Reliable. Sustainable. Resourceful.

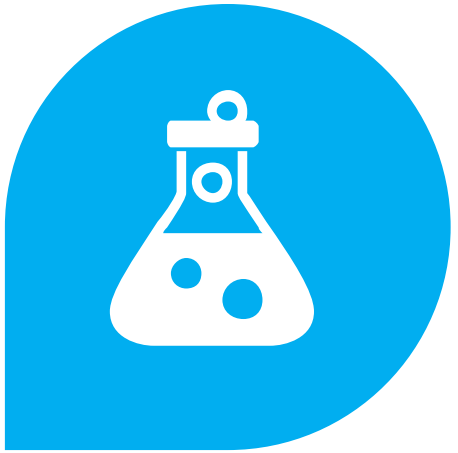
Learnings from VCM release

Andreas Scholz, VP QSHE Vynova Group

A leading European PVC and chlor-alkali company

Strong regional presence

Production network of 6 manufacturing sites, strategically located in key European markets.



Broad product range

Product portfolio that includes PVC, KOH and other potassium derivatives, NaOH and sodium hypochlorite.

Committed employees

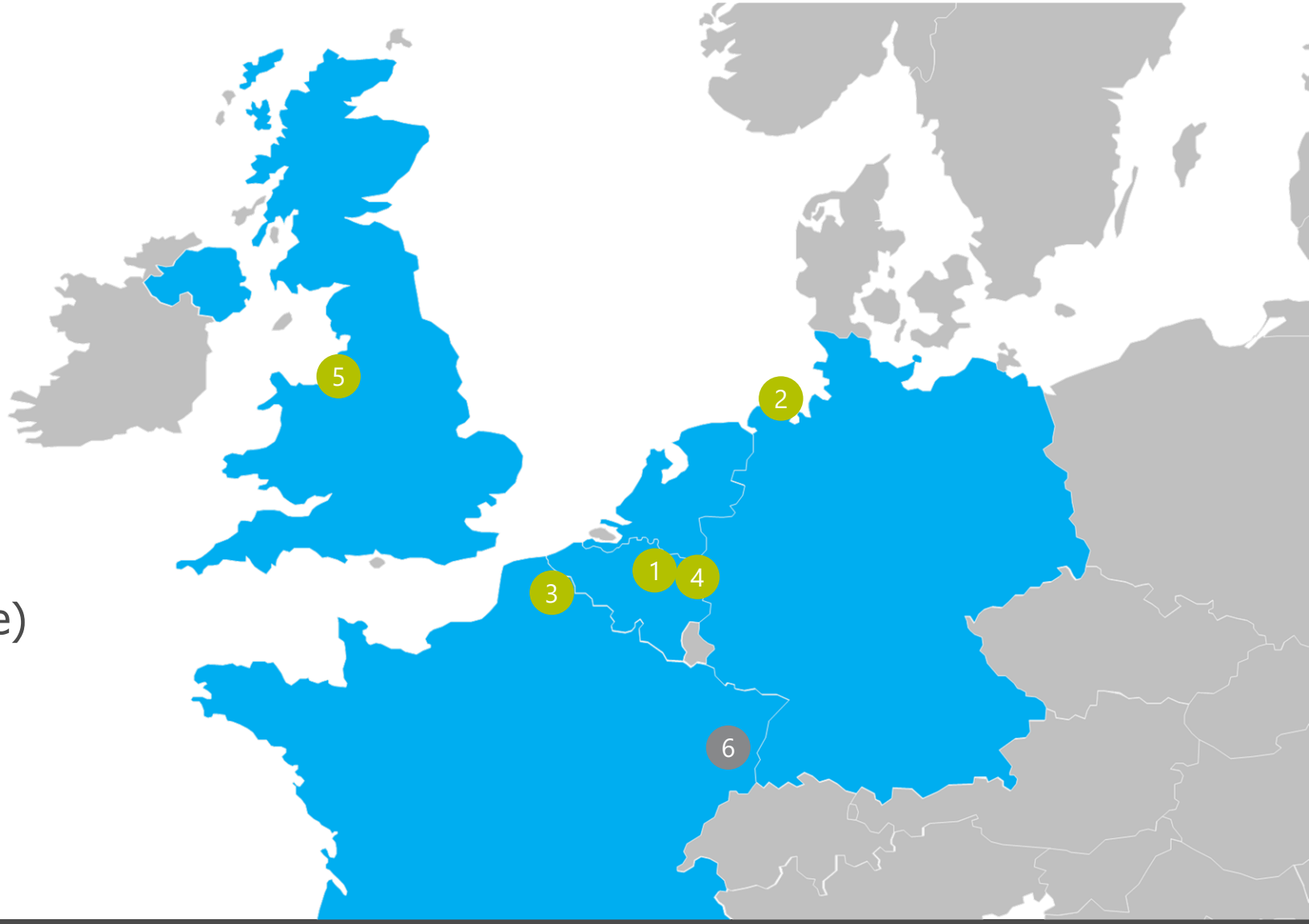
1,265 employees in manufacturing, supply chain, sales & marketing and support services.

