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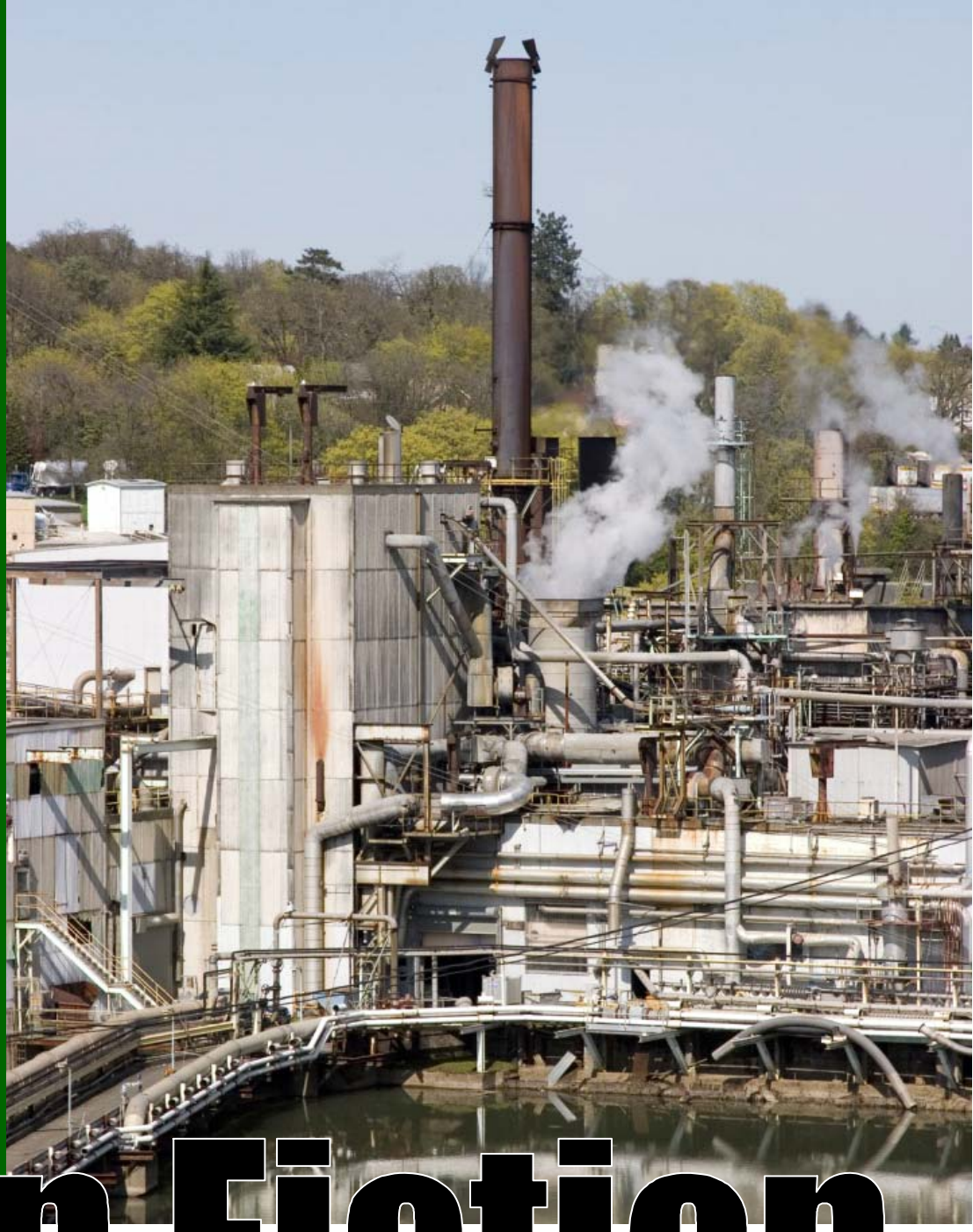

Pulp Fiction

Chemical Hazard Reduction at Pulp and Paper Mills

TexPIRG Education Fund

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Written by Alex Fidis of the TexPIRG Education Fund, 2007.

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EXECUTIVE SUMMARY

Across the country, pulp and paper mills, petroleum refineries, chemical plants and other industrial facilities use and store large amounts of hazardous chemicals that could be released in the event of an accident or terrorist attack. Releases at these chemical facilities could endanger thousands or even millions of people working and living in nearby communities. According to the Environmental Protection Agency (EPA), more than 100 facilities each would endanger at least one million people in a worst-case chemical release. Another 3,000 facilities each would endanger at least 10,000 people or more.

Many of these chemical facilities can eliminate the health and safety risks they pose to local communities. Chemical facilities often have multiple options for their production processes, and some of these options are inherently safer than others. Facilities that reduce or eliminate the use of hazardous chemicals, or that make changes to storage pressure or other processes, can remove the potential of a hazardous chemical release, making the facilities inherently safer and less appealing targets for terrorists.

Pulp and paper mills stand as a salient example of chemical facilities that can implement readily available safer alternatives to eliminate or reduce unnecessary risks to workers and local communities in the event of an accidental or deliberate chemical release.

Chlorine and chlorine dioxide are used as bleaching agents in many pulp and paper-making processes. The dominant industry processes are the elemental chlorine (EC) process, which relies on chlorine gas, or the elemental chlorine-free (ECF) process, which uses chlorine dioxide, a gas with hazards similar to chlorine.

In the event of an accidental or deliberate release, chlorine and chlorine dioxide present serious hazards. Chlorine, used as a chemical weapon, is highly toxic and corrosive. It irritates the mucous membranes of the nose, throat, and lungs, and causes breathing difficulties, violent coughing, acute tracheobronchitis, and chemical pneumonia. Exposure to relatively low levels of chlorine can be fatal. Similarly, chlorine dioxide causes shortness of breath, bronchitis, and emphysema. Acute exposure can cause potentially fatal pulmonary edema.

To estimate the number of Americans at risk of injury or death in the event of a chlorine or chlorine dioxide release at a pulp and paper mill, we examined Risk Management Plans submitted to EPA by the owners or operators of each facility. These plans, legally required under the Clean Air Act, estimate the distance that an extremely hazardous chemical could travel off-site in the event of a release, and the number of people living in the affected area or "vulnerability zone." This data analysis revealed that pulp and paper mills that continue to rely on chlorine or chlorine dioxide endanger millions of people.

Key findings include:

- In the United States, 16 pulp and paper mills still use chlorine and 58 use chlorine dioxide in their processing or store it on-site.

- These 74 facilities use and store almost 4 million pounds of chlorine and chlorine dioxide, endangering 5.7 million people living in 23 different states.

- The states with the most pulp and paper mills using or storing chlorine and chlorine dioxide include Alabama with seven, Florida and Georgia with six, and Louisiana, Maine, and South Carolina with five each.

- In Ohio, two pulp and paper mills place a total of almost 1.3 million people at risk. In Tennessee, three pulp and paper mills endanger a total of 730,000 people. Pulp and paper mills that continue to rely on chlorine and chlorine dioxide endanger at least 400,000 people in Florida, Louisiana, South Carolina, and Washington.

- A single pulp and paper facility that uses or stores chlorine or chlorine dioxide can endanger a large number of people. In Ohio, a single facility places 1.2 million people at risk in a worst-case chemical release; in Tennessee, a single facility endangers more than 600,000 people.

The pulp and paper industry has readily available safer alternatives to chlorine and chlorine dioxide bleaching that can reduce or eliminate these risks. The most commonly used chlorine-free bleaching process, typically called a totally chlorine-free (TCF) process, is oxygen based and uses either hydrogen peroxide or ozone. TCF bleaching protects worker and community health and safety by eliminating the presence of chlorine, chlorine dioxide, and highly toxic chlorinated byproducts, such as dioxins and furans. Another equally safe technology is processed chlorine-free bleaching (PCF), which also eliminates the need for chlorine and chlorine dioxide. TCF material originates from virgin pulp, whereas the PCF process uses recycled material.

Despite the safety and environmental benefits associated with chlorine-free bleaching, most pulp and paper mills have not switched to these safer and more secure technologies.

