U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, Environmental Health Surveillance Branch, Atlanta, Georgia

NATIONAL TOXIC SUBSTANCE INCIDENTS PROGRAM (NTSIP)
ANNUAL REPORT 2010

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences (DTHHS)

In 1980, Congress created the Agency for Toxic Substances and Disease Registry (ATSDR) to implement health-related sections of laws that protect the public from hazardous wastes and environmental spills of hazardous substances. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), commonly known as the Superfund Act, designated ATSDR as the lead agency within the U.S. Public Health Service to help prevent or reduce further exposure to hazardous substances and the adverse health effects that might result from such exposures and to expand the knowledge base about such effects.

In accordance with the legislative mandate, this publication reports results and findings of health studies, registries, or other health-related activities supported by ATSDR

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Agency for Toxic Substances and Disease Registry
Attn: Chief, Environmental Health Surveillance Branch, DTHHS
4770 Buford Highway, Mailstop F-58, NE Atlanta, Georgia 30341

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Definition of Acronyms

Acronym	Definition
ACE	Assessment of Chemical Exposures
ADPH	Alabama Department of Public Health
ATSDR	The Agency for Toxic Substances and Disease Registry
CDC	Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNS	Central Nervous System
DALY	Disability-adjusted life year
DOT	Department of Transportation
DNR	Department of Natural Resources
EPA	Environmental Protection Agency
FOA	Funding Opportunity Announcement
GIS	Geographic Information Systems
HAZMAT	Hazardous Materials
HMIS	Hazardous Materials Information System
HIP	Hazmat Intelligence Portal
HSEES	Hazardous Substances Emergency Events Surveillance
HVAC	Heating, Ventilation, and Air Conditioning
IEM	Innovative Emergency Management
IST	Inherently Safer Technology
LEPC	Local Emergency Planning Committee
LHD	Local Health Department
NRC	National Response Center
NTSIP	National Toxic Substance Incidents Program
OSHA	Occupational Safety and Health Administration
PCC	Poison Control Center
PPE	Personal Protective Equipment
VOCs	Volatile Organic Compounds
WHO	World Health Organization
WFC	World Finance Center

1.0 Executive Summary

This Annual Report documents the inaugural year of the National Toxic Substance Incidents Program (NTSIP), the only toxic substance surveillance system to collect information on all aspects of acute toxic incidents. The program has three goals

1. Build capacity at state health departments to establish and maintain a program that
   a. collects information on toxic substance spills,
   b. identifies vulnerable populations by using mapping tools,
   c. creates and implements community intervention strategies,
   d. incorporates green chemistry initiatives, and
   e. enhances toxic substance exposure knowledge.
2. Establish a comprehensive national toxic substance incident database through the maintenance of a data repository that incorporates state data with supplemental data from the National Response Center (NRC) and the Department of Transportation (DOT) to create national toxic substance incident estimates. Use these national estimates to monitor trends and publish information about relevant toxic substance exposure prevention.
3. Support large-scale toxic substance incident investigations through assessment of exposure (ACE) teams. Data and information gathered from these investigations will aid in promoting emergency response and preparedness activities and in creating a cohort of exposed persons that can be followed up to study long-term health effects.

This document reports detailed results of these efforts. The following are key findings of the analysis:

- In 2010, 2,981 NTSIP incidents occurred in fixed facilities or during transportation, resulting in 1,189 injured persons, of which 48 were fatalities.
- More incidents, injuries, and fatalities occurred in fixed facilities than in transportation-related incidents. Fixed facility incidents accounted for 62.5% of all incidents, 88.8% of injuries, and 68.8% of fatalities.
- Of the 1,864 incidents reported in fixed facilities, the Top 20 chemicals were involved in 66.6%. For the 1,117 transportation-related incidents, the Top 10 chemicals were involved in 44.9%.

- A total of 722 incidents were caused by four chemicals: ammonia (n = 133), carbon monoxide (n = 125), chlorine (n = 99), and petroleum (n = 365). These four chemicals resulted in 448 injuries and 13 fatalities. Exposure to carbon monoxide resulted in the most injuries (n = 191) and fatalities (n = 12).
- Human error and equipment failure/malfunction were the primary contributing factors in over 50.0% and 38.0% of all incidents, respectively. Human error accounted for 33.9% of fixed facility events and 77.6% of transportation events and equipment failure/malfunction resulted in 49.1% of fixed facility and 19.4% of transportation related events. These primary contributing factors also resulted in the most injuries 53.5% for human error (composed of 51.5% from fixed facility events and 69.2% from transportation related events) and 29.9% for equipment failure/malfunction (resulting from 31.9% fixed facility and 14.35 transportation related events).
- More than half (50.6%) of all injuries were among the general public.
- 67.2% of injured persons reported only one adverse health effect. Respiratory system problems were the most commonly reported symptom.
- 522 incidents (17.5%) required an ordered evacuation; an additional 51 incidents (1.7%) resulted in a shelter-in-place order.

State activities, such as establishing partnerships with regional health departments, emergency management agencies, and first responders and studying transportation corridors to reduce hazardous material exposures, have resulted in measurable outcomes. These outcomes allow a better understanding of acute toxic substance releases and guidance for initiatives to reduce the morbidity and mortality associated with future releases. The stories in the Annual Report demonstrate both the depth and variety of the program's activities. Each state program creates activities that focus on pertinent issues. The programs are charged with finding innovative solutions to assist emergency management and responders with the information necessary to reduce the effects of a toxic substance spill.

The NTSIP national database uses reported incidents from seven funded states, in conjunction with other national toxic substance incident and injury databases (including NRC and DOT), to estimate the number of toxic substance incidents occurring in all states. In 2010, 15,245 total incidents were estimated to have occurred across the United States; 9,241 incidents were estimated to have occurred in fixed facilities, while 6,004 incidents were estimated to be transportation-related. ATSDR continues to research and acquire data to supplement NTSIP-reported data, strengthening the ratios used to estimate incidents in non-reporting states (see Section 4.0, National Database, to learn how national estimates are derived and view the estimates for 2010). The ability to provide better national estimates of toxic substance incidents supports states to be more proactive in their responses.

The ACE team is a resource for states to use when large spills occur. The team helps collect and document information relevant to an incident. Two ACE Team deployments occurred in 2010:

(1) a chlorine release at a metal recycling facility in California

(2) an ammonia release from a refrigeration facility in Alabama

Each ACE investigation has had positive effects on the health of individuals, prevention of future releases, enhancement of preparedness for chemical release incidents, or monitoring for long-term health effects in the exposed population.

2.0 Introduction

2.1 Historical Perspective and Background

Each day, nearly the entire U.S. population is at risk for exposure from toxic substance spills. Thousands of chemicals surround us at home, work, school, or play. However, very little information exists about these chemicals and the potential threat they pose to the public when they are spilled [1].

What adverse health effects can be expected following exposure to a specific toxin? What is the best evacuation route if an evacuation is ordered in a neighborhood or workplace due to a chemical spill? How prepared are local fire and police departments to deal with the effects of a toxic substance incident? Are hospital employees trained to treat numerous injured persons exposed to multiple toxic substances in the environment? The answers to such questions are important.

Much work remains before the United States can monitor releases throughout the life cycle of toxic substances (including manufacturing, transport, use, and disposal). The result of such monitoring would be a reduction in the number of toxic substance incidents that affect public health.

There is an increased risk among the general public to exposure from spills and releases along corridors used to transport toxic substances across the country. Additionally, changes in zoning requirements and the urban sprawl that has occurred in many cities have left large industries in close proximity to residential areas, increasing the potential for exposure of the public when a toxic substance spill occurs [2].

For example, approximately 14,000 chemical facilities in the United States store or use hazardous substances that could kill or cause serious harm to workers or the nearby public if such substances were released, and more than 450 chemical plants are located near populations of 100,000 people or more [3].

A recent study published by the World Health Organization (WHO) calculated the global burden of disease attributable to both acute and chronic toxic exposures in 2004 at 4.9 million deaths per year. Of this total burden, industrial and agricultural chemicals and acute poisonings (excluding air pollution and drinking water sources contaminated with arsenic) accounted for a global disease burden of approximately 1.2 million deaths, or 2.0% of all deaths worldwide. Approximately 346,000 acute poisoning deaths resulted from unintentional ingestion, inhalation, or contact with chemicals in 2004; 30,000 of these deaths occurred in workplaces. The WHO study estimated that 71% of these unintentional poisonings would have been preventable through the implementation of improved chemical safety measures. These estimates likely undercount the number truly affected by acute chemical exposures, for the figures derived apply only to the chemicals for which data currently exist; for many chemicals, no data on deaths and injuries are collected and reported [4].

In 1989, a comprehensive study by Binder [5] examined deaths, injuries, and evacuations from acute hazardous materials releases. Binder's data came from three national databases, the National Response Center (NRC) Database, the Hazardous Materials Information System (HMIS), and the Acute Hazardous Events Database. Of the 587 acute releases of hazardous materials collectively captured by these three databases in 1986, only eight (1%) were common to all three. Additionally, none of the three databases collected similar information, exposing limitations in the three databases including the inability to capture key pieces of information necessary to accurately assess the effects of exposure.

The study identified other gaps in toxic substance incident knowledge, including the facts that (1) there was no existing legal mandate requiring information from toxic spills to be reported; (2) there was no standard definition created for hazardous substance releases or injured persons, and (3) there was no system for identifying exposed people or populations and correlating the impacts of exposures or injuries on public health. In addition to identifying these deficiencies, the Binder study also made recommendations that would lead to improved toxic substance incident reporting. These recommendations included enforcing laws on incident reporting, obtaining more specific information about injured persons in toxic substance incidents (i.e., evacuations, injuries, and deaths), and validating the information collected and entered into the national database.

In response to Binder's findings, the Agency for Toxic Substances and Disease Registry (ATSDR) created the Hazardous Substances Emergency Events Surveillance (HSEES) system to describe more fully the public health consequences of hazardous substance releases and to support informed prevention activities. From 1990 through 2009, ATSDR supported the state-based HSEES system to increase the capacity for data collection, analysis, and dissemination of toxic substance exposure information.

ATSDR conducted the HSEES program for 20 years (including the 1990–1992 pilot), with state cooperative agreement partners reporting qualifying toxic incidents occurring in their respective states. Nineteen states participated in the program: Alabama, Colorado, Florida, Iowa, Louisiana, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Oregon, Rhode Island, Texas, Utah, Washington, and Wisconsin. As a result of the participation of these states, ATSDR has developed a large repository of acute toxic substance release data.

In 2010, ATSDR introduced the National Toxic Substance Incidents Program (NTSIP) as a new program to replace HSEES and is aimed at establishing a national surveillance system for the identification of hazardous substance spills. NTSIP collects and combines information from many sources to protect populations from harm caused by toxic substance releases. Participating states gather specific information on toxic incidents—location of incident, evacuation details, number of injured persons, adverse health effects experienced by those injured or exposed—and enter the information into a Web-based database. Such information can be used to prevent or reduce the morbidity and mortality caused by these types of toxic incidents as well as to assist in planning proactively for dealing with future incidents involving toxic substances.

The NTSIP has three primary components: (1) state surveillance, (2) a national database, and (3) an incident investigation (Assessment of Chemical Exposures—ACE) response team. This report will discuss the components individually, highlighting the public health problems each component addresses and the benefits gained from the addition of each program piece. The design is such that each component is interdependent for the purpose of creating a comprehensive surveillance system for acute toxic substance exposures.

3.0 State Surveillance

In 2010, NTSIP partnered with state health departments to

- Build surveillance capacity,
- Establish and maintain data reporting partnerships,
- Identify vulnerable populations by using mapping tools,
- Develop and implement community intervention strategies,
- Incorporate green chemistry initiatives within a state, and
- Enhance toxic substance exposure knowledge.

Each state gains access to hazardous spill data through a variety of sources; these sources should account for all the toxic substance incidents occurring in a state. Data-sharing partners include, but are not limited to, the state Department of Transportation's (DOT) HAZMAT Intelligence Portal (HIP), the state and national Poison Control Center (PCC), the NRC, the state Department of Natural Resources (DNR), local health departments (LHDs), local emergency planning committees (LEPCs), the state Department of Agriculture, the state Division of Emergency Management, the media, regional epidemiologists, the state police, and the state bureaus of investigation. Each state develops data-sharing agreements with the organizations most responsible for addressing the types of incidents reported in their state. This arrangement allows each state to develop a network of stakeholders with which to share incident data.

