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Section on Prevention in the Chemical Industry

Hot Works and Explosion Protection

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International Symposium ”Hazardous Substances in Maintenance Work: Risks and Prevention“

11–12 June 2024 | Frankfurt/Main, Germany

How is an explosion generated?

Simultaneous presence of

- Flammable substance
  and
- Oxidizing agent
  and
- Effective ignition source

in the same space

Approach to „explosion hazard“ ⇔ „hotworks“

Assessment of the situation
preventive measures

➔ **goal: no flammables present**

After a number of hot work accidents in the USA between July 2008 and May 2009, Chemical Safety and Hazard Investigation Board (CSB) has focused on

Seven key Lessons
to Prevent Worker Deaths During Hot Work In and Around Tanks [1]

Highlighting the importance of

effective hazard assessment and use of **combustible gas monitoring**

SEVEN KEY LESSONS FROM HOT WORK ACCIDENTS (1)

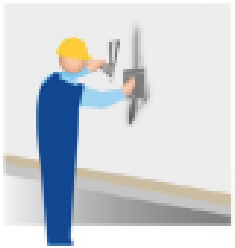
1. **Use Alternatives**
   Whenever possible, avoid hot work and consider alternative methods

2. **Analyze the Hazards**
   Prior to the initiation of hot work, perform a hazard assessment that identifies the scope of the work, potential hazards, and methods of hazard control.

   If the object to be welded or cut cannot readily be moved, all movable fire hazards in the vicinity shall be taken to a safe place. All combustibles shall be relocated at least 35 feet (10.7 m) from the work site.

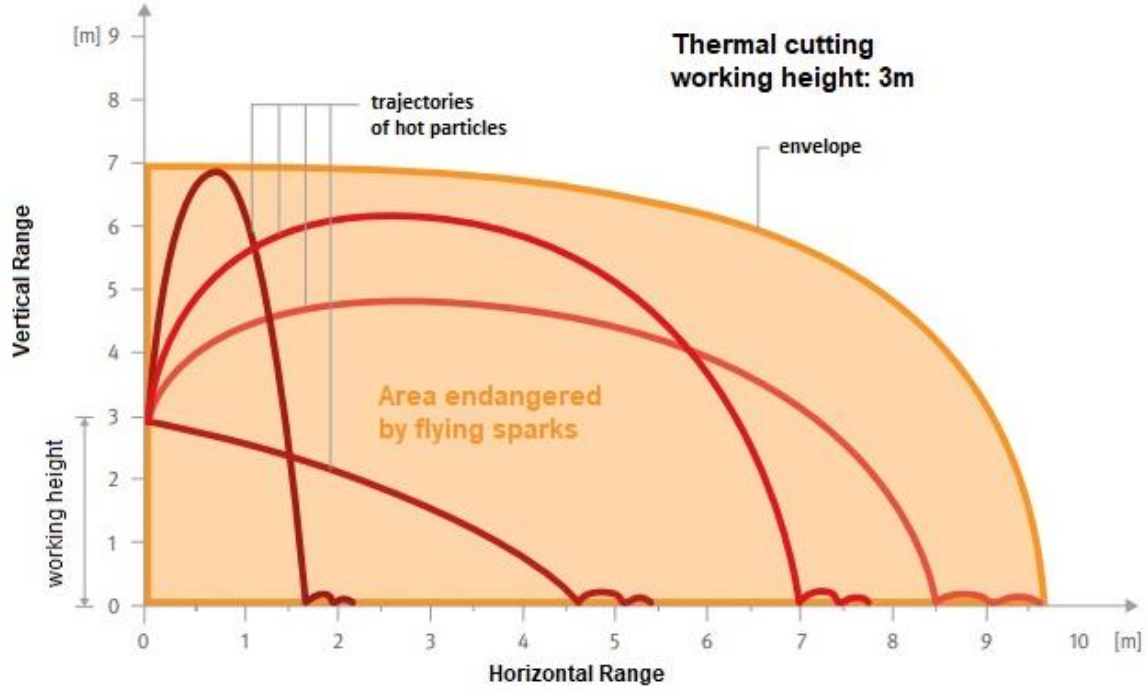
   Where impracticable, combustibles shall be protected with flameproofed covers or otherwise shielded with guards or curtains.

