

# *Unsuspected Events Lead to Hydrogen Sulfide Fatality*



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# Reason For Inspection

**On February 15 2006, the Cincinnati Area OSHA Office was notified by the media of a chemical release at a local chemical manufacturer. Several people were sent to the local hospitals as a result of their exposure.**

**The OSHA Area Director sent two of his senior Industrial Hygienists to the site**



# The Operation

A medium size chemical manufacturing plant in Cincinnati of a very large multi-national corporation

- The plant site contained a number of processes throughout a number of buildings some of which involved quantities of highly hazardous chemicals that were covered by OSHA's Process Safety Management Standard.
- This particular operation was not a PSM-covered process although the Company did conduct a PHA on it
- This operation and its sister operation both manufactured chemical intermediates



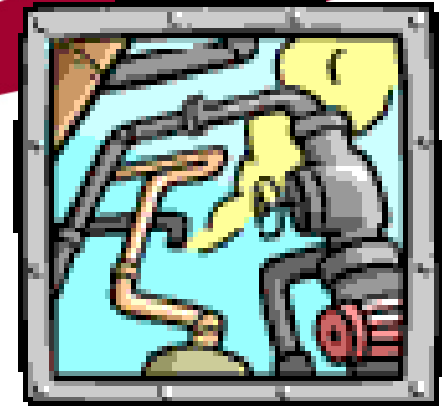
## According to the Safety Director...

1. Two maintenance workers were assigned to troubleshoot a chemical process system that could not pull sufficient vacuum. This was a routine job that they had done before.
2. The crew was the most experienced and knowledgeable on the maintenance staff.



# Initial Investigation

**A process operator had narrowed the process problem down to the vacuum system**



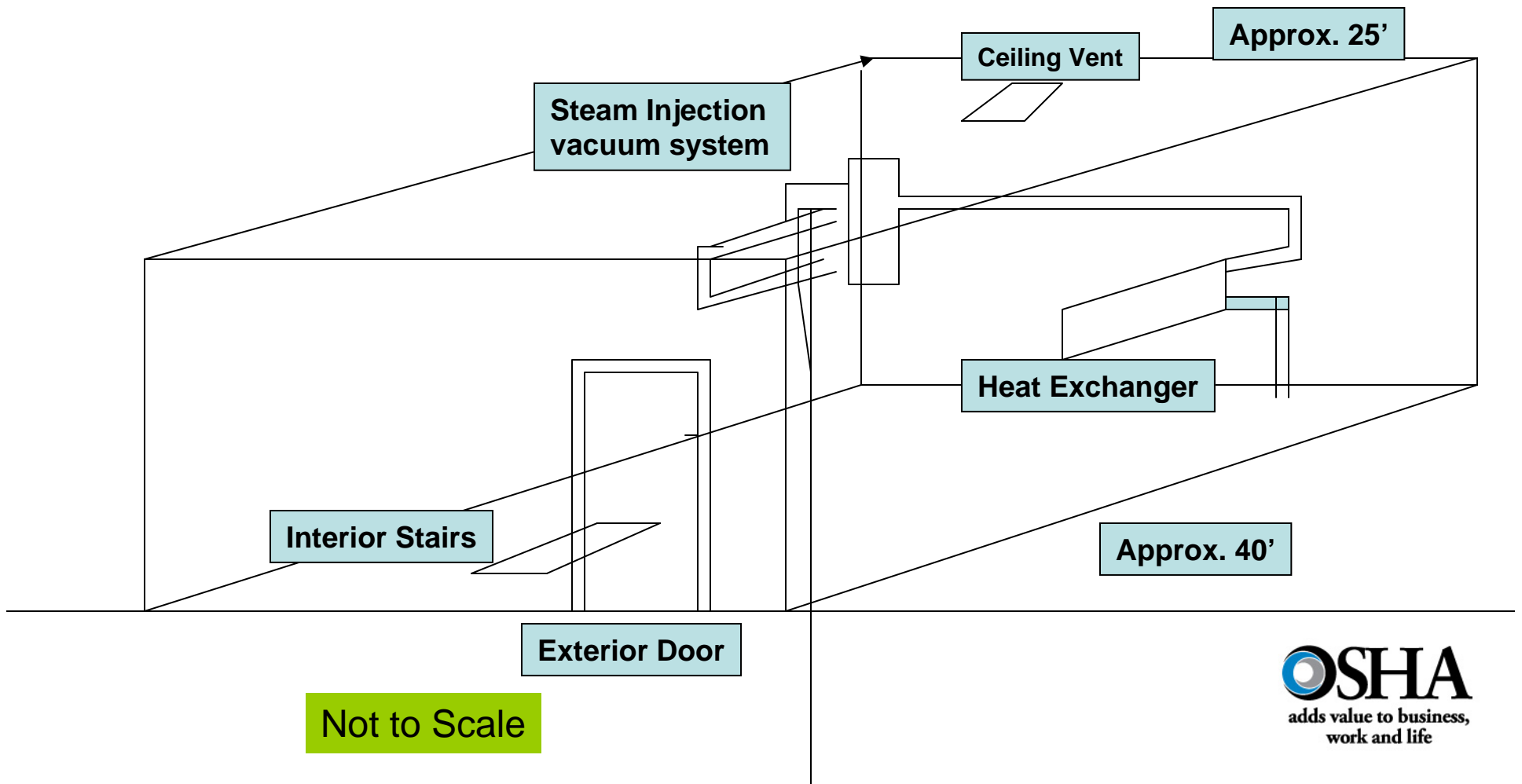
**The vacuum systems used for this and an adjacent system required the flow of process air through narrow nozzles and these nozzles became clogged periodically.**

