# Eni
# Process Safety Fundamentals

# INDICE



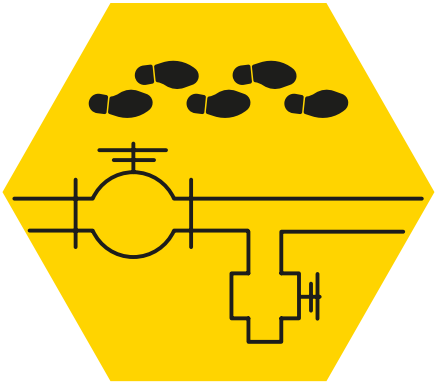
## GUIDANCE ON USING THE PROCESS SAFETY FUNDAMENTALS (PSFS)

These are safe operating principles related to hazardous substances, in order to **avoid losses of containment** by:

- Establishing Process Safety Excellence on production sites, by **enhancing awareness** on typical hazardous operations and discussing the relevant details
- Understanding the compromising factors and the **good practices** that help to get things right
- Emphasizing on **critical tasks**, to be fully understood and supported by all operational people
- Understanding of the **dilemmas** that frontline may face to comply with the PSFs – make Process Safety an everyday frontline conversation
- Establishing **clear agreement & rules** on the discussed PSFs – attention on "risk normalization" and substandard practices

Use the PSFs to **start the discussion** – it is the discussion that provides the understanding of where you really are and what can be improved.

# Verify process line-up condition before start-up



## HAZARD:

Uncontrolled pressure increases, unintentional mixing or other process anomalies, which can be caused by incorrect alignments of valves, lines or tanks, or by open ends.





### WHEN IMPORTANT

- Start-up after shutdown, isolation or modification of a line or equipment;
- After maintenance works or use of temporary piping.

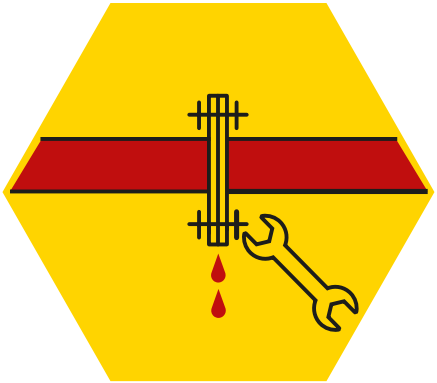
### POSSIBLE CHALLENGES IN THE FIELD

- Location of the element to be inspected;
- Limited accessibility;
- Poor visibility at night or in bad weather.

### OPTIONS TO GET IT RIGHT

- Before start-up, physically walk along the lines, checking that the alignment and positions of the valves reflect what is specified on the P&ID;
- Check that valves, if required, are locked; that the blind flanges have been removed; that all open ends are closed by appropriate means;
- Check that all the drains and vents are closed and capped; that the expected instrumentation is present; that there are no leaks due to incorrect assembly of flanges or seals;
- In case of inconsistencies with what is expected, agree the operations to be done with the control room. If required, apply for a work permit;
- Update the P&ID and highlight any deviations;
- Tag the valves and the alignment conditions of the equipment on field, to support subsequent identification and control.

# Verify connections tightness before returning to service



## HAZARD:

Flanges and process equipment whose lack of tightness (for example due to temperature variations or in case of strong vibrations) could generate releases of hazardous fluids.





### WHEN IMPORTANT

- During the tightening of an equipment or line before going into operation, or in case of loosening of the tie rods of the flanges;
- During a plant shutdown, when changes and replacements of flanged lines or equipment can be made.

