected catalytic activity	Unknown	Yes (Flammable)	No	OSHA IMS; Brethrick's Handbook
130	5/4/1988	Henderson, Nevada	Pacific Engineering and Production Company Plant (PEPCON)	Ammonium perchlorate	Oxidizer	4	NA	NA	Decomposition	Unknown	Storage Tank	Chem Manufact	2	Yes	Yes	F&E	Yes	Thermal/ Mechanical Shock - Excess Heating	Unknown	Yes (listed)	No	Las Vegas Review Journal, May 3, 1995; CCPS Guidelines for Investigating Chemical Process Incidents-Appendix D; IChemE Accident Database
131	3/21/1988	Charlotte, North Carolina	Unknown	Sodium hydroxide	Sodium hydroxide	2	NA	NA	Water reactive	Known	Drum	Unknown	0	No	Yes	F&E	Unknown	Incompat. Mixts - Inadvertent Mixing	Unknown	No	No	NFPA File Journal, Sept/Oct 1988
132	1/9/1988	Houston, Texas	Archem Co.	Methanol, caustic, ortho nitrochlorobenzene	Nitro compound	0	Alcohol-caustic	0	Redox	Undetermined	Reactor	Chem Manufact	1	Yes	Yes	F&E	Unknown	Unknown	Unknown	Yes (Flammable)	No	OSHA IMS

