

EPSC PROCESS SAFETY CONFERENCE

Vojtech MERVA

Group Head of Process & Fire Safety
MOL Group

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PROCESS EVENT WITH ASSET DAMAGE FROM MOL GROUP

Date: October, 2020

A site sour water tank got damaged and released approx. 23 kg of H₂S and 800 m³ of HC+N₂ vapors to its surrounding. The event happened during the sour water manipulation and the tank's related steam purging. Fire brigade evacuated the area, and the sour water was rerouted to Sulphur Recovery unit.

Process involvement – Few hydroprocessing units at the site generate sour water that is directly processed at Claus (Sulphur recovery) units and / or temporarily stored at the particular tank.

Sour water origin – due to H₂S, NH₃ and HCl formation in hydroprocessing technologies and their mutual ammonium salt formation:
 $\text{NH}_3 + \text{H}_2\text{S} = \text{NH}_4\text{HS}$
a wash water has to be used that becomes a sour water, that is steam stripped.

Sour water tank –

Vertical cylindrical vessel 1400 m³
Filling at the rate of 11 m³/h
Level in the tank at 40 %
Temperature in the tank: 30 deg C

Brief event chronology

Sour water redirected from one hydroprocessing unit to the tank

Level and pressure fluctuation in the tank

Steam purging from tank to flare

Pressure stabilized, level still increasing

Second steam purging

Over pressurization of the tank with a consequent damage

Visual identification of the damage and gas detection H₂S indication

Fire brigade arrival on site and evacuation of the present people

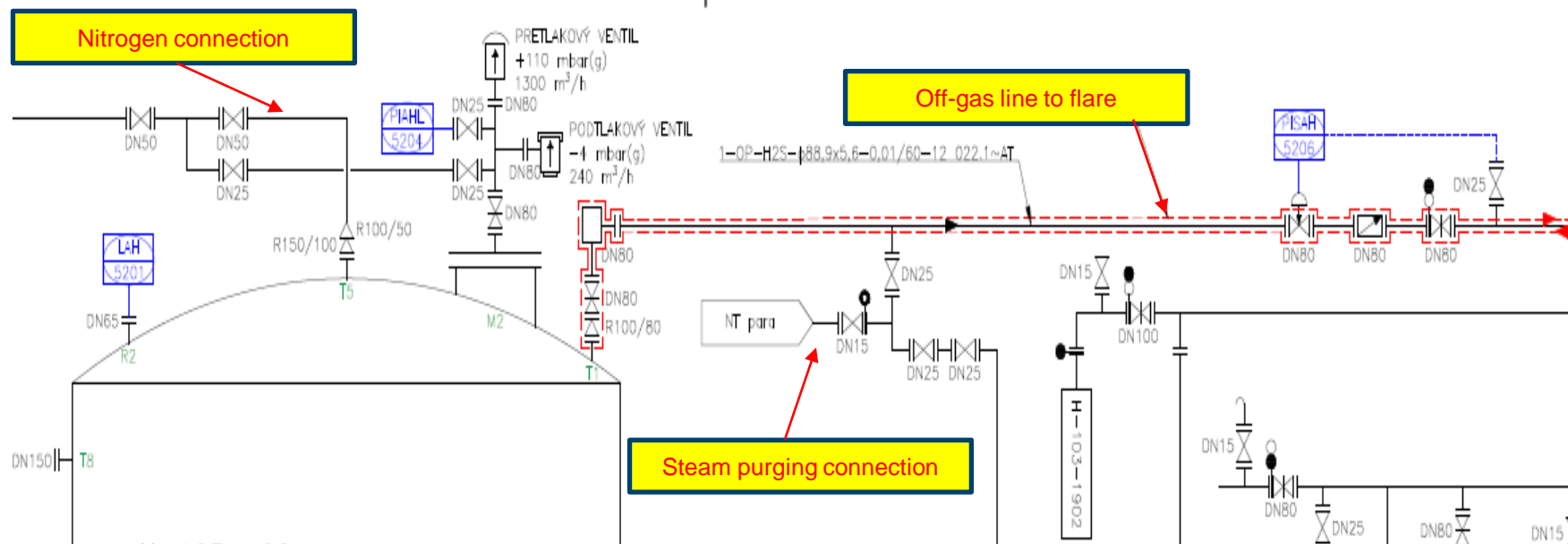
Emptying the tank and neutralization of the unpumpable material