Solid financial performance

Founded in 2015, we have grown to generate sales of 830 million euros. Our profitability enables us to pursue ambitious growth opportunities.

Production network in five countries

1. Tessenderlo - Belgium
2. Wilhelmshaven - Germany
3. Mazingarbe - France
4. Beek - Netherlands
5. Runcorn - UK
6. Thann - France (affiliated site)



Incident Summary & General Information

- Major release of Vinyl Chloride Monomer (VCM) during a “routine job” to replace an untighten valve
- Incident happened at a VCM plant to produce VCM as intermediate for PVC-manufacturing
- Release occurred at the outlet of a “Rundown vessel”
  - Intermediate storage for quality control before pumping to storage spheres
- Total loss of ca. 5 tons of VCM during the incident
- No ignition of the released VCM, no injured persons or complaints
- Limited environmental damage (soil remediation)
- GHS-Classification for Vinyl Chloride Monomer:
  - May cause cancer (H350; Carc. 1A)
  - Extremely flammable gas (H220; Flam Gas 1)

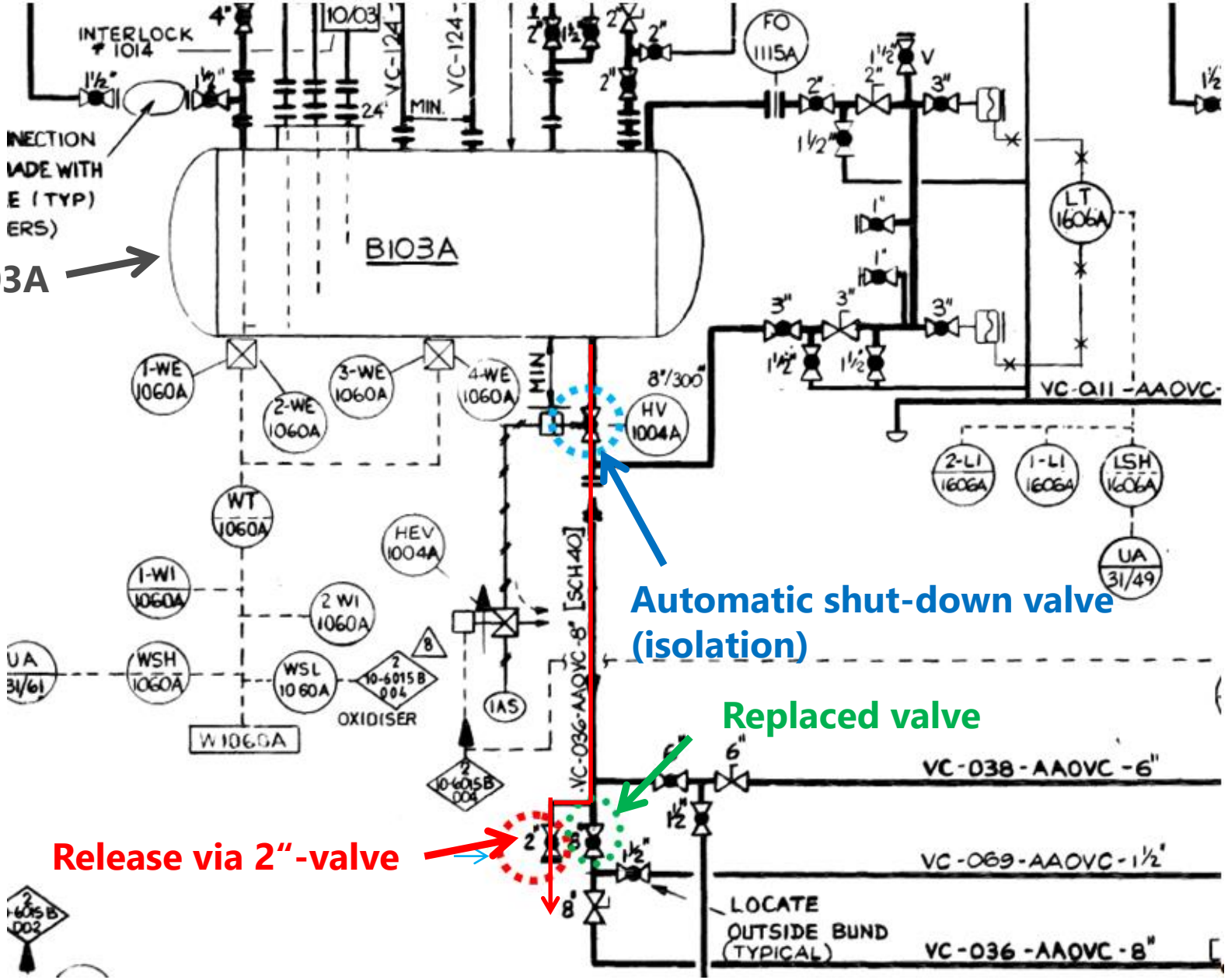