In order to adequately address the recognized safety and security threats created by facilities using and storing dangerous chemicals, the United States needs a comprehensive policy dedicated to making its pulp and paper mills—and all chemical plants—safer. This policy should:

- **Eliminate or reduce the use of highly toxic chemicals by switching to safer technologies where feasible.** Safer technologies are the most effective way to secure facilities and to protect workers and communities in the event of a deliberate or accidental chemical release. Pulp and paper mills can eliminate or significantly reduce the use of chlorine and chlorine dioxide by implementing readily available safer alternatives.

- **Maintain and expand public access to basic information about chemical use and hazards at individual facilities.** In order to evaluate, understand, and respond to potential chemical threats, workers and communities must have access to information about the use, storage, and release of hazardous chemicals.

- **Preserve the ability of states and localities to address chemical facility safety and security.** Threats at chemical facilities vary by community and state. Confronting these threats requires collaboration between local, state, and federal officials. In order to promote effective collaboration, states and localities must be allowed to establish safety and security programs that are more protective than federal requirements. In the absence of a comprehensive and permanent federal program, states including Maryland, New Jersey, New York, and North Carolina already have adopted measures to improve chemical security and safety within their borders.

By adopting safer technologies, chemical facilities can achieve a number of benefits. For example:

- **Safety and security reliability.** Hazard reduction makes chemical and industrial processes inherently safer by reducing or eliminating the use of highly toxic, volatile, or flammable chemicals or by limiting the quantity of these substances used or stored on-site. From a security perspective, eliminating the source of the threat can make facilities less attractive targets for terrorists.

- **Improved environmental performance.** In addition to safety and security benefits, safer technologies also can improve environmental performance at chemical facilities. Using hazardous chemicals in production and manufacturing processes often results in toxic byproducts or pollution. For example, chlorine-based pulp and paper bleaching processes generate dioxins and furans. Chlorine-free technologies eliminate these toxic pollutants by taking chlorine out of the equation.

- **Operating cost savings.** Although switching to safer technologies may require an initial capital investment, these technologies can offset recurring operating costs. For example, pulp and paper mills that eliminate the use of chlorine or chlorine dioxide can achieve significant cost savings associated with pollution control, workplace safety requirements, emergency response, employee training, security costs, and safety equipment. In the long-term, avoiding or reducing these annually recurring costs can save facilities money.

CHEMICAL INSECURITY: HAZARDS LEAVE COMMUNITIES EXPOSED

Across the United States, thousands of industrial facilities endanger workers and local communities by storing and using large quantities of extremely hazardous chemicals. According to information supplied by these facilities to the Environmental Protection Agency (EPA), approximately 106 facilities each endanger at least one million people based on a worst-case chemical release. Another 3,000 facilities each endanger at least 10,000 or more. Nearly 5,000 facilities store more than 100,000 pounds of at least one EPA-classified "extremely hazardous substance."[1]

ACCIDENTAL CHEMICAL RELEASES

Accidents at chemical and industrial facilities involving highly hazardous chemicals are more common than most Americans would imagine. In 2006, more than 36,000 chemical incidents were reported to the federal National Response Center.[2] The majority of these incidents were minor and quickly addressed and mitigated. The rare incidents of perilous toxic chemical releases have the potential to kill or seriously injure hundreds, if not thousands, of people. Each year, companies report more than 25,000 fires, explosions, or spills involving hazardous chemicals. Annually, at least 1,000 of these events involve deaths, injuries, or evacuations.[3]

Recent events involving hazardous chemicals have caused fatalities, serious injuries, large-scale evacuations, and significant property damage.

On the eve of Thanksgiving Day 2006, the CAI chemical facility in Danvers, Massachusetts exploded in the early morning hours with the force of a 2,000 ton bomb. The potent explosion sparked a 10 alarm fire and drew rescuers and firemen from more than 30 surrounding towns and cities. After the explosion, then-Governor Mitt Romney said it was a "Thanksgiving miracle" that no one was seriously injured or killed.[4]

One month earlier in Apex, North Carolina, a hazardous chemical storage and treatment facility ignited in flames, prompting the evacuation of more than 17,000 residents as chemical laden yellow smoke threatened nearby residents.[5] Fortunately, light rain and low winds suppressed the chemical cloud and gave residents enough time to safely evacuate the area.

When hazardous chemical releases occur, workers are often the first exposed. In March 2005, multiple chemical explosions at the BP oil refinery in Texas City, Texas killed 15 employees and injured many more.[6]

DELIBERATE CHEMICAL RELEASES

The potential for accidental chemical releases has long threatened workers and nearby communities. September 11, 2001 elevated a new and more sinister threat, that terrorists intent on causing heavy casualties would target chemical facilities to deliberately release highly hazardous chemicals.

The Army Surgeon General ranked an attack on a chemical plant second only to a

widespread biological attack in magnitude of danger to public health and safety.[7] Appearing before the Senate Homeland Security Committee in January 2005, President Bush's former Deputy Homeland Security Advisor Richard Falkenrath testified that "[o]f all the various remaining civilian vulnerabilities in America today, one stands alone as uniquely deadly, pervasive and susceptible to terrorist attack: toxic inhalation hazard industrial chemicals."[8]

Even before September 11, 2001, federal agencies warned of deficient security and safety programs at chemical facilities. The Agency for Toxic Substances and Disease Registry (ATSDR) commented on the deplorable security at chemical facilities in a 1999 study of two communities – the Kanawha Valley in West Virginia and Las Vegas, Nevada. The study assessed multiple chemical facilities in these communities and found each facility poorly prepared for a deliberate attack. ATSDR also remarked that the toxic chemicals stored at the assessed facilities provide "effective and readily accessible materials to develop improvised explosives, incendiaries and poisons."[9]

EPA came to a similar conclusion in its February 2000 Chemical Security Alert. The Agency voiced concern that the accidental or deliberate release of a highly hazardous chemical from a facility threatened public safety. EPA's proposed solution to reduce these threats involved deploying new and improved designs and processes to replace hazardous substances with safer alternatives wherever possible.[10]

A number of investigative reports, conducted after 9/11, have uncovered lax security at more than 100 chemical facilities nationwide. As recently as January 2007, an investigative reporter for the *Pittsburgh Tribune* penetrated 48 chemical plants and rail lines to reach hazardous chemicals. These chemicals threatened densely populated parts of Seattle, Atlanta, Pittsburgh, Las Vegas, San Francisco, and New Jersey.[11]

THE PAPER INDUSTRY AND CHLORINE COMPOUNDS

Wood consists of two primary components, cellulose and lignin. Cellulose, which is the fibrous component of wood, is used to make pulp and paper. Lignin is the "glue" that holds the wood fibers together. The pulping process reduces wood materials to a fibrous material by separating the cellulose from the lignin. To accomplish this, wood materials are heated with chemicals in a large vessel to dissolve and extract the lignin. Once the majority of the lignin is removed, the resulting pulp is washed, at which point the unbleached pulp can be made into products like brown paper bags or cardboard boxes.

In order to create lighter or white paper products, the pulp must be put through an additional bleaching process to remove the remaining lignin in order to brighten the pulp. The majority of mills in the United States use the "kraft" chemical bleaching process, which utilizes chlorine or chlorine dioxide as bleaching agents to turn pulp white.[12] The kraft bleaching process applies one of five basic bleaching technologies: elemental chlorine (EC), elemental chlorine-free (ECF), ozone elemental chlorine-free (OECF), totally chlorine-free (TCF), and processed chlorine-free (PCF).

The EC and ECF methods of bleaching pose serious health and safety risks because they rely on chlorine and chlorine dioxide, respectively. Similar to the ECF process, the OECF process uses hazardous chlorine dioxide as a bleaching agent. The OECF process, however, also incorporates ozone, which reduces the amount of chlorine dioxide required, making it a safer technology than the traditional ECF process. In addition, some pulp and paper mills operate bleaching processes that generate chlorine dioxide only as it is needed. The TCF and PCF bleaching processes are the safest technologies because they completely eliminate the use of chlorine and chlorine dioxide.