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 490325	Chemical 2 Class	Chemical 2 NFPA Number from 490325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
133	11/24/1987	Tombaca, California	Mobil	Potassium hydroxide and hydrofluoric acid	Base	1	Acid	Undetermined	Acidbase	Known	Process Tank	Refinery	0	No	\$15,000,000	F&E	Unknown	Incompat. Mixts. - (NOS)	Unknown	Yes (leaked)	Yes (toxic)	Marsh & McLennan, A Thirty-Year Review, 15th edition
134	8/24/1987	Seneca, South Carolina	Engelhard Cos-Specialty Chemicals Div.	Hydrochloric acid, ammonia	Acid	Undetermined	Base	0	Acidbase	Known	Separation Equipment	Chem Manufact	0	Yes	No	TG	Unknown	Incompat. Mixts. - Inadvertent mixing	Unknown	Maybe (concentration)	Maybe (concentration)	OSHA IMIS
135	7/30/1987	Minden, Nevada	ETI Group International, Berkeley Nevada-Main Plant	Sulfuric acid, caustic solution, ammonium chloride, and water	Acid	2	Base	1	Acidbase	Known	Drum	Other	0	Yes	No	TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	No	No	OSHA IMIS
136	5/26/1987	Cincinnati, Ohio	United Service Company	Sodium hypochlorite and acid	Sodium hypochlorite	Undetermined	Acid	Unknown	Acidbase	Known	Unknown	Other	0	Yes	No	TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	No	No	OSHA IMIS
137	01/07/87	Bath, Pennsylvania	Savage Industries Inc.	Sulfuric acid, isopropyl alcohol and acrylonitrile	Monomer	2	Acid	2	Oxidation	Known	Reactor	Chem Manufact	1	Yes	Yes	F&E and TG	Unknown	Thermal run away - Mixture	Unknown	Yes (flammable)	Yes (toxic)	OSHA IMIS, MHDAS
138	12/13/1986	Lobeco, South Carolina	Lobeco Products Inc.	Herbicide intermediate known as A.D.D.	NA	Unknown	NA	NA	Decomposition	Undetermined	Reactor	Chem Manufact	0	Yes	Yes	F&E	Unknown	Thermal run away - (NOS)	Unknown	No	No	OSHA IMIS
139	8/18/1986	Newark, Delaware	Helix Associates, Inc.	Glycerin, sulfuric acid, anisole, and soda	Organic	0	Acid	2	Unknown	NA	Reactor	Chem Manufact	0	Yes	No	TG	Unknown	Unknown	Unknown	Maybe (concentration)	Maybe (concentration)	OSHA IMIS, MHDAS
140	8/15/1986	Hunt Valley, Maryland	McCormick-Stange Flavor Division	Salt, sugar, propylene glycol, caramel coloring, sodium nitrate sodium nitrite	NA	Unknown	NA	NA	Unknown	NA	Process Tank	Other	0	Yes	No	TG	Unknown	Unknown	Unknown	No	No	OSHA IMIS, MHDAS
141	8/15/1986	Pascagoula, Mississippi	First Chemical Corp.	Aniline	Amine	0	NA	NA	Unknown	NA	Separation Equipment	Chem Manufact	0	No	\$10,000,000	F&E	Unknown	Thermal run away - Incorrect Operating conditions	Unknown	No	No	Marsh & McLennan 10th edition, MHDAS
142	8/12/1986	Barcelona, Puerto Rico	Merck Sharp & Dohme Quimica De P.R., Inc.	Nitro ethane (and possibly other chemicals including toluene and ammonia)	Nitroaraffins	3	NA	NA	Decomposition	Known	Reactor	Chem Manufact	3	Yes	Yes	F&E	Unknown	Thermal run away - Excess Heating	Unknown	Yes (flammable)	No	OSHA IMIS
143	1/22/1986	Zelwood, Florida	Douglas Fertilizer & Chemical, Inc.	Magnesium nitrate solution and nitric acid	Oxidizer	Undetermined	Acid	0	Unknown	NA	Unknown	Chem Manufact	1	No	Yes	F&E and TL	Unknown	Incompat. Mixts. - (NOS)	Unknown	No	No	OSHA IMIS
144	11/22/1985	St. Petersburg, Florida	Eci Division of E-Systems, Inc.	Silver cyanide and hydrogen peroxide	Cyanide salt	Undetermined	Peroxide	3	Decomposition	Known	Drum	Other	0	Yes	Yes	F&E and TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	Maybe (concentration)	No	OSHA IMIS
145	11/6/1985	Cary, North Carolina	Town of Cary Department of Public Works	Trichloro-s-triazine, calcium hypochlorite	Acid	2	Inorganic	1	Water reactive	Known	Waste System	Other	0	Yes	Yes	F&E	Unknown	Unknown	Unknown	Unknown	Unknown	OSHA IMIS
146	10/1/1985	Dayton, Ohio	Monark Company	Bromine liquid, acetone	Inorganic-halogen	0	Organic	0	Halogenation	Known	Process Tank	Chem Manufact	0	Yes	No	TG	Unknown	Incompat. Mixts. - Inadvertent Mixing	Unknown	Yes (leaked)	Yes (toxic)	OSHA IMIS
147	8/29/1985	Rowebuck, South Carolina	Abco Industries Inc.	Thiourea dioxide and water	Urea	Undetermined	Water	NA	Water reactive	Known	Process Tank	Chem Manufact	0	Yes	No	TG	Yes	Incompat. Mixts. - (NOS)	Unknown	No	No	OSHA IMIS, MHDAS
148	8/26/1985	West Chester, Pennsylvania	Unknown	Unknown	NA	Unknown	NA	NA	Unknown	NA	Unknown	Chem Manufact	0	Yes	No	TG	Yes	Unknown	Unknown	Unknown	Unknown	MHDAS
149	8/11/1985	Institute, West Virginia	Union Carbide	Methylene chloride, amaldicarb oxime	Organic chloride	0	Organic	Undetermined	Decomposition	Known	Storage Tank	Chem Manufact	0	Yes	No	TG	Yes (injury)	Thermal run away - Excess heating	Unknown	No	No	The Charleston Gazette, 11/27/1985, Houston Chronicle, 05/23/1985, MHDAS
150	8/26/1985	Eugene, Oregon	All American Plating Service	33% sulfuric acid and 3% hydrochloric acid, soda ash	Acid	2	Base	1	Acidbase	Known	Process Tank	Other	0	Yes	No	TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	No	No	OSHA IMIS
151	5/8/1985	Barronsville, Illinois	Access Plating Industries	Hydrochloric, sulfuric, and nitric acids (possibly other chemicals)	NA	Unknown	NA	NA	Unknown	NA	Storage Tank	Other	0	Yes	No	TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	Maybe (concentration)	Maybe (concentration)	OSHA IMIS