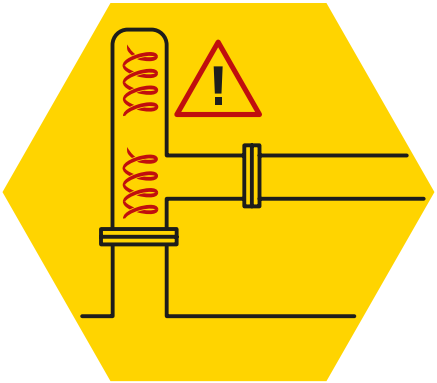
### POSSIBLE CHALLENGES IN THE FIELD

- Tightening activity requires competent people, as well as the leak testing.

### OPTIONS TO GET IT RIGHT

- Select properly the sealing material and sealing gaskets;
- Follow the tightening procedure, applying the correct torque with torque wrenches;
- Select a leak test/tightness test that is suitable for the functionality of the equipment;
- Perform the leak test before introducing hazardous fluids into the process lines;
- Records all the test results, to be approved in accordance with the current procedures (for example the Pre Start-up Safety Review in case of major maintenance or modification to the plant);
- Attend the area during the reintroduction of process fluids, respecting the requirements of the work permit;
- Monitor the pressurization of the equipment and verifies that it follows the predetermined gradient; be prepared to respond to any deviations.

# Report & take interim mitigating measures for impaired SECEs



**HAZARD:**
Safety and Environmental Critical Element (SECE) are such parts of an installation the failure of which could cause or contribute substantially to a significant accident; or a purpose of which is to prevent, or limit the effect of, a significant accident (e.g. by automatically activating emergency shutdown systems or gas and fire alarms; by releasing overpressure). SECEs malfunction could therefore have serious consequences.





## WHEN IMPORTANT

- During testing, maintenance, inspection or normal operation activities, when a malfunction or loss of integrity of a SECE is detected;
- During well operations, when one of the two barriers (mud/cement column or BOP) is not available.

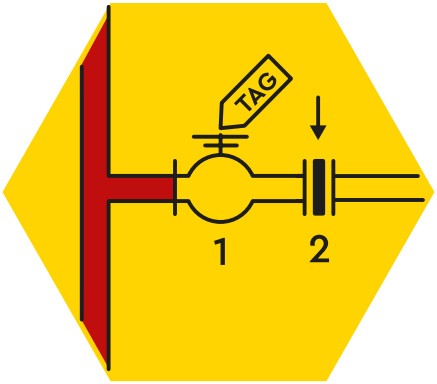
## POSSIBLE CHALLENGES IN THE FIELD

- Protection systems which, if unavailable, would require plant shutdown;
- Unawareness of the SECE criticality or unawareness of the SECE failure (no testing).

## OPTIONS TO GET IT RIGHT

- Know the SECEs in your work area and the procedures to follow in case they fail;
- Make sure of any failure that causes the SECE unavailability, even going on the field if necessary;
- Always wear the appropriate PPE for the operation and bring the necessary safety devices and tools with you;
- Repair or replace an impaired SECE as soon as possible; where SECE is unavailable, make sure interim protection measures are in place and plan the urgency procurement;
- Once the new SECE has been installed, proceed with the operation of the plant in a controlled and provisional manner;
- Keep up to date a register for the SECEs out of order;
- Remember that each SECE must follow a test protocol with a specific frequency (keep an eye on the maintenance backlog on SECEs).

# Provide safe isolation before starting a maintenance job




## HAZARD:

Presence of a single barrier (for example a single valve) not sufficient to guarantee isolation.





### WHEN IMPORTANT

- In case of hazardous fluids, before, during and after the opening of the line for repairs or maintenance activities;
- In case of automatic valves remotely closed, to carry out maintenance without the application of a physical barrier (for example a blind flange).

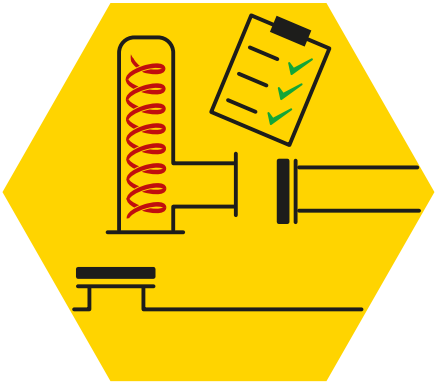
### POSSIBLE CHALLENGES IN THE FIELD

- Design of older plant may not include the presence of a second barrier or a double block & bleed to isolate the equipment;
- Difficulty in positioning a blind on a line.