VCM-plant

Sequence of the incident

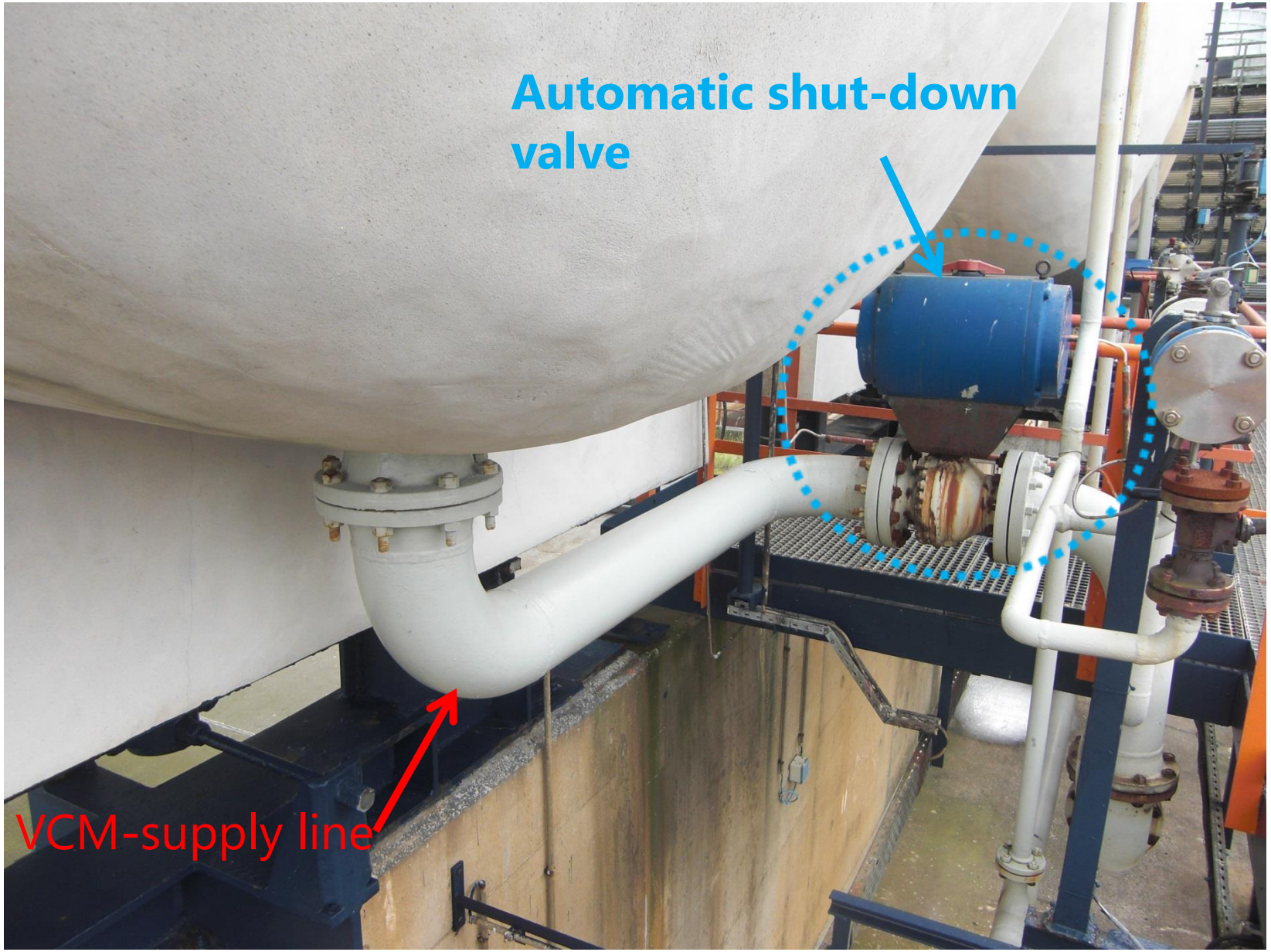
- Isolation of VCM-supply-line of a rundown-vessel (260 m^3) for replacement of an untighten valve
- Automatic shut-down-valve was forced via DCS in closed position (interlock) and the system behind prepared for the job (emptying, purging with N_2).
- After replacement of the valve, the supply line was purged O_2-free with Nitrogen to atmosphere via 2″-handvalve.
- During Nitrogen-purge the closed shut-down-valve of the vessel was opened by mistake via DCS (deactivation of the interlock).
- VCM out of the higher positioned rundown-vessel was released via the open 2″-valve
- Release was alarmed by a VCM-sample-point (COMA-system) nearby
- Release stopped after ca. 25 min by an operator under respiratory protection who closed the valve.
  - Emergency stop-button (on-site and in control room) was not used!
- Risk of ignition of the released VCM was existing!
- The incident had to be reported to authority under German Seveso-Regulation (StörfallV)

P&I-D

Rundown-vessel B103A (260 m³)



