

Preventing a Toxic Chemical Disaster: RMPs in Theory and in Practice

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ABSTRACT

For many years, dry chemical scrubbers have been considered as low maintenance alternatives to wet scrubbers in controlling, for example, a worst-case toxic gas release scenario such as a chlorine leak from a 1-ton cylinder at a wastewater treatment plant (WWTP). When the U.S. Environmental Protection Agency mandated the development and implementation of risk management plans in the late 1990s, the use of dry emergency gas scrubbers (EGS) has increased and remains steady.

The basic concept of an EGS is not complicated. At its simplest, it is a packed-bed chemical reactor consisting of a media containment vessel, the dry-scrubbing media, and a blower. One type of medium in use against chlorine gas claims an improved performance both in terms of removal efficiency and capacity. The results of a full bed-depth challenge test backed up these claims, and detailed the key design parameters for use of this medium in an EGS application. Based on this, many systems have been installed in domestically and abroad specifically for the control of a catastrophic chlorine gas release.

Design theory and full-scale testing is one thing, but when one of these systems is placed at a WWTP with several tons of chlorine on-site, there can be no question as to whether the EGS will perform as designed should the need arise. These questions were answered when a potentially devastating chlorine release occurred at the Moccasin Bend WWTP (Chattanooga, Tennessee) in 2009 and the 9-year old EGS neutralized all of the chlorine that had leaked from a one-ton cylinder.

Theory and reality highlight the benefits of a properly designed, installed, and maintained EGS for toxic gas control. The dry-scrubbing medium used in this example has proved its use can effectively help to save the priceless elements of a community facing a potentially catastrophic toxic gas release.

INTRODUCTION

By their nature, the manufacture, storage, and transport of chemicals are accidents waiting to happen. Chemicals can be corrosive, toxic, and they may react, often explosively. The impacts of chemical accidents can be deadly, for both human beings and the environment.

Many if not most products we use in everyday life are made from chemicals and thousands of chemicals are used by manufacturing industries to make these products. The source of many of these chemicals is petroleum, which is refined into two main fractions: fuels and the chemical feedstocks that are the building blocks of plastics, paints, dyes, inks, polyester, and many of the products we buy and use every day. Fuels and chemical feedstocks made from petroleum are called organic chemicals. The other important class of chemicals is inorganics, which include acids, caustics, cyanide, and metals. Commercial products made from inorganics range from car bodies to computer circuit boards.

Of the more than forty thousand chemicals in commercial use, most are subject to accidental spills or releases. Chemical spills and accidents range from small to large and can occur anywhere chemicals are found, from oil drilling rigs to factories, tanker trucks to fifty-five gallon drums and all the way to the local dry cleaner or your garden tool shed.

One of the worst industrial chemical disasters occurred without warning early on the morning of December 3, 1984, at Union Carbide's pesticide plant in Bhopal, India.¹ While most people slept, a leak, caused by a series of mechanical and human failures, released a cloud of lethal methyl isocyanate over the sleeping city. Some two thousand people died immediately and another eight thousand died later. Health officials, not informed about chemicals at the factory, were completely unprepared for the tragedy.

SAFETY REGULATIONS

After Union Carbide's disaster, Congressional hearings in the U.S. and media attention led to enactment of the Emergency Planning and Community Right to Know Act of 1986 (EPCRA),² requiring companies to provide information about their potentially toxic chemicals. At the same time, states were required to establish emergency planning districts and local committees to prepare for any emergency—a fire, an explosion, a flood that might result in the release of chemicals into the environment. In 2003, more than 31,000 industrial facilities began reporting on more than 650 individually listed toxic chemicals and chemical categories to the U.S. Environmental Protection Agency (EPA) that is made public in the Toxic Release Inventory.

Several laws and the regulations developed to implement them are the foundation of EPA's Emergency Management Program. These are listed in Tables 1 and 2.