### OPTIONS TO GET IT RIGHT

- Make sure that the isolation method has been chosen according to the requirements of the specific procedure and according to the provisions of the Work Permit;
- In case of high risk check the possibility of performing a physical disconnection with a blind flange or, if not possible, to work in the presence of a double barrier (for example using a double block & bleed);
- In cases where isolation with double block & bleed is not feasible or available:
  - Make sure that the isolation is guaranteed with a single block valve, a pressure gauge and a bleed, so as to check there is no residual energy in the system;
  - Disconnect the line and install a blind flange downstream of the single valve;
  - Evaluate whether the valve handwheel requires to be locked to prevent accidental opening during the activity;
- Before resuming normal operations make sure that blind flanges, plugs, double isolation valves are positioned at the free ends of pipes and equipment, at the sampling points and in the vent and drain lines. If necessary, perform a leak test to check the tightness;
- Remember that each isolation is specific and it must be assessed on a case-by-case basis.

# Operate override and bypass of safeguards[1] only with authorization



**HAZARD:**
When a safety system is bypassed or inhibited, the safety measures present are insufficient.





## WHEN IMPORTANT

- Maintenance turnarounds;
- Inspection, test or calibration of equipment and instruments;
- Commissioning and start-up phases;
- Testing of interlocks;
- Malfunctions of a primary element.

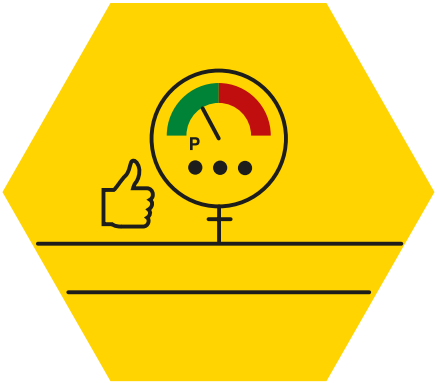
## POSSIBLE CHALLENGES IN THE FIELD

- The function of some protection systems may not be known to everyone, as well as the possible consequences due to the unavailability of the system;
- Some protection systems, if unavailable, can prevent the start-up of the system.

## OPTIONS TO GET IT RIGHT

- Understand the function and criticality of the system to be bypassed or inhibited;
- Against the unavailability of a protection system, perform a risk assessment and define alternative protection measures to compensate for the temporarily missing system;
- Remember that any override[2] or bypass of the protection systems must be done in accordance with company procedures and it requires formal authorization. The level of authorization must be in line with the criticality;
- Record and keep updated each bypass/override in a dedicated register, to be kept available in the control room;
- Discuss and re-authorize active bypasses and overrides at each shift change;
- Protect the safety interlocks from "easy" exclusion in the field and in the control room;
- Limit the duration of bypasses and overrides, avoiding extension beyond the allowed time. Longer periods require an appropriate management of change process;
- Always consider the cumulative risk of multiple protections excluded at the same time.

# Stay within safe operating limits[3]




**HAZARD:**
Equipment damage or hazardous fluid release which can be caused when safe operating limits are exceeded (e.g. level, temperature, pressure, flow, composition, etc.).





## WHEN IMPORTANT

- Deviation from normal operation;
- Transient operations, batch process, start-up/ shut-down.