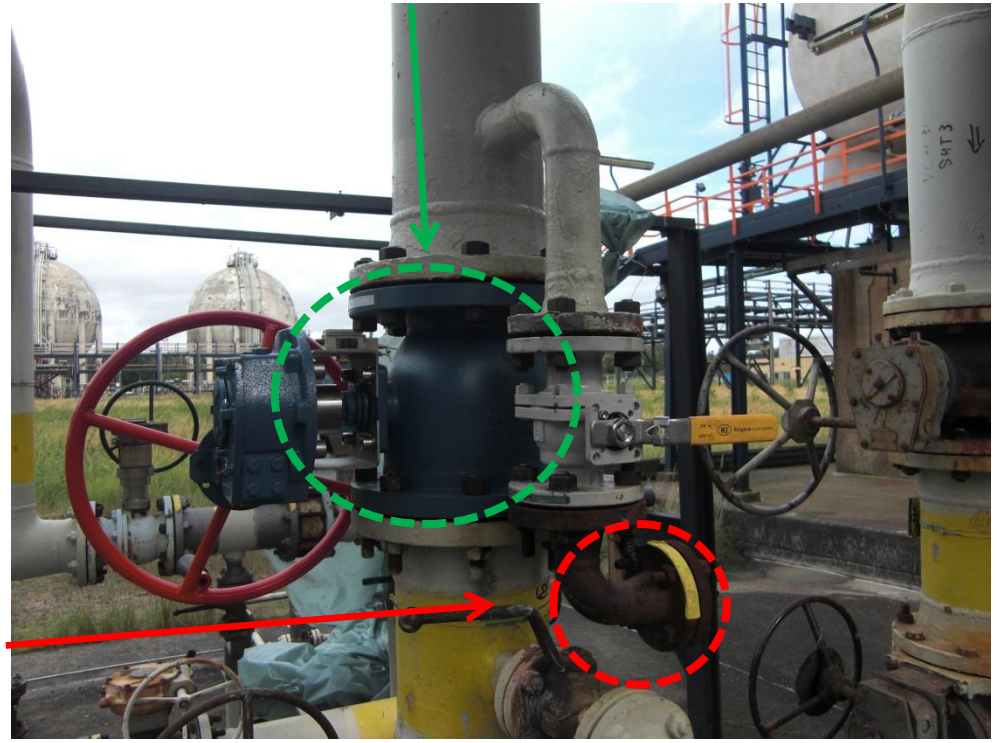
Pictures



Pictures

Automatic shut-down valve

Replaced valve



Release via the open 2"-valve

Pictures

Release

Release

Why?

Immediate Causes:

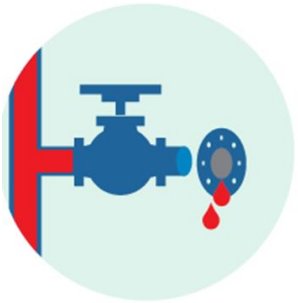
- Closed shut-down-valve opened while the system was still purged with N_2 and open to atmosphere
- No sufficient isolation of the VCM-supply line during the job (no isolation plate, only one closed shut-down valve)

System Causes:

- No sufficient knowledge of function of forced shut-down valve.
  - DCS Technician was asked by the shift supervisor to remove the interlock of the shut-down-valve
  - Shift supervisor was not aware that this will as well move the valve into open position
- Communication between all involved people was not sufficient (Shift supervisor, DCS Technician, Control room operator)
- Isolation standards and rules for purging of systems were not sufficient!
  - In general, no clear rules for the isolation process in place
  - No double isolation applied for short-duration routine tasks like replacement of a valve
- Emergency procedure (activation of emergency stop-button) not known and followed

Learnings:

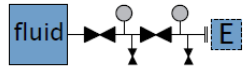
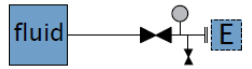
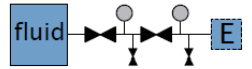
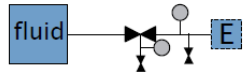
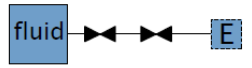