Table 1. Laws Defining EPA's Emergency Management Program.³

Clean Air Act (CAA)
Clean Water Act (CWA)
Oil Pollution Act (OPA)
Comprehensive Environmental Response, Compensation, & Liability Act (CERCLA)
Superfund Amendments & Reauthorization Act (SARA)
Emergency Planning & Community Right-to-Know (EPCRA)
Chemical Safety Information, Site Security and Fuels Regulatory Relief Act (CSISSFRRA)
Hazardous Materials Transportation Act (HMTA)

Table 2. Regulations Implementing EPA's Emergency Management Program.⁴

Chemical Accident Prevention Provisions
Criteria for State, Local and Regional Oil Removal Contingency Plans
Oil Pollution Prevention
National Oil and Hazardous Substances Pollution Contingency Plan
Designation, Reportable Quantities, and Notification
Reimbursement to Local Governments for Emergency Response to Hazardous Substance Releases
Emergency Planning and Notification
Hazardous Chemical Reporting: Community Right-to-Know

In 1990, amendments to the U.S. Clean Air Act⁵ required industrial chemical companies to submit a risk management plan that included "worst case" chemical accident scenarios. Industry leaders did not want these potential disasters made public and argued that they could alert terrorists which facilities to target. In July 2002, the Senate's Environment and Public Works Committee approved a bill to identify plants vulnerable to terrorist attacks that produce hazardous chemicals. Congress also voted against a landmark community right to know law that would have required some 6,600 chemical facilities to reveal their "worst case" accident scenarios.

THE CLEAN AIR ACT

The Clean Air Act (CAA) is the law that defines EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer. The last major change in the law, the CAA Amendments of 1990, was enacted by Congress in 1990. Legislation passed since then has made several minor changes.

Accidental Release Prevention / Risk Management Plan Rule⁶

When Congress passed the CAA Amendments of 1990, Section 112(r) required EPA to publish regulations and guidance for chemical accident prevention at facilities using substances that posed the greatest risk of harm from accidental releases. These 40 CFR Part 68 regulations were built upon existing industry codes and standards and require companies of all sizes that produce, handle, process, distribute, or store certain listed regulated flammable and toxic substances to develop a Risk Management Program, which includes a(n):

- Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases scenarios;
- Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and

- Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g., the fire department) should an accident occur.

By June 21, 1999, a summary of the facility's risk management program (known as a "Risk Management Plan" or "RMP") was to be submitted to EPA. Since its implementation, the RMP Rule⁷ has been amended on several occasions, most recently in 2004, and by the end of 2008, EPA had RMPs from about 14,000 facilities. The plans must be revised and resubmitted every five years. There are other circumstances described in the RMP regulations which may require a more frequent submission. New facilities must submit a completed RMP as soon as they have a covered chemical above the listed threshold quantity.

The Risk Management Program is about reducing chemical risk at the local level. The RMP information helps local fire, police, and emergency response personnel (who must prepare for and respond to chemical accidents), and is useful to citizens in understanding the chemical hazards in their community.

Who is Covered by the RMP Regulations?

Owners and operators of a facility (stationary source) that manufactures, uses, stores, or otherwise handles more than a threshold quantity of a listed regulated substance in a process, must implement a risk management program and submit a single RMP for all covered processes at the facility. "Process" means any activity involving a listed regulated substance, including any use, storage, manufacturing, handling, or onsite movement of such substances, or combination of these activities. The regulations do not apply to transportation, including storage incident to transportation. However, transportation containers used for storage not incident to transportation and transportation containers connected to equipment at a stationary source are considered part of the stationary source, and are potentially covered by the regulations.

What Chemicals Are Covered?

The 40 CFR Part 68 regulations include a List of Regulated Substances under section 112(r) of the CAA, including their synonyms and threshold quantities (TQs, in pounds). States who have taken delegation of the program may have additional requirements for the federally listed chemicals, and/or additional listed chemicals. The TQs for toxics range from 500 to 20,000 pounds. For all listed flammables, the TQ is 10,000 pounds.^a

Currently there are 77 toxic and 63 flammable chemicals with associated TQs. The list of chemicals in Table 3 is not inclusive, rather, it is intended to show some of the more common toxic industrial chemicals and gases in wide use today and the range of TQs above which an RMP has to be developed and submitted to the EPA.

