Emergency Planning
Preparedness, Prevention & Response

June 29, 30 and July 1, 2004
Orlando, Florida

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Center for Chemical Process Safety
19th Annual International Conference

Emergency Planning
Preparedness, Prevention & Response

June 29, 30 and July 1, 2004
Orlando, Florida
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20th Annual CCPS International Conference  
April 12 – 14, 2005 at the Hyatt Regency, Atlanta, Georgia  

Call for Papers  

Risk Management: The Path Forward  

The Center for Chemical Process Safety was formally chartered by AIChE on March 25, 1985, following preliminary discussion on February 26 with seventeen senior executives from thirteen major chemical and petroleum companies. While the immediate driving force was the Bhopal incident of December 1984, CCPS in concert with industry envisioned a broad and far reaching mission to advance the state-of-the-art process safety technology and management practices.

Looking backward over the intervening three decades much has transpired.

- Mergers, acquisitions, and globalization have transformed the industry.
- Security has become a watchword and a major government agency has been created to address its issues.
- Regulatory oversight has increased by an order of magnitude.
- Process monitoring capability (i.e. data acquisition and storage) has increased exponentially according to Moore’s Law.
- CCPS has become a vibrant organization with broad industry and government support.

From the perspective of April 2005, what has been accomplished?

- Have process safety incidents been reduced?
- Do regulations address the right issues and are they cost effective?
- Is security sufficient to prevent successful terrorist acts, and have the right scenarios been addressed?
- Has enhanced process monitoring led to superior process control?
- Are we better and can we prove it?

Looking forward and recognizing that resources both financial and human are limited where should industry and government focus?

Proposed session titles and topics include:

- Practical measurement of performance. What is the slope?
- Managing for better results with 21st century tools and resources.
- Case histories and lessons learned.
- LNG: Issues on LNG transportation and modeling.
- Risk analysis: How risk is quantified considering estimates of consequences and frequencies.
- Risk assessment: The process by which the results of risk analysis are used to make decisions.
- Risk management: The systematic application of management practices to the task of controlling risk to protect employees, the public, the environment and company assets.
- Building process safety culture.
- Human factors.
- Inherently safer technology.
- Process/equipment integrity.
- Enhanced process measurement and control.

For more information:

Call Karen Person at (212) 591-7319 or e-mail karep@aiche.org
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In preparing for battle I have always found that plans are useless, but planning is indispensable.

*Dwight D. Eisenhower*

**Emergency** *n.* a situation requiring immediate action.

**Plan** *n.* a strategy worked out in advance of an action.

We all know emergencies can wreak havoc on communities, industry, and governments; none of us has a crystal ball that can predict when the next accident or emergency will occur. We have tools, however, to help us understand the risks we face and we can undoubtedly define strategies to anticipate the actions needed when such an event occurs. As a result, the negative impact can be reduced or eliminated.

There are two goals for those responsible for emergency planning. The first goal, of course, is to prevent emergencies from happening. The second goal is to be prepared for them when they do occur. A timely response reduces the impact of an emergency, which is why planning, training, and practice drills are necessary. We all know of events that could have been lessened by preplanning, or that were minimized because of the capable actions of the first responders. We are also obligated to communicate with the communities and government agencies that grant us permission to operate our facilities.

The theme for the 19th Annual CCPS International Conference is Emergency Planning, Preparedness, Prevention, and Response. Included are sessions on emergency planning and response, community involvement, consequence assessment, transportation, layers of protection analysis, and several case histories. Different perspectives and experiences from industry, government, and academia are offered in the spirit of learning and sharing knowledge. Hopefully, these ideas will help us in our continuing efforts to make our facilities and communities safer, cleaner, and more secure.

