



DEP/GIAE/JJW

OCT - 2 2012

MEMORANDUM FOR: REGIONAL ADMINISTRATORS
STATE PLAN DESIGNEES

THROUGH:

Richard E. Fairfax
RICHARD E. FAIRFAX
DEPUTY ASSISTANT SECRETARY

FROM:

Thomas Galassi
THOMAS GALASSI, DIRECTOR
DIRECTORATE OF ENFORCEMENT PROGRAMS

SUBJECT: DuPont Belle, West Virginia, Incident and Use of Flexible
Hose in Toxic Gas Service

Introduction

This memorandum discusses the details of a fatal phosgene exposure, the root and contributing causes, as well as appropriate recognized and generally acceptable good engineering practices (RAGAGEP) for toxic gas systems.

On January 23, 2010, at the DuPont facility in Belle, West Virginia, the catastrophic failure of a flexible hose caused a fatal phosgene exposure to one worker. Following its investigation, the US Chemical Safety and Hazard Investigation Board (CSB) recommended that the Occupational Safety and Health Administration (OSHA):

Take sustained measures to minimize the exposure of hazards to workers handling highly toxic gases from cylinders and associated regulators, gages, hoses, and appliances. Ensure that OSHA managers, compliance officers, equivalent state OSHA plan personnel, and regulated parties conform, under the Process Safety Management Standard (29 CFR 1910.119) Recognized and Generally Accepted Good Engineering Practices (RAGAGEP) provisions, to industry practices at least as effective as the following:

- *NFPA 55 – Compressed Gases and Cryogenic Fluids Code (2010)*
- *CGA P-1 – Safe Handling of Compressed Gases in Containers (2008)*

- *CGA E-9 – Standard for Flexible, PTFE-lined Pigtails for Compressed Gas Service (2010)*
- *ASME B31.3 – Process Piping (2008)*

The Incident

On the afternoon of January 23, 2010, an operator entered the phosgene shack at the DuPont Belle Plant in Belle, West Virginia, to check the weight of the on-line phosgene cylinder. He anticipated the phosgene cylinder was near empty and would soon require replacement. DuPont requires workers to don a fully-encapsulated suit when entering the shack to change phosgene cylinders. However, DuPont does not require a fully-encapsulated suit when checking the cylinder weight. Therefore, the worker was only wearing his standard personal protective equipment.

As the operator checked the cylinder weight, the hose leading to the offline phosgene cylinder catastrophically ruptured due to thermal expansion of residual liquid. The phosgene sprayed the chest and face of the operator. Two days later, the operator died from the phosgene exposure.

The investigation found the hose (Teflon® inner layer and stainless steel braided outer layer) had weakened beneath a manufacturer-applied identification label. The label, affixed with adhesive tape to the braided stainless steel outer layer, allowed permeating phosgene to accumulate rather than diffuse into the room. The high phosgene concentration beneath the label corroded the stainless steel braid and, after six months of service, caused a weak spot in the flexible hose.

OSHA cited DuPont under paragraph (j)(4)(i) of 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals* (PSM) for not following its own inspection and change-out procedures for hoses in phosgene service.

Root and Contributing Causes

During its investigation, the CSB identified multiple root and contributing causes to the incident.

Specifically:

- DuPont allowed the phosgene transfer hoses to remain in service well-beyond DuPont's corporate recommendations for phosgene use.
- DuPont ignored engineers' concerns regarding the susceptibility of materials of hose construction to degradation due to long-term phosgene service.
- The incident hose was left charged with liquid phosgene contrary to DuPont's internal operating procedures.
- A similar hose failure almost occurred a few hours before the exposure of the worker; however, operators' observation of a near failure of a phosgene hose on

the morning of the fatal release did not prompt an investigation or protective actions.

- DuPont's 2009 PHA did not address thermal expansion and corrosion potential for phosgene transfer hoses.
- DuPont used phosgene hoses constructed of a permeation-prone Teflon® inner layer and corrosion-susceptible braided stainless steel contrary to the recommendations of a corporate expert and the internal DuPont phosgene standard even though a 2006 audit recorded the incorrect hose materials as an observation as opposed to a major finding.

Flexible Hoses in Toxic Gas Service

Employers with toxic gas processes regulated by OSHA's PSM standard, such as the phosgene process at the DuPont Belle facility, must comply with recognized and generally acceptable good engineering practice (RAGAGEP). OSHA does not specify the RAGAGEP employers use for PSM-covered toxic gas systems. It is the responsibility of the employer to document which codes and standards they employ for the equipment in their covered processes (29 CFR 1910.119(d)(3)(i)(F)) and then they must document that the equipment (e.g., flexible hoses) complies with RAGAGEP (29 CFR 1910.119(d)(3)(ii)). Additionally, 29 CFR 1910.119(j)(2) requires that employers develop and implement mechanical integrity procedures, including inspection and testing procedures, and 29 CFR 1910.119(j)(4)(ii) requires employers' inspections and testing procedures to follow RAGAGEP.

When conducting inspections of PSM-covered toxic gas processes, CSHOs should evaluate the RAGAGEP the employer chose, the appropriateness of the RAGAGEP, and whether the employer complies with the chosen RAGAGEP.

For toxic gas systems, appropriate RAGAGEP include; but may not be limited to:

- NFPA 55 – Compressed Gases and Cryogenic Fluids Code (2010)
- CGA P-1 – Safe Handling of Compressed Gases in Containers (2008)
- ASME B31.3 – Process Piping (2008)

ASME B31.3 is a piping design standard applicable to all piping in the process industries. NFPA 55 and CGA P-1 are more specific to industrial applications involving containerized gas and include specific requirements for toxic gas systems. All but the smallest processes involving toxic gases are regulated under PSM (e.g., the threshold quantity for phosgene is 100 pounds) and CSHOs must familiarize themselves with the provisions in CGA P-1 and NFPA 55 to understand an employer's compliance with 29 CFR 1910.119(d)(3)(ii) and (j)(4)(ii).

In addition to the standards discussed above, the Compressed Gas Association publishes a standard specific to the use of PTFE- (e.g., Teflon®) lined hoses for use in gas systems. CGA E-9, *Standard for Flexible, PTFE-Lined Pigtailed for Compressed Gas Service* provides guidance specifically on the type of hose used in the DuPont system. CSHOs

encountering PTFE-lined hoses in this service should consult with CGA E-9 for protective and abatement measures and take these into account when evaluating compliance and developing any citations.

ASME 31.3, NFPA 55, CGA P-1, and CGA E-9 are available on the OSHA global drive (O: drive).

Large manufacturers may prepare additional internal standards, such as the hose requirements at DuPont, or use foreign standards. CSHOs should evaluate any internal or foreign standards to determine if they are as protective as the four referenced standards above.