Of the seven NTSIP states that currently participate in ATSDR's cooperative agreement, six also participated in the HSEES program (Figure 1); Tennessee joined the NTSIP as a cooperative agreement state in 2009. While fulfilling the objectives of the program outlined in the funding opportunity announcement (FOA), each state is focused on tracking and developing prevention outreach activities targeted at reducing chemical incidents within the state.

Additionally, two states (Connecticut and Michigan) that are not funded under the current NTSIP award participate voluntarily and report toxic substance incidents. Although the incidents entered by these two states are not included in the results presented in this 2010 annual report, data reported by these states are reported at the individual state level and used to target prevention activities and develop national toxic incident estimates.

Table 1. Summary of the state surveillance components of NTSIP.

Description	Funded States	Core Functions
• Collect data on toxic substance incidents as well as information on toxic substance use and transport occurring within the state • Use data and mapping tools to identify and prioritize areas and populations vulnerable to specific types of toxic substance incidents • Provide data by which emergency response teams, local emergency planning committees, state and local health departments, and police and fire departments can proactively prepare for toxic substance incidents by knowing the types of vulnerable populations (i.e., schools, daycare and nursing home facilities, and residences) in the area, as well as by mapping out evacuation routes and the fastest access to hospitals	• Louisiana • New York • North Carolina • Oregon • Tennessee • Utah • Wisconsin	Perform prevention outreach activities within the three-year award cycle and have a theme; in the current cycle, the focus is on green chemistry initiatives as well as on a reduction in the release of toxic chemicals to be achieved by education about inherently safer technologies

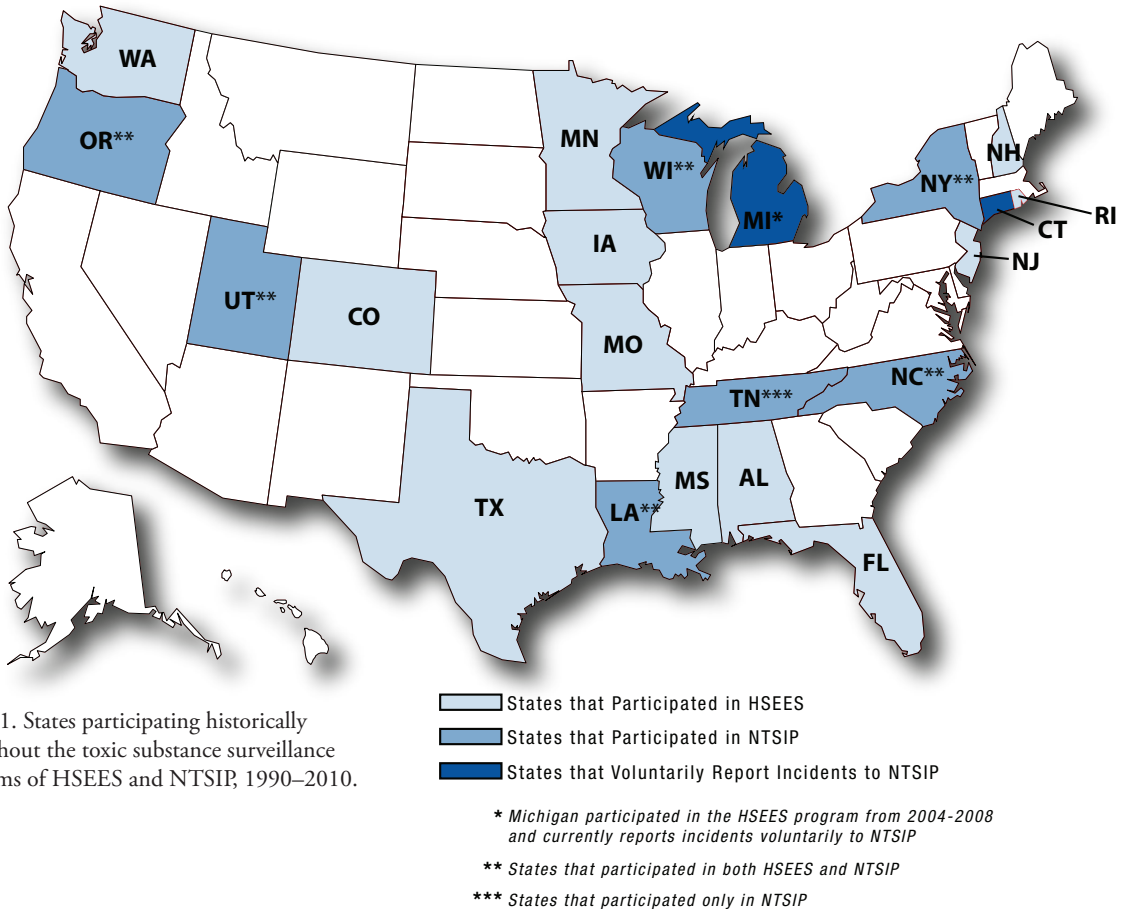

Figure 1. States participating historically throughout the toxic substance surveillance programs of HSEES and NTSIP, 1990–2010.

3.1 Data Collection Methodology

For the purpose of maintaining database consistency and streamlining data collection and analysis, data on all incidents occurring in the participating states are entered into a Web-based data entry system provided by ATSDR.

A NTSIP incident is defined as an uncontrolled or illegal acute release of any toxic substance. A toxic substance includes any element, substance, compound, or mixture, including disease-causing agents, that after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through the food chain, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malformations, including malformations in reproduction, or physical deformation in such organisms or their offspring [6]. Toxic substances include chemical, biological, radiological, and medical materials. The primary focus of the NTSIP database is to capture information on adverse health effects, emergency response activities, details of any decontamination efforts, identification of susceptible populations, and victim demographics. The data elements collected are described in more detail in Table 2.

Table 2. Detailed description of core data elements reported through NTSIP.

Data Element	Specific Example of Reported Data
Chemical	• Substance released • Quantity released • Type of release (e.g., air, spill, fire, explosion)
Location	• Type of location (fixed facility or transportation) • Surrounding area use • Transportation – Mode – Phase • Fixed facility – Area • Equipment
External factors leading to incident	• Weather conditions • Primary contributing factor • Secondary contributing factor
Response	• Decontamination performed • Entry restrictions • Evacuations • Road closures • Emergency Response personnel
Injured persons	• Demographic information • Injuries sustained • Severity of medical disposition • Use of personal protective equipment (PPE) • Decontamination status • Distance from release

Participating states are encouraged strongly to record data on significant non-qualifying incidents (e.g., incidents below the reportable quantity with injured people or near misses) in the data collection system and to mark them as not meeting the NTSIP definition. These incidents are reviewed to assess whether changes in the case definition are needed.

Several quality control systems have been implemented to ensure that the national database is valid and free of errors. Quarterly, each state selects a random 10% sample of entered NTSIP incidents to undergo a quality assurance/quality control verification. The results from this procedure are transmitted to the ATSDR technical advisor for review and approval. Periodically, each state also performs a duplicate incident report query to identify potential record duplications and remove them from the system.

Access to the complete raw data sets is limited to ATSDR staff and researchers who have completed a signed data use agreement. The NTSIP dataset maintains confidentiality through encryption of identifying information at the federal level.

3.2 Reporting Changes

Although many of the principles important to the HSEES program served as the foundation for the NTSIP, various requirements are new to NTSIP. Many of the changes involve the type of chemicals considered reportable, as well as the reporting quantities.

One of the largest additions to the NTSIP database is the inclusion of incidents involving petroleum. For example, in the HSEES database, releases of petroleum only (i.e., crude oil, kerosene, gasoline, or other petroleum fuels) were not reportable; however, in NTSIP, petroleum incidents are reportable if a public health action (e.g., an evacuation, a health advisory, etc.) or an injury caused by the chemical occurs. Spills of fuel being used by a vehicle at the time of the incident are not included. For reporting purposes, NTSIP uses the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) definition for petroleum. This definition excludes crude oil and fractions of crude oil, including hazardous substances like benzene that are indigenous in petroleum substances. Under this interpretation, petroleum includes substances that are normally mixed with or added to crude oil or crude oil fractions during the refining process. However, substances that are added to petroleum or that increase in concentration as a result of contamination of the petroleum during use are not considered part of petroleum.

Threatened releases were reported under HSEES, but are not included in incidents reportable to NTSIP. However, states may continue to enter them to acquire added information for use at the state level. Additionally, in NTSIP, unlike HSEES, incidents involving a stack or a flare have been limited to only those for which a public health action or injury has occurred. Home incidents are now limited to those with a public health action.

Another reporting change is the establishment of minimum quantity requirements for specific substances in NTSIP. These substances (Table 3) were chosen because they were involved in numerous chemical incidents, but their release resulted in few injuries or deaths from exposure to them. Therefore, it was determined that the value of the amount of information gathered from incidents involving these substances was not proportional to the amount of staff time used to enter the data.

Table 3. Minimum quantity requirements for specific NTSIP substances.

Substance	Minimum NTSIP Reporting Quantity
Paint, Paint not otherwise specified (NOS), Paint or coating NOS	100 gallons
PCBs with a concentration greater than 50 ppm	10 gallons
Propylene glycol, ethylene glycol	50 gallons
Freons	100 gallons

3.3 Definition of Terms

In order to allow full interpretation of the results discussed below, we provide the following definitions in Table 4.

Table 4. Important definitions for interpreting NTSIP results.

Term	Definition
NTSIP incident	Any acute, uncontrolled, or illegal hazardous substance release that meets the established minimum reporting quantity
Threatened release	An imminent release that did not occur but did lead to a public health action (e.g., evacuation) that could potentially affect the health of employees, emergency responders, or members of the general public
Transportation-related incident	Incidents occurring during the surface, air, pipeline, or water transport of hazardous substances and before a substance was totally unloaded from a vehicle or vessel
Fixed facility incident	Incidents occurring at stationary sites, including industrial sites, schools, farms, or any other type of facility not involved in the transport of hazardous substances
Injured person/ people	Anyone (e.g., members of the general population, employees, or emergency responders) who experiences at least one documented adverse health effect within 24 hours after an incident or who dies as a consequence of an incident. Injured persons may have been exposed to more than one toxic substance and may experience more than one injury or symptom as a result of exposure

3.4 2010 Combined State NTSIP Results

3.41 Showcasing State Impact Through Project Highlights

For the success of any program to be measured, specific public health outcomes that support long-term program goals and objectives must be defined and documented. NTSIP recognizes that the following elements are necessary for an assessment of impact and success within the program:

- Identification of the public health need, including relaying how that need was discovered
- Describing NTSIP's involvement (at the state and national levels)
- Describing the resulting public health action or success story, showcasing impact
- Linking the public health action or success story back to NTSIP goals and objectives

Since the inception of the NTSIP in January 2010, state cooperative agreement partners have been collecting, tracking, and submitting stories of impact for their annual activities. For 2010, more than 25 stories were documented, revealing how a state's NTSIP activities affect public health. These impacts vary from establishing and strengthening collaborative partnerships to demonstrating positive impacts on vulnerable populations following one wastewater treatment's adoption of a safer alternative to chlorine gas. A summary of impacts documented by the state program is placed within the appropriate results section to document specific stories of how the program benefits health agencies, first responders, and the public.

As part of the current grant cycle, NTSIP states also were asked to incorporate inherently safer technology (IST) initiatives into their programs. The goal of IST is to prevent toxic exposures, accidents and environmental contamination by replacing hazardous chemicals, processes, and products with safer alternatives. Combining gathered data with geographic information system (GIS) technology, each state could develop national and state materials flow databases to identify vulnerabilities and mitigate them either with green chemistry, better land use management, or improvement of emergency response capabilities and preparedness efforts. Many states embraced the green chemistry initiative and created and implemented inherently safer technology in numerous different ways; some of the projects implemented will be highlighted in state project boxes in the results section (Sections 3.42–3.47).

NTSIP fosters…Collaboration:

Tennessee enhances notification partnerships

Through the establishment of partnerships with regional health departments, emergency management agencies, and first responders, the newly established Tennessee NTSIP observed an increase in the proportion of reports from these agencies, resulting in a more comprehensive state database on chemical spills.