^a NOTE: Listed flammable substances used as fuel or held for sale as fuel at a retail facility are not covered by the Part 68 regulations. However, flammable substances used for some other purpose, such as a chemical feedstock or when held for sale as fuel at a wholesale facility are covered by the regulations.

Table 3. CAA List of Regulated Substances (partial).

Name on CAA 112(r) list	CAS #	TQ
Ammonia (anhydrous)	7664-41-7	10,000
Ammonia (conc. 20% or greater)	7664-41-7	20,000
Arsine	7784-42-1	1,000
Boron trifluoride	7/2/7637	5,000
Chlorine	7782-50-5	2,500
Chlorine dioxide	10049-04-4	1,000
Diborane	19287-45-7	2,500
Formaldehyde	50-00-0	15,000
Hydrazine	302-01-2	15,000
Hydrochloric acid (conc. 37% or greater)	7647-01-0	15,000
Hydrofluoric acid (conc. 50% or greater)	7664-39-3	1,000
Hydrogen chloride (gas only)	7647-01-0	5,000
Hydrogen cyanide	74-90-8	2,500
Hydrogen fluoride (anhydrous)	7664-39-3	1,000
Hydrogen selenide	7/5/7783	500
Hydrogen sulfide	6/4/7783	10,000
Nitric acid (>= conc. 80%)	7697-37-2	15,000
Phosgene	75-44-5	500
Phosphine	7803-51-2	5,000
Silane	7803-62-5	10,000
Sulfur dioxide (anhydrous)	9/5/7446	5,000
Sulfur tetrafluoride	7783-60-0	2,500
Sulfuric acid (fuming)	8014-95-7	10,000
Vinyl chloride	75-01-4	10,000

RISK MANAGEMENT PLANNING⁸

The EPA's vision for the United States' risk management program is to:

1. Emphasize the public's right-to-know about hazardous materials being produced, stored, transported, or used in their communities.
2. Let the available information drive actions with regard to regulations and oversight.
3. Focus the program and coordinate communication at the local level.
4. Have the EPA support local and state activities.

The EPA's duties included development of a list of toxic, flammable, or otherwise hazardous substances with threshold quantities and a risk management program rule. The general duties for any applicable facility are to identify hazards that may result from releases, design and maintain a safe facility, and minimize the consequences of releases.

All risk management programs for accidental chemical release prevention⁹ require that affected facilities register with the EPA or with their state “EPA” if that state’s RMP program has been approved by the federal EPA and has been granted authority to regulate RMPs.^b The risk management program can then be implemented beginning with a hazard assessment and off-site consequence analysis. A 5-year accident history, the current prevention and emergency response programs, along with any onsite documentation is included when the RMP is submitted.

An RMP should summarize the key elements of a facility’s risk management program and basically tell a story that includes a list of current hazards, a model for a worst case scenario, alternate release scenarios, a 5-year accident history, and prevention program(s) in place. All emergency response programs should be described in clear language.

If an RMP is applicable to a facility, actions required to comply are divided into three program levels. These program levels are based on processes’ relative potential for public impacts and the level of effort to prevent accidents. For each program level, the rule defines requirements that reflect the level of risk and effort associated with the processes at that level. Program level requirements are summarized in Table 4.

Table 4. RMP Program Level Requirements.⁸

Program 1	Program 2	Program 3
Hazard Assessment	Hazard Assessment	Hazard Assessment
Worst-case analysis	Worst-case analysis	Worst-case analysis
5-yr accident history	5-yr accident history	5-yr accident history
Certify no additional steps required	Certify no additional steps required	Certify no additional steps required
	Management Program	Management Program
	Document management system	Document management system
	Prevention Program	Prevention Program
	Safety information	Safety information
	Hazard review	Hazard review
	Operating procedures	Operating procedures
	Training	Training
	Maintenance	Maintenance
	Incident investigation	Incident investigation
	Compliance audit	Compliance audit
	Emergency Response Program	Management of change
	Develop and plan program	Pre-startup safety review
		Contractors
		Employee participation
		Hot work permits
		Emergency Response Program
		Develop and plan program

^b The following states have been granted full or partial delegation: Delaware, Florida, Georgia, Kentucky, Mississippi, New Jersey, North Carolina, North Dakota, Ohio, and South Carolina. For instance, Georgia facilities would submit RMPs to the Georgia Environmental Protection Division (EPD); while all other states not listed here would submit to their regional EPA RMP coordinator.