- Clear and sufficient rules and standards for isolation of equipment with hazardous substances are required and must be followed for all tasks!
  - New isolation standard was implemented with clear specification of minimum standards
  - Safe isolation of systems in general with a visible separation or with isolation plates, also for short-duration tasks like replacement of a valve!
  - An isolation with only one valve is not sufficient to avoid a relevant Loss of Containment!
  - PSF “Avoid working behind a single valve” is a good support to transfer this basic principle into the field



- Operating mode and functionality of the plant, the safety critical isolation valves and the emergency devices must be known by all operating employees
- Adequate training and qualification of supervisors and operators is required

Implementation of Isolation Guideline

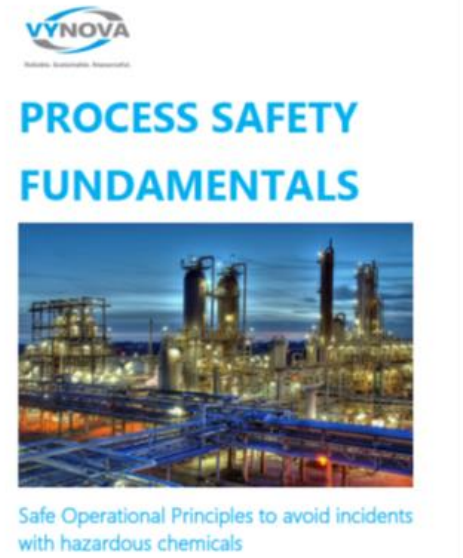
- Clear rules for isolation of equipment required!
- Vynova has implemented a Group Guideline on safe Isolation of plant and equipment with a risk-based approach
- 3 categories of isolations:
  - Positive Isolation
  - Proved Isolation
  - Non-Proved Isolation
- Selection of isolation method according a hazard & risk calculation of the task!
- Mitigation actions for isolations on not matching plant design required
  - Specific Risk Assessment!