3.42 Events/Incidents

In 2010, there were 4,036 incidents entered into the system; of those, 2,981 (73.9%) were eligible and 1,055 (26.1%) were ineligible incidents under the definition of NTSIP. With the grant requirement that all toxic substance incidents be entered into the NTSIP database within 48 hours, many states enter all toxic substance incidents into the system and use additional information that is released about the incidents to classify their eligibility according to the NTSIP definition. The most common reasons for ineligibility were as follows: (1) the incident was a petroleum release that resulted in no public health action or injured person (26.5%); (2) the quantity released was not large enough under the NTSIP definition (24.6%); or (3) there was no actual release (i.e., the "release" was threatened only) (20.9%). The rest of this section describes the characteristics of the 2,981 eligible incidents.

More incidents occurred in fixed facilities (n = 1,864) than during transportation-related (n = 1,117) episodes. Within these incidents, 412 fixed facility incidents resulted in 1,056 injuries, while 77 transportation-related incidents resulted in 133 injuries. Over twice as many fatalities occurred in fixed facility incidents than in transportation-related incidents (Table 5).

The number of incidents reported within each state tended to correlate with the population size of the state. States with larger populations, such as New York (2010 estimated population ~ 19 million), generally reported more incidents overall, more incidents with injured people, and a greater number of injured people than states with smaller populations, such as Oregon (2010 estimated population ~ 3.8 million). Each state recorded at least one fatality (Table 5).

Additionally, some states have access to additional sources for collecting information and monitoring injuries about NTSIP-eligible incidents, including Emergency Medical Services call logs, first responder news, and hospital discharge data. Such access allows states to collect more complete data than otherwise with regard to the number and types of injuries sustained in incidents.

Notification about a toxic substance incident can occur through a variety of sources. Approximately 92% of incidents were reported through five primary notification sources, namely, emergency government/emergency services (28.7%), DOT/HMIS (26.0%), environmental department or division (18.6%), media (12.9%), and NRC (5.4%).

NTSIP fosters…Understanding:

New York increases mercury awareness through education

Immediately following a mercury spill in an unventilated area of the World Finance Center (WFC) in New York, NTSIP staff provided training materials to employees on mitigating health risks from mercury exposure. This information increased understanding of the proper procedures for remediation of a mercury spill, ultimately resulting in better protection of the 7,000 employees who work in the WFC.

Fixed Facility

Fixed facility incidents include all incidents that occur in stationary structures (i.e., buildings) or any other area not involved in the transport of a toxic substance. The specification of the area or equipment involved in an incident is important for understanding fixed facility incidents. Of the 1,864 total incidents attributed to fixed facilities, over 40% (n = 762) of the incidents involved the following areas or types of equipment:

- 295 incidents (15.8%) were due to a pipe failure.
- 146 incidents (7.8%) were caused by ancillary process equipment failure.
- In 96 (5.2%) incidents, two or more equipment pieces or areas were involved.
- Incidents occurred in an above-ground storage area, including a warehouse, tank, or storage shed (n = 76, 4.1%), a process vessel (n = 39, 2.1%), a material handling area or loading dock (n = 26, 1.4%), a transformer or capacitor (n = 25, 1.3%), a waste area or sewer (n = 15, 0.8%), transportation within the facility (n = 12, 0.6%), failure with the building heating or cooling (n = 7, 0.4%), an incinerator (n = 4, 0.2%), and a laboratory (n = 1, 0.1%).

No evacuation was ordered in 1,409 fixed facility incidents, while 454 fixed facility incidents resulted in an ordered evacuation. Table 6 shows that, of the incidents in which evacuations were ordered, 137 incidents resulted in at least one injured person being reported, accounting for a total of 598 injured people.

When one compares the effect an evacuation has on the number of incidents with injuries, it becomes clear that ordering an evacuation reduces the number of incidents with injured people. When an official evacuation was ordered, 137 incidents had injuries; on the other hand, there were 274 incidents with injuries when no evacuation was ordered. These results show that issuing an evacuation order reduced the number of NTSIP incidents with injuries 200%.

Transportation

Of the 1,117 transportation-related incidents, the majority (87.9%) occurred (1) during unloading from a stationary vehicle or vessel (31.7%); (2) while a shipment was en route, with the incident later discovered at a fixed facility (28.6%); and (3) in a moving vehicle or vessel and discovered during the shipment itself (27.7%) (Table 7). A large portion of toxic substance spills occurred while the toxic substance was in movement (i.e., being transported from the place of origin to the place of use); such incidents also contribute to non-chemical trauma experienced by drivers transporting these materials. Additionally, the

highest probability of exposing the greatest number of people (i.e., chemical spill on an interstate in a city) also occurs while the toxic substance is being transported. More than half the injuries (60.9%) occurred while a vehicle or vessel was moving, whereas 30.1% of the injuries occurred from a vehicle or vessel that was stationary or being unloaded (Table 7).

The largest number of transportation-related incidents occurred during ground transportation (n = 938, 84.0%), a category that represented transportation via tanker truck, non-tanker truck, van, automobile, or bus. Railway modes of transportation (including containers on a flat car, tank car, or box car) also accounted for a large number of incidents (n = 102, 9.1%).

3.43 Chemicals

The program has created lists of the chemicals most commonly involved in NTSIP incidents, including a Top 20 chemicals list for fixed facility incidents and a Top 10 chemicals list for transportation-related incidents. Of the 1,864 incidents reported in fixed facilities, the Top 20 chemicals accounted for 62.5% of the incidents; the chemicals accounting for the largest number of incidents were natural gas, carbon monoxide, chemicals involved in the production of methamphetamine, and ammonia (Table 8).

Of the 1,117 transportation-related incidents, the Top 10 chemicals accounted for 38.9% of all incidents. Alkaline hydroxides, including sodium hydroxide and potassium hydroxide, accounted for the most transportation-related incidents (12%), followed by hydrochloric acid, sulfuric acid, and natural gas (Table 9). Some of the dangers associated with these types of toxic substances are that, when released during transport, they are associated with toxic properties (i.e., caustic, corrosive, reactive, and volatile) which have the potential to expose large numbers of people and result in numerous injuries.

The pathway by which a toxic substance is released is important for development of an understanding of the types of injuries expected, as well as for development of containment or clean-up procedures and activities. Toxic substance spills (in liquid or in solid form) or volatilization of a chemical were the two most common release types in both fixed facility and transportation-related incidents, with 55.1% and 32.2% incidents reported, respectively. Of all the various types of toxic releases resulting in injuries and fatalities, volatilization contributed a proportionately larger percentage of both injuries and fatalities; 553 incidents with injuries occurred through volatilization, accounting for almost half (46.5%) of the NTSIP-eligible incidents. The same was true with fatalities, in which more than 60% of all deaths

NTSIP fosters…Safety:

North Carolina proactively studies transportation corridors to reduce exposure to hazardous materials

The NC NTSIP program was part of a study initiated to identify transportation corridors for hazardous material transport in NC that also included Emergency Management, the Department of Environment and Natural Resources, and Innovative Emergency Management (IEM). As a result the transport of Silicon Tetrafluoride (SiF4) was re-routed to reduce the potential for a hazardous spill in a vulnerable area.

were attributable to the volatilization of toxic substances (n = 29). Twenty-four of these volatilization fatalities occurred in fixed facility incidents (Table 10). In short, results show that future response plans should be aimed at reducing exposure of both responders and the public following a volatile toxic substance incident.

Because exposure to a combination of chemicals often can be more toxic and detrimental than a single chemical exposure, we analyzed the total number of chemicals involved in each incident. In over 94% of all incidents (n = 2,803), only one chemical was involved, while 3.7% (n = 111) of all incidents had two chemicals involved and 2.2% (n = 67) involved three or more chemicals. This pattern also applied to incidents involving injured persons, with 1,109 persons (93.3%) injured by exposure to a single chemical, 64 (5.4%) injured by exposure to two chemicals, and 16 (1.3%) injured by exposure to three or more chemicals.

Forty-eight fatalities occurred in NTSIP-eligible incidents in 2010; of these fatalities, all were attributed to exposure to a single chemical. Chemicals leading to the most deaths were carbon monoxide (n = 12, 25.0%) and the 'other' chemical category and 'other inorganic substances', both with 10 events (20.8%). Additionally, exposure to mixtures across chemical categories, VOCs, pesticides, and chlorine, resulted in at least one death. Chemicals resulting in a large number of fatalities can be targeted by state NTSIP coordinators as well as by the federal NTSIP for the purpose of creating and implementing intervention strategies aimed at reducing future fatalities.

Chemicals commonly involved in NTSIP incidents were analyzed separately to provide additional details on adverse health effects, injuries, and fatalities. Chemicals selected for additional analysis in 2010 included ammonia, carbon monoxide, chlorine, and petroleum. As previously stated, petroleum was added as an eligible chemical under NTSIP if a public health action was taken during the spill or release; therefore, it was chosen as a chemical for additional analysis. We present details about each of these selected chemicals in the sub-sections that follow.

Ammonia

Events involving ammonia are of interest to NTSIP because ammonia is among the most frequently released toxic substance. Moreover, because of ammonia's volatility, exposure can occur quickly and result in large numbers of injuries. Ammonia is an ingredient in many cleaning supplies, fertilizers, and refrigerants. It is also a component in the production of methamphetamine. Exposure to ammonia generally results in respiratory system problems and eye irritation. In 2010, there were 133 events involving ammonia, and 26 persons were injured in these events. No fatalities resulted from ammonia exposure. The most reported symptoms of ammonia exposure were respiratory system problems (n = 8, or 30.8%) and a combination of any two other adverse health effects (Table 11). Shortness of breath and heat stress were commonly reported as effects of ammonia exposure.

When ammonia incidents were categorized by North American Industry Classification Code (NAICS) code, the largest number of fixed facility incidents (n = 66, 59.5%) occurred in the manufacturing sectors, including the refrigeration of foods and beverages (NAICS Code 31), wood, paper, printing, petroleum and coal, chemical, plastic and rubber, and non-metallic mineral manufacturing (NAICS Code 32), as well as metal, machinery, electronics, appliances, transportation equipment, furniture, and miscellaneous manufacturing (NAICS Code 33). When we considered transportation-related incidents, half (n = 11) were attributable to NAICS Code 48, refrigerated transportation and warehousing by air, rail, or water.

Carbon Monoxide

Carbon monoxide is produced by the incomplete burning of various fuels, including charcoal, propane, and natural gas. Carbon monoxide is referred to as the "silent killer" because it is colorless and odorless and its victims often succumb before realizing they have been exposed.

Carbon monoxide exposure was the leading cause of both injuries and fatalities reported to NTSIP. There were 140 total carbon monoxide incidents entered into the NTSIP database in 2010; 15 of these incidents involved carbon monoxide and another chemical and were therefore combined into a multiple chemical category for reporting purposes. Of the 125 carbon monoxide incidents in which only carbon monoxide was involved, there were 191 injuries reported (Table 12). The most common adverse health effects included dizziness or other central nervous system (CNS) symptoms, a combination of any two adverse health effects, and headaches.

Twelve deaths resulted from carbon monoxide exposure; nine (75.0%) of these deaths occurred in fixed facility incidents and three (25.0%) in transportation-related incidents.

When carbon monoxide release incidents were classified by type of sector reported by NAICS codes, the real estate sector (NAICS code 53) was found to have the largest number of incidents. NAICS code 53 applies to incidents occurring in structures such as apartment homes. Forty-eight such incidents (38.7%) occurred in rented residences (NAICS code 53), followed by incidents occurring in locations for which the NAICS code was unknown or missing (n = 29, 23.4%) and the utilities sector (NAICS code 22), which reported 20 incidents (16.1%).

NTSIP fosters…Knowledge:

Utah educates wastewater treatment facilities on the benefits of adopting Inherently Safer Technology (IST)

Through showcasing the effects on the state if one wastewater treatment plant adopts safer alternatives to chlorine (approximately 6,900 residents, 3 schools, and 1 elderly care facility positively impacted), it was possible to educate 62 Utah wastewater treatment facilities on the reduction in exposure to communities.

Chlorine

NTSIP monitors chlorine because exposure can occur through several different processes, including the cleaning and maintenance of residential and commercial swimming pools and water treatment facilities. Its pungent odor can lead to respiratory system irritation. In 2010, there were 89 injuries from exposure to chlorine. Respiratory system irritation was the most common single adverse health effect, reported in over 57% of all chlorine exposures. Other injuries besides respiratory effects alone included a combination of any two adverse health effects and any three adverse health effects. Trauma was also reported in six injured people; four of the six injuries were attributable to chemical exposure to chlorine (Table 13) and the other two were attributable to a vehicle collision. One fatality resulted from chlorine exposure in a fixed facility incident.