   Openings or cracks shall be closed or shielded … **(OSHA standard 1910.252 [3])**



DGUV Information 209-011 [2]

Range of flying sparks

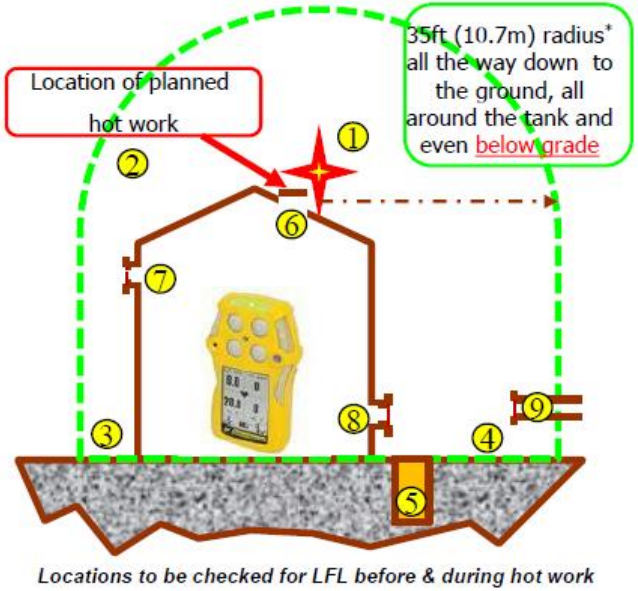


DGUV Information 209-011 [2]

SEVEN KEY LESSONS FROM HOT WORK ACCIDENTS (2)

3. Monitor the Atmosphere

Conduct effective gas monitoring
in the work area
using a properly calibrated combustible gas detector
prior to
and during hot work activities,
(Example 1)
even in areas
where a flammable atmosphere
is not anticipated. (Example 2)



Locations to be checked for LFL before & during hot work

Process safety beacon August 2020 [4]

Example 1

TEPPCO Partners, Garner, Arkansas,
May 12, 2009

3 Workers Killed

Three contractors were using a cutting torch on top of the roof of a gasoline storage tank when an internalexplosion blew both the top of the floating roof and the secondary lid off the tank.
The contractors were cutting an opening into the roof for a gauge pole for level measurement to be inserted.

CSB Hot work safety bulletin [1]

The torch-cutting activity most likely ignited flammable vapor within the tank.
Gas testing only occurred at the start of the work shift (7:00 am). More than five hours later (ca. 2:30 pm) they started the hot work activities.

Work atmospheres can change rapidly; it is vital to ensure that workers are constantly aware of the potential development of an explosive atmosphere.

Example 2

Packaging Corporation of America,
Tomahawk, Wisconsin, July 29, 2008

3 Workers Killed, 1 Injured

Three workers were welding on a flange connection on top of an 80-foot tall storage tank that contained recycled water and fiber waste.

CSB Hot work safety bulletin [1]

Facility personnel were unaware of the potential presence of flammable gas from the decomposition of the organic material in the tank, and combustible gas monitoring was not typically required or performed prior to starting work. Sparks from the welding ignited flammable vapors inside the tank. The resulting explosion ripped open the tank lid, knocking two of the workers to the ground 80 feet below. Anaerobic bacteria had multiplied inside the tank and water recycle system over time, feeding on organic waste material. The bacteria likely produced hydrogen, which ignited during the welding.

SEVEN KEY LESSONS FROM HOT WORK ACCIDENTS (3)

4. **Test the Area**
   In work areas where flammable liquids and gases are stored or handled, drain and/or purge all equipment and piping before hot work is conducted.
   When welding on or in the vicinity of storage tanks and other containers, properly test and

   if necessary continuously monitor
   all surrounding tanks (Example 3)

   or adjacent spaces (not just the tank or container being worked on)

   for the presence of flammables and eliminate potential sources of flammables.

CSB Final Report: Kuraray … [5]

Example 3

MAR Oil, La Rue, Ohio, October 19, 2008

2 Workers Killed

An explosion killed two contract workers while they were welding above a series of three interconnected crude oil storage tanks. The explosion occurred when the workers attempted to weld a bracket on top of one of the tanks, near an atmospheric vent.

Because the tanks were interconnected, oil flowing into an adjacent tank likely displaced flammable vapor into the tank being welded. The vapor escaped through the vent and was ignited by welding sparks.

CSB Hot work safety bulletin [1]

SEVEN KEY LESSONS FROM HOT WORK ACCIDENTS (4)

5. **Use Written Permits**
   Ensure that qualified personnel familiar with the specific site hazards
   - review and authorize all hot work and
   - issue permits
     specifically identifying the work to be conducted
     and the required precautions.