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DuPont
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Center for Chemical Process Safety
19th Annual International Conference

Emergency Planning
Preparedness, Prevention & Response

June 29, 30 and July 1, 2004
Orlando, Florida
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Emergency Response

Session Chair: Shakeel Kadri
Air Products and Chemicals, Inc.
Three Incidents: Tank Truck Explosion, Television Interview Railcar Fire, and Intentional Destruction of Acrylic Acid Railcar Using “Vent and Burn”

Robert M. Rosen
Macungie, PA
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ABSTRACT

This topic demonstrates with video and pictures several critical aspects of Emergency Response. Regardless of the cause of the incident, technical expertise is required for a successful mitigation. Three incidents are reviewed in depth showing: an explosion in a Styrene truck, media coverage for a decomposing material in a hopper railcar, and a demonstration of “vent and burn” technology where a railcar is intentionally blown up. This session will stimulate discussion, and leave the attendees with a greater appreciation of the potential dangers of an incident, and the advantages of technical excellence in response.

1. INTRODUCTION

This paper is based upon three separate incidents. Each one demonstrates a unique aspect of Emergency Response.

2. INCIDENT #1

The first is an explosion of a Styrene tank truck in Asia. The video was taken, and edited for the reporter’s comments, most of which are incorrect.

The less than three-minute video has six items, which were incorrectly reported. These are listed below with the appropriate corrections.

A. Flames are shooting out from the pressure relief valve at an estimated height of 30 feet or more. The scene shows firefighters putting water on the insulated truck and then using foam.
   a. With flames that high the internal pressure of the tank truck warrants evacuation.
   b. The insulated truck cannot be adequately cooled with water from a fire hose.
   c. Foam is totally ineffective in this situation.
   d. The response team needed to withdraw rather than approach the burning truck.
B. The reporter states that, “No amount of training could have prepared these brave men for an incident like this”
   a. Training in several areas would have made a significant difference. These include but are not limited to: Chemical fire in an enclosed vessel; the limitations of external cooling for an insulated vessel; and explosion precursor signs.
   b. Personal protective equipment was inadequate as several firefighters were without SCBA, and the equipment they had on was not properly worn.

I want to personally thank David Ghormley of Rohm and Haas for sharing this information with me.

3. INCIDENT #2

The second incident deals with a flame retardant polystyrene, which in a concentrated form, in a hopper car, started decomposing. This took place in Jim Thorpe, located in Eastern Pennsylvania, during below freezing temperatures, and just above a pristine fishing stream.

The local fire department(s) were called to the scene, put water into the hopper car, stopped the smoldering, and the owning company of the polystyrene was called in to effect the cleanup.

To complicate the situation, the fire retardant material, a bromine salt, when mixed with water formed hydrobromic acid, which corroded the closed outlets on the hopper car.

The point I want to make about this incident is the television interview that took place with a representative from the company that owned the material in the railcar.

There were three main issues raised by the interviewer:

A. The first is in reference to the details of the incident. The conversation went like this:

   Television Interviewer: What are the details of this incident?
   Company Representative: We have a solid block of plastic in the railcar, and we have to cut it out one piece at a time using high pressure water.
   Comments: Non-technical, visual picture painted for the audience, easily understood.

B. The second is in reference to the length of time until the clean up is complete.

   Television Interviewer: Work has been going on throughout the week using sunlight during the day, and these lights at night. How long will the clean up take?
Company Representative: Our goal is to be out of Jim Thorpe’s hair as soon as possible.

Comments: Addresses the concern of timing, acknowledges the 24 hour operation, avoids a specific time and date, and shows empathy for any inconvenience.

C. The third point is in reference to the cost of the clean up and who is going to pay.

Television Interviewer: Although no official amount has been determined yet, officials say that the incident carries a hefty price tag. So, who is going to pay for the expensive clean up?

Company Representative: We are arranging everything and handling everything, and we are going to pay for everything that the clean up takes.

Television Interviewer: So you are not relying on the county to pay for anything?

Company Representative: No.

Comments: This dialogue puts the community at ease knowing that they will not be financially burdened because of this incident. No figures are given, and details are not disclosed. The point here is that sometimes a short, simple answer is best.

4. INCIDENT #3

The third incident involves a major train derailment that took place in Eunice, Louisiana, in May of 2000. The part that I am focusing on involves a railcar of Acrylic Acid that had flames impinging upon it for over two days. With the fire ongoing, the car upside down, and the overall situation in a high level of concern, the decision was made to intentionally destroy the railcar.