SW Tank's key safety protective barriers

- ❖ Over-pressure / vacuum breathing valves
- ❖ Flame arrestor
- ❖ Level indication and switch
- ❖ High pressure shut-off valve
- ❖ Nitrogen flow (purge)
- ❖ Liquid seal with ethylenglykol
- ❖ Gas detection system



PROCESS EVENT WITH ASSET DAMAGE FROM MOL GROUP



NH₄HS salt formation

- As a solid substance it adds to plugging
- As a corrosive substance it adds to rust formation that further contributes to plugging

Pressure increase

- Due to the possible presence of light hydrocarbons
- Steam purging to tank and flare direction

Emergency response

1. Determination of:

HOT zone: direct danger zone

WARM zone: indirect danger zone

COLD zone: safe zone

2. Considering the:

- Site survey in respect to wind direction
- Specifying measure and communication for each zones
- dividing the commanding responsibilities for each zone



Hydro-seal valve



Upper N₂ inlet to tank



Flange from tank to breathing valve

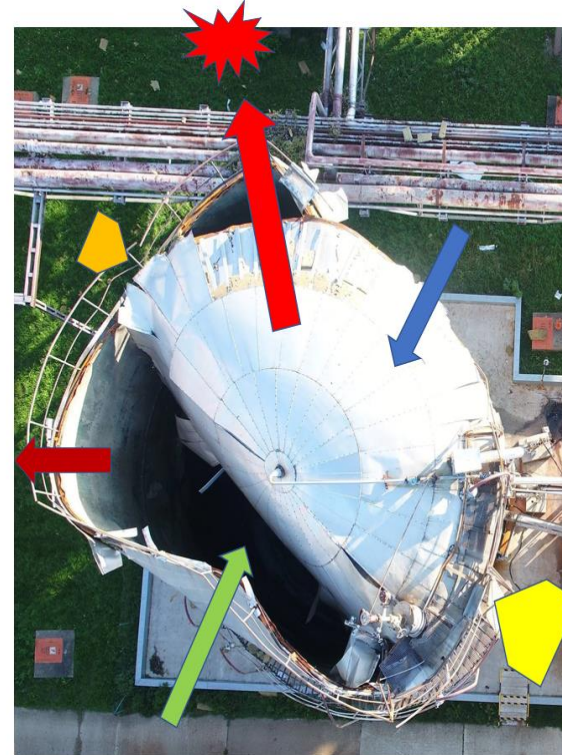


Block valves to breathing valve

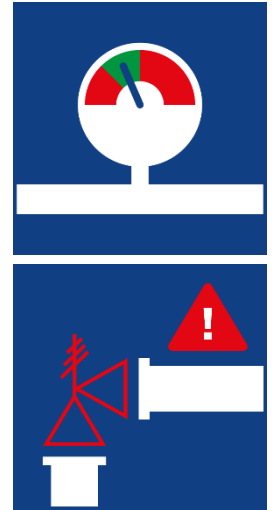
PROCESS EVENT WITH ASSET DAMAGE FROM MOL GROUP

THE POSSIBLE MECHANISM OF DEFORMATION:

	Initial opening (Likely the first place where the hoop burst), blow out direction of gaseous contents, wall extrusion, weakest place
	Wall bulging — counter-movement induced by movement when opened in the direction of the red arrow followed by a „vacuum“
	Probably just a strong reaction to the green direction. There was no debris in that direction.
	vacuum this deformation could have been caused by vacuum and at the same time the roof bent inwards. Subsequently, the forces could bulge the wall in the direction of the brown arrow.
	Fixed Space Narrow Width
	Fixed space — greater width due to stairs, firmer