In modern mills, due in large part to concerns about toxic chemical pollution associated with elemental chlorine, the industry trend has been to transition from using the EC bleaching process to the ECF process.[13]

ELEMENTAL CHLORINE BLEACHING

Historically, pulp and paper mills have used elemental chlorine in the bleaching process because it is a strong oxidant that easily breaks down the remaining lignin in the unbleached pulp. EC bleaching mills use an average of 110-176 pounds of chlorine for every ton of wood pulp bleached.[14] In the late 1990s, as concern over insidious chlorine by-products – toxic pollutants like dioxins and furans – grew, many facilities began to switch to other bleaching technologies. However, 16 pulp and paper mills still use elemental chlorine in their processes.[15]

Chlorine is a highly toxic and corrosive element. According to the Occupational Safety and Health Administration (OSHA), "severe acute effects of chlorine exposure in humans have been well documented since World War I when chlorine gas was used as a chemical warfare agent." Exposure to gaseous

chlorine in concentrations as low as 1 to 3 parts per million (ppm) irritates the mucous membranes of the nose, throat, and lungs. As concentrations increase, so too do the health effects, resulting in difficulty breathing, violent coughing, nausea, vomiting, cyanosis, dizziness, headache, choking, laryngeal edema, acute tracheobronchitis, and chemical pneumonia.[16] A single exposure to chlorine can permanently disfigure the lungs or cause death (*Table 1*).

Table 1. Health Effects of Short-Term Chlorine Inhalation[17]

Chlorine Concentration (parts per million)	Health Effect
1-3 ppm	Mild mucous membrane irritation, tolerable up to one hour
5-15 ppm	Irritation of upper respiratory tract
30 ppm	Immediate chest pain, vomiting, dyspnea, and coughing
40-60 ppm	Toxic pneumonitis and pulmonary edema
430 ppm	Death within 30 minutes
1,000 ppm	Death in a few minutes

Once released into the ambient air, chlorine gas is difficult to contain and can quietly spread great distances before reaching an endpoint, the distance at which a chemical release is no longer considered dangerous.[18] The exact endpoint for a chlorine release varies depending on the total amount released and external factors such as wind and weather conditions. The pulp and paper mills that continue to use chlorine in their processes predict possible endpoints ranging from 1.3 to 25 miles.[19]

REPLACING ELEMENTAL CHLORINE

In 1990, nearly every facility that bleached pulp used an EC process.[20] The EC process, however, generates significant amounts of AOX (absorbable organic halogens) – a measure of highly toxic and persistent chlorine-based pollutants such as dioxins and furans.[21] To address this toxic pollution, the EPA established a new "cluster rule."[22]

The cluster rule is an integrated regulation that limits the amount of toxic air and water pollution from the pulp and paper industry. To achieve these pollutant reductions, pulp and paper mills were, in effect, required to transition from the EC process to either an ECF or TCF approach. Pulp and paper industry associations recommended that facilities pursue the ECF alternative because capital costs to implement the technology were lower than the new TCF alternatives. As a result, most U.S. facilities adopted the ECF process.

By 2001, ECF technologies were used for approximately 95% of bleached pulp production; 4% of production continued to use EC bleaching; and only 1% used a TCF process.[23] The conversion to ECF, although an improvement over the EC process, uses chlorine dioxide, which still poses serious risks to worker and community health and safety.

ELEMENTAL CHLORINE-FREE BLEACHING

Chlorine dioxide replaces chlorine as the chemical feedstock in the ECF bleaching process. Chlorine and chlorine dioxide react differently with the lignin, resulting in different levels of toxic byproducts.[24] Replacing EC with ECF bleaching reduces the amount of toxic chemicals released as production byproducts.[25] Because chlorine dioxide is a derivative of chlorine, however, the ECF process still produces AOX pollutants, but in lesser amounts than the EC process.[26] Fifty-eight (58) pulp and paper mills currently use significant amounts of chlorine dioxide in their processes.[27]

Chlorine dioxide is an unstable synthetic yellow-green gas with a chlorine-like odor that does not occur naturally in the environment.[28] It is an unstable and potentially explosive chemical that must be manufactured on-site using another chemical, sodium chlorate. Sodium chlorate reacts with a reducing agent, forming a strong acid, as well as byproducts including chlorine gas, additional chlorine dioxide, formic acid, and methanol.[29]

Exposure to chlorine dioxide can result in both chronic and acute toxic effects. Chlorine dioxide is a strong respiratory and eye irritant. Chronic exposure to chlorine dioxide can cause bronchitis, emphysema, and loss of taste and smell. In a gaseous state, chlorine dioxide can cause coughing, wheezing, respiratory distress, and congestion in the lungs. Acute exposure to chlorine dioxide gas can cause headaches, respiratory difficulties, bronchitis, and pulmonary edema.[30]

As an oxidizing agent, chlorine dioxide is ten times more potent than chlorine gas.[31] This is an advantage in the bleaching process but presents a serious hazard to workers and communities near mills.

ACCIDENTS INVOLVING CHLORINE OR CHLORINE DIOXIDE

Pulp and paper mills and other facilities using and transporting chlorine compounds have a long history of accidents caused by mechanical or human error that demonstrate the potentially devastating effects of a release. From 1987 to 2004, officials recorded more than 4,100 incidents involving chlorine or chlorine dioxide.[32]

For example:

• On January 6, 2005, a train carrying 90 tons of chlorine crashed into a parked train in Graniteville, South Carolina, releasing a yellow vapor cloud. Approximately 5,400 people living within a mile of the accident had to be immediately evacuated, 54 people were hospitalized, and eight people, mostly employees of a nearby chemical plant, died.[33]

• In April of 1996, in Alberton, Montana, a tanker of spent potassium cresylate crashed into a chlorine tanker, resulting in the release of 59 tons of chlorine gas. Clouds of chlorine gas formed over a section of a busy highway and neighborhood. One person died of chlorine gas inhalation, 350 people were treated for chlorine exposure, and 1,000 people were evacuated from their homes for two weeks.[34]

• On October 17, 1994, an explosion in a wooden pulp storage tank at the Macmillan Bloedel paper mill in Powell River, British Columbia showered timbers and pulp on two tanks holding 600,000 pounds of chlorine dioxide, which then ruptured. Gas was released and formed a cloud over the mill, which, thanks to prevailing winds, blew offshore, narrowly missing several coastal communities.[35]

• In Camas, Washington, in February of 2001, a chlorine dioxide release from the Georgia Pacific paper mill sent 50 children to the hospital. At this same plant in 2004, 12.5 pounds of chlorine dioxide were released when communication between a computer and pump failed, forcing the evacuation of nearly 50 employees.[36]

• On July 11, 2002, a yellow-green cloud of chlorine dioxide gas was released from the Weyerhaeuser pulp mill in Cosmopolis, Washington because of a lack of water in an absorption tower, which allowed the gas to concentrate and decompose, causing a pipe to break. Two more releases followed due to improper handling of a compressor. Two major highways were shut down for hours; ten homes and 180 mill workers were evacuated.[37]

• Improper safety practices at the DPC Enterprises facility in Glendale, Arizona caused the November 17, 2003 release of more than 3,500 pounds of chlorine gas as it was being transferred from a railcar. The release prompted the evacuation of more than 4,000 people and sent 14 people, including ten police officers responding to the release, to the hospital with chlorine inhalation symptoms.[38]

• One year earlier, on August 14, 2002, at another DPC Enterprises facility in Festus, Missouri, chlorine gas corroded a metal braid causing a hose to rupture. A subsequent failure of the safety shutdown system resulted in the release of 48,000 pounds of chlorine gas that sent three workers and 63 residents to the hospital.[39]

• On June 28, 2004, a train derailment on the southern edge of San Antonio, Texas ruptured a 90-ton tank of chlorine gas. The chlorine gas cloud released from the tank killed three people and seriously injured another 50.[40]

REPORT FINDINGS: COMMUNITIES AT RISK

Under the Clean Air Act's chemical accident prevention provisions, an industrial facility that uses or stores one or more listed extremely hazardous substance at volumes that exceed established thresholds must file a Risk Management Plan (RMP) with the EPA.[41] A filed RMP must include an analysis of a worst-case toxic chemical release scenario, including estimates of the distance that the regulated toxic chemical could travel off-site and the population living within that distance, a measure referred to as the "vulnerability zone."[42] The vulnerability zone represents the number of people living nearby who are at risk by the use or storage of extremely hazardous chemicals.[43]

We examined the most recent Risk Management Plan submissions for facilities with North American Industrial Classification System (NAICS) codes applicable to the pulp and paper industry. We found 88 pulp and paper mills with current RMPs on file with the EPA.[44] These facilities do not represent the entire universe of pulp and paper facilities in the United States, but only those facilities that use or store RMP extremely hazardous chemicals in volumes that exceed regulatory thresholds.