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 49/225	Chemical 2 Class	Chemical 2 NFPA Number from 49/225	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
152	10/6/1984	Port of New York, New Jersey	Unknown	Malathion	NA	Unknown	NA	NA	Unknown	NA	Storage Tank	Other	0	Yes	No	TG	Yes	Unknown	Unknown	No	No	MHDAS
153	8/24/1984	Colorado Springs, Colorado	Honeywell Inc	Hydrogen chloride and hydrogen peroxide	Acid	Undetermined	Peroxide	3	Decomposition	Known	Process Tank	Other	0	Yes	No	TG	Unknown	Incompat. Mixts. - (NOS)	Unknown	Maybe (concentration)	No	OSHA IMIS
154	8/20/1984	Aurora, North Carolina	Texas Gulf Chemicals Co.	Super phosphate acid	NA	Unknown	NA	NA	Unknown	NA	Storage Tank	Chem Manufact	1	No	Unknown	TL	Unknown	Incompat. Mixts. - Inadvertent mixing	Unknown	No	No	OSHA IMIS
155	6/7/1984	St. Louis, Missouri	US Polymers Inc.	Phthalic anhydride, water	Anhydride	0	Water	NA	Water reactive	Known	Process Tank	Chem Manufact	1	Yes	Unknown	TL	Unknown	Unknown	Unknown	No	No	OSHA IMIS
156	5/23/1984	Fall River, Massachusetts	Swan Finishing Co.	Sulfuric acid and unknown chemicals	NA	2	NA	NA	Unknown	NA	Drum	Other	0	Yes	Yes	F&E and TL	Unknown	Incompat. Mixts. - (NOS)	Unknown	Maybe (concentration)	Maybe (concentration)	OSHA IMIS
157	9/21/1983	Salisbury, North Carolina	Unknown	Acrylonitrile (and possibly other chemicals including methyl-isobutylketone)	Monomer	2	NA	NA	Unknown	NA	Reactor	Chem Manufact	0	Yes	Yes	F&E	Yes	Thermal run away - (NOS)	Unknown	Yes (flammable)	Yes (toxic)	MHDAS
158	Apr-83	Ottawa, Illinois	Unknown	Cumene hydroperoxide, rust, and water	Organic peroxide	4	NA	NA	Decomposition	Known	Storage Tank	Chem Manufact	2	Yes	Yes	F&E	Unknown	Thermal run away - contamination	Unknown	Yes (listed)	No	NFPA Fire Journal, 1/1983
159	Mar-83	South Charleston West Virginia	FMC Corporation	Nitrogen trichloride	Nitrogen trichloride	Undetermined	NA	NA	Decomposition	Known	Separation Equipment	Chem Manufact	1	No	Yes	F&E	Unknown	Thermal/ Mechanical Shock - (NOS)	Unknown	No	No	Nitrogen trichloride case studies documented in the U.S. from the Chlorine Institute, 1997
160	11/12/1982	Taft, Louisiana	Union Carbide	Acrolein and other chemicals	Monomer	3	NA	NA	Polymerization	Known	Storage Tank	Chem Manufact	0	No	Yes	F&E	Yes	Thermal run away - Control System failure	Unknown	Yes (listed)	Yes (toxic)	MHDAS
161	8/2/1982	Cloutport, Mississippi	Plastifac Inc., a division of NL Industries	2-ethylhexanol, nitric and sulfuric acids	Alcohol	0	Acid	2	Nitration	Known	Reactor	Chem Manufact	3	Yes	Yes	F&E	Yes	Thermal run away - Mischage	Unknown	Maybe (concentration)	Maybe (concentration)	MHDAS, OSHA Review Commission and Admin Law Judge Decisions - NL Industries - Docket Number 83-25
162	3/9/1982	Philadelphia, Pennsylvania	Allied Chemical	Cumene hydroperoxide (50%)	Organic peroxide	4	NA	NA	Decomposition	Known	Process Tank	Chem Manufact	0	Yes	\$25,000,000	F&E	Yes	Thermal run away - Excess Heating	Unknown	Yes (listed)	No	Marsh & McLennan 20 Year Review, 18th Ed, Bucks County Courser Times, 03/10/82, Loss Prevention Symposium, 3/82
163	1/22/1982	Lyons, Illinois	Pelton Corporation	Ethylene oxide, phosphorous oxychloride, diethylene glycol	Ethylene oxide	3	Phosphorous halide	2	Decomposition	Known	Reactor	Chem Manufact	1	Yes	Yes	F&E	No	Thermal run away - Mischage	Inadequate operating limits, inadequate procedures and training, inadequate engineering design of emergency relief system	Yes (listed)	Yes (toxic)	OSHA Review Commission and Admin Law Judge Decisions - Pelton Corp. Docket Number 82-388, OSHA Incident Summary Interview

ID#	Date	Location	Company	Chemical(s)	Chemical 1 Class	Chemical 1 NFPA Number from 49/325	Chemical 2 Class	Chemical 2 NFPA Number from 49/325	Type of Reaction	Known/Unknown Chemistry	Equipment Involved	Facility Type	Fatality	Injury	Property Damage	Type of Consequences	Public Impact	Reactive Hazards	Management System Deficiencies	OSHA PSM List	EPA RMP List	Data Source(s)
164	7/19/1981	Greens Bayou, Texas	Unknown	Water and benzenethiolyldichloride	NA	Unknown	NA	NA	Hydrolysis	Known	Reactor	Chem Manufact	0	No	\$10,000,000	F&E	Unknown	Thermal run away - (NOS)	Unknown	No	No	Marsh & McLennan 35 Year Review 15th Ed., MHIDAS
165	5/20/1981	Childersburg, Alabama	Unknown	32% 2-sec-butyl-4-β-nitrophenol	Nitro compound	Undetermined	NA	NA	Unknown	NA	Process Tank	Chem Manufact	0	No	Yes	F&E	Yes	Thermal run away - (NOS)	Unknown	No	No	MHIDAS
166	2/11/1981	Chicago Heights, Illinois	Unknown	Steam and catalyst	NA	Unknown	NA	NA	Unknown	NA	Process Tank	Chem Manufact	1	Yes	\$15,540,000	F&E	Unknown	Thermal run away - Excess Heating	Unknown	Unknown	Unknown	Five Protection Manual for Hydro-processing Plants, Vol. 1, MHIDAS
167	7/23/1980	Seadrift, Texas	Unknown	Ethylene oxide	Ethylene oxide	3	NA	NA	Oxidation / Decomposition	Known	Reactor	Chem Manufact	0	No	\$12,000,000	F&E	Unknown	Thermal run away - (NOS)	Unknown	Yes (listed)	Yes (toxic)	Marsh & McLennan 35 Year Review 18th Ed., MHIDAS

