NETHERLOCKS
safety systems

Process Interlocking

Safe pigging operations,
The full story.

Reliability matters

Pigging Systems:

Pigging operations have been recognized in the industry as a highly dangerous procedure. A slight mistake or lack in concentration could result in a disastrous consequence.

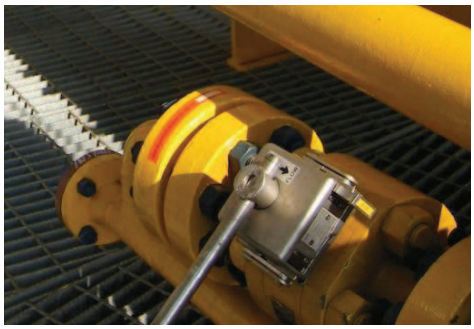
A few examples of incidents which could occur and unfortunately do are listed below.

- Closure door is opened, while pressure still possibly remains inside the vessel.
- Main process valve is opened, while the closure door is still not yet fully or properly closed.
- Closure door is opened, while a high concentration level of H_2S or other toxins still remain inside the vessel.
- Vent valve remains open, while the vessel is being pressurized with its medium.

The operation of the various valves and closure door involved in achieving this looks simple, but they're often tied to a complex non-linear process sequence. Plus as stated early, there is always the added danger of high pressure and the various mediums containing high levels of H_2S or other toxins.

These dangers are acknowledged; therefore the "BS 8010 Code of Practice for Pipelines Recommendations" recommends the use of mechanical interlocking systems on all critical items around the vessel (Part 2 1992 – section 2.8 & Part 3 1993 – section 6.6). Furthermore, ASME VIII – Division 1 mentions the effective safety solution with the use of interlocks.

Mechanical Interlocks



An interlock guides the operator through the sequence with unique keys for each step. It is only when a mistake is made that the operator will not be allowed to proceed – a key will not fit or a valve will be locked in position.

The principle of mechanical key interlocking is the transfer of keys. Each lock is executed with two keys: one for the locked open position and one for the locked closed position. When the valve is open the "open" key is released, can be removed ready to operate the next lock in the sequence, which will share the same code. All keys are unique and depending on the sequence **NETHER**LOCKS will determine the codes to guarantee the required sequence.

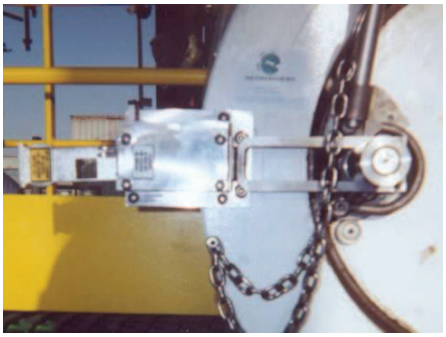
NO interference in procedure:

Often there is a misconception that mechanical interlocking interferes with the standard switch over procedures of systems, please note; **THIS IS NOT TRUE**.

Key interlocking switch over procedures are based on a "one free key" principle. The key which you have in your hand is released and fits only in its dedicated valve interlock or closure door at its correct time in its procedure.

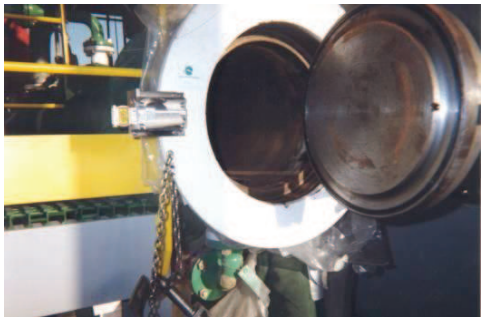
Closure doors and bleed bolts:

People have the impression that a bleed bolt on a closure door is a more than adequate safety precaution, to avoid any incidents. However, what function does the bleed bolt have if the door is already open?
It cannot stop anybody from opening the main, kicker or a drain valve now by mistake at this point.



Key can only be freed when the door is fully closed

With an interlocking system installed, it is not possible to operate any process valve while the closure door is still open or not in its fully locked closed position. This is because the start key to start the sequence in unlocking these various valves is currently trapped in the closure door lock.



Key is trapped while the door Is open

Vent and Drain:
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. As different vessels and also clients have different procedures, it is therefore a good HSE practice to have mechanical interlocking mounted onto all these critical valves.

Now all valves involved shall only be operated according to its written procedure, thus giving the assurance before any breaking of confinement that the vessel is clear of any pressure and possible toxins. We should realize that 0.1 of a bar (equal to 10.000 N/m2) could kill an operator.

Note: Operators should still always check the pressure gauge which is installed on the vessel or attach a temporary gauge; this is to confirm no pressure remains. If there is a sign of pressure re-building back up, it means that a valve somewhere in the sequence is passing.