**Troubleshooting identified a clogged nozzle as the problem. The fix required disassembling the system for access.**

**When maintenance opened the system the worker who actually removed the part, passed out.**

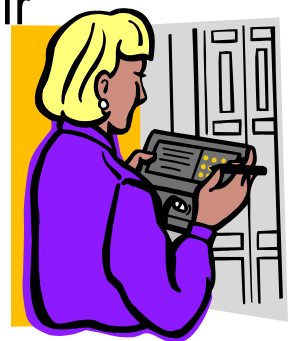
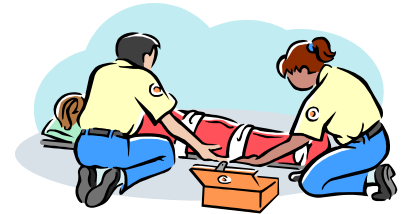
**Believing that he had suffered a heart attack, his partner radioed for the plant's Emergency Response Team to respond to a heart attack.**

# Process Area



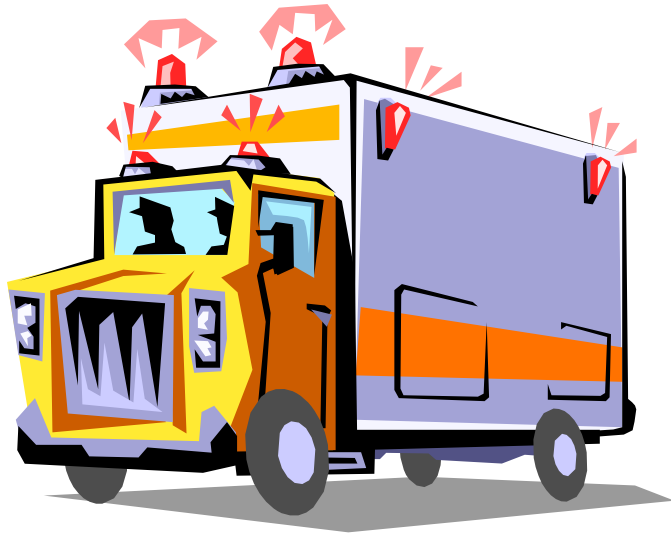
# Employer's Emergency Response

- Within minutes, > 10 members of the plant's (ERT) Emergency Response Team responded to the scene:
  - carrying AED's and cardiac resuscitation equipment
  - none had a gas monitor
  - none wore respiratory protection
- When a 2nd maintenance worker collapsed & then a member of the response team said that he was woozy, a manager retrieved an air monitoring device.
- No one ever smelled hydrogen sulfide.
- When an air monitor was brought in, it instantly pegged at 52ppm for Hydrogen Sulfide at the doorway.
- The room was then evacuated