For chlorine incidents by NAICS code occurring in fixed facilities, the manufacturing sector involving wood, paper, printing, petroleum and coal, chemical, plastic and rubber, and non-metallic minerals (NAICS Code 32) accounted for the largest number (n = 26, 32.1%), followed by the utilities sector (NAICS Code 22) (n = 18, approximately 22%). For transportation-related incidents involving chlorine, the transportation and warehousing sector (NAICS code 48) by air, rail, or water resulted in the most chlorine incidents, with 13 incidents (72.2%) attributed to this sector.

Petroleum

The reporting of incidents involving petroleum is new to NTSIP. Therefore, understanding the injuries and health effects of these incidents is crucial to quantifying their impact. There were 365 total incidents involving petroleum or chemicals considered petroleum, comprising 12.2% of all incidents. Of these incidents, 284 (16.6%) occurred in fixed facilities and 81 (7.4%) occurred during transportation.

Exposure to petroleum in 365 total NTSIP-eligible incidents resulted in 142 injuries, with a variety of adverse health effects reported. Burns were the largest adverse health effect reported (n = 37, 26.1%). However, only three of the 37 burns reported were chemical-related (8.1%)–all other burns were thermal in nature and thus these injuries were not a direct result of the chemical release (n = 29, 78.4%). This was followed by those reporting burns that were both chemical and thermal in nature (n = 4, 10.8%) or an adverse health effect that was unreported or missing (n = 1, 2.7%). Trauma resulted in the second highest adverse health effect (n = 27, 19.0%). Only five of the reported traumas were related to the chemical (18.5%); the remaining 22 traumas were not a result of the spill. Additional adverse health effects reported from exposure to petroleum included any two adverse health effects (n = 29, 20.4%), dizziness or other CNS symptoms (n = 9, 6.3%), headache (n = 8, 5.6%), and gastrointestinal problems (n = 6, 4.2%) (Table 14).

When petroleum incidents were separated by NAICS code, the utilities sector (NAICS Code 22) was found to account for the largest number of incidents (n = 92, 27.6%), followed by incidents occurring in private residences or vehicles (n = 63, 18.8%). Also of note was NAICS code 53, real estate or rental leasing (n = 26, 7.5%), and the transportation and warehousing sector (NAICS codes 48 and 49) (n = 25, 7.2%). These four industry codes accounted for approximately 70.0% of all petroleum related incidents.

3.44 Factors Contributing to the Incidents

Timing of Incidents

The timing of incidents (including month of the year, day of the week, and time of day) is prominent in the occurrence of NTSIP-eligible incidents. A greater number of incidents occurred in warmer months (April–September) than in colder months (October–March) for fixed facilities (n = 1,017 for April–September vs. n = 847 incidents for October–March.). The difference was particularly pronounced in transportation-related incidents (n = 702 vs. n = 415 incidents). During the spring and summer months, more agricultural chemicals are being transported and used, and that fact may offer an explanation of the difference. Approximately 31% (n = 586) of the fixed facility events and almost 36% (n = 402) of transportation-related events occurred in the summer months of June, July, and August. As expected, a greater number of injuries also occurred in the summer months. Approximately 31% (n = 326) of injuries from fixed facility incidents and about 42% of injuries from transportation-related incidents occurred during the summer months. In addition, the majority of incidents (n = 2,511, 84.2%) occurred during the weekdays of Monday through Friday, a pattern consistent with a standard business schedule and the occurrence of most commerce. More than 75% of injuries (n = 912) resulted from incidents during weekdays. The majority of incidents (n = 1,946 or 65.2%) occurred during normal business hours, between 6:00 am and 6:00 pm. The number of people injured correlated to this 12-hour time period as well, with 859 (72.2%) of the 1,189 injuries occurring during this time.

Weather

All NTSIP-eligible incidents were analyzed for varying weather conditions by season—spring, summer, fall, and winter. Weather conditions were not a factor in the majority of fixed facility and transportation-related incidents (n = 1,774, 95.2% and 1,065, 95.3%, respectively). Although weather conditions played a role in only approximately 5% of incidents, rain was the most common weather-related factor contributing to NTSIP incidents (n = 80, 2.7%), followed by extreme heat (n = 13, 0.4%), extreme cold (n = 10, 0.3%), snow (n = 15, 0.5%), high winds (n = 5, 0.2%), and weather-related disasters (i.e., tornado, hurricane, flood) (n = 4, 0.1%). As expected, rain was a relevant incident factor in all seasons, with the summer months of June, July, and August recording the largest number of incidents in which rain was a contributing factor.

Primary/Secondary Contributing Factors

Understanding contributing factors that lead to a chemical release is the key to reducing chemical spills and the injuries associated with such spills. Primary contributing factors (Table 15) are the fundamental conditions that may have led to a hazardous release, while secondary contributing factors (if applicable) (Table 17) are any additional factors that also may have played a role in an incident. If either a primary or a secondary contributing factor was chosen, a more specific factor was entered into the database; such factors are referred to as primary and secondary supplemental factors (Tables 16 and 18). Although the specific factors are not always entered, when they are reported they provide more insight into the circumstances surrounding a release.

A primary factor was specified in almost all NTSIP-eligible incidents; over 50% of incidents were the result of human error, and 38.0% were caused by equipment failure (Table 15). The primary contributing factors of human error and equipment failure also resulted in the majority of injured persons (n = 636, 53.5% and n = 356, 29.9%, respectively). In fixed facility events for which a primary contributing factor was reported, equipment failure resulted in the largest number of events (n = 916, 49.1%) while human error was the cause of the largest number of transportation related events (n = 867, 77.6%). Other factors contributing to the injuries of persons were in the categories of 'intentional', 'other', 'bad weather conditions/natural disasters,' and 'illegal act' (Table 15).

The more specific primary supplemental factors contributing to a chemical release were varied, with the most common factors including improper filling, loading, or packing (n = 683, 22.9%) and a system/process upset (n = 468, 15.7%). It is important to note that no primary supplemental factor was entered in more than 18% (n = 550) of the total incidents (Table 16). For those events for which a specific primary supplemental factor was identified, improper filling, loading, or packing resulted in the most transportation events (n = 559, 50.0%) and system/process upset resulted in the largest number of fixed facility incidents (n = 433, 23.2%). However, when the number of injuries was examined by primary supplemental factor, system/process upset did not result in the most injuries for fixed facility events; more injuries occurred by improper mixing (n = 127, 12.0%) than system/process upset (n = 76, 7.2%). This was also the case for injuries related to transportation events—although improper filling, loading, or packing resulted in half of the transportation events, the largest number of injuries resulted from a vehicle or vessel collision (n = 36, 27.1%). Additional details about primary supplemental factors can be found in Table 16.

The majority of incidents did not have a secondary contributing factor (n = 2,463, 82.6%) (Table 17) or a supplemental factor reported (n = 2,774, 93.1%), Table 18. Additional details regarding secondary contributing and supplemental factors can be found in Tables 17 and 18.

3.45 Injury Characterization

Of the 2,981 NTSIP-eligible incidents, 489 (16.4%) resulted in a total of 1,189 injured persons. More than half of these incidents (59.1%) resulted in one person's being injured (Table 19). When injuries were characterized according to severity or disposition, the majority of injuries (78.1%) resulted in treatment at a hospital without admittance, or else injured persons were treated on scene by first aid and released. Almost 14% of injuries required the injured person to be admitted to a hospital for treatment (Table 20).

Category, Age, and Gender of Injured People

For all incidents with injuries, injured people were categorized into a victim category; the public, consisting of both the general public and students at school, accounted for just over half of all injuries. Other categories of the injured included employees and responders/hospital personnel; the latter category included responder (not specified), career firefighter, volunteer firefighter, firefighter (not specified), police officer, EMT personnel, and hospital personnel (i.e., doctor or nurse) (Table 21). Of the 980 injured persons who reported gender, over two-thirds were male; however, the breakdown was dependent on the victim category. More male employees than female employees were injured (Table 22).This may be explained by the general existence of more males than females who are employed in factory environments, where workers can be readily exposed to chemical releases. A similar pattern also is observed with respect to responders and hospital personnel: over six times more male responders were injured than female responders (Table 22). First responders in emergency situations generally are composed of firefighters, police officers, and EMT personnel, occupations that are predominantly held by men. A different pattern was observed in the public category, where injuries were fairly evenly split between males and females (Table 22). Of the 1,102 people injured for whom data by age existed, 20.4% were children (age 18 and under) and 79.6% were adults. The majority of these injuries resulted from the public's being exposed to toxic substances; as expected, more adults than children were injured (Table 22).

Adverse Health Effects of Injured People

Depending on the types of toxic substances that result in injuries, a variety of adverse health effects can be observed, including trauma, respiratory irritation, eye irritation, burns, headache, and others. Of 1,189 injuries reported, the majority of injured people (n = 799, 67.2%) reported one adverse health effect. Over 30% of injured people reported more than one adverse health effect (Table 23).The most commonly reported adverse health effects were respiratory system problems, dizziness or other CNS problems, burns, and trauma. Non-chemical related traumas and thermal burns were probably related to a fire or a vehicle accident, not direct exposure to a chemical. Trauma accounted for 40.6% of transportation-related events with injuries, compared to 4.4% in fixed facility events with injuries. However, 36.8% of transportation-related trauma injuries were not chemical-related. They were more likely the result of a vehicle/vessel accident.

Personal Protective Equipment (PPE)

Because the level of personal protective equipment (PPE) worn by a first responder should reduce or mitigate adverse effects from toxic substance exposure, it is imperative to document the type of protection that injured emergency responders were wearing when they were injured. Emergency responders and employees were the only victim categories eligible to answer the PPE question; the public (including both students and the general public) generally would not have access to PPE beyond such basic equipment as gloves or masks. The most injuries occurred when employees and response personnel were equipped with level "D" PPE (the least restrictive and thus least protective PPE level; see definition in Table 24) [7]. A total of 21 injuries occurred in employees and emergency responders wearing level D PPE; 20 of these injuries occurred in fixed facility incidents and one was from a transportation-related incident. Alternatively, more firefighters were injured wearing turn-out gear with respiratory protection, as opposed to being without respiratory protection; almost twice as many injuries occurred to firefighters (regardless of firefighter status) with respiratory protection (41 total injuries, fixed facility and transportation combined) than to those without respiratory protection (22 total injuries, fixed facility and transportation combined). Some possible explanations for observing injuries occurring to responders while wearing PPE could be that (1) the PPE level might not have been adequate to the chemical(s) the responders were exposed to at an incident or (2) the PPE may have been adequate to protect the responder, but the responder might not have been fitted properly or else removed it prematurely, or the responder suffered heat-related injuries to which the PPE contributed.

NTSIP fosters…Preparedness:

Oregon creates hazard awareness and emergency plans to protect vulnerable populations

Through the creation of NTSIP-eligible event maps in Oregon, NTSIP staff educated the Office of the State Fire Marshal and Local Emergency Planning Committees (LEPCs) about vulnerable populations (including hospitals, daycare providers, and adult care facilities) in close proximity to areas with high spill densities.

Decontamination Status

Decontamination is the reduction or removal of chemical agents. Chemical decontamination is generally accomplished through detoxification or neutralization. Because the decontamination process can be involved, costing both time and money, it is important to know the number of people decontaminated at a site, what toxic substance exposures resulted in decontamination, and the place where decontamination occurs (i.e., at the scene of the incident, at a medical facility, or both). This information helps first responders as well as hospital staff better prepare for toxic substance incidents. The decontamination status of all injured people shows that the majority were not decontaminated (n = 859, 72.3%). Of the total number of injured people, 12.5% (n = 149 injured people) were decontaminated at the scene and 11.0% (n = 131 injured people) were decontaminated at a medical facility.