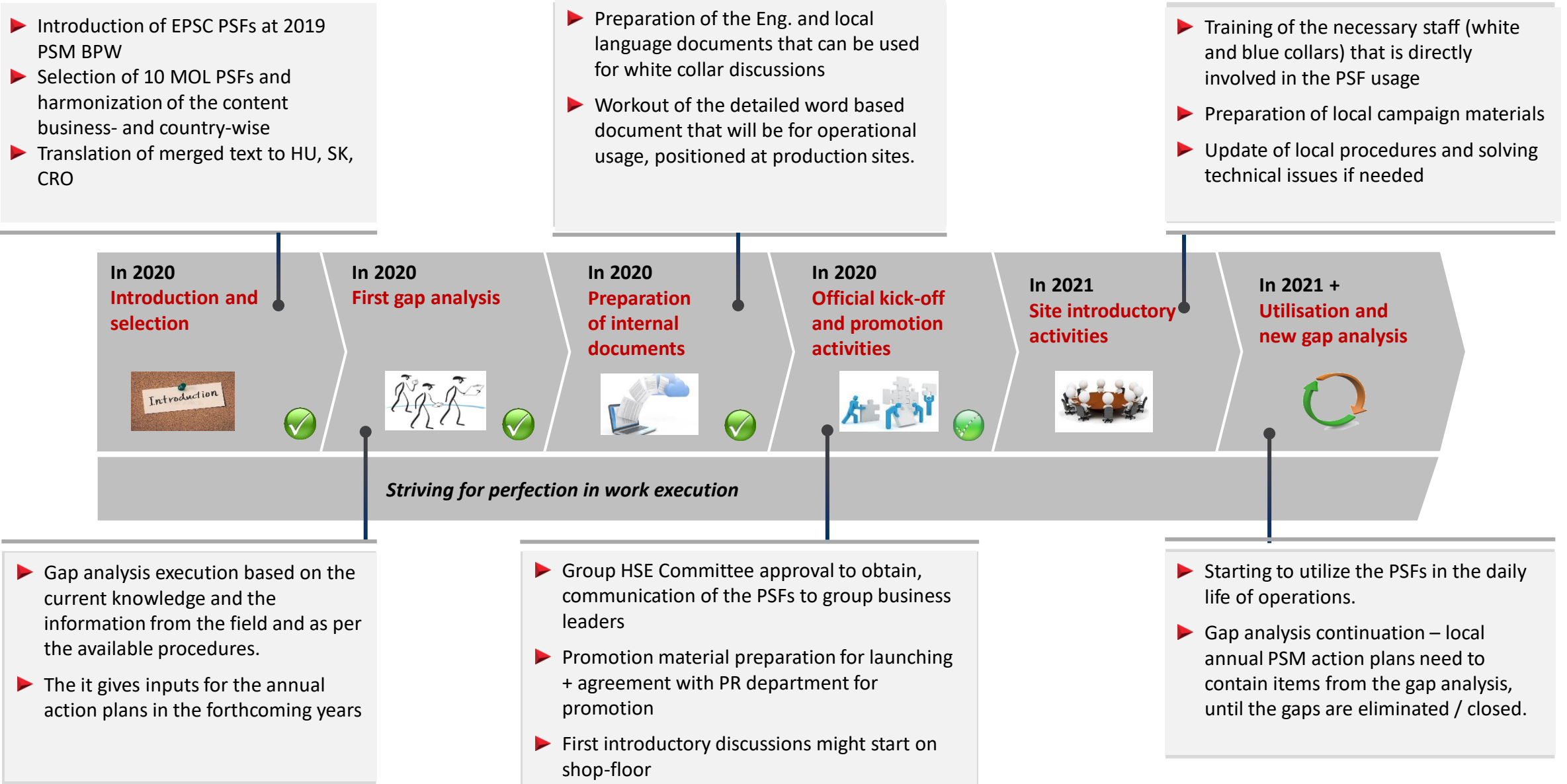
PSF relevance



Lessons learnt to be shared

- ❖ Majority of the pipelines to **protective barriers** have been out of function (plugged), like e.g. breathing valves and process indications
- ❖ In sour water service, always assume the enhanced **corrosion** and a **solid salts / sediment formation** on the inner side of the tank and its equipment thus limiting its designed operation of the vessel
- ❖ **Regular inspection and cleaning** shall be performed on all safety elements in fouling service
- ❖ DCS based indications of process parameters shall routinely be cross-checked with field gauge indications
- ❖ Implement **HAZOP / LOPA** recommendations related to safety devices and instrumentation defined in the hazard analysis report
- ❖ Be cautious when executing **purging by utilities** particularly to a storage tanks
- ❖ Pay attention during SU/SD activities to use by-pass of regulation valves
- ❖ Have the **emergency response plan** always worked out for such unexpected situations and **train** them regularly