SEVEN KEY LESSONS FROM HOT WORK ACCIDENTS (5)

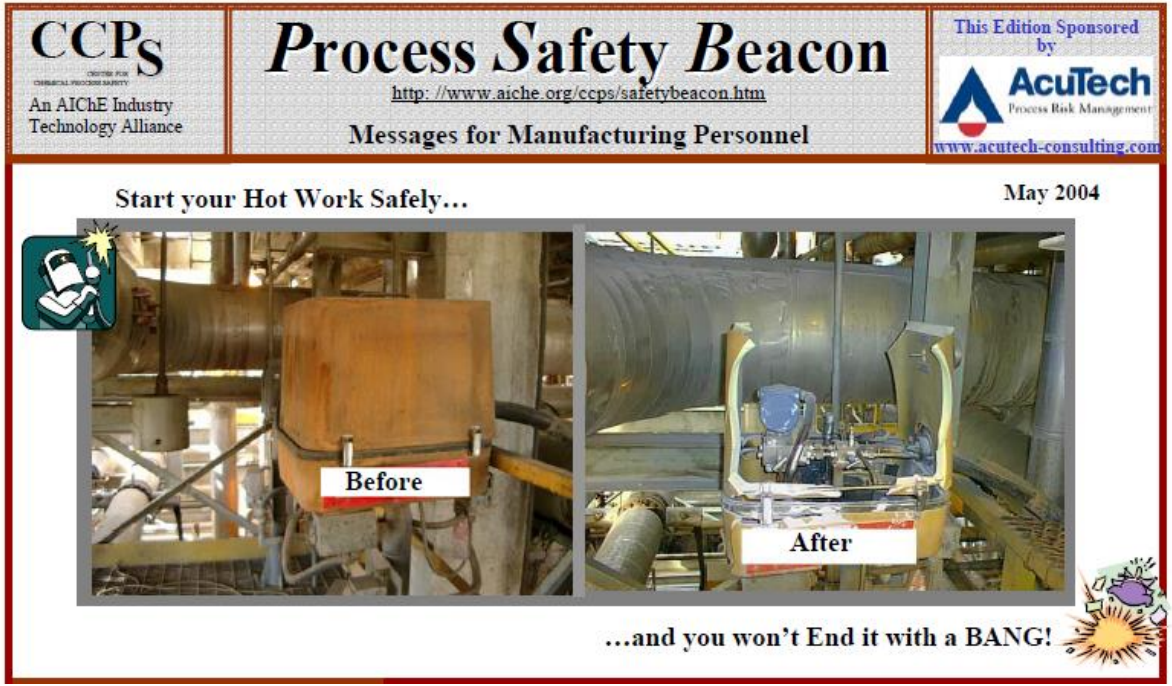
6. **Train Thoroughly**
   Train personnel
   - on hot work policies/procedures,
   - proper use and calibration of combustible gas detectors,
   - safety equipment, and
   - job specific hazards and controls

   in a language understood by the workforce.

7. **Supervise Contractors**
   Provide safety supervision for outside contractors conducting hot work.

   Inform contractors about site-specific hazards
   including the presence of flammable materials

Start your Hot Work Safely …



Process safety beacon May 2004 [6]

Thank you
for your attention.

Do you have questions?

Sources/Literature

- **[1] Seven Key Lessons to Prevent Worker Deaths During Hot Work In and Around Tanks - Effective Hazard Assessment and Use of Combustible Gas Monitoring Will Save Lives, The U.S. Chemical Safety and Hazard Investigation Board (CSB) No. 2009-01-SB (February 2010),** https://www.csb.gov/assets/1/17/csb_hot_work_safety_bulletin_embargoed_until_10_a_m__3_4_101.pdf?14329 last visited 2024-03-15 16:06h
- **[2] DGUV Information 209-011, Gasschweißen (gas welding), Oktober 2018,** https://publikationen.dguv.de/regelwerk/dguv-informationen/319/gasschweissen last visited 2024-04-04 12:11h
- **[3] OSHA Standard 1910.252** https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.252 last visited 2024-04-22 21:43h
- **[4] Process safety beacon, August 2020,** http://www.aiche.org/ccps/safetybeacon.htm last visited 2024-04-03 17:48h
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- **[6] Process safety beacon, May 2004,** http://www.aiche.org/ccps/safetybeacon.htm last visited 2024-04-03 18:11h

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