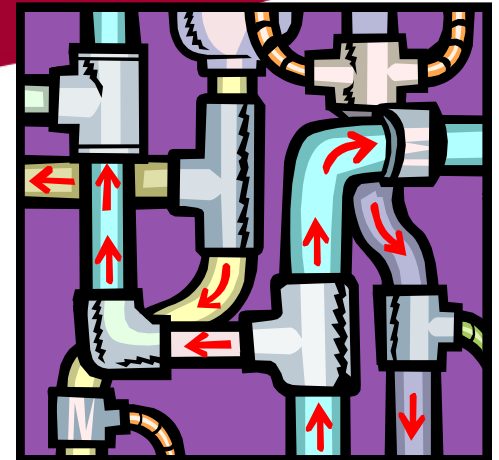
# OSHA's Focus

- Process & Equipment Evaluation
- Maintenance Operation
- Emergency Response



# Process & Equipment Evaluation

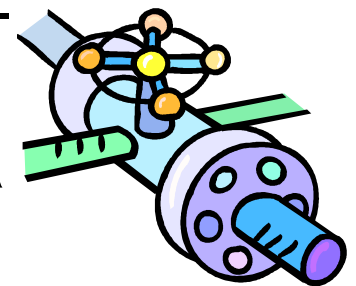
Two Chemical Processes shared a common vent/drain line for the vacuum systems



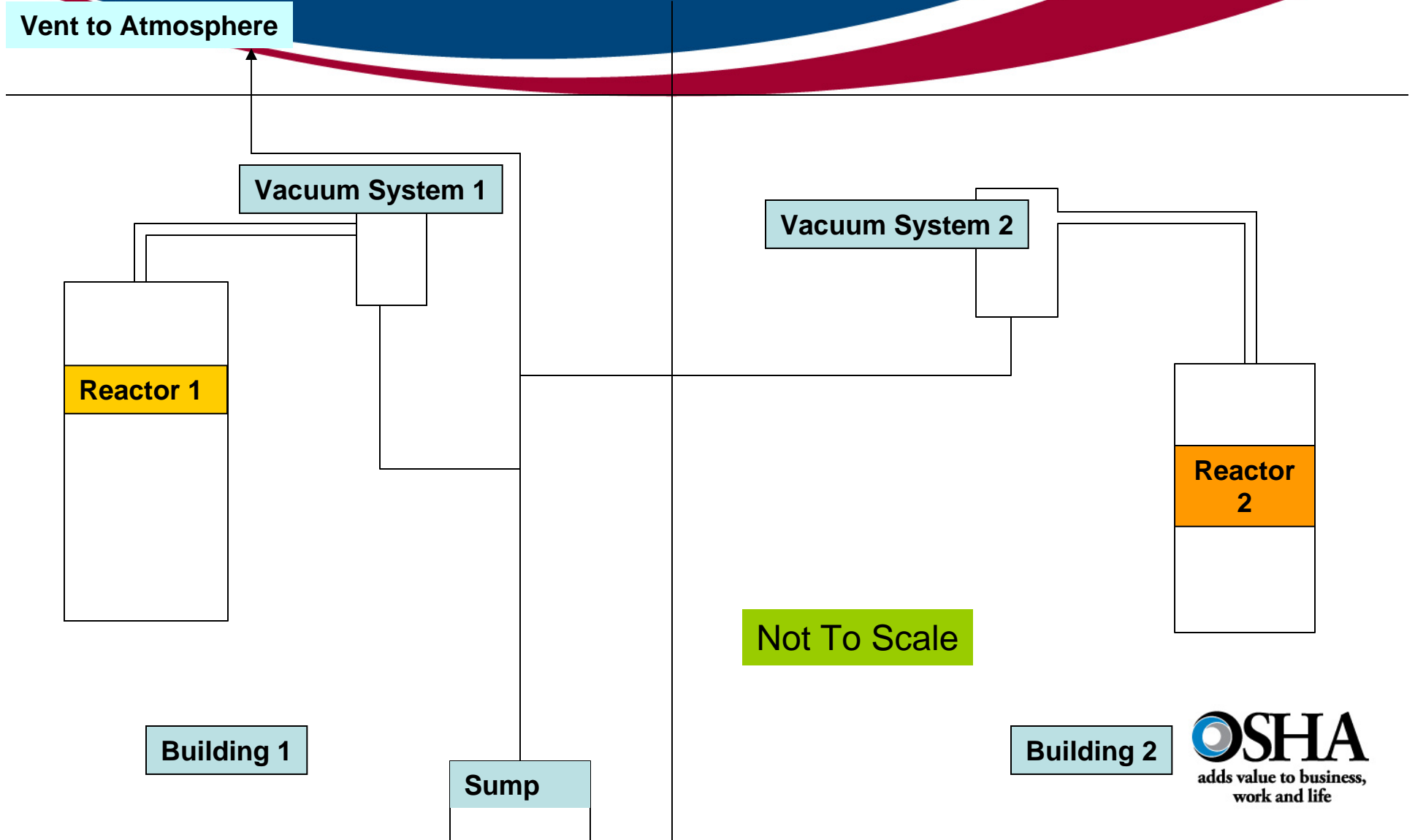
- Vent Line not inspected nor regularly cleaned
- Both processes had the same type of vacuum system using steam at 160 degrees C
- Only one of the processes used, 2-Mercaptoethanol (2-ME) which decomposed @150-160 degrees C into Hydrogen Sulfide and Carbon Monoxide