Of the 88 mills with current RMPs on file, 16 use chlorine and 58 use chlorine dioxide. The remaining 14 facilities submitted RMPs for other regulated toxic chemicals such as ammonia or sulfur dioxide.

The 74 facilities that submitted RMPs for chlorine and chlorine dioxide reported using and storing a combined total of 3.9 million pounds of these toxic chemicals. These 74 facilities endanger millions of people, reporting aggregate vulnerability zone populations of approximately 5.7 million people in 23 different states (*Table 2*).

Table 2. Population at Risk in Event of Worst-Case Release of Chlorine or Chlorine Dioxide from Pulp and Paper Mills: By State

State	Number of Mills*	Population At Risk
AL	7	115,000
AR	4	218,192
FL	6	408,331
GA	6	173,583
ID	1	51,000
KY	2	112,123
LA	5	558,910
MD	1	30,000
ME	5	51,280
MI	4	23,248
MN	1	24,124
MS	2	154,401
NC	2	260,363
NY	1	950
OH	2	1,275,000
OR	3	48,413
PA	4	45,500
SC	5	592,409
TN	3	731,563
TX	2	246,213
VA	3	72,816
WA	3	497,000
WI	2	26,200
Total	**74**	**5,716,619**

**Totals only include mills that filed RMPs with EPA for chlorine or chlorine dioxide stored or used on-site.*

The states with the most pulp and paper mills that continue to use chlorine or chlorine dioxide are Alabama (7), Florida (6), Georgia

(6), Louisiana (5), Maine (5), and South Carolina (5).

In Ohio, two pulp and paper mills place a total of almost 1.3 million people in harm's way. In Tennessee, three mills endanger a total of more than 730,000 people. In the states of Florida, Louisiana, South Carolina, and Washington, mills threaten the health and safety of at least 400,000 people.

A single pulp and paper facility that uses or stores chlorine or chlorine dioxide can endanger a large number of people, especially if it is located near a highly populated area. In Ohio, a single facility places 1.2 million people at risk in a worst-case chemical release; in Tennessee, a single facility endangers more than 600,000 people (*Table 3*). See *Appendix A* for a list of all facilities reporting RMPs to EPA for chlorine or chlorine dioxide.

Data obtained from EPA in June 2007 revealed that the Shweitzer-Mauduit facility in Spotswood, New Jersey used and stored 180,000 pounds of chlorine gas. In its last RMP filing with EPA, this facility reported a vulnerability zone threatening 1.1 million people.

Conversations with state officials in July, however, revealed that the facility recently switched from a chlorine to chlorine dioxide bleaching process that generates chlorine dioxide on-demand or as it is needed in the production process.

The switch to on-demand chlorine dioxide bleaching may well provide another example of a facility reducing the threat to workers and the local community by adopting a safer technology. Because the chlorine dioxide is apparently generated on-demand, the quantities on-site at any given point in time are less than if the chemical was stockpiled and stored for use. We were unable to obtain an updated Risk Management Plan for this facility in time for the release of this report. As a result, we could not verify the facility's switch to a safer process or any change to its vulnerability zone. As a result, we omitted the facility from the findings of this report.

Table 3. Pulp and Paper Mills Endangering at Least 100,000 People in the Event of a Worst-Case Release of Chlorine or Chlorine Dioxide

Rank	Facility Name	City	State	Population at Risk
1	Appleton Papers Inc., West Carrollton Mill	West Carrollton	OH	1,200,000
2	Buckeye Technologies Inc. - Memphis Plant	Memphis	TN	639,180
3	Port Hudson Operations	Zachary	LA	520,000
4	MeadWestvaco South Carolina, LLC - Kraft Division	North Charleston	SC	400,829
5	Georgia-Pacific Consumer Products (Camas) LLC	Camas	WA	400,000
6	Blue Ridge Paper Products, Inc.	Canton	NC	260,363
7	MeadWestvaco Texas LP	Evadale	TX	242,313
8	Ecusta Business Development Center, LLC	Pisgah Forest	NC	180,000
9	Bowater Coated and Specialty Paper Division	Catawba	SC	157,780
10	Georgia-Pacific Corporation, Palatka Operations	Palatka	FL	148,315
11	Smurfit-Stone Container Corp., Panama City Mill	Panama City	FL	133,607
12	Domtar Industries Inc. Ashdown Mill	Ashdown	AR	129,750
13	MeadWestvaco Kentucky, L.P.	Wickliffe	KY	103,923
14	Leaf River Cellulose, LLC	New Augusta	MS	103,010

HAZARD REDUCTION AT THE SOURCE

American industry and regulatory policy have historically addressed chemical hazards by managing chemical accidents and creating plans to respond to toxic chemical releases. Despite these efforts, facilities have reported more than 26,000 incidents involving hazardous chemicals to the National Response Center since 2005.[45] Fortunately, most of these incidents are relatively minor and present a minimal threat of serious injury. Catastrophic chemical accidents, while infrequent, still pose a tangible and grave risk to workers and nearby communities.

The widespread and continued occurrence of hazardous chemical incidents is reason to question the current approach of containing, managing, and responding to releases. In addition, the prospect of chemical terrorism adds another dimension to the threat. Many safety measures designed to contain or reduce hazardous chemical releases could be foiled by a saboteur.

The most effective way to protect workers and communities is to adopt safer technologies and processes that reduce or eliminate the use or storage of hazardous chemicals. This concept, referred to as hazard reduction, makes chemical and industrial processes inherently safer by reducing or eliminating the use of highly toxic, volatile, or flammable chemicals, or by limiting the quantity of these substances used or stored on-site.

In recent years, many private and governmental security experts and analysts have increasingly identified safer alternatives as the preferred approach to make chemical facilities safer and more secure. A 2006 chemical security report from the National Research Council led with the recommendation that "[t]he most desirable solution to preventing chemical releases is to reduce or eliminate the hazard where possible, not to control it."[46]

The concept of improving chemical plant safety and security by replacing hazardous chemicals with safer alternatives is steadily gaining support. Across the country, many facilities already have switched to safer chemicals or processes that pose less of a threat to surrounding communities in the event of a major chemical release.

For example, soon after September 11th, the Blue Plains Sewage Treatment Plant in Washington, DC switched from using and storing deadly chlorine gas and sulfur dioxide to a process using sodium hypochlorite bleach, a safer alternative that, if released, would have no serious off-site consequences. In adopting a safer alternative, Blue Plains eliminated a vulnerability zone extending 15 miles over an area where 1.7 million people live.[47]

Businesses that deal with extremely hazardous chemicals also are beginning to call for change. In recent testimony before the House of Representatives, the Association of American Railroads supported safer technologies and processes as substitutes for extremely hazardous chemicals. Railroads are required to ship hazardous chemicals and face potentially disastrous liability in the event of an accidental or deliberate release. For this reason, the railroads "strongly support efforts aimed at finding and utilizing 'inherently safer technologies' as substitutes for hazardous materials, especially for toxic inhalation hazards that are shipped by rail."[48]

A 2006 survey completed by Paul Orum and the Center for American Progress identified other facilities that have taken steps to reduce the threat to local communities by incorporating safer and more secure technologies that eliminate or reduce hazardous chemical use or storage. The survey results identified 284 facilities in 47 states that adopted safer alternatives or moved to safer locations, eliminating toxic chemical threats that previously endangered more than 38 million Americans.[49]

A small number of facilities have voluntarily adopted safer alternatives, and many others could have followed their lead but have not acted. Instead, industry organizations like the American Chemistry Council have focused on preventing deliberate chemical releases by emphasizing increased physical security, such as adding more guards and building fences. Additional guards, stronger fences, and other physical security requirements are all part of a good security plan, but do not actually reduce the threat or consequences of a toxic chemical release. The exclusive reliance on physical security measures is an attempt to control and contain the chemical threats, rather than taking the sensible steps to eliminate or reduce these hazards where possible.

