



sofis

valve operation

Guaranteeing safe pigging operations



Guaranteeing safe operation of pig launchers and receivers

Pipeline pigging is a form of flow assurance, where pipeline pigs are used to purge, clean, and inspect pipelines to keep them running smoothly. It is a vital component of pipeline maintenance, operation, and integrity. Pigging helps improve pipeline flow, increase operating efficiency, and reduce costs and

downtime. The main benefit of this type of maintenance is that it can be carried out without interrupting the process in operation. However, pigging operations are also high-risk events. Since the operation is hazardous, pigging is to be carried out by experienced professionals.



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How pigging operations work

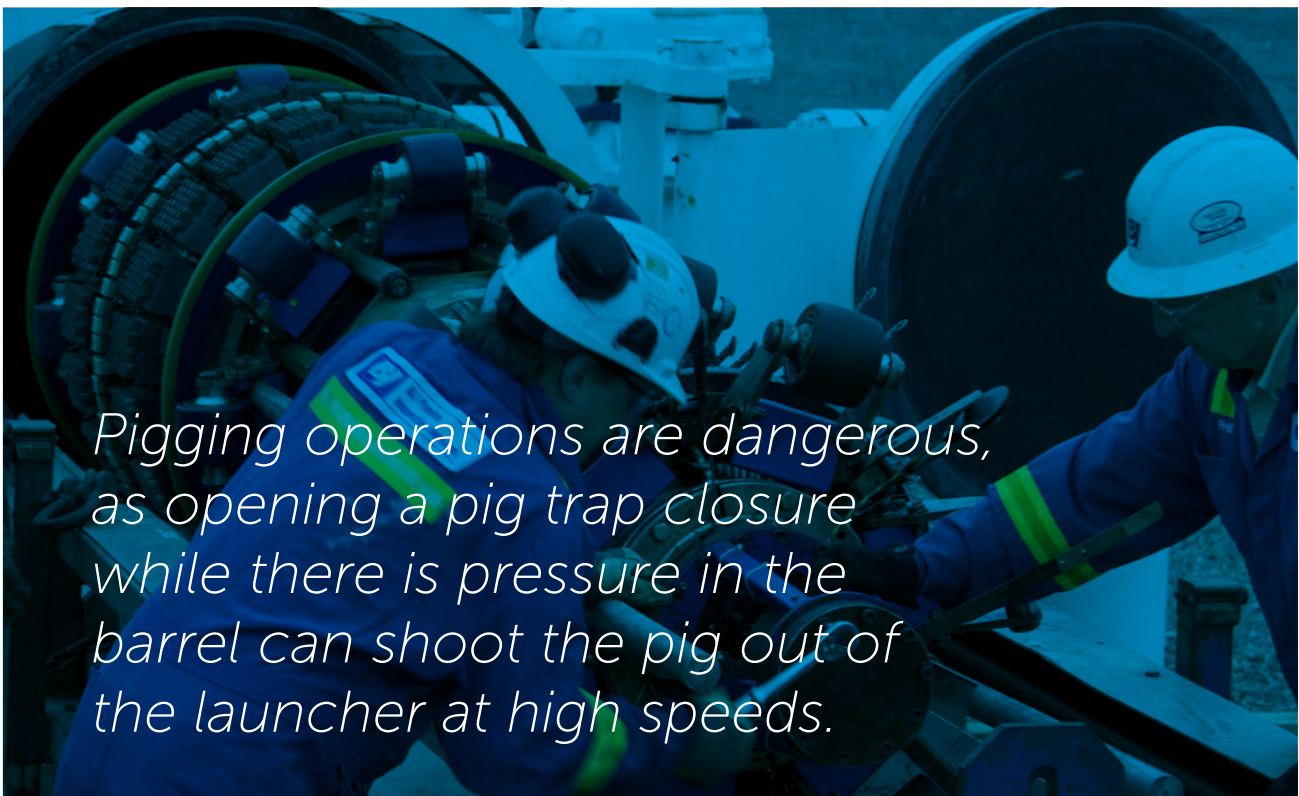
In its simplest form, a pigging system consists of a solid projectile or plug (the 'pig') with a diameter slightly larger than the pipeline or tubing that is transporting the liquid. Pigging works by introducing the pig into the pipeline and pushing it through the pipe. A launcher or receiver station is typically a vessel, connected in parallel to the existing pipeline. This allows launching or receiving the pig, using the pipeline's normal operating pressure, and without interrupting the flow or production.