# Process & Equipment Evaluation

- Process Hazard Analyses**, though not required by 29CFR1910.119, had been completed on each of the two processes, **but several issues not considered:**
- The interconnection of the processes (or the potential hazard thereof)
  - The potential of the vacuum system to breakdown 2-ME
  - Inconsistency of MSDS information eg., identifying a boiling vs. decomposition temperature
  - History of apparent hydrogen sulfide exposures in that and the adjacent building



# Process Flow



# Problems with MSDS's

## Process & Equipment Evaluation

### MSDS for 2-Methcaptoethanol, aka 2-ME,

- **MSDS Supplier A** listed a **Boiling Point** = 149-161C & thermal decomposition to hydrogen sulfide @ undefined temperature
- **MSDS Supplier B** listed a **Boiling Point** = 155.8 C & decomposition @ 157-158 C, but no decomposition product
- Company's **MSDS** listed a **Boiling Point** = 157.7 C & decomposition product as hydrogen sulfide @ undefined temperature
- **MSDS D (from Internet)** listed a **decomposition point** not a Boiling Point of 157 C & decomposition formation of hydrogen sulfide



# Maintenance Operations

The Employer had Lockout and Line Break Programs but they were not always implemented

- Steam and process lines were isolated by double valving and bleeding **but valves were not locked out**
- **Vent line to the vacuum system was never recognized as a hazard source and so, not isolated.**
- When the ejector system was opened in preparation to rod out the nozzle, no **air testing for any gases was done as none were expected.**



# Emergency Response

- In-plant emergency responders responded only to a heart attack
- No air testing equipment was brought to the response scene
- No responder reported smelling anything
- No responder wore any respiratory protection
- The emergency response plan did not require air testing for medical emergency responses



# Violations

29CFR1910.147(d)(3) for **not isolating drain/vent line nor following safe line breaking procedures**

29CFR1910.147(d)(4)(i) for **not locking out process and steam lines,**

29CFR1910.1200(d)(2) for **an inadequate MSDS – did not state that 2-ME decomposed to H<sub>2</sub>S at a set temperature or range nor identified the polymerization capability of 2-ME**

29CFR1910.147(d)(6) for **not assuring isolation or safety of the common vent line, and,**

29CFR 1910.120(q)(2)(iii) : **not wearing respiratory protection before an air assessment**

29CFR 1910.134(d)(1)(iii): **not monitoring for hydrogen sulfide**

29CFR 1910.1000(b)(2): **exposures >PEL for Hydrogen Sulfide**

## *The Company's response*

- \* Settled the OSHA case Informally
- **Separated the vent systems**
- **Revised their lockout and line breaking procedures and retrained their workforce on both**
- **Revised their MSDS for 2-ME**
- **Revised their PM procedures for vents**
- **Revised their Emergency Response Procedures**
- **Greatly improved their H2S monitoring program:**
  - purchased >100 H2S personal monitors
  - Installed additional area monitors for H2S

# Lessons Learned

- **Assess all lines in a process**
- **Check chemicals reactivity and decomposition potential thoroughly for the chemicals in process**
- **100% Lockout and Line Break procedure use**
- **Respond to emergencies in a chemical facility as if it is a chemical-related emergency, make no assumptions**
- **Protect the responders first**
- **Watch out for chemicals that can produce Hydrogen Sulfide**

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**Questions?**