In many industries, safer technologies are readily available. In the pulp and paper industry, the TCF bleaching process provides a prime example of a technology that makes mills safer and more secure by eliminating the use and storage of chlorine and chlorine dioxide.

ALTERNATIVES TO CHLORINE AND CHLORINE DIOXIDE

TOTALLY CHLORINE-FREE

The Totally Chlorine-Free (TCF) bleaching process is performed without using chlorinated agents to bleach the pulp, eliminating the need to use chlorine and chlorine dioxide and the toxic byproducts generated by these substances. Instead, the TCF process bleaches virgin pulp with an oxygen-based process that also incorporates hydrogen peroxide and/or ozone.[50] The combination of the oxygen-based process and hydrogen peroxide and/or ozone increases pulp brightness and strength. The final products from the TCF process are comparable in brightness and strength to products made using chlorine or chlorine dioxide.[51] In 1997, the EPA concluded that TCF bleaching was an available and demonstrated technology for the production of high brightness and high strength hardwood and softwood kraft pulps.[52]

The Wisconsin Tissue Mill in Menasha, Wisconsin (now SCA Tissue) switched from an EC process to a TCF process using hydrogen peroxide and sodium hydrosulfite as bleaching agents. In doing so, the mill reduced the costs associated with air and water pollution and avoided additional regulation under the EPA's cluster rule. By replacing chlorine gas with a TCF process, the mill also eliminated its vulnerability zone and removed the threat of chlorine gas exposure to mill workers and 210,000 people in the nearby community.[53]

Similarly, the Katahdin Paper facility (formerly Great Northern Paper, Inc.), located in East Millinocket, Maine, switched from chlorine gas to liquid bleach to treat incoming process water. This change eliminated a vulnerability zone affecting 3,200 people. The Wausau-Mosinee Paper Corporation in Brokaw, Wisconsin switched from chlorine to a TCF bleaching process, eliminating the threat to 59,000 people residing in the facility's vulnerability zone.[54]

OZONE ELEMENTAL CHLORINE-FREE

Ozone bleaching in particular is an emerging and increasingly promising technology to eliminate the use of chlorine and chlorine dioxide. Ozone bleaching can be incorporated into TCF, PCF, and ECF bleaching technologies. After oxygen is used to remove the lignin, ozone is added and reacts rapidly to produce high quality bright pulp.[55] In the Ozone Elemental Chlorine-Free (OECF) process, ozone is substituted for chlorine dioxide in the enhanced bleaching stages, creating significant reductions in the use and storage of this hazardous substance and its toxic byproducts.

Ozone bleaching is advantageous for a number of reasons. First, ozone decomposes rapidly to oxygen, reducing any potential hazards associated with a release. Second, the ozone bleaching reaction only takes a few minutes, instead of hours, and therefore requires a smaller reactor vessel. In addition, the gas produced from ozone bleaching can be fed directly back into the bleaching process, leaving very little residual chemical. The OECF process also reduces wastewater by 70-90% below ECF levels[56] and reduces pollution.[57]

Because ozone is unstable, the facility must generate it on-site, requiring additional energy. New technologies, however, have cut the energy needed to generate ozone in half. In addition, the production of ozone creates oxygen as a byproduct that can be captured and used to offset energy and resource demands in other systems at the mill.[58]

PROCESSED CHLORINE-FREE

Processed chlorine-free (PCF) bleaching technology is similar to TCF bleaching in that it eliminates the use of chlorine and chlorine dioxide. The primary difference between the two processes is the source of the production feedstock. TCF processes typically use virgin wood pulp, whereas PCF processes use recycled fiber that is not re-bleached with any chlorine-based substances. In order to be certified as PCF, a minimum of 30% post-consumer content is required.[59]

From an environmental perspective, the PCF process is desirable because it incorporates recycled material. From a facility safety and security standpoint the two technologies are equivalent because neither uses chlorine or chlorine dioxide.

Manistique Papers, located in Manistique, Michigan, was the first mill in North America to receive the distinction of PCF. This mill uses all recycled materials and has eliminated the use of chlorine in its processes. The Chlorine Free Paper Association, with its industry-backed certification process, certified the mill in March 1998. Manistique Papers is a unique company; when it was founded in the 1920s it rejected the use of chlorine and instead used non-chlorine bleaching processes.[60]

SAFER AND MORE SECURE: LOUISIANA PACIFIC'S SAMOA PULP MILL

The Louisiana-Pacific Corporation's Samoa Pulp Mill, constructed in 1964, is located on the Samoa Peninsula in California. The mill's original operations utilized an EC bleaching process to produce approximately 700 tons of pulp per day.

In 1989, a lawsuit initiated by the environmental organization Surfrider prompted the mill to develop a long-term plan for environmental and safety improvements. The result of the plan was a 1990 decision to adopt a TCF process that eliminated the use of chlorine. At the time, the still emerging TCF technology was limited to only a few Scandinavian mills.

In January of 1994, the Samoa Mill became the first in the United States to employ a TCF process, using oxygen and hydrogen peroxide to replace chlorine as the bleaching agent. The capital costs to convert to a TCF process totaled $11 million – $7 million to install an oxygen delignification unit and $4 million to construct the hydrogen peroxide bleaching system.

After five years of operation, the Samoa Mill issued a report detailing the benefits derived from the switch to TCF bleaching. The company reported a 71% reduction in the volume of bleach plant wastewater; a 50% reduction in bleach plant water use; and the elimination of AOX pollutants.

Successful implementation of the TCF process provided the Samoa Mill with an additional opportunity to upgrade operations to a closed-cycle bleaching process. Due to the corrosiveness of chlorine and chlorine dioxide, mills that use these chemicals are unable to recover and reuse bleach plant effluent. The residual toxic chemicals in the chlorinated effluent are so potent they quickly

corrode equipment, preventing the capture and reuse of chlorinated effluents.

In 2000, the Samoa Mill became the first in the world to operate a closed-cycle TCF process (CC-TCF). The conversion from TCF to CC-TCF required an additional $7.2 million in capital expenditures. The mill predicted, however, that the long-term benefits of CC-TCF would greatly outweigh the initial costs. The benefits of the CC-TCF process, as measured from the TCF baseline, include a 2% increase in pulp production; a 12% reduction in total mill effluent, including a 31% reduction in bleach plant effluent; a 19% decrease in water usage, including an 18% reduction in bleach plant water usage; and a 43% increase in steam use efficiency.

By adopting the CC-TCF process, the Samoa Mill achieved significant cost savings. Switching from an ECF to a TCF process can reduce operating costs, and upgrading to a CC-TCF process can further reduce costs. The CC-TCF improvements in steam efficiency and increased production capacity cut the Samoa Mill's annual operating costs by $1.1 million.[61] With the potential for cost savings, mills that pursue similar upgrades can recoup capital costs and significantly reduce long-term operating costs.

The Samoa Mill is an example of how pulp and paper mills can reduce health and safety threats to workers and local communities by eliminating the use of chlorine and chlorine dioxide. The Mill also demonstrated the significant cost savings that can accrue by investing in new, safer technologies. These technologies minimize costs associated with environmental, workplace, and security requirements and also can reduce operating costs.

BENEFITS OF ELIMINATING CHLORINE AND CHLORINE DIOXIDE AS BLEACHING AGENTS

By eliminating chlorine and chlorine dioxide as bleaching agents in pulp and paper production, facilities can achieve benefits including improved safety and security, enhanced environmental performance, and cost savings.

- Safer and More Secure without Chlorine or Chlorine Dioxide -

The most preferable bleaching technologies are the PCF and TCF processes because they completely eliminate the hazardous sources of chlorine and chlorine dioxide. After these technologies, the OECF process is the next best because it uses less chlorine dioxide than the traditional ECF process. Due to their heavy reliance on chlorine and chlorine dioxide, the most antiquated and dangerous technologies are the ECF and EC bleaching processes.

The 74 pulp and paper mills currently registered under EPA's RMP program for chlorine or chlorine dioxide store and use almost 4 million pounds of these chemicals. The potential for an accidental or deliberate release at these facilities jeopardizes thousands of workers and millions of residents in adjacent communities.

As past accidents demonstrate, releases of chlorine and chlorine dioxide, whether from mechanical failure or human error, do occur. These accidents have injured and killed workers, emergency responders, and members of the community.