THE ACTIVITY TIMELINE OF PSF IMPLEMENTATION



THE LIST OF PROCESS SAFETY FUNDAMENTALS

EPSC listed 18 fundamentals



Selection process:

- ✓ via team work
- ✓ merging few ones from EPSC
- ✓ considering failures
- ✓ accepting business diversity
- ✓ targeting safety discipline

MOL Group PS Fundamentals

- 1 Ensure proper equipment isolation for normal operation and maintenance works
- 2 De-energize equipment before opening and reenergize it before start-up
- 3 Monitor an open drain
- 4 Manage overrides and safety critical systems
- 5 Walk the line (to ensure operational readiness via pipeline and valve line-up)
- 6 Verify the conditions of flexible hoses
- 7 Operate within safe limits
- 8 Identify safety critical equipment and report on their deficiencies
- 9 Ensure safe atmosphere in the fire box before igniting the burners
- 10 Do not make a change without proper MoC process



Who was targeted . . .



The program is to be done in 2 phases at:

**REFINING & PETCHEM
LOGISTICS
ON- / OFF-SHORE
UPSTREAM**



based on the work scope the full implementation is expected to last few years

THE PROCESS SAFETY FUNDAMENTALS CAMPAIGN

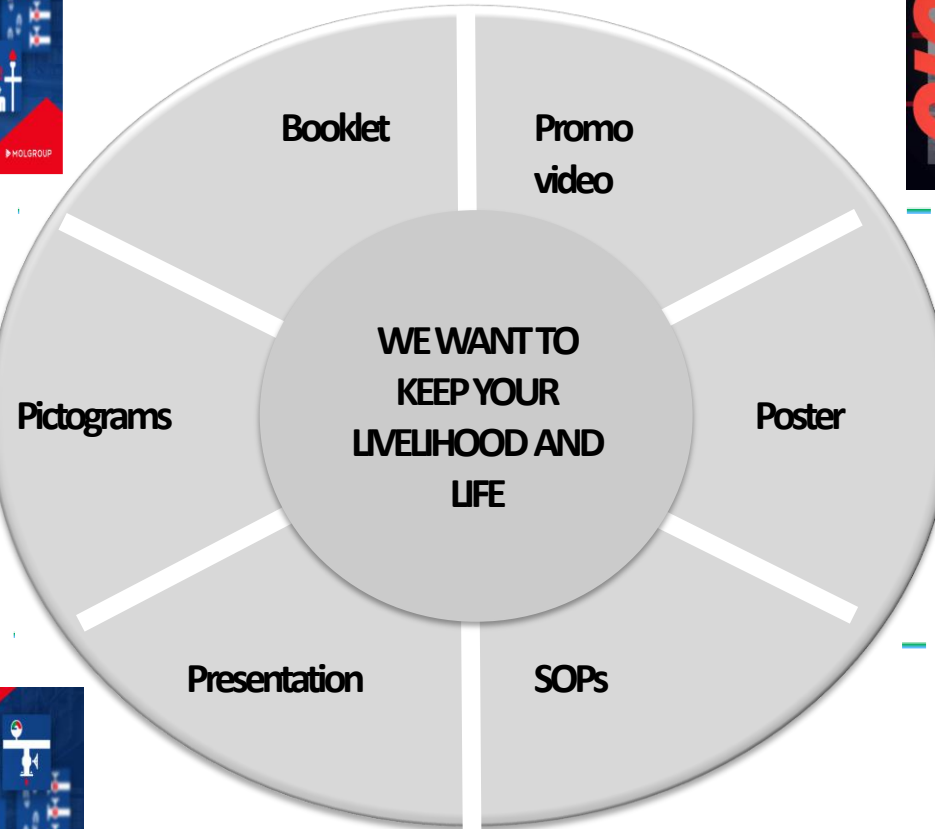
Booklet
A simple hand tool
for quick familiarity
with
SPFs