The vessel is equipped with a closure door to load or offload a pig. Receiving or launching the pig involves several sequential valve operations, in combination with opening and closing the closure door. Pigging operations are dangerous, as opening a pig trap closure while there is pressure in the barrel can shoot the pig out of the launcher at high speeds. Attempting to pass a pig through a partially open outlet valve, or prematurely opening the pig trap in the presence of

high levels of toxic hydrogen sulphide, can have fatal consequences.

Before opening the closure safely, there are several basic safety criteria that need to be met.

- The vessel must be drained and depressurized.
- The vessel must be isolated from the process pipeline by closing the kicker lines and the main valves.
- In case of a closed drain systems and/or vent headers, the vessel must also be isolated by closing the drain and vent valves.
- The vessel needs to be free from toxic gasses like H₂S.
- At the same time, the vessel must remain isolated when the door is open
- When the launching or receiving procedure starts, the closure should be properly closed.
- Since the pigging station is a bypass, there is also a potential danger that production is interrupted when the throttle is not fully opened before starting to isolate the launcher and receiver station again.



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Dangers of incorrect pigging operations

If safety criteria are not strictly met during pigging operations, incidents and accidents can occur due to incorrect valve operation procedures.

- The closure door is opened, while pressure still possibly remains inside the vessel
- The main process valve is opened, while the closure door is still not yet fully or properly closed.
- The closure door is opened, while a high concentration level of H₂S or other toxins remain inside the vessel.
- The vent valve remains open, while the vessel is being pressurized with its medium.

Procedures do not guarantee safe operations

Procedures do not guarantee safe pigging operations. Formal procedures can be set up to prevent opening the closure door under pressure. However, these are no guarantee that all safety criteria are taken into consideration. Many accidents have occurred all over the world during dangerous pigging maintenance operations, even with strict procedures in place.

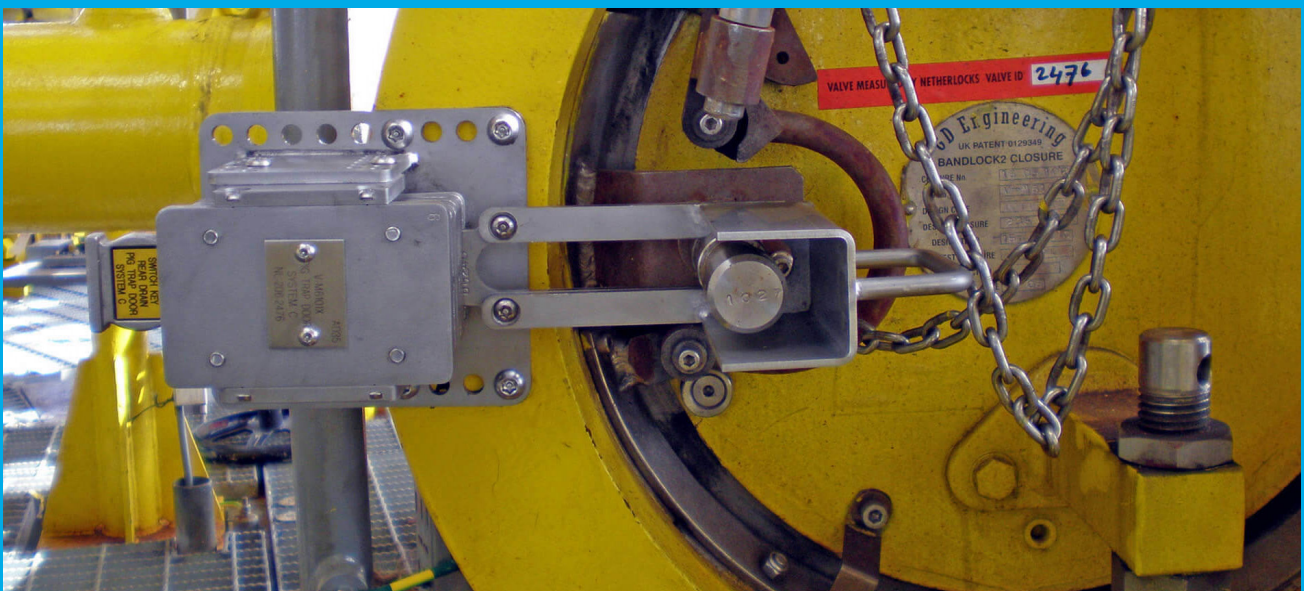
Operators can be trained to follow procedures and informed about potential dangers, but mistakes cannot be excluded.