Toxic substances resulting in the largest number of decontaminated people were also evaluated. This section discusses any person who was decontaminated during a NTSIP-eligible event, regardless of whether an injury resulted. Examining incidents in this way helps both state programs and ATSDR to quantify the chemical classes or types that result in the largest number of decontaminations. Such a quantification is an indicator of the ability of the substance to cause adverse health effects upon exposure and if decontamination is successful, the minimization of the adverse health effects. For fixed facility incidents, decontamination was required for 71 (26.6%) incidents with toxic substances reported under the 'other' category. For individual chemicals, chlorine (n = 29, 10.9%), acids (n = 26, 9.7%), volatile organic compounds (VOCs), and ammonia (n = 9, and 7 incidents, respectively) most frequently required decontamination

3.46 Response and Evacuation

Emergency Response

The majority (n = 2,475 or 83.0%) of NTSIP-eligible incidents did not require any actions to protect public health. Almost 17% (n = 503) of incidents had at least one health action. More health actions were taken in fixed facility incidents than in transportation-related incidents (n =454, 24.4% of fixed facility incidents and n =49, 4.4% of transportation-related incidents, respectively). In fixed facility incidents, the public health action undertaken most frequently was environmental sampling (n = 381 incidents), followed by the issuance of a health advisory (n = 51 incidents); in transportation-related incidents, environmental sampling was also the most prevalent public health action undertaken, with 44 incidents requiring sampling of an environmental medium (i.e., air, soil, or water).

NTSIP fosters…Responsiveness:

Wisconsin identifies vulnerable populations during evacuations

Through the use of mapping tools, a proactive outreach plan was developed to identify vulnerable populations in the event of a chemical spill. This plan was discussed with local public health agencies, LEPCs, school planning committees, minority groups, hospitals, and private sector organizations and incorporated into the emergency response protocol.

An examination of the type of responders aiding in NTSIP-eligible incidents shows 44.0% of incidents were responded to by a company response team: 37.0% of incidents from fixed facilities and 54.9% of incidents during transportation (Table 25). For both fixed facility and transportation events the company response team by itself was the most frequent (43.7%). More than a third of the incidents (n = 1072, approximately 36%) required multiple types of responders (Table 25).

Evacuation and in-place sheltering

Evacuation occurred when an exposure required people to leave the contaminated area for the protection of their health. In some situations, it may be better to alert people in the exposure area to shelter in place or to remain inside with exterior doors and windows closed and the turning off of heating, ventilation, and air conditioning (HVAC) systems until the threat has been remediated. In 2010, there were 522 incidents (17.5%) requiring an ordered evacuation, while an additional 51 incidents (1.7%) resulted in an ordered in-place shelter.

In incidents requiring an ordered evacuation, the number of people evacuated generally depends on where the incident occurred, the time of day, and the land use areas surrounding the incident. The majority of incidents that required an ordered evacuation (n = 352 or 67.4%) required the evacuation of 50 or fewer people. A larger number of fixed facility incidents required evacuations than did transportation-related incidents (n = 454 and n = 68, respectively.) When a release occurs in a facility, it generally occurs indoors, with the potential to expose workers who are employed by the facility. Such a release necessitates an evacuation. On the other hand, in transportation-related incidents, a release generally occurs outdoors. Although an outdoor release generally can allow a contaminant to travel further, potentially exposing a larger number of people, it can also allow the contaminant to dilute into air or water, thus reducing its toxic effects.

More than a third of incidents requiring an ordered evacuation (n = 199, 38.1%) affected a single general land use. The most common single general land use in incidents included (in decreasing order by total number of incidents) residential (n = 108 incidents), commercial (n = 52 incidents), industrial (n = 30 incidents), undeveloped (n = 6 incidents), and agricultural areas (n = 3 incidents). However, when mixed land use (consisting of two different land uses) was evaluated, it was found that more than 45% of incidents (n = 236) occurred in a combination of both commercial and residential areas

Vulnerable populations

The proximity of a toxic substance release to vulnerable populations is of concern because vulnerable populations may need additional time or assistance during an evacuation. Therefore, it is critical that these populations be identified before a toxic substance incident occurs to

ensure that they receive assistance during an evacuation or a sheltering in place process. NTSIP regards vulnerable populations as places where populations sensitive to toxic exposures may reside, including residences, schools, hospitals, nursing homes, licensed daycares, industries or businesses, or recreational areas (e.g., parks). Although almost 97% of all NTSIP incidents requiring an ordered evacuation (n = 506) had at least one type of vulnerable populations within a quarter-mile of the release, many incidents had numerous populations identified. Of the 522 incidents that required an evacuation, 438 (83.9%) had two or more different vulnerable population facilities within a quarter-mile.

3.47 Industry Codes

For all qualifying NTSIP-eligible incidents, an Industry Code based on the NAICS was entered. The NAICS is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

In 2010, the largest number of NTSIP-eligible incidents (n = 1,022 or 34.3%) was attributed to the transportation and warehousing sector (NAICS codes 48 and 49) (Table 26). There were 871 incidents in the NAICS code 48 transportation and warehousing sector. This sector includes transportation by air, rail, water, truck, transit, as well as ground passenger, pipeline, scenic and sightseeing, transportation support activities, postal services, and couriers. Second in the number of incidents was the manufacturing sector (NAICS codes of 31, 32, and 33) (n = 649 or 21.8%). The largest number of incidents within this code grouping was in NAICS code 32 (n = 558 or 18.7%.) Code 32 is associated with the manufacturing of wood, paper, printing, petroleum and coal, chemical, plastic and rubber, and non-metallic mineral manufacturing.

Although transportation and warehousing contributed the largest number of incidents, private residences accounted for the largest number of injured. In 261 incidents occurring in private residences, there were 251 injured. This number was significantly higher than the injured in the next highest sector, manufacturing (NAICS code 32), which accounted for 112 injured in 558 incidents. The fact that the larger number of injured occurred in private residences highlights this sector as a sub-population that may require additional information targeted at reducing common injured related to household toxic substance exposures (Table 26).

The Educational Services sector (NAICS code 61) was the next highest; in that sector, 68 incidents resulted in 96 injuries (8.1% of injured persons). The Educational Services sector consists of establishments (i.e., schools, colleges, universities, and training centers) that provide instruction and training on a variety of subjects; because these establishments can vary widely, they host a large range of activities that could expose people to hazardous substances and create injuries. Such activities include mixing chemicals in science labs, improper mixing of cleaning chemicals by janitorial staff, and improper use of pesticides on fields. The fact that the injuries outnumbered the incidents indicates that generally more than one person was injured in some incidents; the numbers also illustrate that the educational services sector can be the source of a surprisingly large number of injuries (Table 26).

4.0 National Database

NTSIP uses data collected and reported from the cooperative agreement partner states, coupled with supplemental data from governmental reporting agencies (i.e., DOT and NRC), to create national estimates of toxic substance incidents. The national estimates are important for the monitoring of trends and the publication of information regarding relevant toxic substance exposure prevention. A detailed description of the national database, its core functions, and key partnerships is provided in Table 28.

Table 28. Summary of the national database components of NTSIP.

Description	Existing Partnerships	Core Functions
• Collaboration among various federal and state agencies to combine existing data from the NRC's Incident Reporting Information System (IRIS) and the DOT's HMIS) with the NTSIP state surveillance data • Housed within the DOT HIP	• ATSDR • DOT • NRC • State Health Departments	• Can be used by federal, state, and local agencies, emergency responders, and researchers for preparedness planning activities • Continue to explore toxic substance incidents and injury data from additional sources so that the ability to estimate toxic substance spill incidents will improve on a national scale • Used to monitor trends and publish information regarding exposure prevention

Fixed facility estimates are calculated by use of the NRC IRIS data; transportation-related incidents are estimated by use of the DOT HMIS. Modeled fixed facility and transportation data are calculated through use of a matching ratio derived from the comparison of state-reported NTSIP incidents and incidents reported from the appropriate

Table 29. Incident estimates for fixed facility and transportation incidents for the 43 states not currently reporting to NTSIP and actual counts for the bolded, NTSIP funded states

		2010 Modeled or Reported Incidents[1]	
State	**State Abbreviation**	**Fixed Facility**	**Transportation**
Alabama	AL	250	72
Alaska	AK	68	49
Arizona	AZ	47	97
Arkansas	AR	140	67
California	CA	922	524
Colorado	CO	77	149
Connecticut	CT	120	65
Delaware	DE	34	5
Florida	FL	440	228
Georgia	GA	220	171
Hawaii	HI	262	6
Idaho	ID	20	20
Illinois	IL	266	491
Indiana	IN	133	159
Iowa	IA	86	51
Kansas	KS	155	114
Kentucky	KY	147	180
Louisiana	**LA**	**552**	**209**
Maine	ME	50	15
Maryland	MD	130	119
Massachusetts	MA	99	100
Michigan	MI	163	121
Minnesota	MN	85	108
Mississippi	MS	117	47
Missouri	MO	109	106
Montana	MT	14	22
Nebraska	NE	45	22
Nevada	NV	15	40
New Hampshire	NH	30	13
New Jersey	NJ	196	137
New Mexico	NM	43	23
New York	**NY**	**645**	**198**
North Carolina	**NC**	**185**	**161**
North Dakota	ND	17	13
Ohio	OH	286	346
Oklahoma	OK	125	61
Oregon	**OR**	**99**	**110**
Pennsylvania	PA	314	303
Rhode Island	RI	28	15
South Carolina	SC	109	67
South Dakota	SD	15	10
Tennessee	**TN**	**149**	**200**
Texas	TX	1,426	479
Utah	**UT**	**142**	**76**
Vermont	VT	22	5
Virginia	VA	217	85
Washington	WA	292	94
West Virginia	WV	84	20
Wisconsin	**WI**	**122**	**160**
Wyoming	WY	49	9
	Total	9,361	5,942

[1] The National Database can be found on the NTSIP website at: https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Dashboard&NQUser=ATSDRPortalAccess&NQPassword=ATSDRP0rt@lAcc3ss&PortalPath=/shared/ATSDR/_portal/ATSDR%20Portal.

data source (NRC for fixed facility and DOT for transportation) for current NTSIP states. This ratio is then applied to NRC or DOT records for states not participating in NTSIP and the derivation of an estimate of toxic substance incidents for a particular year is calculated. The NTSIP national database can be accessed via the NTSIP Web site.

Annual maps are included in the national database for both fixed facility and transportation-related incidents. In the portal, a user can view a cumulative map that represents data from all modeled years, or users can query by a specific year of interest.

Currently, NTSIP has modeled estimates for national toxic substance incidents dating back to 2000. Table 29 shows the estimated incidents for the remaining 43 states that currently do not report to NTSIP. These estimates are based on the reported incidents of the seven funded state programs participating in the cooperative agreement program and the additional national databases (NRC and DOT) that are used as comparison data sources.

Applying the developed matching ratios to states not reporting through the cooperative agreement program yielded the incident estimates reported in Table 29. Overall, 15,303 toxic substance incidents were estimated to have occurred in 2010; 9,361 occurred in fixed facilities, while transportation-related incidents were estimated at 5,942. The estimated number of incidents generally follows a pattern based on state population. For example, states with large populations generally will have more toxic substance incidents than states with smaller populations; the reason is that more populous states have more large cities, more industrial areas/businesses, and additional highways for the transport of toxic substances into and out of the state. These factors increase the number of incidents that can occur and, because these areas have concentrated populations, the probability of exposure during a toxic substance incident therefore becomes greater.

In an effort to obtain more precise estimates of toxic substance incidents occurring in non-reporting states, NTSIP continues to research national toxic substance incident and injury databases to improve the matching ratio and thus strengthen estimates of toxic substance incidents.

NTSIP will continue to collect toxic substance surveillance data from current reporting states and use these data, coupled with supplemental data accessed from additional national surveillance systems, to estimate toxic substance incidents on a national scale. For example, NTSIP has agreements with the EPA Risk Management Plan and the American Association Poison Centers to try to match records. Because additional data sources are determined to complement the state-reported data and the methodology is becoming further refined, more precise estimates of national toxic substance incidents and injuries will be derived.

5.0 Incident Investigation (ACE)

When large-scale toxic substance incidents occur, state and local governments often need assistance to respond to, as well as to collect pertinent information about, spills. In these instances, a state can request the assistance of NTSIP's Assessment of Chemical Exposures (ACE) team. ACE team members can assist with the characterization of exposure data as well as the gathering of information about acute health effects that may result from exposure.

A state epidemiologist can request the assistance of the ACE team through the Epi-Aid mechanism. Epi-Aid provides CDC with the agility to respond rapidly to serious and urgent public health crises. An event qualifies under Epi-Aid if a large number (approximately 100 or more people) are exposed to a toxic substance at levels that could produce acute health effects; however, the team may investigate smaller releases as well, especially if the expected health effects are severe. The ACE team, equipped with individuals from diverse backgrounds, including epidemiology, medicine, statistics, veterinary medicine, industrial hygiene, toxicology, and data management, is immediately deployed to assist with an investigation.

A detailed summary of the ACE program, describing the core functions of the program and the existing partnerships, is provided in Table 30.