The deliberate release of chlorine or chlorine dioxide by terrorists intent on using these substances to inflict human casualties is also cause for serious concern. In Iraq, insurgents have begun using canisters of chlorine gas as

makeshift chemical weapons.[62] The large quantities of chlorine and chlorine dioxide stored at pulp and paper mills, ranging from 200 to 1.3 million pounds, are an attractive target with devastating potential.

Adopting a TCF or PCF process that completely eliminates chlorine and chlorine dioxide is the only alternative that guarantees the safety of workers and the community in the event of an accident or deliberate attack. In addition, security experts have stated that replacing hazardous chemicals with inherently safer technologies is the most effective method to reduce the consequences of a successful terrorist attack, making the facilities less attractive terrorist targets and decreasing the probability of an attack.[63]

- Reducing Environmental Impact -

The most significant environmental impacts from the manufacture of pulp and paper are a result of the bleaching process. Bleaching pulp is an energy intensive process that creates significant air and water pollution and solid waste.[64] Since the 1970s, the pulp and paper industry has dramatically improved its environmental performance. The implementation of EPA's cluster rule helped to limit the amount of AOX and other pollutants generated during the bleaching process.

Despite this progress, the ECF process currently employed by the majority of mills that use chemical bleaching agents in the United States still generates AOX pollution that cannot be recovered. The only way for mills to ensure that no toxic chlorinated pollutants are generated during the bleaching process is to eliminate the use of all chlorine compounds. [65]

In addition to reducing toxic pollution, chlorine and chlorine dioxide-free bleaching processes offer the option of implementing a closed cycle process that can conserve water, limit wastewater effluent, and reduce energy consumption.

In a comparison between TCF and ECF effluent pollution, the TCF process achieved a better environmental performance in all categories.[66] The environmental advantages of eliminating chlorine and chlorine compounds from pulp and paper production prompted the World Bank to adopt a preference for the TCF bleaching process.[67] Consequently, the Bank now requires that all pulp and paper projects it funds use a TCF bleaching process.[68]

- Reducing Operating Costs -

The costs required to implement a TCF or OECF bleaching process can vary widely depending on the existing mill process. Regardless of the initial capital outlays required to upgrade a facility, bleaching processes that do not rely on the hazardous chemicals chlorine and chlorine dioxide can achieve significant long-term operating cost reductions associated with environmental compliance, safety and security. In fact, the multi-stakeholder Paper Task Force recognized that TCF systems offer the best economics because they have the lowest operating costs and avoid the investment in chlorine dioxide generators and large effluent treatment systems.[69]

Environmental Compliance Savings

The issuance of EPA's cluster rule in the 1990s marked a new era of multimedia environmental regulation for pulp and paper mills. The new regulations prompted many mills to switch from EC to ECF bleaching to reduce the generation of AOX pollutants, thereby decreasing the costs of pollution controls.

On an annual basis, pollution control measures cost the industry over $1 billion.[70]

The federal Clean Water and Clean Air Acts require that pollution reduction efforts mirror technological progress.[71] This technology-forcing approach ensures that facilities keep pace with new technological treatment standards developed by EPA. Consequently, periodic pollution control upgrades may be needed to match new developments. For pulp and paper mills, this would mean additional capital expenditures and improvements. Because the TCF process eliminates the generation of AOX pollution, facilities can avoid future pollution control costs associated with these toxic pollutants.

The TCF bleaching process also reduces the volume of wastewater that must be treated and provides the option of a closed-cycle bleaching process for additional cost savings.[72] The TCF process offers the best opportunity to re-circulate water because it eliminates all corrosive chlorine compounds from the bleaching stage.[73] The example of the Samoa Mill demonstrates that process modifications that prevent pollution are more cost-effective approaches than traditional end-of-pipe pollution treatment.[74]

Safety Cost Savings

Eliminating toxic chlorine and chlorine dioxide can reduce costs associated with mill workplace safety. Although difficult to quantify, a recent survey of chemical facilities conducted by the Center for American Progress identified a variety of safety-related cost savings associated with switching to less hazardous substances or processes, such as TCF bleaching. In survey responses, companies reported saving money on safety inspections and devices (such as leak detection or scrubbers); specialized emergency response teams; hazardous materials safety training; lost work time from chemical exposures; placards and material safety data sheets; community notification; evacuation and contingency plans; and compliance with Process Safety Management and Risk Management Planning.[75]

Minimizing Security Costs

As noted earlier, security experts from numerous agencies have concluded that chemical facilities are vulnerable terrorist targets and threaten public safety in the event of an accidental chemical release or deliberate attack.[76] Toxic chemicals present at these facilities provide "effective and readily accessible materials to develop improvised explosives, incendiaries and poisons."[77]

Despite numerous attempts, Congress has been unable to pass comprehensive chemical security legislation.[78] After negotiations over a promising bill broke down in September 2006, Congress authorized the Department of Homeland Security (DHS) to issue interim regulations to address chemical security at high risk facilities until it could legislate a more complete program.[79]

In April 2006, DHS finalized the interim regulations. The regulations require facilities that use or store certain hazardous chemicals to complete a risk assessment to determine if they present a high risk. If a facility qualifies as high risk, it must then prepare and submit to DHS a vulnerability assessment and a site security plan that implements self-selected measures to meet general security performance standards. The assessment and plans must be approved by DHS. [80]

Chlorine and chlorine dioxide are included on DHS's list of regulated hazardous chemicals.[81] Consequently, pulp and paper mills that continue to use these chemicals in their processes will be required to complete the risk analysis. Based on the outcome of these assessments, certain mills may be required to conduct vulnerability assessments and to develop and implement security plans.

Although the regulations are still being implemented, DHS provided estimates of the average cost to secure a facility. Depending on a facility's level of risk, initial capital costs to implement the security requirements range from $227,260 to $5.3 million. In addition to the initial capital outlay, annual security costs are expected to range from $83,000 to $1.7 million.[82] Pulp and paper mills that use or store dangerous amounts of chlorine or chlorine dioxide, or with large vulnerability zone populations, will likely incur costs on the higher end of DHS's estimates.

The new DHS security requirements provide another example of costs that can be avoided by adopting safer and more secure processes such as TCF bleaching. By eliminating chlorine and chlorine dioxide from production processes, mills can avoid security costs associated with risk assessments, vulnerability plans, and the implementation and annual continuance of security measures.

RECOMMENDATIONS: REDUCING CHEMICAL HAZARDS

The events of September 11th legitimized concerns about chemical facility safety and security long voiced by workers and local communities. Thousands of facilities store, use, or produce highly toxic chemicals. At many of these facilities, a toxic release, whether accidental or deliberate, could kill or seriously injure thousands, and in some cases millions. Industry should eliminate these threats where feasible.

The most effective method to make chemical facilities safer and more secure is to encourage the adoption of safer processes and technologies that can eliminate or significantly reduce the source of the toxic chemical threat. Rather than implementing measures to control or secure access to these chemicals, which may or may not prove effective, the only fail-safe way to prevent the consequences of exposure is to eliminate the source of the threat.

Fortunately, safer and more secure technologies already exist across many industry sectors. As described in this report, the pulp and paper industry is one sector that can reduce chemical exposure threats by adopting processes that significantly reduce or completely eliminate the use of chlorine and chlorine dioxide.

Technologies including TCF, PCF, and OECF bleaching processes provide numerous benefits. In addition to creating safer workplaces and communities, these technologies also eliminate AOX releases, improve overall environmental performance, and decrease operating costs. Furthermore, by eliminating chlorine and chlorine dioxide, mills can reduce cost uncertainties associated with future environmental, workplace safety, and security regulations.

Investment in safer and more secure technologies also demonstrates commitment to American production facilities. Such investments protect against job loss and mill closures that could result from a terrorist attack. Furthermore, by investing in safer technologies that reduce annual operating costs and limit future uncertainties, domestic mills are in a better position to remain competitive in a growing global market.

SPECIFIC RECOMMENDATIONS FOR THE PULP AND PAPER INDUSTRY

- The most effective way for the pulp and paper industry to protect workers and communities from exposure to chlorine and chlorine dioxide is to adopt safer and more secure technologies such as the TCF or PCF processes that eliminate the use of hazardous chemicals. If a facility uses an ECF process, it should adopt an OECF process to limit the quantity of chlorine dioxide and therefore the risk to workers and the community.