There was no safe way to ascertain the temperature or pressure inside the insulated car. The fear was that the Acrylic Acid had started to polymerize and that the railcar would explode when the pressure reached a critical point.

The area had already been evacuated, and by intentionally destroying the railcar, the evacuation could be canceled once the danger was over.

The technology utilized is known as Vent and Burn, and is described as such: Cone shaped charges are placed on the upper most point of the railcar with the intention of relieving the pressure and igniting the resulting vapors. A line of charges is placed along the underbelly of the railcar to ignite shortly after the top charges have relieved the pressure. These second charges blow open the length of the railcar and ignite the
remaining material. The whole process takes less than five minutes, and leaves the area safe to enter in order to effect final cleanup.

It is difficult to completely describe this procedure in words, but the video shows the pressure relief with flames shooting many feet into the air indicating that polymerization had indeed begun. Inspection of the inside of the railcar after the vent and burn also showed polymer buildup. This process, while reserved for special instances, can greatly reduce the harm to responders, and shorten the time of an evacuation.
World Wide Electronic Specialty Gas Emergency Response Program

Eugene Y. Ngai
Air Products and Chemicals Inc.
ngaiey@airproducts.com

ABSTRACT

Air Products and Chemicals Inc. is a leading supplier of chemicals, equipment and services to the worldwide Electronics Industry. Over 200 different gases and in a variety of packages are produced, purified, repackaged and/or distributed by Electronic Specialty Gases (ESG) group. These have a wide range of hazard characteristics: Toxic, Corrosive, Pyrophoric, Flammable, Water Reactive, Oxidizer or a combination of these. Packages are as small as lecture bottles and as large as ISO modules. To insure a safe and timely response custom emergency response equipment and protocols have been developed to consider all of these characteristics.

Over the last 20 years, Air Products has developed an extensive worldwide ESG ER program. This program is based on a number of Best Practices:

- ER team readily available and close by;
- Appropriate ER kits and tools available to the team.
- The teams are trained regularly on the use of equipment
- ER preplans for all packages
- Timely communications to alert the team
- Training of local public responders
- Translation of Medical Treatment Protocols

The following article will summarize the key details of this program.

1. INTRODUCTION

Air Products and Chemicals Inc. as a major worldwide supplier of chemicals, equipment and services ($1.2 Billion in 2003) to the Electronics Industry has an extensive emergency response program to support the business and the customers. The Electronic Specialty Gas segment is a significant part of this business (>25%) and requires a comprehensive ER program to support it.

2. BACKGROUND

Electronic Specialty Gases are used in a variety of Electronic Industry processes.

The major process types include:
- Semiconductor
Element (Silicon)  
Compound (III-V, II-VI)
- Microelectromechanical Devices (MEMS)  
- Optoelectronic Devices  
- Fiber optic Cable  
- Photovoltaic Cells  
- Optical Lens  
- Silicon Carbide Coatings  
- Liquid Crystal Displays

The components (memory chips, LED’s, lasers, etc) from these processes are used to make a wide variety of electronic products, which have become indispensable in our lives. These products have widespread use, with new products being introduced daily.

- Commercial Barcode Scanners, Displays, Lighting, Printers, Copiers  
- Medical Diagnostics, Therapy, Surgical Tools  
- Security Infrared Scanners, Identification Systems, Analyzers  
- Personal Computers, Toys, Cameras, Televisions, Cellphones, Printers, Digital Cameras, Digital Recorders, CD/DVD Players  
- Military Missiles, Radar, Night Vision, Weapons Control  
- Industry Welding, Automation, Solar Cells, Instruments Remote Temperature Sensing, Inspection  
- Communications Fiber optic Cable, Laser Transmitters, Satellites

Electronic Specialty Gases are key raw materials used in almost every step of the manufacturing processes. For example, Silane or Dichlorosilane can be used to grow silicon epitaxial or insulating layers, Hydrogen Chloride or Chlorine can be used for cleaning or etching, Tungsten Hexafluoride for interlayer connection, Nitrogen Trifluoride for reactor cleaning, Ammonia or Phosphine for the device seal layer.