Pigging processes cannot be fully automated

Even though some larger valves are equipped with motor operated valves (MOV), the process cannot be fully automated, since the loading and offloading of the pig requires manual operations. Therefore, partially equipping MOV's on valves does not sufficiently guarantee the safety of people and processes.

Valve interlocks

Pigging is a notoriously complex process, but one which can be made significantly safer by using mechanical valve interlocks. Valve interlocks prevent operators from bypassing procedures. The transfer of uniquely coded, linear keys, from valve to valve, compel operators to follow the correct process steps. This way, you create a safer working environment for your team of operators and those that work with them.



Guaranteeing safe pigging operation with valve interlocks

Valve interlock systems provide a simple, fail-safe process that ensures accidents cannot happen during a pigging operation.

- When starting a pigging operation, valve interlock keys are used to unlock and open the vent and drain valve respectively. These actions release a key that



- can then be used to open the vessel door safely and load the pig.
- Once the pig is loaded and the vessel door is closed and locked, a key is released to close the drain and vent. This action releases the key that opens the kicker valve and launches the pig.
- Once the pig is launched, the trap is re-isolated by closing and locking the mainline valve. This releases a sequence of keys that depressurise the trap by closing the kicker and opening the vent and drain.
- The last step involves closing all valves and returning the final key to the control room key cabinet, where it is kept until the process starts again.

Valve interlock systems must be operator friendly, and they should require no additional work effort from the operator other than normal procedures would

require. They should also keep the process simple and transparent.

Prevent operating valves while closure door is fully open

Valve interlocking systems prevent operators to operate any process valve while the closure door is still open, or not in its fully locked closed position. This is because the key to start the operating sequence is



still trapped in the closure door lock.

Guarantee venting and draining before opening the vessel.

To ensure the safety of the operators while opening a closure door, the vessel involved needs to be vented, drained, purged, and isolated from the main process line. Vessel lay-outs vary, just as procedures, and from an HSE point of view it is therefore good practice to have valve interlocks mounted onto all critical valves. This way, these valves can only be operated according to procedure, and the vessel is clear of any pressure and toxic gasses.

Guaranteeing correct purging and draining procedures with sequence control devices

H₂S gasses are extremely dangerous. When H₂S gases are trapped inside a vessel, it needs to be purged to remove these gases. The volume of the vessel and the H₂S content determine how many times purging should take place. Often, vessels need to be purged at least 7 times before it's safe to open the closure



door. To guarantee that procedures are followed, an extra control unit is used in addition to standard valve interlocks. This unit guarantees correct purging procedures, without shortcuts. For example, when a vessel needs to be purged 7 times, the mechanical control unit is programmed to force operators to purge 7 times before opening the vessel. These steps cannot be skipped. This will keep the integrity of the plant and the safety of the operator a priority.