- At a growth rate of 2%, global demand for paper will double in 35 years.[83] New mills constructed in the United States should utilize chlorine and chlorine dioxide-free bleaching technologies. In addition, as mills age and require upgrades, the paper industry should dedicate new capital expenditures toward implementing safer and more secure

technologies, prioritizing the TCF and PCF processes.

- U.S. businesses and consumers should buy domestically produced chlorine and chlorine dioxide-free paper. Such purchasing decisions will help improve the market for these products and encourage American mills to invest in safer and more secure technologies. Buying domestically produced chlorine-free paper also ensures that chemical risks are not shifted to countries, especially developing countries, where safety, environmental, and security regulations are weaker or do not exist.

GENERAL RECOMMENDATIONS FOR REDUCING CHEMICAL HAZARDS

Pulp and paper mills that use chlorine or chlorine dioxide are just one salient example of how the availability of safer alternatives can eliminate safety risks to workers and neighboring communities. In order to address the recognized security threat posed by facilities using and storing dangerous chemicals, the United States needs a comprehensive policy dedicated to making its chemical plants safer. This policy should:

- Require facilities to evaluate the availability of safer technologies to replace hazardous processes and chemicals. If safer technologies are available and feasible, chemical facilities should implement these technologies. Safer technologies eliminate or reduce chemical hazards and are the most effective method to make chemical facilities inherently safer and more secure.

- Allow states and localities to enact more protective chemical plant security regulations that can address specific needs and supplement federal efforts. This will ensure that local, state, and federal officials continue to work collaboratively to address chemical facility safety and security issues. In the absence of a comprehensive and permanent federal program, states including Maryland, New Jersey, New York, and North Carolina already have adopted measures to improve chemical security and safety in their borders.

- Protect the public's right-to-know about hazardous chemicals used and stored at industrial facilities. The right-to-know about hazardous chemicals at chemical facilities is critical to protecting communities from toxic chemical releases. Efforts to restrict security information at chemical facilities must be limited to information that is truly sensitive in nature. Communities need access to information about local toxic chemical hazards in order to hold government accountable to public safety. For example, in the wake of the chemical fire in Apex, the North Carolina legislature improved and expanded the public's right-to-know about nearby chemical hazards.

METHODOLOGY

Pulp and paper mills that use chlorine and chlorine dioxide are subject to section 112(r) of the Clean Air Act, which requires stationary facilities to prevent and mitigate the releases of extremely hazardous substances.[84] This EPA administered program, titled the Risk Management Program, requires covered facilities to identify hazards that would result from a chemical release; to design and maintain a safe facility; and to mitigate releases when they do occur.

To implement Congress' direction, EPA listed 140 chemicals and their threshold quantities based on potential harm to human health and the environment. Facilities using or storing a listed chemical in more than the threshold quantity must conduct a hazard assessment, develop and implement an accident prevention and emergency response program, and analyze the potential consequences of worst-case and alternative (less severe) release scenarios. The information that chemical facilities develop to respond to these informational requirements are submitted to EPA as a risk management plan (RMP).

RMPs contain valuable information about a chemical facility and its potential hazards. The RMP report identifies the quantity of each regulated chemical stored or used on-site, information about measures to prevent releases, a history of significant accidents at a facility, and the facility's off-site release consequence analysis.

Many pulp and paper mills are subject to these requirements and were required to submit RMPs to EPA starting in 1999. We obtained the data used for this report from the RMPs submitted by facilities operating under the North American Industrial Classification System Category for businesses engaged in pulp and paper manufacture and production.

Starting in 1999, RMPs developed and submitted by chemical facilities were publicly available by accessing EPA's website. EPA later removed the information about vulnerability zone and population data from its website in response to concerns about making this information publicly-available. Shortly after September 11th, EPA withdrew all RMP information from its website and the public domain.

Members of the public can still access RMPs, but they most do so at specified reading rooms operated by the EPA and Department of Justice. In addition, public access to RMPs is limited with each visit. A member of the public can only review ten RMPs a month, or all the RMPs in the county of their residence. These restrictions make it difficult to identify and review RMPs that have been submitted.

With the assistance of Paul Orum, we submitted a Freedom of Information Act request for a complete list of registered RMP facilities. Once the list of facilities was obtained, volunteers participated in a joint effort to review RMPs for each facility registered under a pulp and paper industrial classification.

Data collection efforts occurred between May and June 2007, and the data represents all information received by EPA as of June 26, 2007. If a facility altered its process after this date or failed to amend its registered RMP, we were unable to reflect this change in the report. The one exception is the Shweitzer-Mauduit facility in Spotswood, New Jersey. We learned that this facility switched from using chlorine to chlorine dioxide in mid-

2007, but we were unable to obtain an updated RMP. As a result, we omitted this facility from the report's findings.

To estimate the total number of people living in the vulnerability zones in each state and nationally, we reviewed the geographic location of each facility, as some pulp and paper mills are grouped together. In order to avoid double counting, we assumed if the vulnerability zones of two or more facilities overlapped at all that they overlapped entirely. In these instances, we included the highest at-risk population from the facilities in our calculations. As a result, the reported totals may be a conservative estimate of the total population at risk. Specifically:

- In Alabama, the Georgia Pacific Corporation Naheola Mill in Pennington, with a 23 mile vulnerability zone, is about 36 miles from the Demopolis Mill, with a 19 mile vulnerability zone. To calculate the total number of people at risk in Alabama, we only included the 35,000 people living in the vulnerability zone of the Georgia Pacific mill in Pennington.

- In Florida, both the Smurfit-Stone Container Enterprises facility and Rayonier Performance Fibers facility are located in Fernandina. To calculate the total number of people at risk in Florida, we only included the 57,400 people living in the vulnerability zone of the Smurfit-Stone facility.

- In North Carolina, the Pisgah Forest-based Ecusta Business Development Center facility, with a vulnerability zone of 22 miles, is located about 36 miles from the Blue Ridge Paper Products facility in Canton, with a vulnerability zone of 25 miles. To calculate the total number of people at risk in North Carolina, we only included the 260,363 people living in the vulnerability zone of the Blue Ridge Paper facility.