The packages containing ESG are as small as a lecture bottle, which contains ½ lb or less of product to a ISO Module containing upto 40,000 lbs. a 49 liter cylinder which are approximately 10” diameter by 61” tall which can hold 10-70 pounds of gas, depending on the product.

3. EMERGENCY RESPONSE PROGRAM

Air Products sells over 200 Electronic Specialty Gases, which have a wide variety of hazards, Toxic, Corrosive, Pyrophoric, Flammable, Oxidizing, Water Reactive, Pressure or a combination of these. Critical to Air Product’s continuing growth in the Electronic Specialty Gas market is the development of a comprehensive Environmental Health and Safety (EHS) support program. Our employees, customers, the regulatory agencies, distributors, The public and transportation companies all have an expectation that Air Products as the manufacturer is the most knowledgeable about the product and will support these responsibly. The Air Product’s Emergency Response Program is a key element of the Responsible Care® program which we live by everyday.
World Wide Electronic Specialty Gas Emergency Response Program

Within Air Products a Corporate Emergency Response Manager is responsible for all activities and training for all of the products. Electronic Specialty Gases as this article will highlight are a unique subset of this effort and the program is more comprehensive than that of other product lines. 

ESG emergency response is a part-time responsibility for the employees, who all have full-time responsibilities in other areas. The involved employees are highly motivated and specially selected for their skills and capabilities. They must commit extra effort to maintain their ability to provide safe and effective emergency response support for our customers and other stakeholders. 

As mentioned earlier, Electronic Specialty Gases have a variety of hazard characteristics and come in a large number of different packages. In order to have a high level of safety and a timely response the equipment or procedures must take these characteristics and packaging into account. There is no magic wand or single approach that will accommodate all gases or scenarios. The cost of emergency response equipment and personal protective equipment is significant and considerable time is required to maintain both the equipment and the responders’ capabilities.

For a successful ER program there are a number of key elements that must be considered:

- ER team must be readily available and close by;
- Appropriate ER kits and tools must be available.
- The teams must be trained on the use of the equipment and techniques
- Timely communications systems must be in place to alert the team

The Environmental, Health and Safety issues at every stage of the life cycle of a product and their packages, from research and development all the way through to disposal, are reviewed to determine that necessary safeguards are in place. An emergency can happen at any point in the cycle.

Because of the complexity of the gases, variety of packages, and the limited number of incidents, it is not economically attractive for third party contractors to provide ER services for ESG products as they do for other industrial chemicals. Much of the equipment and systems are custom designed and made in limited quantities making them expensive. There are very few private contractors in the US and Europe who, have the experience, equipment and the training to respond effectively to ESG emergencies and in the Far East there are none. As a result, the Electronic Specialty Gas Industry is unique in that each company must maintain fully trained and equipped teams in their service areas if they chose to fully support their customers and others. These teams will typically respond to incidents on the supplier site, during transportation or at a customer site.
The Best Practice that is used as a guideline for all of Air Products’ Electronic Specialty Gases in planning for a new location or product considers the following elements:

- Communications
- Equipment or Procedures in place for every package handled at each location
- Development of generic ER preplans for Product/Package combinations
- Design ER Equipment if none available
- Training of Responders
- Training of local Public Agencies
- Site Specific ER Preplan
- Specialized Package and/or Product Training
- Translation of MSDS and Safetygrams into local language
- Translation of key Medical Treatment protocols into local language
- Training of Medical Facilities
- Donation of Reference Manuals to local Public Agencies and Hospitals
- Mutual Aid Support
- Local resources
The Emergency Communication Center at the Allentown, Pennsylvania headquarters is a critical part of the ER program. Trained operators are available 24 hours a day to answer emergency calls, contact the appropriate individuals, forward information and activate ER teams. There are also local country numbers to contact local ER services around the world.