There were two ACE Team deployments in 2010: (1) a chlorine release at a metal recycling facility in California; (2) an ammonia release from a refrigeration facility in Alabama Each ACE investigation has had positive effects on the health of the persons involved, prevention of future releases, preparedness for future chemical release incidents, and monitoring for long-term health effects in the exposed populations.

Table 30. Summary of the Incident investigation (ACE) components of NTSIP.

Description	Existing Partnerships	Core Functions
• Can provide a variety of services to the state or local government, which include – Increasing the personnel available to rapidly respond to a situation affecting public health – Streamlining access to CDC subject matter experts and laboratory resources – Facilitating the coordination of multi-stage investigations	• State Health Departments • Local Health Departments • National Institute for Occupational Safety and Health (NIOSH) • Occupational Safety and Health Administration (OSHA) • Emergency response management and personnel teams • Chemical Safety and Hazard Investigation Board (CSB) • National Institute for Environmental Health Sciences (NIEHS)	• During a field investigation, the ACE team collects information through interviews administered to key response personnel (i.e., local fire department staff, HAZMAT first responders, environmental health officers, hospital staff, business owners, and employees) • These key informant interviews create a structured timeline of incidents • A survey is administered to people in the exposed area during the release • All data collected through the administration of the surveys are entered into a database so that preliminary analysis can be performed in the field to provide as much relevant information to the requesting agency as quickly as possible • Medical charts are abstracted for treated persons • Findings from ACE investigations are published to expand chemical exposure knowledge

5.1 Chlorine Release at a Metal Recycling Facility in California

As a pilot of the program, the ACE team deployed after a June, 2010 chlorine release from a tank at a metal recycling facility in California. The ACE team interviewed responders to identify response issues and performed an industrial hygiene review of the facility. Twenty-seven of 29 potentially exposed persons were interviewed, and medical records for the 23 patients treated at seven hospitals were abstracted. Persistent health effects and mental stress were reported during the surveys, as were difficulties obtaining medical care. California Department of Public Health (CDPH) assisted victims in obtaining referrals for care and followed up with them six months later. Because this was the second tank release in a short period of time, the ACE team worked with CDPH to develop a tank alert flyer that was mailed to 1200 recycling facilities in CA and is available on the CDPH and NTSIP websites. A CDC Morbidity and Mortality Weekly Report was published [8] describing the health effects of the chlorine exposure. Because of the ACE investigation, nine injured persons received assistance in finding medical or mental health care that they would not have received otherwise. The alert flyer has been used widely to promote safe handling of tanks and to encourage water treatment facilities to change from chlorine disinfection to safer alternatives.

5.2 Ammonia Release from a Refrigeration Facility in Alabama

In August, 2010 ACE assisted after ammonia was released from a ruptured pipe on the roof of a refrigeration facility in Alabama. Approximately 800 Deepwater Horizon clean-up workers were exposed downwind of the facility. The team abstracted the medical charts of the 152 persons treated at five hospitals and interviewed 116 workers. Recommendations made as a result of the assessment included: to monitor the health of the exposed, survey hospitals to assess the impact, and assess emergency response procedures in the county. A review of the response highlighted that the community surrounding the refrigeration facility was not warned of the release and given instructions to evacuate the area. Afterwards, the county implemented a reverse 911 system, allowing for better notification of the public in an emergency. The ACE team arranged for NIEHS to follow the health of the exposed persons in conjunction with the Gulf Long-Term Follow-Up Study. The results of that follow-up are not available at this time.

6.0 Conclusions

NTSIP bridges a necessary gap in current toxic substance surveillance; it is the only existing comprehensive surveillance system for acute toxic substance exposures. It therefore occupies an important niche by profiling toxic releases and providing a valuable record of those releases. The wealth of knowledge gained through these surveillance activities can be used not only to learn from past toxic substance incidents, but to proactively plan and prepare for future ones. As this program continues its toxic surveillance activities, the data collected will become more powerful and useful in the prevention of toxic releases.

7.0 References

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Appendix A: 2010 NTSIP Publications

Duncan, MA and MF Orr. (2010). "Evolving with the Times, the New National Toxic Substance Incidents Program". Journal of Medical Toxicology 6**(4)**: 461-463. December 2010.

Appendix B: Supporting data from NTSIP 2010 Report

Table 5. Number of NTSIP-eligible events, events with injured persons/fatalities, and total number of injured persons/fatalities by type of events and reporting states, NTSIP 2010.

State	NTSIP-eligible Events—Injuries[a]								
	Total			Fixed Facility			Transportation		
	# of events	# of events with injured people	Total # of injured people	# of events	# of events with injured people	Total # of injured people	# of events	# of events with injured people	Total # of injured people
Louisiana	740	62	91	531	46	70	209	16	21
New York	838	180	543	638	156	493	200	24	50
North Carolina	347	54	81	185	39	61	162	15	20
Oregon	208	25	68	98	23	64	110	2	4
Tennessee	348	48	107	148	36	87	200	12	20
Utah	218	94	142	142	88	126	76	6	16
Wisconsin	282	26	157	122	24	155	160	2	2
Total	**2,981**	**489**	**1,189**	**1,864**	**412**	**1,056**	**1,117**	**77**	**133**
State	**NTSIP-eligible Events—Fatalities[a]**								
	Total			**Fixed Facility**			**Transportation**		
	# of events	**# of events with fatalities**	**Total # of fatalities**	**# of events**	**# of events with fatalities**	**Total # of fatalities**	**# of events**	**# of events with fatalities**	**Total # of fatalities**
Louisiana	740	2	2	531	2	2	209	0	0
New York	838	18	21	638	15	16	200	3	5
North Carolina	347	7	7	185	2	2	162	5	5
Oregon	208	1	1	98	1	1	110	0	0
Tennessee	348	8	9	148	5	5	200	3	4
Utah	218	5	6	142	4	5	76	1	1
Wisconsin	282	1	2	122	1	2	160	0	0
Total	**2,981**	**42**	**48**	**1,864**	**30**	**33**	**1,117**	**12**	**15**

[a]Injuries and fatalities were analyzed independently, therefore, the number of injuries represents the number of people who sustained injury as a result of a chemical incident, while fatalities represent the number of people who died as a result of their injuries.

Table 6. Number of fixed facility events, fixed facility events with injured people, and total number of injured people by number of employees at a fixed facility by evacuation order status, NTSIP 2010.

Number of employees at fixed facility	NTSIP-eligible Fixed Facility Events*		
	# of Fixed Facility Events	# of Fixed Facility Events with Injured People	Total # of Injured People
	Official Evacuation Ordered		
0	27	12	23
1–5	23	12	26
6–20	30	8	46
21–50	33	10	39
51–100	26	11	132
101–500	33	8	53
501–1000	10	3	10
>1000	9	1	1
Missing number of employees	263	72	268
Total	**454**	**137**	**598**
	No Official Evacuation Ordered		
0	141	69	100
1–5	97	28	43
6–20	90	31	41
21–50	93	10	16
51–100	77	9	15
101–500	250	16	26
501–1000	78	8	19
>1000	209	11	18
Missing number of employees	374	92	179
Total	**1,409**	**274**	**457**

* Two events had a missing evacuation status

Table 7. Number of transportation events, transportation events with injured people/fatalities, and total number of injured people/fatalities by transportation stage, NTSIP 2010.

Transportation Stage	NTSIP-eligible Transportation Events				
	Events	Injuries		Fatalities	
	# of Transportation Events	# of Transportation Events with Injured People	Total # of Injured People	# of Transportation Events with Fatalities	Total # of Fatalities
Occurred during unloading of a stationary vehicle or vessel	354	7	9	0	0
From a moving vehicle or vessel	309	49	81	7	8
En route and later discovered at a fixed facility	319	2	2	0	0
Occurred from a stationary vehicle or vessel	122	18	31	5	7
Other	11	1	10	0	0
Missing transportation route	2	0	0	0	0
Total	**1,117**	**77**	**133**	**12**	**15**

Table 8. The Top 20 most common individual chemicals released in fixed facility NTSIP events, 2010.

Top 20 Chemicals Involved in NTSIP-eligible Fixed Facility Events, 2010			
Rank	**Chemical Name**	**#**	**Percentage of Total Fixed Facility Incidents (%)[a]**
(1)	Natural Gas	181	9.7
(2)	Carbon Monoxide	139	7.5
(3)	Methamphetamine Chemicals	117	6.3
(4)	Ammonia	114	6.1
(5)	Sulfuric Acid	73	3.9
(6)	Hydrochloric Acid	59	3.2
(7)	Chlorine	54	2.9
(8)	Propane	52	2.8
(9)	Mercury	50	2.7
(10)	Alkaline Hydroxide[b]	49	2.6
(11)	Benzene	45	2.4
(12)	Ethylene	39	2.1
(13)	Sulfur Dioxide	37	2.0
(14)	Hydrogen Sulfide	28	1.5
(15)	Vinyl Chloride	26	1.4
(16)	Flammable Gas, NOS[c]	25	1.3
(17)	Sodium Hypochlorite	25	1.3
(18)	Propylene	24	1.3
(19)	Transformer Oil	16	0.9
(20)	Polychlorinated Biphenyls	12	0.6
Total number of events with Top 20 chemicals involved in fixed facility events		**1,165**	**62.5**

[a] Percentages calculated on the basis of the total number of fixed facility events (n = 1,864)

[b] Alkaline hydroxide includes both sodium hydroxide and potassium hydroxide

[c] NOS = not otherwise specified

Table 9. The Top 10 most common individual chemicals released in NTSIP transportation events, 2010.

Top 10 Chemicals Involved in NTSIP-eligible Transportation Events, 2010			
Rank	**Chemical Name**	**#**	**Percentage of Total Transportation Incidents (%)[a]**
(1)	Alkaline Hydroxide[b]	134	12.0
(2)	Hydrochloric Acid	76	6.8
(3)	Sulfuric Acid	61	5.5
(4)	Natural Gas	40	3.4
(5)	Isopropanol, NOS[c]	24	2.1
(6)	Hydrogen Peroxide	24	2.1
(7)	Resin, NOS	22	2.0
(8)	Acetone	20	1.8
(9)	Flammable Liquid, NOS[c]	19	1.7
(10)	Ammonia	15	1.3
Total number of events with Top 10 chemicals involved in transportation events		**435**	**38.9**

[a] Percentages calculated on the basis of the total number of transportation events (n = 1,117)
[b] Alkaline hydroxide includes both sodium hydroxide and potassium hydroxide
[c] NOS = not otherwise specified

Table 10. Number of NTSIP-eligible events, injuries, and fatalities by type of chemical release and type of event (fixed facility, transportation, and total), NTSIP 2010.[a]

	NTSIP-eligible Events					
	Fixed Facilities		Transportation		Total	
Chemical release type	#	%	#	%	#	%
Spill (liquid or solid)*	695	37.1	948	84.9	1,643	55.1
Volatilization/aerosolized (vapor) *	859	46.1	101	9.0	960	32.2
Fire*	39	2.1	4	0.4	43	1.4
Explosion*	30	1.6	3	0.3	33	1.1
Any two release types with one chemical only**	127	6.8	47	4.2	174	5.8
2+ release types with multiple chemicals involved***	111	6.0	14	1.3	125	4.2
Missing chemical release type	3	0.2	0	0	3	0.1
Total # of NTSIP-eligible events	**1,864**	**100**	**1,117**	**100**	**2,981**	**100**
	NTSIP-eligible Events—Injuries[b]					
	Fixed Facilities		**Transportation**		**Total**	
Chemical release type	#	%	#	%	#	%
Spill (liquid or solid) *	182	17.2	69	51.9	251	21.1
Volatilization/aerosolized (vapor) *	539	51.0	14	10.5	553	46.5
Fire*	23	2.2	6	4.5	29	2.4
Explosion*	37	3.5	5	3.8	42	3.5
Any two release types with one chemical only**	204	19.3	33	24.8	237	19.9
2+ release types with multiple chemicals involved***	65	6.2	6	4.5	71	6.0
Missing chemical release type	6	0.6	0	0	6	0.5
Total # of Injured People	**1,056**	**100**	**133**	**100**	**1,189**	**100**
	NTSIP-eligible Events—Fatalities[b]					
	Fixed Facilities		**Transportation**		**Total**	
Chemical release type	#	%	#	%	#	%
Spill (liquid or solid) *	0	0	5	33.3	5	10.4
Volatilization/aerosolized (vapor) *	24	72.7	5	33.3	29	60.4
Fire*	0	0	1	6.7	1	2.1
Explosion*	2	6.1	0	0	2	4.2
Any two release types with one chemical only**	7	21.2	4	26.7	11	22.9
Total # of Fatalities	**33**	**100**	**15**	**100**	**48**	**100**

[a] Total percentages do not equal 100 due to rounding

[b] Fatalities are also counted as injuries and therefore contribute to the injury totals

*Includes all events with a single chemical and single route of exposure (e.g., ammonia exposure through volatilization)

**Includes events in which more than one release type was entered for an exposure (e.g.., mercury exposure through both volatilization and spill)

***Includes all events in which multiple different chemical exposures and pathways occurred

Table 11. Number and % of injured people in NTSIP-eligible events by adverse health effects and type of events (fixed facility, transportation, and total) among those who are exposed to ammonia.