Category	Features	Method	Illustrative example
I Positive isolation	Complete separation of the plant/ equipment to be worked on from other parts of the system.	Physical disconnection (eg spool removal)	
	Valved isolation of an appropriate standard is required during the installation of positive isolation.	Double block, bleed and spade	
		Single block and bleed and spade	
II Proved isolation	Valved isolation. Effectiveness of valve closure(s) can be confirmed via vent/ bleed points before intrusive work commences.	Double block and bleed (DBB)	
	Within this isolation category the level of mechanical security is greatest for DBB and lowest for SBB.	Double seals in a single valve body with a bleed in between	
	As a general rule, SBB should not be used with hazardous substances (see paragraph 120).	Single block and bleed (SBB)	
III Non-proved isolation	Valved isolation. No provision to confirm effectiveness of valve closure prior to breaking into system.	Double valve	
	Where possible, double valve isolation should be used rather than single valve.	Single valve	

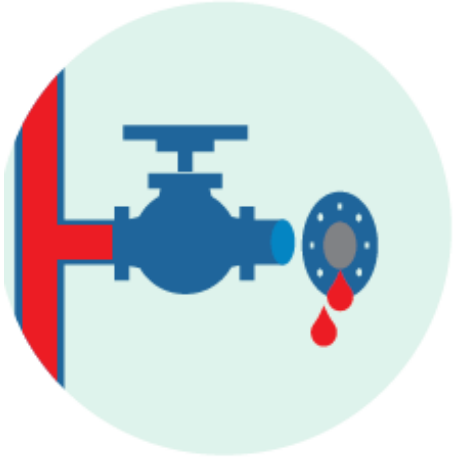
Implementation of Process Safety Fundamentals

- Process Safety Fundamentals (PSF) can support to avoid similar incidents
- Vynova has implemented 7 PSF:

1. **APPLY DOUBLE ISOLATION**
2. **EMPTY AND DE-ENERGIZE BEFORE LINE-BREAKING**
3. **WALK THE LINE**
4. **AVOID WORKING BEHIND A SINGLE VALVE**
5. **CONTROL (UN)LOADING**
6. **REPORT DEFICIENCIES ON SAFETY CRITICAL EQUIPMENT**
7. **OPERATE WITHIN SAFE LIMITS**



Avoid working behind a single valve



Hazards:

- Single valves can start leaking and releasing hazardous chemicals and energies – either because they are not fully closed or leak
- During working behind a single valve the valve might be accidentally opened or start leaking when the process becomes live.

When is this important:

- During and after line breaking due to a repair or maintenance activity
- When the pipe behind the single valve contains hazardous chemicals or energy

Possible challenges in the field:

- Older plant design often do not provide a second barrier or full block and bleed option to isolate equipment
- Placing a blind in a flare line

Options to get it right:

- Have an approved isolation plan before isolating equipment and a permit to work
- Try to remove the substance or energy in the system before start working behind a single valve.
- Isolation by two in-line barriers e.g. two closed valves, double block-and-bleed valves
- If isolation by a single valve cannot be avoided:
  - Validate that the single valve is not leaking e.g. at a drain point downstream of the isolation, by a pressure gauge
  - Consider if the isolation valve handle requires mechanically locking to avoid accidental knocking open during the task, deactivate the actuator for automated valves after checking the valve fail-safe position
  - Mount a blind flange after the single valve directly after the line break
  - Consider if emergency responders should be in place during the line break, until the blind-flange is placed
  - Wear appropriate personal protective equipment (PPE) during the task.
  - Keep working time short and avoid critical process conditions during the task.

Qeustions?

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