Approximately 50 Electronic Specialty Gas ER teams are strategically located throughout the United States, Europe, and the Far East. They are all trained to the OSHA (U.S. Occupational Safety and Health Administration) Hazmat Technician level requirements per 29CFR1910.120q. The training is done by in-house trainers since the content, equipment, products and methods are unique to ESG.

Emergency response at a microelectronics facility can be a challenge. The manufacturing processes are all housed in cleanrooms while the gases are typically in a dedicated gas room or outside area, often hundreds of feet away from the use point. Many of the gas cylinders are enclosed in exhausted gas cabinets with gas sensors, which alarm at the TLV level. This will shut down the process and may trigger an area evacuation. Our response time is critical— for every hour that the process is shutdown, our customer may be losing $100 K or more.

![Figure 2: Air Products ESG ER Teams in the Far East](image)

Emergency response equipment is another area that is critical to the success of the program. In 1989, Air Products first Emergency Response Containment Vessel (ERCV) was developed for use at our Morrisville, PA facility. This is a ASME Pressure Vessel
with a quick opening flange on wheels which allows for the quick and safest containment of cylinders up to a 50 liter capacity.

Figure 3: 5502 ERCV being loaded with a cylinder

The encapsulated problem cylinder can then be more safely transported to a site for reprocessing or disposal. This is the primary device that is used for high pressure gas cylinders for all ESG ER teams. There are now almost 300 ERCV’s used by gas companies, government agencies and customers throughout the world. A larger diameter ERCV, model 5503, was designed last year to accommodate the larger diameter low pressure cylinders commonly used for fuel gases, chlorine and ammonia and other liquefied gases commonly used in non ESG applications.

A small Engineering group in Morrisville, PA designs and validates the effectiveness of the new ER equipment. Once the design has been approved, this group will inventory and supply the AP locations to insure that all ER equipment is standard. This makes it easier to train the teams, reduces cost, determines that the most effective design is used and allows team members from other areas to use the equipment in an emergency.

At all the ESG sites there is a minimum ER equipment package, which includes the items shown in the following figure.
The ESG sites use ERCV’s from 3 different suppliers.
- Sigri (Europe)
- Air Products (Solkatronic)
- Chlorine Institute (Low pressure)

Additionally an ERCV packaged in a cargo ready aircraft crate, can be shipped as a backup to any APCI site and is located at the Phoenix, AZ ESG site.

Several techniques are available for our teams to quickly capture leaking gas until the problem container can be transported offsite. These are devices that can quickly isolate and capture the leak to control it and, if necessary, divert it to a scrubber. Our leaking cylinder cap is a patented system that does this. It can very quickly be used to control a problem until a more permanent solution can be utilized.
The ER teams also have the ability to transfer the contents of the leaking cylinder into empty cylinders for transport back to our production facilities for processing. For non-liquefied compressed gases, the Cascade system is used. For liquefied gases a Cold Coil system is used. The flow schematic for a typical system is shown in the following figure.

Figure 6: Cold Coil Transfer Flow Schematic

This capability is important at overseas locations since it is not legal to ship a ERCV containing a leaking gas cylinder by ship.

Other unique pieces of equipment include remote valve openers, cylinder and valve drilling devices, de-valving kits, and containment systems for large gas containers.

To bring this equipment to the incident scene a variety of vehicles or trailers are used around the world. The specific design is up to the local team. The minimum requirements are that it be capable of transporting 2 fully equipped ER team members with a ERCV, tools, gas detection equipment, reference manuals, PPE and other equipment to the scene.

As the Electronics Industry continues to grow, larger bulk packages (Ton units and ISO’s) are being used to improve safety, quality and reduce cost. As these new Electronic Specialty Gas packages are being developed the design team identifies any safety and Emergency Response issues and will try to modify the design to enhance safety and to facilitate responding to potential leaks. The following figure contains some examples of devices that will minimize leaks or can quickly seal off a leak. Where possible these are located on the package and the ER team closest to the use site has the training and equipment to deal with the emergency.