Adverse Health Effects from Exposure to Ammonia	Number of Injured People in NTSIP-eligible events	
	Total	
	#	%
Non-chemical related trauma*	3	11.5
Respiratory system problems	8	30.8
Eye irritation	1	3.9
Heat stress	2	7.7
Skin irritation	1	3.9
Shortness of breath (unknown cause)	3	11.5
Two adverse health effects	8	30.8
Total # of Injured People	**26**	**100**

[a] Total percentages do not equal 100 due to rounding

*When examining injuries resulting from NTSIP-eligible events, it is necessary to keep in mind that those occurring through non-chemical related traumas should be separated because the injuries were related to a fire or an accident, rather than from exposure to a chemical.

Table 12. Number and % of injured people in NTSIP-eligible events by adverse health effects and type of events (fixed facility, transportation, and total) among those who are exposed to carbon monoxide.

Adverse Health Effects from Exposure to Carbon Monoxide	Number of Injured People in NTSIP-eligible events	
	Total	
	#	%
Respiratory system problems	8	4.2
Gastrointestinal problems	6	3.1
Other	2	1.1
Dizziness or other Central Nervous System (CNS) symptoms	88	46.1
Headache	22	11.5
Heart problems	3	1.6
Shortness of breath (unknown cause)	5	2.6
TWO adverse health effects	47	24.6
THREE adverse health effects	9	4.7
Missing adverse health effect	1	0.5
Total # of Injured People	**191**	**100**

Table 13. Number and % of injured people in NTSIP-eligible events by adverse health effects and type of events (fixed facility, transportation, and total) among those who are exposed to chlorine.[a]

Adverse Health Effects from Exposure to Chlorine	Number of Injured People in NTSIP-eligible events	
	Total	
	#	%
Trauma	**6**	**6.7**
Chemical-related	*4*	*4.5*
*Not chemical-related**	*2*	*2.2*
Respiratory system problems	51	57.3
Eye irritation	1	1.1
Chemical burns	1	1.1
Skin irritation	5	5.6
Shortness of breath (unknown cause)	1	1.1
TWO adverse health effects	18	20.2
THREE adverse health effects	6	6.7
Total # of Injured People	**89**	**100**

[a] Total percentages do not equal 100 due to rounding

*When examining injuries resulting from NTSIP eligible events, it is necessary to keep in mind that those occurring through non-chemical related traumas and thermal burns should be removed because the injuries were related to a fire or an accident, rather than from exposure to a chemical

Table 14. Number and % of injured people in NTSIP-eligible events by adverse health effects and type of events (fixed facility, transportation, and total) among those who are exposed to petroleum.

Adverse Health Effects from Exposure to Petroleum	Number of Injured People in NTSIP-eligible events	
	Total	
	#	%
Trauma	**27**	**19.0**
Chemical-related	*5*	*18.5*
*Not chemical-related**	*22*	*81.5*
Respiratory system problems	4	2.8
Eye irritation	3	2.1
Gastrointestinal problems	6	4.2
Heat stress	4	2.8
Burns	**37**	**26.1**
Thermal	*29*	*78.4*
Chemical	*3*	*8.1*
Both	*4*	*10.8*
Missing	*1*	*2.7*
Other	1	0.7
Skin irritation	2	1.4
Dizziness or other CNS symptoms	9	6.3
Headache	8	5.6
Heart problems	2	1.4
TWO adverse health effects	29	20.4
THREE adverse health effects	4	2.8
Missing adverse health effect	6	4.2
Total # of Injured People	**142**	**100**

*When examining injuries resulting from NTSIP eligible events, it is necessary to keep in mind that those occurring through other than chemical-related traumas and thermal burns should be separated because the injuries were related to a fire or an accident, rather than from exposure to a chemical

Table 15. Number and percent of NTSIP-eligible events and injured people by **primary contributing factors** and type of events (fixed facility, transportation, and total), NTSIP 2010.

	NTSIP-eligible Events					
	Fixed Facilities		Transportation		Total	
Primary Contributing Factor	#	%	#	%	#	%
Equipment failure	916	49.1	217	19.4	1,133	38.0
Human error	632	33.9	867	77.6	1,499	50.3
Other	19	1.0	4	0.4	23	0.8
Intentional	69	3.7	11	1.0	80	2.7
Bad weather condition/natural disasters	40	2.2	8	0.7	48	1.6
Illegal act	165	8.9	8	0.7	173	5.8
Missing primary contributing factor	23	1.2	2	0.2	25	0.8
Total # of NTSIP-eligible events	**1,864**	**100**	**1,117**	**100**	**2,981**	**100**
	NTSIP-eligible Events—Injuries					
	Fixed Facilities		**Transportation**		**Total**	
Primary Contributing Factor	#	%	#	%	#	%
Equipment failure	337	31.9	19	14.3	356	29.9
Human error	544	51.5	92	69.2	636	53.5
Other	7	0.7	1	0.8	8	0.7
Intentional	59	5.6	8	6.0	67	5.6
Bad weather condition/natural disasters	3	0.3	13	9.8	16	1.4
Illegal act	70	6.6	0	0	70	5.9
Missing primary contributing factor	36	3.4	0	0	36	3.0
Total # of Injured People	**1,056**	**100**	**133**	**100**	**1,189**	**100**

Note: Total percentages may not add to 100 due to rounding

Table 16. Number and percent of NTSIP-eligible events and injured people in NTSIP-eligible events by **specific primary supplemental factors** and type of events (fixed facility, transportation, and total, NTSIP 2010.

	NTSIP-eligible Events					
	Fixed Facilities		Transportation		Total	
Primary Supplemental Factor	#	%	#	%	#	%
Improper mixing	46	2.5	4	0.4	50	1.7
Improper filling, loading, or packing	124	6.7	559	50.0	683	22.9
Other	249	13.4	159	14.2	408	13.7
Performing maintenance	46	2.5	4	0.4	50	1.7
System/process upset	433	23.2	35	3.1	468	15.7
System start up and shut down	29	1.6	1	0.1	30	1.0
Power failure/electrical problems	32	1.7	2	0.2	34	1.1
Unauthorized/improper dumping	35	1.9	10	0.9	45	1.5
Vehicle or vessel collision	23	1.2	47	4.2	70	2.4
Fire	97	5.2	7	0.6	104	3.5
Explosion	48	2.6	6	0.5	54	1.8
Overspray/misapplication	62	3.3	6	0.5	68	2.3
Load-shift	1	0.1	26	2.3	27	0.9
Vehicle or vessel derailment/rollover/capsizing	1	0.1	75	6.7	76	2.6
Illicit drug production-related	144	7.7	8	0.7	152	5.1
Forklift puncture	38	2.0	66	5.9	104	3.5
Vandalism	6	0.3	2	0.2	8	0.3
Missing primary supplemental factor	450	24.1	100	9.0	550	18.5
Total # of NTSIP-eligible events	**1,864**	**100**	**1,117**	**100**	**2,981**	**100**
	NTSIP-eligible Events—Injuries					
	Fixed Facilities		**Transportation**		**Total**	
Primary Supplemental Factor	**#**	**%**	**#**	**%**	**#**	**%**
Improper mixing	127	12.0	4	3.0	131	11.0
Improper filling, loading, or packing	11	1.0	8	6.0	19	1.6
Other	110	10.4	12	9.0	122	10.3
Performing maintenance	79	7.5	0	0	79	6.6
System/process upset	76	7.2	13	9.8	89	7.5
System start up and shut down	1	0.1	0	0	1	0.1
Power failure/electrical problems	23	2.2	4	3.0	27	2.3
Unauthorized/improper dumping	10	1.0	6	4.5	16	1.4
Vehicle or vessel collision	3	0.3	36	27.1	39	3.3
Fire	102	9.7	4	3.0	106	8.9
Explosion	65	6.2	9	6.8	74	6.2
Overspray/misapplication	88	8.3	0	0	88	7.4
Load-shift	0	0	1	0.8	1	0.1
Vehicle or vessel derailment/rollover/capsizing	0	0	24	18.1	24	2.0
Illicit drug production-related	59	5.6	0	0	59	5.0
Forklift puncture	6	0.6	0	0	6	0.5
Vandalism	1	0.1	0	0	1	0.1
Missing primary supplemental factor	295	28.0	12	9.0	307	25.8
Total # of Injured People	**1,056**	**100**	**133**	**100**	**1,189**	**100**

Note: Total percentages may not add to 100 due to rounding

Table 17. Number and percent of NTSIP-eligible events by **secondary contributing factors** and type of events (fixed facility, transportation, and total), NTSIP 2010.

	NTSIP-eligible Events					
	Fixed Facilities		Transportation		Total	
Secondary Contributing Factor	#	%	#	%	#	%
Equipment failure	144	7.7	166	14.9	310	10.4
Human error	40	2.2	40	3.6	80	2.7
Other	3	0.2	1	0.1	4	0.1
Intentional	3	0.2	1	0.1	4	0.1
Bad weather condition/natural disasters	8	0.4	6	0.5	14	0.5
Illegal act	9	0.5	0	0	9	0.3
No secondary factor	1,596	85.6	867	77.6	2,463	82.6
Missing secondary contributing factor	61	3.3	36	3.2	97	3.3
Total # of NTSIP-eligible events	**1,864**	**100**	**1,117**	**100**	**2,981**	**100**

Note: Total percentages may not add to 100 due to rounding

Table 18. Number and percent of NTSIP-eligible events in NTSIP-eligible events by **specific secondary supplemental factors** and type of events (fixed facility, transportation, and total), NTSIP 2010.

	NTSIP-eligible Events					
	Fixed Facilities		Transportation		Total	
Secondary Supplemental Factor	#	%	#	%	#	%
Improper filling, loading, or packing	3	0.2	4	0.4	7	0.2
Other	30	1.6	88	7.9	118	4.0
Performing maintenance	1	0.1	1	0.1	2	0.1
System/process upset	8	0.4	1	0.1	9	0.3
System start up and shut down	2	0.1	0	0	2	0.1
Vehicle or vessel collision	0	0	2	0.2	2	0.1
Fire	23	1.2	3	0.3	26	0.9
Explosion	10	0.5	3	0.3	13	0.4
Overspray/misapplication	2	0.1	0	0	2	0.1
Load-shift	1	0.1	19	1.7	20	0.7
Vehicle or vessel derailment/rollover/capsizing	0	0	3	0.3	3	0.1
Illicit drug production-related	1	0.1	0	0	1	0.0[b]
Forklift puncture	0	0	2	0.2	2	0.1
Missing secondary supplemental factor	1,783	96.0	991	88.7	2,774	93.1
Total # of NTSIP-eligible events	**1,864**	**100**	**1,117**	**100**	**2,981**	**100**

Note: Total percentages may not add to 100 due to rounding

[b] Percentage negligible due to rounding

Table 19. Number of NTSIP-eligible events and total number of injured people by number of injured people per event and type of events (fixed facility, transportation, and total), NTSIP 2010.

# of Injured People per Event	NTSIP-eligible Events					
	Fixed Facility		Transportation		Total	
	# of events	Total # of injured people	# of events	Total # of injured people	# of events	Total # of injured people
None	1,452	0	1,040	0	2,492	0
Any:	**412**	**1,056**	**77**	**133**	**489**	**1,189**
1 person	*243*	*243*	*46*	*46*	*289*	*289*
2 persons	*79*	*158*	*17*	*34*	*96*	*192*
3 persons	*29*	*87*	*10*	*30*	*39*	*117*
4 persons	*18*	*72*	*2*	*8*	*20*	*80*
5 persons	*12*	*60*	*1*	*5*	*13*	*65*
6+ persons	*31*	*436*	*1*	*10*	*32*	*446*
Total	**1,864**	**1,056**	**1,117**	**133**	**2,981**	**1,189**

Table 20. Number and percent of injured people in NTSIP-eligible events by severity and disposition of injured people and type of events (fixed facility, transportation, and total), NTSIP 2010.