Pictograms
Give the
fundamentals the
visual presentation



Presentation
A tool for general
training purpose of
white collars



Documents are editable and are supposed
to be further modified for the local site /
business purpose



Promo video
For promotion
purpose to "sell" the
program



Poster
For promotion
highlight the
importance of PSFs



SOPs
A tool for training
purpose of blue
collars and for daily
based use

THE PROCESS SAFETY FUNDAMENTALS FIELD IMPLEMENTATION

FROM . . .

Documents to be used

PROCESS SAFETY FUNDAMENTALS

1 2 3 4 5 6 7 8 9 10

1. Ensure proper equipment isolation for normal operation and maintenance works

Options to get it right:

NECESSARY TECHNICAL CONDITIONS

- Have blind lists prepared, use valid P&ID for blind positioning
- Ensure valve design allows placement of the end cap (with the need of putting the valve handle in a partly open position)
- Isolation by two closed valves, double block and bleed valves is allowed only when the valves are designed for isolation service

IMPORTANT DURING

- Do not rely on a single valve as the only barrier
- Do position isolation for confined space entry, hot works, for toxic fluids, low flash point liquids and extended isolation for assets out of operation.
- Use blinds with the same pressure rating as the pipe spec
- Do not accept missing bolts on blinds and counter flanges
- Valve handles are to be locked to avoid accidental opening
- Fluctuation by a single valve cannot be avoided for work execution:
 - Validate that the single valve is not leaking for a time of counter-flange installation
 - Mount a counter-flange after the single valve
 - Lock or remove the isolation valve handle to avoid accidental opening, deactivate the actuator for automated valves after checking the valve fail-safe position
 - Emergency responder is in place during the counter-flange is placed

Ensure proper equipment isolation for normal operation and maintenance works - Process Safety Fundamental No.1

Topic: How to ensure proper equipment isolation for normal operation and maintenance works Date: 13.6.2020. No. of pages: 2

Main reason of implementation of PS Fundamentals:

Avoid potential release of hazardous materials (loss of containment) from an equipment prepared for works, which could lead to personal injury, fire and/or explosion, or spill to environment.

When it is important:

- Maintenance work execution in/on the asset
- Pressure testing of equipment
- Turnarounds / overhauls for isolations on battery limits
- Normal operation for start-up and auxiliary lines isolation
- Normal operation for isolation of asset out of operation but connected to live systems
- Utility and chemical refill lines disconnections

Potential scenarios and consequences:

Release of hazardous material due to

- Forgotten blinds
- Insufficiently tightened blinds or missing bolts on blinds
- Accidental opening of unlocked valve handle

Fire and explosion due to:

- Release of flammable materials ignited by any kind of ignition source

Personal injury due to:

- Suffocation due to lack of oxygen in confined space
- Burns caused by fire
- Frostbites caused by compressed gas release

Poisoning due to:

- Release of toxic or highly toxic material

Environmental effects due to:

- Release of hazardous materials to soil, air or live water (river, sea, etc.)

Challenges in the field:

- During the work behind a single valve the valve might be accidentally opened or start leaking
- Forgotten blinds after maintenance work
- Blinds & caps installed not with all bolts
- Valve wheels / levers can be opened accidentally

Necessary Technical Conditions	What to do if ... / Troubleshooting
Have blind lists prepared, use valid P&ID for blind positioning	<ul style="list-style-type: none">Ensure the use of valid P&ID for blind positioning and blind list preparation
Ensure valve design allows placement of the end cap (with the need of putting the valve handle in a partly open position)	<ul style="list-style-type: none">When replacing old valves with new ones ensure procurement of valves with the design that allows placement of the end cap (with the need of putting the valve handle in a partly open position)Is this the meaning ??Ensure this through QA regulation