**Table 2. Data field description of reactive incident data**

<b>Data Field</b>	<b>Description</b>
ID #	Number given to track.
Date	Date of incident.
Location	Location of incident.
Company	Facility owner.
Chemicals	Chemicals involved in incident.
Chemical 1 Class	Chemical class for chemical 1.
Chemical 1 NFPA Number from 49/325	NFPA rating given in standard 49 or 325 for chemical 1.
Chemical 2 Class	Chemical class for chemical 2.
Chemical 2 NFPA Number from 49/325	NFPA rating given in standard 49 or 325 for chemical 2.
Type of Reaction	Type of reaction that caused the incident.
Known/Unknown Chemistry	Was knowledge of the chemical reaction involved in incident available in open literature?
Equipment Involved	Equipment where the reaction occurred.
Facility Type	Prominent business operation conducted at facility involved in incident (e.g., chemical manufacturing).
Fatality	Number of fatalities resulting from the incident.
Injury	Did the incident result in an injury?

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Property Damage (\$)	Did the incident result in property damage? And 12 incidents with largest costs regarding property damage.
Consequences	Type of consequences from the incident (e.g., toxic gas release, fire & explosion).
Public Impact	Did incident impact member of public? Public impact is fatality, injury, evacuation, or shelter-in-place of a member of the public.
Reactive Hazards	Classification of the type of reaction involved in the incident.
Management System Deficiencies	Deficiencies in management systems that contributed to the incident. In most cases, this information was not determined by CSB.
OSHA PSM List	For the purposes of analyzing the data, CSB determined if a chemical was covered by OSHA PSM by identifying whether it was listed in PSM or was covered as a flammable chemical by OSHA definition.
EPA RMP List	For the purposes of analyzing the data, CSB determined if a chemical was covered by EPA RMP by identifying whether it was listed in RMP.
Data Sources	Primary sources used to obtain information regarding the incident.

## Appendix A: Hazard Investigation Incident Data Sources

Title	Source
NRC (National Response Center)	U.S. Coast Guard (USCG)
IMIS (Integrated Management Information System)	Occupational Safety and Health Administration (OSHA)
The Accident Database	Institution of Chemical Engineers (ICChemE)
ARIP (Accidental Release Information Program)	U.S. Environmental Protection Agency (EPA)
RMP*Info (Five-Year Accident History Data)	EPA
MHIDAS (Major Hazard Incident Data Service)	Health and Safety Executive, United Kingdom (HSE)
CIRC (Chemical Incident Reports Center)	U.S. Chemical Safety and Hazard Investigation Board (CSB)
Fire Incident Data Organization Database	National Fire Protection Association (NFPA)
Reports of Chemical Safety Occurrences at U.S. Department of Energy (DOE) facilities	DOE
Various Chlorine Related Incident Reports	Chlorine Institute
Hazardous Materials Incident Reports	National Transportation Safety Board (NTSB)
Fire Incident Reports	NFPA
Annual Loss Prevention Symposium (CD ROM)	CCPS
Bretherick's Handbook of Reactive Chemical Hazards, 6th Ed.	Butterworth-Heinemann
Loss Prevention in the Process Industries	F. P. Lees
Large Property Damage Losses in the Hydrocarbon Chemical Industries, A Thirty-Year Review, 18th Ed.	Marsh and McLennan
NAPP Technologies Chemical Accident Investigation Report	EPA/OSHA

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<b>Title</b>	<b>Source</b>
Prevention of Reactive Chemical Explosions	EPA
How to Prevent Runaway Reactions	EPA
Tosco Avon Refinery Chemical Accident Investigation Report	EPA
Surpass Chemical Company Chemical Accident Investigation Report	EPA
Incidents in the Chemical Industry Due to Thermal Runaway Reactions	Barton and Nolan