Severity and Disposition of Injured People	Number of Injured People in NTSIP-eligible events					
	Fixed Facility		Transportation		Total	
	#	%	#	%	#	%
Treated on scene (first aid)	234	22.2	17	12.8	251	21.1
Treated at hospital (not admitted)	619	58.6	59	44.4	678	57.0
Treated at hospital (admitted)	125	11.8	38	28.6	163	13.7
Observation at hospital; no treatment	8	0.8	0	0	8	0.7
Seen by private physician within 24 hours	15	1.4	1	0.8	16	1.4
Injuries experienced within 24 hours of event and reported by official (e.g., fire department, EMT)	5	0.5	0	0	5	0.4
Death on scene/on arrival at hospital	18	1.7	14	10.5	32	2.7
Death after arrival at hospital	15	1.4	1	0.8	16	1.4
Missing severity/disposition	17	1.6	3	2.3	20	1.7
Total # of Injured People	**1,056**	**100**	**133**	**100**	**1,189**	**100**

Table 21. Number and percent of injured people in NTSIP-eligible events by category of injured people and type of events (fixed facility, transportation, and total), NTSIP 2010.

Category of Injured People	Number of Injured People in NTSIP-eligible events					
	Fixed Facility		Transportation		Total	
	#	%	#	%	#	%
Employee	**420**	**39.8**	**67**	**50.4**	**487**	**41.0**
Employee	*420*	*39.8*	*67*	*50.4*	*487*	*41.0*
Public	**543**	**51.4**	**59**	**44.4**	**602**	**50.6**
General public	*464*	*44.0*	*59*	*44.4*	*523*	*44.0*
Student *(at school)*	*79*	*7.5*	*0*	*0*	*79*	*6.7*
Responders/hospital personnel	**93**	**8.8**	**7**	**5.3**	**100**	**8.4**
Responder (not specified)	*1*	*0.1*	*2*	*1.5*	*3*	*0.3*
Career firefighter	*49*	*4.6*	*1*	*0.8*	*50*	*4.2*
Volunteer Firefighter	*10*	*1.0*	*1*	*0.8*	*11*	*0.9*
Firefighter *(not specified)*	*11*	*1.0*	*0*	*0*	*11*	*0.9*
Police officer	*12*	*1.1*	*3*	*2.3*	*15*	*1.3*
EMT personnel	*1*	*0.1*	*0*	*0*	*1*	*0.1*
Hospital personnel (e.g., doctor, nurse)	*9*	*0.9*	*0*	*0*	*9*	*0.8*
Total # of Injured People	**1,056**	**100**	**133**	**100**	**1,189**	**100**

Note: Total percentages may not add to 100 due to rounding

Table 22. Number of injured people in NTSIP-eligible events by category of injured people and gender and age, NTSIP 2010.

Category of Injured People	Number of Injured People in NTSIP-eligible events					
	Gender			Age Category		
	Male	Female	Missing	Child*	Adult**	Missing
Employee	**290**	**74**	**123**	**6**	**433**	**48**
Employee	*290*	*74*	*123*	*6*	*433*	*48*
Public	**267**	**258**	**77**	**218**	**357**	**27**
General public	*235*	*219*	*69*	*158*	*338*	*27*
Student *(at school)*	*32*	*39*	*8*	*60*	*19*	*0*
Responders/hospital personnel	**79**	**12**	**9**	**1**	**87**	**12**
Responder (not specified)	*2*	*1*	*0*	*1*	*0*	*2*
Career firefighter	*45*	*2*	*3*	*0*	*46*	*4*
Volunteer firefighter	*11*	*0*	*0*	*0*	*11*	*0*
Firefighter *(not specified)*	*11*	*0*	*0*	*0*	*11*	*0*
Police officer	*9*	*0*	*6*	*0*	*9*	*6*
EMT personnel	*0*	*1*	*0*	*0*	*1*	*0*
Hospital personnel (e.g., doctor, nurse)	*1*	*8*	*0*	*0*	*9*	*0*
Total # of Injured People	**636**	**344**	**209**	**225**	**877**	**87**

* Child: under 18 years old

** Adult: 18 years old or greater

Table 23. Number and percent of injured people in NTSIP-eligible events by adverse health effects and type of events (fixed facility, transportation, and total), NTSIP 2010.

Adverse Health Effects	Total # of Injured People in NTSIP events					
	Fixed Facilities		Transportation		Total	
	#	%	#	%	#	%
Trauma	**46**	**4.4**	**54**	**40.6**	**100**	**8.4**
Chemical-related	*28*	*2.7*	*3*	*2.3*	*31*	*2.6*
*Not chemical-related**	*18**	*1.7**	*49**	*36.8**	*67**	*5.6**
Missing	*0*	*0*	*2*	*1.5*	*2*	*0.2*
Respiratory system problems	197	18.7	11	8.3	208	17.5
Eye irritation	14	1.3	4	3.0	18	1.5
Gastrointestinal problems	52	4.9	0	0	52	4.4
Heat stress	20	1.9	0	0	20	1.7
Burns	**102**	**9.7**	**18**	**13.5**	**120**	**10.1**
*Thermal**	*48**	*4.6**	*9**	*6.8**	*57**	*4.8**
Chemical	*39*	*3.7*	*9*	*6.8*	*48*	*4.0*
Both	*10*	*1.0*	*0*	*0*	*10*	*0.8*
Missing	*5*	*0.5*	*0*	*0*	*5*	*0.4*
Other	24	2.3	6	4.5	30	2.5
Skin irritation	30	2.8	4	3.0	34	2.9
Dizziness or other CNS symptoms	148	14.0	4	3.0	152	12.8
Headache	42	4.0	4	3.0	46	3.9
Heart problems	3	0.3	3	2.3	6	0.5
Shortness of breath (unknown cause)	13	1.2	0	0	13	1.1
TWO adverse health effects	239	22.6	20	15.0	259	21.8
THREE adverse health effects	85	8.1	3	2.3	88	7.4
More than THREE adverse health effects	12	1.1	0	0	12	1.0
Missing adverse health effect	29	2.8	2	1.5	31	2.6
Total # of Injured People	**1,056**	**100**	**133**	**100**	**1,189**	**100**

Note: Total percentages may not add to 100 due to rounding

*When examining injuries resulting from NTSIP eligible events, it is necessary to keep in mind that those occurring through non-chemical related traumas and thermal burns should be separated because the injuries were related to a fire or an accident, rather than from exposure to a chemical

Table 24. Description of Levels of Personal Protective Equipment (PPE).

Level of PPE Protection	Requirements for Use	Examples of Clothing and Equipment
A	• Circumstances when the greatest potential for exposure to hazards exists and when the greatest level of skin, respiratory, and eye protection is necessary	• Positive pressure, full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA • Fully encapsulating chemical- and vapor-protective suit • Inner and outer chemical resistant gloves • Disposable protective suit, gloves, and boots
B	• Circumstances requiring the highest level of respiratory protection, with a lesser level of skin protection	• Positive pressure, full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA • Inner and outer chemical resistant gloves • Face shield • Hooded chemical resistant clothing • Coveralls • Outer chemical-resistant boots
C	• Circumstances in which the concentration and type of airborne substance is known and the criteria for using air purifying respirators are met	• Full-face, air purifying respirator • Inner and outer chemical-resistant gloves • Hard hat • Escape mask • Disposable chemical-resistant outer boots
D	• Sufficient when no contaminants are present or work operations preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of chemicals	• Gloves • Coveralls • Safety glasses • Face shield • Chemical-resistant steel-toe boots or shoes

Table 25. Number and percent of NTSIP-eligible events by main type of responders and type of events (fixed facility, transportation, and total), NTSIP 2010.

	Number of NTSIP-eligible events					
	Fixed Facilities		Transportation		Total	
Type of responders	**#**	**%**	**#**	**%**	**#**	**%**
No response	93	5.0	124	11.1	217	7.3
Certified HazMat team	23	1.2	23	2.1	46	1.5
Company response team	690	37.0	613	54.9	1,303	43.7
Law enforcement agency	54	2.9	9	0.8	63	2.1
Fire department	63	3.4	13	1.2	76	2.6
EMS	7	0.4	2	0.2	9	0.3
Other	4	0.2	0	0	4	0.1
Health department/health agency	5	0.3	1	0.1	6	0.2
Environmental agency/EPA response team	13	0.7	2	0.2	15	0.5
3rd Party clean-up contractor	53	2.8	58	5.2	111	3.7
Department of works/utilities/transportation (includes Coast Guard)	29	1.6	4	0.4	33	1.1
State, county, or local emergency manager/coordinators/planning committees	1	0.1	1	0.1	2	0.1
Hospital	18	1.0	0	0	18	0.6
Poison Center	1	0.1	0	0	1	0.0[b]
Two types of responders	399	21.4	121	10.8	520	17.4
Three types of responders	231	12.4	63	5.6	294	9.9
More than Three types of responders	178	9.6	80	7.2	258	8.7
Missing responder types	2	0.1	3	0.3	5	0.2
Total # of NTSIP-eligible events	**1,864**	**100**	**1,117**	**100**	**2,981**	**100**

Note: Total percentages may not add to 100 due to rounding

Table 26. Type of industries (listed by NAICS code) involved in NTSIP-eligible events and injuries, NTSIP 2010.

2-Digit NAICS Classification Code	NTSIP-eligible Events			
	Events		Injuries	
	#	%[a]	#	%[a]
11—Agriculture, Forestry, Fishing, and Hunting	46	1.5	4	0.3
21—Mining	22	0.7	10	0.8
22—Utilities	182	6.1	15	1.3
23—Construction	29	1.0	6	0.5
31—Manufacturing (includes food, beverage, tobacco, textile and apparel, leather and allied product manufacturing)	48	1.6	10	0.8
32—Manufacturing (includes wood, paper, printing, petroleum and coal, chemical, plastic and rubber, and non-metallic mineral manufacturing)	558	18.7	112	9.4
33—Manufacturing (includes metal, machinery, electronics, appliances, transportation equipment, furniture, and miscellaneous manufacturing)	43	1.4	52	4.4
42—Wholesale Trade	82	2.8	31	2.6
44—Retail Trade (includes motor vehicle, furniture and home furnishings, electronics and appliances, building materials and garden equipment, food and beverages, health and personal care, gasoline, and clothing and accessories)	37	1.2	14	1.2
45—Retail Trade (includes sporting goods, hobby, book and music supplies, general merchandise, and miscellaneous)	17	0.6	22	1.9
48—Transportation and Warehousing (includes transportation by air, rail, water, truck, transit, and ground passenger, pipeline, scenic and sightseeing, and transportation support activities)	871	29.2	65	5.5
49—Transportation and Warehousing (includes postal service, couriers)	151	5.1	15	1.3
51—Information	3	0.1	0	0
52—Finance and Insurance	2	0.1	0	0
53—Real Estate and Rental Leasing	122	4.1	88	7.4
54—Professional, Scientific, and Technical Services	21	0.7	29	2.4
55—Management of Companies and Enterprises	1	0.0[b]	3	0.3
56—Administrative, Support, Waste Management and Remediation Services	54	1.8	16	1.4
61—Educational Services	68	2.3	96	8.1
62—Health Care and Social Assistance	53	1.8	73	6.1
71—Arts, Entertainment and Recreation	22	0.7	48	4.0
72—Accommodation and Food Services	39	1.3	85	7.2
81—Other Services	76	2.6	56	4.7
92—Public Administration	27	0.9	25	2.1
No NAICS Industry Code Vehicle or Residence	261	8.8	251	21.1
Missing	17	0.6	13	1.1
Not Identified	53	1. 8	40	3.4
Not an Industry or residence/vehicle	76	2.6	10	0.8
Total	**2,981**	**100**	**1,189**	**100**

[a] Total percentages do not equal 100 due to rounding

[b] Percentage negligible due to rounding

Comments regarding this report are welcome. Please send your comments to the following address:

Agency for Toxic Substances and Disease Registry
Attn: Chief, Environmental Health Surveillance Branch, DTHHS
4770 Buford Highway, Mailstop F-58, NE Atlanta, Georgia 30341