Once an RMP has been submitted and accepted, the final phase of the risk management program is implementation. The implementing agency is the federal, state, or local agency that is taking the lead for implementation and enforcement. This agency will review RMPs, select some RMPs for audits, and conduct on-site inspections.

However, even with everything in place, one cannot always prepare for an accidental release. Many believe that when dealing with large quantities of hazardous chemicals, the question is not if an accidental release will occur, but rather when?

TOXIC CHEMICAL DISASTERS – IMAGINED AND REAL

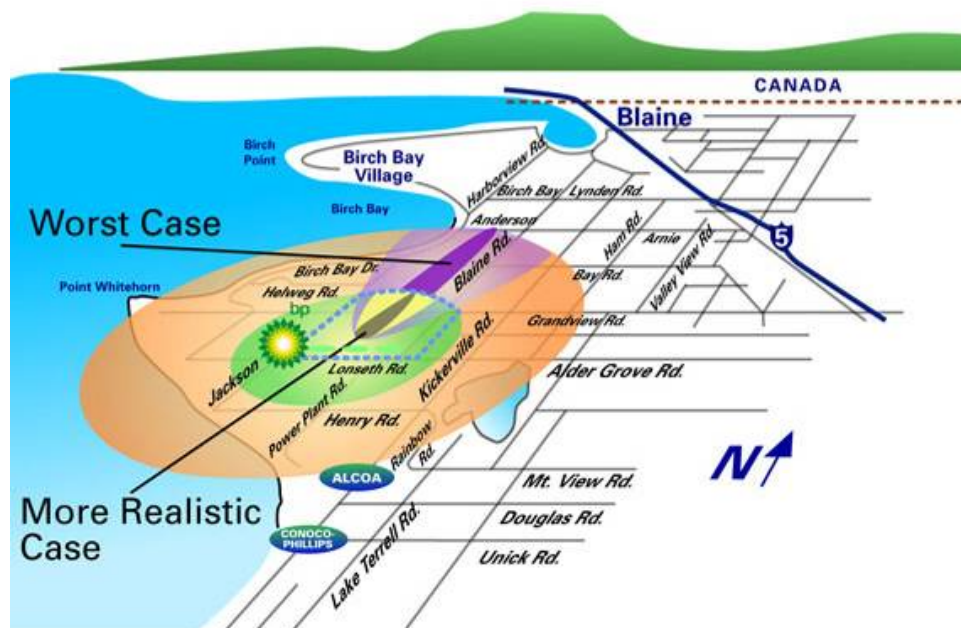
There have been thousands of chemical disasters before and since Bhopal, India – even with the implementation of the rules and regulations pertaining to risk management programs and the development of risk management plans. In the following, two examples of accidental releases are presented, one hypothetical and one that was all too real.

Ammonia – BP Cherry Point Oil Refinery, Blaine, Washington (USA)¹⁰

Anhydrous ammonia is used as part of oil refining in the hydrocracking processes. The hydrocracker is a combined hydrogenation and catalytic cracking process designed to convert low-grade gas oils to high quality gasoline and middle distillate products with a net consumption of hydrogen. The hydrocracker is Program 3 because of regulated flammable mixtures and toxic ammonia.

BP reports that as much as 55,000 pounds of anhydrous ammonia could be stored on site at any one time. Accordingly, hypothetical accidental release scenarios, including a “more realistic scenario” and a “worst-case scenario” have been developed (Figure 1).

Figure 1. Accidental Release Scenarios: Ammonia.