Incorporate signals from other field devices

Additional sequence control products address unusual conditions during a pigging procedure.

These products combine digital technology with traditional interlocking. Sequence control products bring signals from other field devices, like pressure or H₂S/CO₂ sensors, into the interlocking sequence, and only release keys for mechanical interlocking if all conditions in the process have been met. process variables – for example vessel pressure or H₂S-levels – can be incorporated within safeguarded operating procedures. Electro-mechanics enable mechanical valve interlocks to be fully integrated within the context of a common system for control and safety of pigging operations. Additional safeguards, such as electrical signals from valve positioners via a switchbox, can also be incorporated in the system.

Combining mechanical and electronic safety measures

Recent developments in mechanical valve interlock products also made it possible to integrate valve interlocks within sophisticated electro-mechanical and PLC controlled cabinets, combining mechanical and electronic safety measures into one single safety system. These solutions allow for communicating detailed instructions, monitoring the status of the procedure and operating part of the sequence from the control room.

Eliminate human error on pigging operations!

Even the best procedures cannot fully prevent mistakes to happen, and for this reason they do not sufficiently guarantee the safety of people and processes. This would be especially true for pigging operations, where the effects of mistakes can be disastrous. Also routine tasks which involve working with dangerous pressure levels can have serious consequences when not carried out correctly. Modern valve interlocking solutions are the ultimate additional safety measure. They have proven to provide excellent safety levels for pigging operations. And they seamlessly integrate within operations, enabling operating companies to eliminate human error on pigging operations.

Pipeline pigging configuration 2

Application field

This configuration is applicable:

when the drain is connected to a closed system;
 when venting to a closed systems is required before atmospheric venting is allowed.

Basic functionality

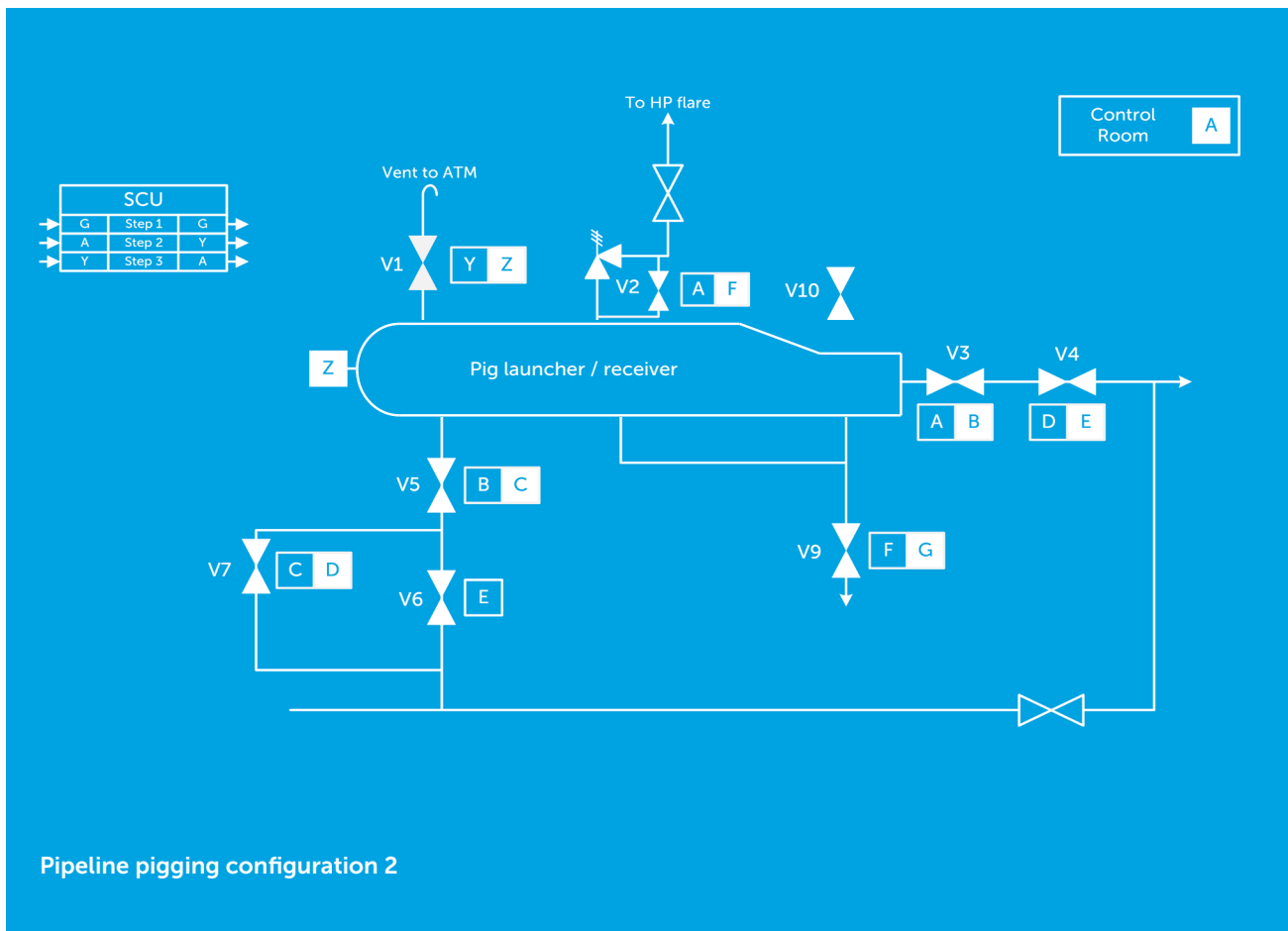
- All main and kicker valves to the vessel are locked closed before the closure door can be opened
- Before the vessel is opened, the draining and venting procedure is performed at least once
- The atmospheric vent has to be opened before the closure door can be opened