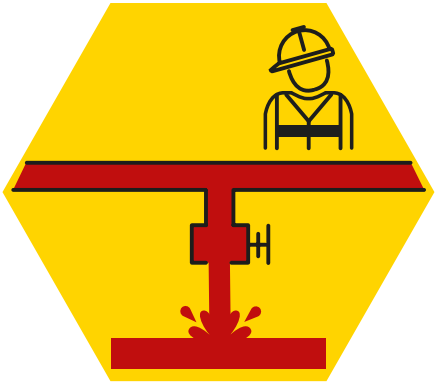
## POSSIBLE CHALLENGES IN THE FIELD

- Lack of knowledge of safe operating limits;
- Requests to push production to the limits;
- Management of change process not followed.

## OPTIONS TO GET IT RIGHT

- Make sure the values of safe operating limits are available for the key process variables and for the different operating phases;
- Make sure the safe operating limits are available to operators in the control room;
- Monitor the progress of critical process parameters for the plant, the ones that if modified can cause damage to equipment or loss of containment;
- Make sure there are alarms for critical process parameters;
- Take action to ensure the critical parameters are brought within the safe operating limits;
- If safe operating limits are exceeded, report, investigate and discuss the causes.

# Monitor open draining operations



**HAZARD:**
Inadvertent and uncontrolled leakage of a hazardous fluid during open drainage.





## WHEN IMPORTANT

- During the removal of liquid from process equipment towards an open system (e.g. drainage of water to open drains from a tank containing hydrocarbons).

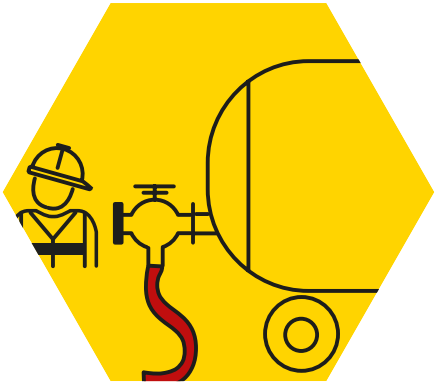
## POSSIBLE CHALLENGES IN THE FIELD

- Distraction of personnel also occupied in other concomitant activities;
- Long time for drainage;
- Bad weather conditions;
- Underestimation of the potential consequences of the released fluid.

## OPTIONS TO GET IT RIGHT

- Identify, among the different types of drainage, those allowed in an open system and ensure hazardous fluids are drained in closed systems;
- Evaluate the duration and make the necessary checks before starting the drainage operation;
- Make sure that open drain is monitored by a dedicated person, who is wearing the appropriate PPE;
- Check the quality of the drained product and convey it to the necessary treatment system;
- Install a plug or blind flange after draining is complete;
- In critical situations or in case of shift change, stop the drainage activity before leaving the drain.

# Control loading & unloading operations of hazardous fluids



## HAZARD:

- Error in level measurement during loading, with consequent overfilling;
- Generation of static electricity during the filling, which can cause ignition;
- Reactivity of chemicals, if mixed by mistake.





### WHEN IMPORTANT

- During loading and unloading of hazardous fluids in storage tanks and means of transport.

### POSSIBLE CHALLENGES IN THE FIELD

- Overfill protection does not work properly, but nobody knows about it;
- Failure to supervise during loading operations.

### OPTIONS TO GET IT RIGHT

- Follow the current operating instructions for loading and unloading of hazardous fluids;
- Make sure that the quantity of product to be transferred is in line with the capacity of the receiver and that the high level protection is working;
- Check that the valves line-up is correct with the direction of the expected flow, to avoid unwanted mixing of different fluids;
- Complete the dedicated checklist before starting the activity and attend the unloading operation;
- When loading a storage tank without high level protection, constantly communicate with the personnel involved in the operation, to avoid "blind" filling;
- When loading a vehicle, make sure it is properly grounded and that the vapor recovery system is running. If there is no vapor recovery system, make sure that the area is cordoned off;
- When loading a tank from above, make sure that the filling tube of the loading arm is near the bottom or below the liquid level, to avoid splashing or electrostatic charges;
- Check the fitness for service of flexible hoses and portable equipment before use (for example that they are certified and properly maintained). Keep an inspection log for hoses;
- Make sure that the material safety data sheets (MSDS) of the fluids to be transferred are available at the loading areas.