Summarizing BP's hazard assessment from their RMP for an accidental release of anhydrous ammonia, in a worst-case scenario, the cloud would stay highly concentrated for 1.5 miles. People exposed within this distance could experience serious health effects, possibly life threatening. As the cloud dispersed, it would spread out, becoming less concentrated and less harmful. Still if one was exposed within 1.5 miles and 2.3 miles from the release, one could experience some serious or irreversible health effects that require medical attention and that may prevent the seeking of shelter. Beyond 2.3 miles, nearly all people could be exposed to the vapor cloud for up to an hour with no irreversible or serious health effects. These effects would not keep them from seeking shelter.

Chlorine – Avondale Mills, Graniteville, South Carolina (USA)^{11,12,13}

At roughly 2:40 am Eastern Standard Time, two Norfolk Southern trains collided near an Avondale Mills plant in Graniteville, South Carolina. Norfolk Southern train No. P22 was parked on a siding near the Avondale Mills plant. Train No. 192, which was transporting chlorine gas, sodium hydroxide and cresol, was diverted by an improperly lined railroad switch onto the siding, where it collided with P22. The collision derailed both locomotives and 16 of 192's 42 freight cars, as well as the locomotive and one of P22's two freight cars. One of 192's tank cars loaded with chlorine ruptured, releasing at least 90 tons of the gas (Figure 2).

Figure 2. Graniteville train disaster (photo courtesy Andrew Davis Tucker, The Augusta Chronicle via The AP).



Nine people died (eight at the time of the accident, one later due to chlorine inhalation), and at least 250 people were treated for chlorine exposure. Within a mile of the crash site, 5,400

residents were forced to evacuate for nearly two weeks while HAZMAT teams and cleanup crews decontaminated the area.

"Chlorine and other highly reactive chemicals are of great concern because they're shipped daily by rail, barge and truck," says Lisa Detter-Hoskin, a Georgia Tech Research Institute (GTRI) senior research scientist involved with the accident investigation. "There have been some leaks in U.S. history, but until Graniteville, they were mostly small, and little damage was done. So there was very little public information on how to best serve Avondale Mills in this accident."

"This accident happened in the small community of Graniteville, South Carolina, and in my estimate, its ultimate economic impact to the town will likely exceed \$1 billion," Detter-Hoskin says. "Had this occurred in Atlanta or another large city, you would have had hundreds of thousands of people hurt and killed within a 10-minute period. The financial impact would be immense, as well. Metal equipment and electrical wiring would be destroyed, and computer data would be lost."

TOXIC CHEMICAL DISASTER PREVENTION

As illustrated in the two examples above, the release of large amounts of toxic gases can have catastrophic effects. Accidental releases can be planned for, but even with the most comprehensive RMP in place, there are some instances where nothing can be done to prevent significant harm to people, property, and infrastructure.

Where toxic, flammable, or otherwise hazardous chemicals are stored in significant quantities, the general duty clause of the EPA's Clean Air Act requires owners and operators of "stationary sources [of extremely harmful substances]...to design and maintain a safe (storage) facility and to minimize the consequences of releases when they occur." Both wet and dry scrubbers can prevent accidental releases of chlorine (Cl_2) for example, but only dry scrubbers can provide a virtually maintenance-free solution.

Emergency Gas Scrubbers (EGS)

Wet scrubbers follow a simple operation process. When a wet scrubber senses Cl_2 , the gas is drawn from the storage area to a packed bed tower; it then flows countercurrent to the liquid caustic solution, which is typically sodium hydroxide (NaOH). The caustic neutralizes the gas, with a maximum specified Cl_2 discharge concentration of approximately 0.5 parts per million (ppm).

Though they function easily, wet scrubbers require routine maintenance on parts such as pumps, valves, spray nozzles, and pH controls, and they need heaters for outdoor applications. Moreover, the liquid caustic solution is toxic, and because naturally occurring elements in the air gradually neutralize the NaOH, this material must be replaced every two or three years regardless of an accidental release. Sensors that detect Cl_2 also require periodic maintenance and calibration; otherwise if the Cl_2 concentration is extremely high – as in a catastrophic release scenario – the sensors might provide unreliable results.