In pipeline pigging procedures, various valve interlock configurations can be distinguished. To start the pigging procedure, start key A is taken from the control room and used for (a) opening and closing vents and drains; only after that, the atmospheric vent

and the closure door can be opened or (b) opening the main line and proceeding with pressurizing the vessel.

Sequence specifics

This particular configuration can be achieved by using a 'mini-MPCU' in pigging operations. This device is used to affirm opening and closing of the vent and drain. Only after opening and closing of these valves,



Pipeline pigging configuration 2

Pipeline pigging configuration 3

Application field

This advanced configuration is applicable:

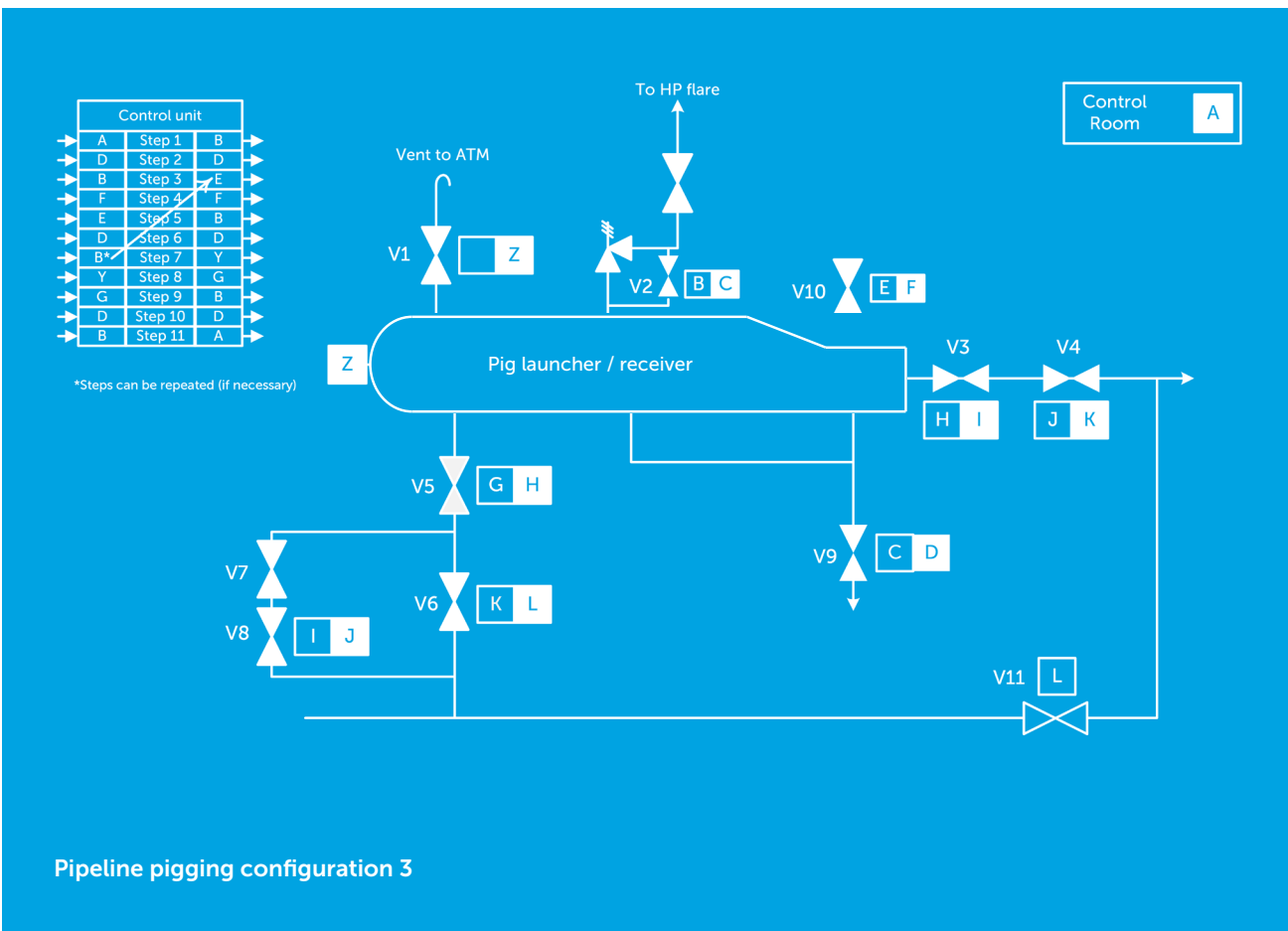
- when the vent and drain is connected to a closed system;
- when one or more purging cycles are required to degas the vessel before it can be opened safely.

Basic functionality

- All main and kicker valves to the vessel are locked closed before the closure door can be opened;
- The vents and drains are opened and closed again, the purge is opened and closed again, then vents and drains are opened and closed once more;
- Above cycle may have to be repeated several times before the closure door can be opened;
- The atmospheric vent has to be opened before the closure door can be opened;
- After launching, the vessel is guaranteed to be vented and drained.

Sequence specifics

This configuration can be achieved by using a Mechanical Process Control Unit (MPCU). The MPCU is a mechanically-programmed key exchange system where sequence steps need to be confirmed before one can proceed to the subsequent step. After venting and draining key D is released and inserted in the MPCU, confirming that vents and drains have been opened. The same key is released and drains and vents are closed again, resulting in the release of key B from the vent, which is entered in the MPCU to confirm the closing of vents and drains. Similarly, the opening and closing of the purge valve is confirmed in the MPCU. After that, the venting and draining is repeated. If required, purging, venting and draining is repeated several times using the MPCU. After the required number of repeated steps of venting, draining and purging, the key is released to open the closure door.



The image shows a complex industrial facility with a color gradient from blue on the left to yellow on the right. The machinery includes large pipes, valves with handwheels, and structural beams. A central component is labeled 'SCRAPER LAUNCHER'.

Contact us

Do you want to know more about our custom-made solutions avoiding unsafe pigging operations?

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