# Empty & de-energize process equipment before opening

## HAZARD:

Uncontrolled release of energy or hazardous fluids during the opening of piping or equipment.





### WHEN IMPORTANT:

- When unbolting, unscrewing, drilling or cutting of process equipment.

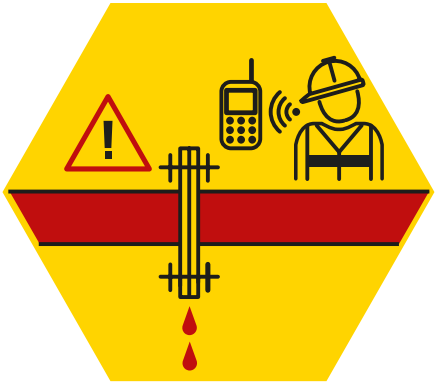
### POSSIBLE CHALLENGES IN THE FIELD

- Complexity of piping or break points arrangements;
- Double block & bleed not available;
- Vents/drains plugged;
- Leaking valves;
- Work inadvertently carried out in the wrong place.

### OPTIONS TO GET IT RIGHT

- Before proceeding with emptying and depressurization, provide for electrical and mechanical isolation of the equipment, according to the work permit and according to the isolation procedures and Lock-Out/Tag-Out (LOTO);
- Use a validated isolation plan, that indicates all isolation points in the correct numbered order;
- Clearly define the isolation points (to be marked on a sketch or a P&ID) and the persons who are responsible for the isolation of the various equipment (valves, electrical devices, etc.);
- Verify and record the completion of the isolation plan, according to the procedure;
- Wear PPE selected for residual chemicals that may not have been fully purged or drained;
- Perform venting and drainage operations in accordance with the dedicated procedure, then proceed with the cleaning operations by carrying out the necessary washes;
- According to the work permit, before opening check that the equipment has been isolated and emptied, the pressure indicator is at zero, the drain is open, the system is at ambient temperature and there is no flow.

# Report & manage any loss of containment[4] on site



## HAZARD:

- Initially limited losses which, due to particular conditions, may intensify and cause serious damage (e.g. weeping from the gasket of a pump, valve or flange, which if not promptly detected may ignite and cause escalation on adjacent equipment).
- "Small" recurring incidents can be the prelude to a more serious accident.





### WHEN IMPORTANT

- During operations on assets, in order to promptly detect a potential risk of escalation and catch the "weak signals" on the field.

### POSSIBLE CHALLENGES IN THE FIELD

- Low propensity to report "minor" losses of containment as "incidents";
- Preference for handling problems "on their own".

### OPTIONS TO GET IT RIGHT

- Immediately report the detected or suspected leak to the Control Room (even "weeps & seeps");
- In the case of possible presence of flammable or toxic gases, stop activities by securing the equipment and withdraw from the affected area, activating the emergency plan if necessary;
- Evaluate the risk to determine the most appropriate intervention method;
- Record any process leak, according to the procedures and using the company tools;
- Investigate and discuss the causes of the leak, sharing the lessons learned;
- Remember that accurate reporting and recording of losses, even minimal ones, shall be pursued not only to prevent more serious events, but also to spread the culture of process safety.

## Notes

1. A safeguard is a system that protect process equipment from exceeding specific set points (e.g. mechanical: relief valves, interlock systems; instrumented: alarms, shutdown functions).
2. An inhibits/override is an imposed interruption to the normal operation (mechanical or instrumented actions) of the safeguard.
3. Safe operating limit: an established level which, if exceeded, could lead to rapid equipment deterioration in a fairly short timeframe.
4. Loss of primary containment (LOPC): an unplanned or uncontrolled release of any material from primary containment.

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