Initial and detailed gap analysis

Name of the PS Fundamental:	PSF 1_Ensure proper equipment isolation for normal operation and maintenance works			
GAP ANALYSIS - current status:	Please review the current practice comparing with expected requirement defined in fundamental description			
1. Existence of regulation	Yes	No	Other	Blinding Instructions, LOTO Procedures, Work Permit Procedure
2. Problems identified during:	Audits	Incident Inv.	Other	Comment
3. Regular trainings are provided	Yes	No	Other	There are no double barriers on older units
4. Priority of implementation	High	Medium	Low	Comment
5. Other important aspects	NA d.d. regulation about two barriers before open end needs to be written (2 valves or valve and a blind). To make a list starting with strategic units			
Review of Implementation:	Please estimate necessary resources and other important aspects of PS Fundamental implementation			
Estimation of necessary timeline	How long the implementation can last - weeks, months, years? Both procedures are ongoing for several years. To cover all positions with double barriers it will take several years			
Resource needs	Financial or non-financial - CAPEX, OPEX, human resources - e.g. IT, Communication, etc. LOTO equipment is regularly ordered using OPEX budget. For double barriers CAPEX			
Training needs	Is there a need for further training program? Who should hold the training? No			
Owner of the PS Fundamental	Who should be the owner of this given fundamental? Production, Maintenance			
Support needs from Group	What kind of support will you need from Business PSM or Group HSE? To issue regulation and to support projects to install double barriers			
Other comments	Can be supervised by OP and SWP audit, PSM Site Visit, Housekeeping			

- Gap analysis means a physical checking of the possibilities of work execution as defined by the fundamentals. It predetermines the success of PSFs to be used.
- The field checks are done as per checklists
- Requested prioritization at the businesses
- Identification of already implemented good practices for sharing with others in Group

TO . . .

Training of all responsables

PSF Implementation Schedule

Implementation of PSF 1_Ensure proper equipment isolation for normal operation and maintenance works

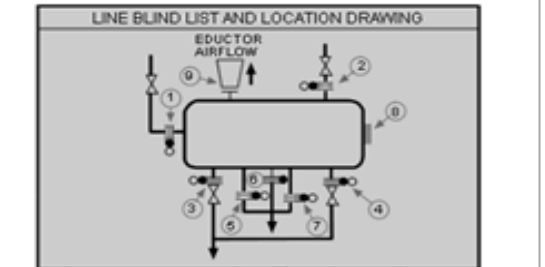
2020

Training of all responsables

- Training of the necessary staff (white and blue collars) that is directly involved in the PSF usage requires event arrangements either on-line or personal to introduce the PSFs and ensure the common understanding
- It is necessary to clarify when the compliance with standards is fulfilled . . . the rule of “doing it right”
- Creative solutions to be used

Please define when the Asset Team complete the assessment of given fundamental												
MPC	FAT	30.09	30.09	30.09	31.08	31.08	31.08	31.08	31.07	31.07	31.07	31.07
	FAT	30.09	30.09	30.09	31.08	31.08	31.08	31.08	31.07	31.07	31.07	31.07
	FAT	30.09	30.09	30.09	31.08	31.08	31.08	31.08	31.07	31.07	31.07	31.07
	FAT	30.09	30.09	30.09	31.08	31.08	31.08	31.08	31.07	31.07	31.07	31.07
	FAT	30.09	30.09	30.09	31.08	31.08	31.08	31.08	31.07	31.07	31.07	31.07
MOL	AT1	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
	AT2	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
	AT3	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
	AT4	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
	AT5	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
SH	P1	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09
	P2	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09
	P3	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09
	P4	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09
	P5	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09	30.09
Ripke	AT1	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
	AT2	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
	AT3	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
	AT4	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
	AT5	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08	02.08
Slovak	AT1	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07
	AT2	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07

Utilisation



- Identification of necessary resources – human and financial. Gradual gap elimination is necessary.
- Raising questions and boosting discussion to conduct safe work execution before commencing works
- Request standard work execution by unit / depot / plant management level and connection of PSF utilization to operating discipline
- During the first few years to regularly do repetitive refreshing trainings
- Linking PSF to incidents with feedback to affected staff