For many years, dry chemical scrubbers have been considered as low maintenance alternatives to wet scrubbers in controlling, for example, a worst-case toxic gas release scenario such as a chlorine leak from a 1-ton cylinder at a wastewater treatment plant (WWTP). If a total release did occur from a one-ton cylinder, the thermodynamic properties of chlorine indicate that approximately 400 pounds of liquid chlorine would immediately flash into vapor and the remaining contents of the cylinder would spill out as a liquid at its boiling point. According to the American Water Works Association (AWWA) Risk Management Program (RMP) Guidance, the outer limit of the impact area, in a chlorine release, is drawn at a five-mile radius in all directions from the point of impact.

The basic concept of a dry-chemical EGS is not complicated. At its simplest, it is a packed-bed chemical reactor consisting of a media containment vessel, the dry-scrubbing media, and a blower. One type of medium in use against chlorine gas has been shown to provide an improved performance both in terms of removal efficiency and capacity versus a wet scrubber. The results of a full bed-depth challenge test verified these claims, and detailed the key design parameters for use of this medium in an EGS application.¹⁴ Based on this, many systems have been installed at WWTPs domestically and abroad specifically for the control of a catastrophic chlorine gas release.

DISASTER AVERTED – AN RMP AND EGS IN ACTION

The Tennessee River and Cumberland Escarpment region's wastewater treatment plant was built in the 1960s and bears the same name as the ancient settlement. The Moccasin Bend Wastewater Treatment Plant (MBWWTP), Chattanooga, Tennessee (USA), serves 250,000 people, treats 140 million gallons of water per day (MGD), and has a maximum hydraulic capacity of 220 MGD. The City of Chattanooga runs and operates MBWWTP and has a risk management plan for this facility on file with the EPA with the most recent revision being submitted in June 2009.

Moccasin Bend Wastewater Treatment Plant (MBWWTP) Risk Management Plan¹⁵

The plant uses chlorine, which is classified as an extremely hazardous substance, for disinfection. Liquid chlorine flows into the bottom of a hot water bath vaporizer and is converted to gaseous chlorine through a series of pipes and a chlorinator. A vacuum draws the gaseous chlorine into water passing through the injector. The chlorine gas goes into solution and is piped to chlorine contact diffusers, where it is mixed with clarified effluent from secondary clarifiers before entering the chlorine contact tanks. In these tanks, the chlorine solution is mixed with the clarified effluent to achieve adequate disinfection.

Two release scenarios were modeled using the Aerial Location of Hazardous Atmospheres (ALOHA)¹⁶ computer program developed by the National Safety Council for emergency planning and training. The worse case scenario (i.e., catastrophic failure of a 2000-pound tank over a 10-minute period due to corrosion, impact, or construction defect, a wind speed of 1.5 meters per second, and an atmospheric stability class of “F”) resulted in a toxic endpoint of 2.6 miles. Approximately 33,630 people in Marion and Hamilton counties are estimated to reside in the 2.6 mile radius surrounding the facility. The alternate-case scenario (i.e., a release of liquid

chlorine from a horizontal cylindrical 1-ton container through a short pipe or valve in the bottom of the tank, resulting in a two-phase release, a wind speed of 2.24 meters per second and an atmospheric stability class of “C”) resulted in a toxic endpoint of 1.2 mile radius surrounding the facility. Approximately 3,230 people in Marion and Hamilton counties are estimated to reside in the 1.2 mile radius surrounding the facility.

The plant is subject to federal requirements, including the preparation of process safety management (PSM)¹⁷ and RMP programs. Additionally MBWWTP is subject to and in compliance with OSHA rules. MBWWTP has:

1. In-house procedures for the safe operation of the chlorination process;
2. A training program for workers (including contractors and subcontractors) on or near the chlorination process of process hazardous and appropriate response actions;
3. A mechanical integrity program to ensure that regular preventive maintenance is performed;
4. An incident investigation program to identify the underlying cause of incidents and implementing steps to prevent similar events from reoccurring;
5. Compliance audits every 3 years to ensure compliance with OSHA and EPA; and
6. An emergency response action plan.

In October, 2000, the MBWWTP began a major reworking of the chlorine facility including all piping, valves, vaporizers, chlorinators alarms, alarm panel, automatic fan cut-offs and door closers, and a passive emergency gas scrubber that is alarmed initiated and capable of adsorbing 2,000 pounds of chlorine. This work was completed in April 2001.