APPENDIX A. PULP AND PAPER MILLS REPORTING RISK MANAGEMENT PLANS TO EPA FOR CHLORINE AND CHLORINE DIOXIDE

State	Facility Name	City	Chemical	Pounds Stored or Used Onsite	Vulnerability Zone (Miles)	Population at Risk
AL	Smurfit-Stone Container Enterprises, Inc.	Brewton	Chlorine dioxide	14,300	12	14,300
AL	Boise Cascade Corporation	Jackson	Chlorine dioxide	9,341	10	5,800
AL	Alabama River Pulp Company, Inc.	Perdue Hill	Chlorine dioxide	12,873	24	42,900
AL	International Paper - Courtland Mill	Courtland	Chlorine dioxide	24,000	9	13,000
AL	Georgia Pacific Corporation, Naheola Mill	Pennington	Chlorine dioxide	19,000	23	35,000
AL	International Paper Riverdale Mill	Selma	Chlorine dioxide	15,000	7	4,000
AL	Demopolis Mill	Demopolis	Chlorine dioxide	11,000	19	28,000
Alabama Total*				**105,514**		**115,000**
AR	Potlatch Corporation, Arkansas Pulp and Paperboard	Arkansas City	Chlorine dioxide	2,520	1	30
AR	Evergreen Packaging Inc. - Pine Bluff Mill	Pine Bluff	Chlorine dioxide	11,643	10	58,412
AR	Domtar Industries Inc. Ashdown Mill	Ashdown	Chlorine dioxide	26,540	25	129,750
AR	Georgia-Pacific Crossett Paper Operations	Crossett	Chlorine dioxide	1,317,720	25	30,000
Arkansas Total				**1,358,423**		**218,192**
FL	Buckeye Florida, Limited Partnership	Perry	Chlorine	180,000	14	17,009
FL	Smurfit-Stone Container Enterprises Inc Fernandina	Fernandina Beach	Chlorine	180,000	13	57,400
FL	Smurfit-Stone Container Corp., Panama City Mill	Panama City	Chlorine dioxide	19,248	16	133,607
FL	Rayonier Performance Fibers LLC, Fernandina Mill	Fernandina Beach	Chlorine dioxide	9,609	16	47,293
FL	Pensacola Mill	Cantonment	Chlorine dioxide	17,014	7	52,000
FL	Georgia-Pacific Corporation, Palatka Operations	Palatka	Chlorine dioxide	26,730	25	148,315
Florida Total*				**432,601**		**408,331**
GA	Rayonier Performance Fibers, LLC, Jesup Mill	Jesup	Chlorine	180,000	14	30,475
GA	Interstate Paper, LLC	Riceboro	Chlorine	2,000	2	313
GA	Brunswick Cellulose	Brunswick	Chlorine dioxide	43,000	25	90,000
GA	Weyerhaeuser Company, Flint River Operations	Oglethorpe	Chlorine dioxide	7,240	15	25,485
GA	Weyerhaeuser Company, Port Wentworth Mill	Port Wentworth	Chlorine dioxide	18,930	6	25,000
GA	International Paper - Augusta Mill	Augusta	Chlorine dioxide	13,400	2	2,310
Georgia Total				**264,570**		**173,583**
ID	Potlatch Forest Products Corp. Idaho P&P Divison	Lewiston	Chlorine	180,000	8	51,000
Idaho Total				**180,000**		**51,000**
KY	MeadWestvaco Kentucky, L.P.	Wickliffe	Chlorine dioxide	25,500	25	103,923
KY	Domtar Paper Company, LLC-Hawesville Mill	Hawesville	Chlorine dioxide	11,684	5	8,200
Kentucky Total				**37,184**		**112,123**
LA	Weyerhaeuser Company - Red River Mill	Campti	Chlorine	2,000	3	550
LA	Graphic Packaging International, Inc - West Monroe	West Monroe	Chlorine	2,000	1	4,774
LA	Boise Cascade De Ridder Mill	DeRidder	Chlorine dioxide	6,033	11	17,000
LA	Louisiana Mill	Bastrop	Chlorine dioxide	17,615	7	16,586
LA	Port Hudson Operations	Zachary	Chlorine dioxide	48,100	25	520,000
Louisiana Total				**75,748**		**558,910**
MD	NewPage Corporation, Luke Paper Company	Luke	Chlorine dioxide	9,250	11	30,000
Maryland Total				**9,250**		**30,000**

State	Facility Name	City	Chemical	Pounds Stored or Used Onsite	Vulnerability Zone (Miles)	Population at Risk
ME	Red Shield Environmental, LLC	Old Town	Chlorine dioxide	18,235	9	32,000
ME	Domtar Maine Corp.	Baileyville	Chlorine dioxide	20,550	25	13,007
ME	Androscoggin Mill	Jay	Chlorine dioxide	20,000	3	1,800
ME	Mead Oxford Corporation	Rumford	Chlorine dioxide	224	1	4,200
ME	Somerset Mill	Skowhegan	Chlorine dioxide	9,171	2	273
Maine Total				**68,180**		**51,280**
MI	Smurfit-Stone Container Corp., Ontonagon Mill	Ontonagon	Chlorine	2,000	3	2,018
MI	S.D. Warren Co. (Muskegon Mill revised 8-2006)	Muskegon	Chlorine	2,000	1	2,730
MI	Escanaba Paper Company	Escanaba	Chlorine dioxide	8,924	3	3,500
MI	Quinnesec Mill	Quinnesec	Chlorine dioxide	10,000	6	15,000
Michigan Total				**22,924**		**23,248**
MN	Boise Paper	International Falls	Chlorine dioxide	17,100	12	24,124
Minnesota Total				**17,100**		**24,124**
MS	Columbus Pulp & Paper Complex	Columbus	Chlorine dioxide	4,681	12	51,391
MS	Leaf River Cellulose, LLC	New Augusta	Chlorine dioxide	24,200	24	103,010
Mississippi Total				**28,881**		**154,401**
NC	Ecusta Business Development Center, LLC	Pisgah Forest	Chlorine	180,000	22	180,000
NC	Blue Ridge Paper Products, Inc.	Canton	Chlorine dioxide	10,700	25	260,363
North Carolina Total*				**190,700**		**260,363**
NY	International Paper--Ticonderoga Mill	Ticonderoga	Chlorine	2,000	3	950
New York Total				**2,000**		**950**
OH	Appleton Papers Inc., West Carrollton Mill	West Carrollton	Chlorine	360,000	25	1,200,000
OH	P.H. Glatfelter Company - Chillicothe Facility	Chillicothe	Chlorine dioxide	18,000	13	75,000
Ohio Total				**378,000**		**1,275,000**
OR	Wauna Mill	Clatskanie	Chlorine dioxide	7,000	17	16,000
OR	Boise Cascade	St. Helens	Chlorine dioxide	22,840	7	31,113
OR	Pope & Talbot, Inc. Halsey Pulp Mill	Halsey	Chlorine dioxide	6,300	4	1,300
Oregon Total				**36,140**		**48,413**
PA	Procter & Gamble Paper Products Co. - Mehoopany	Mehoopany	Chlorine	2,000	3	1,500
PA	Weyerhaeuser - Johnsonburg Mill	Johnsonburg	Chlorine dioxide	7,453	3	1,200
PA	Appleton Papers Inc. - Spring Mill	Roaring Spring	Chlorine dioxide	2,700	8	38,000
PA	P. H. Glatfelter Co. - Spring Grove Mill	Spring Grove	Chlorine dioxide	7,920	2	4,800
Pennsylvania Total				**20,073**		**45,500**
SC	MeadWestvaco South Carolina, LLC - Kraft Division	North Charleston	Chlorine	180,000	14	400,829
SC	International Paper Georgetown Mill	Georgetown	Chlorine dioxide	32,000	8	20,000
SC	Marlboro Paper Mill	Bennettsville	Chlorine dioxide	11,700	6	12,000
SC	Bowater Coated and Specialty Paper Division	Catawba	Chlorine dioxide	31,267	14	157,780
SC	International Paper Eastover Mill	Eastover	Chlorine dioxide	5,040	4	1,800
South Carolina Total				**260,007**		**592,409**

State	Facility Name	City	Chemical	Pounds Stored or Used Onsite	Vulnerability Zone (Miles)	Population at Risk
TN	Buckeye Technologies Inc. - Memphis Plant	Memphis	Chlorine	110,000	10	639,180
TN	Weyerhaeuser Company - Kingpsort Mill	Kingsport	Chlorine dioxide	12,500	6	78,883
TN	Bowater Newsprint	Calhoun	Chlorine dioxide	18,775	8	13,500
Tennessee Total				**141,275**		**731,563**
TX	Texarkana Mill	Texarkana	Chlorine dioxide	16,700	7	3,900
TX	MeadWestvaco Texas LP	Evadale	Chlorine dioxide	41,630	25	242,313
Texas Total				**58,330**		**246,213**
VA	Smurfit-Stone Container Enterprises, Inc West Pt	West Point	Chlorine dioxide	13,300	17	48,000
VA	MeadWestvaco of Virginia, Corp.	Covington	Chlorine dioxide	16,064	5	10,508
VA	International Paper	Franklin	Chlorine dioxide	13,890	6	14,308
Virginia Total				**43,254**		**72,816**
WA	Weyerhaeuser Company - Longview Washington	Longview	Chlorine	180,000	14	93,000
WA	Georgia-Pacific Consumer Products (Camas) LLC	Camas	Chlorine dioxide	9,156	20	400,000
WA	Boise Cascade Wallula Mill	Wallula	Chlorine dioxide	26,100	8	4,000
Washington Total				**215,256**		**497,000**
WI	Nekoosa Mill - ClO2	Nekoosa	Chlorine dioxide	9,013	3	3,200
WI	Wisconsin Rapids Pulp Mill	Wisconsin Rapids	Chlorine dioxide	8,600	4	23,000
Wisconsin Total				**17,613**		**26,200**
National Total				**3,963,023**		**5,716,619**

* The sum of the population at risk in each facility's vulnerability zone does not equal the state's total. The vulnerability zones of two facilities may overlap. In order to avoid double counting, we assumed if the vulnerability zones of two or more facilities overlapped at all that they overlapped entirely. In these instances, we included the highest at-risk population from the facilities in our calculations.

END NOTES

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