Sensors installed in the chlorine room (Figure 3) are able to measure fugitive leaks of 1 part per million (ppm) which would activate an alarm and seal the building to contain the gas. In 2004, plant professionals also conducted the largest regional chlorine drill with the fire department to enact proper procedures during a simulated leak.

Figure 3. Chlorine Room



Disaster Averted

As part of MBWWTP’s safety measures they purchased a Purafil[®] FOC-1 (fiberglass, one-ton, EGS) with Chlorosorb[®] dry-scrubbing medium and installed it adjacent to the chlorination room in 2000 (Figure 4). This dry-chemical EGS was designed to contain the entire contents of a fully loaded one-ton chlorine cylinder in a worst-case release scenario. This EGS could neutralize an initial 400 pounds of chlorine in the

first minute and any additional chlorine at a rate of 80 pounds per minute (lb/min) thereafter. This exceeds the requirements of the Uniform Fire Code, Article 80 which states that the full contents of the single largest storage container must be mitigated in 30 minutes.¹⁸

On October 2, 2009, a plant worker at the MBWWTP was attempting to switch lines from an empty chlorine cylinder to a full one when a potentially catastrophic chlorine leak occurred. Although the worker escaped with only minor injuries, the Moccasin Bend facility, surrounding streets, a golf course and a radio station were temporarily evacuated until rescue workers could access the potential risk and a contractor had shut off the leak. Emergency personnel reported said that “at most,” 1 ton of chlorine leaked inside the building.¹⁹

Plant officials acknowledge that the EGS which had been installed 9 years before immediately began to remove the chlorine gas and “neutralized all of the chlorine that leaked out of the one-ton cylinder.”²⁰ After confirming that the leak had been shut off, the plant resumed operations, the evacuation was called off, and the roads were re-opened. The incident was over in about an hour.

This incident and the operation of this unit are prime examples of the benefits of an EGS with dry-scrubbing media. Field analysis of the medium showed that even after the chlorine release it still had more than 10% of the original capacity remaining.

SUMMARY & CONCLUSIONS

Facilities storing large quantities of hazardous materials (e.g., chlorine, typically in one or more one-ton cylinders), must invest in emergency standby equipment to prevent accidental chemical releases. The U.S. Environmental Protection Agency’s (EPA) Risk Management Program for Chemical Accident Release Prevention “requires regulated facilities to develop and implement appropriate risk management programs to minimize the frequency and severity of chemical plant accidents.” In addition, “a performance based approach towards compliance with the risk management program rule is required.” From these mandated Risk Management Plans (RMPs) in the late 1990s, the use of dry chemical Emergency Gas Scrubbers (EGS) has increased and remains steady.

Figure 4. Dry Chemical Emergency Gas Scrubber



Due to the critical nature of the device and the regulations that govern the design of such scrubbers, a thorough investigation of the components and the system's operating parameters is demanded. EGSs require professional design and application expertise due to the inherent danger and potential liability in the use of these systems to totally contain accidental releases of toxic gases. Proper performance testing must focus on specific design criteria and simulate actual conditions during an accidental release.

Dry chemical EGSs can prevent chlorine (Cl₂), sulfur dioxide (SO₂) and/or ammonia (NH₃) gas releases at wastewater treatment plants that might be caused by a failure in the storage cylinder or storage system. They provide immediate on-line control of gas leaking into or from a room or building.

During a chlorine leak at the Moccasin Bend WWTP, the dry chemical EGS immediately began to remove the chlorine gas, minimizing the risk to the workers on site as well as the surrounding area. The unit installed at the Moccasin Bend site provides a prime example of the benefits of using an EGS with dry-scrubbing media as an integral part of a facility's risk management plan. The dry-scrubbing medium within the unit is non-toxic, non-hazardous, maintenance-free, UL Classified, and most importantly, it can effectively help to save the priceless elements of a community.

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KEYWORDS

Chlorine, emergency gas scrubber, risk management plan, toxic gas control, WWTP