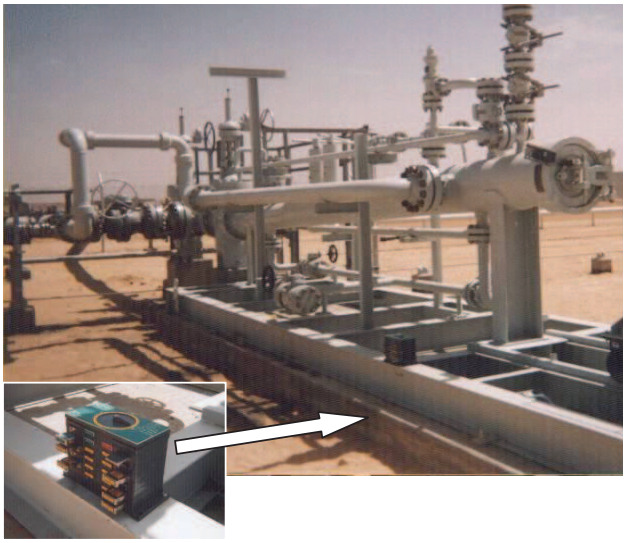
Sequence Procedures:
It goes without saying, H_2S is extremely dangerous. When H_2S is trapped inside a vessel, you need to purge in order to remove it. The volume of the vessel and the H_2S content determines how many times purging should take place. Very often, you will need to vent and purge at least 7 times before it's safe to open the closure door.

Ball valve with an Interlock installed

How can we guarantee that a written procedure is followed?

The answer to this question is simply by using a MPCU, a Mechanical Process Key Exchange Unit.

Netherlocks have designed the MPCU (mechanical process control unit – a mechanical PLC) to assist the operator in the field, but to also assure that the operator is following the correct procedure and not taking any short cut's. For example if you have to purge a system 7 times, we program into the MPCU that this has to be done, so you cannot skip these steps.



A pig launcher with interlocking installed and a MPCU

Procedures are written for a reason, one being the safe operation and working environment of a plant, but sometimes these written procedures can lead to the work taking longer. As we're all human, it is within our nature to try and take a short cut in which we could cut down on the work and time involved.

But when using an MPCU, each step in a written procedure **must** be followed. This then keeps the integrity of the plant and the safety of the operator priority.

Shown above, are mechanical interlocks with a MPCU as an intergraded part of a launcher or receiver skid.

So how do we achieve this?
The mechanical process control unit (MPCU) is a step-by-step key exchange system which guides the operator through the complicated procedures involved. For example on pig-launchers & receivers or non-linear heat exchange units.

In order to achieve this, Netherlocks mechanically programs the written procedure of the applicable vessel into our MPCU design. So now only at the correct time in a particular sequence, shall the correct key be freed to make the necessary next step.

A Mechanical Process Control Unit

There is **No extra work** involved for the operator when using this system, just the confirmation that the correct step has been made.

The knob on the top of the MPCU can only be rotated when the appropriate key has been inserted. 100% error free, even an operator with less field experience can follow these steps quickly and easily.

Therefore, a seven step cycle purge-vent operation must be followed, as the MPCU does not allow you to skip these.

If sometimes more purging cycles are required. We've incorporated into our design, an option where it is possible to repeat further extra purge-vent operations, but not less.

Features:

- All MPCU- components are made of stainless steel AISI 316
- Maintenance-free design
- Tamperproof
- Tested to work in the most extreme operating environments

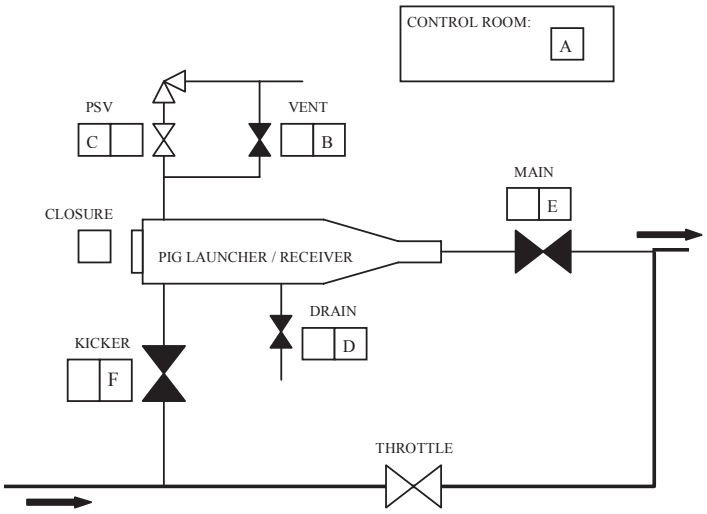
Optional:

- The Integration of electronics like limit & proximity switches, solenoids etc..
- The mounting of the MPCU into a lockable cabinet for further security and protection. (Stainless steel or epoxy-coated steel available)

A simple Pig launcher & Receiver sequence

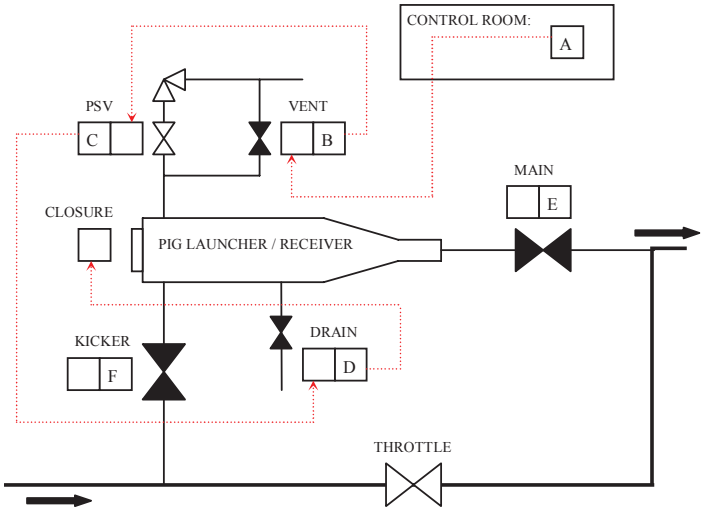
NORMAL OPERATION

The pig trap is isolated from the main flow line. **Key A**, which starts the sequence is in its key cabinet located in the control room, stating normal operation.



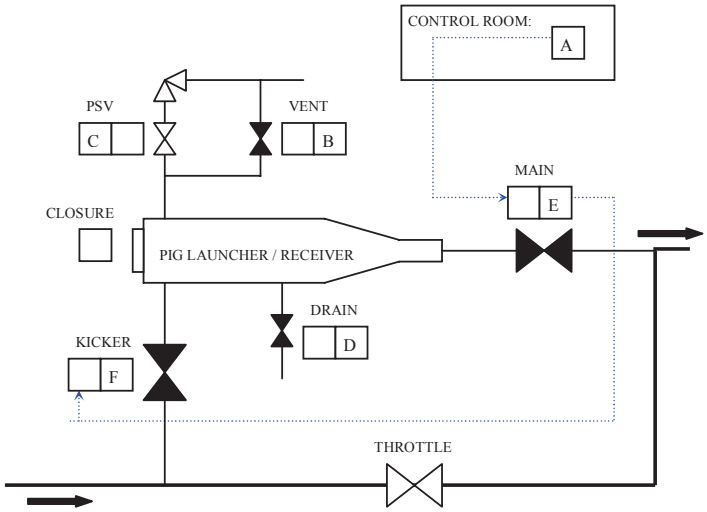
STEP 1: loading the pig

To begin the launch sequence, **key A** must be issued from the control room. With this key, the vent can be opened, releasing **key B**. This key is used to close the PSV, which releases **key C**. This key is used to open the drain to clear the vessel from any liquids. At this point the door can be opened with **key D** and the pig can be loaded. Closing the door releases **key D** again, then the sequence must be repeated backwards to make sure the drain is closed, the PSV is open and the vent is closed. **Key A** is necessary to continue.



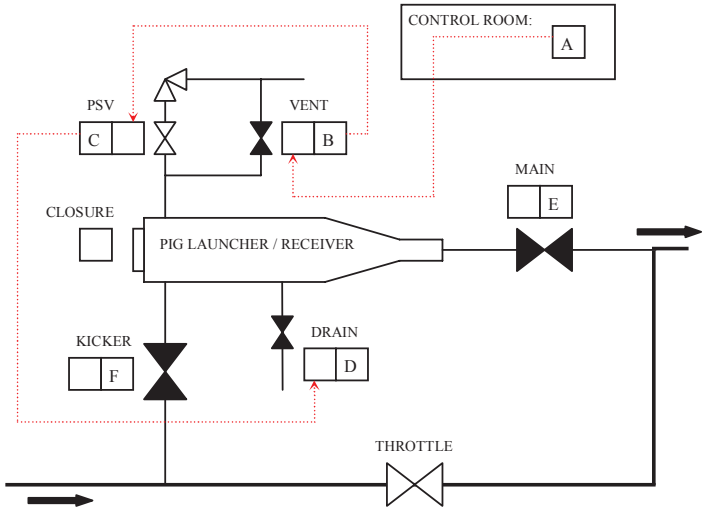
STEP 2: Launching the pig

To launch the pig, **key A** is used to open the main valve. This releases **key E**, which is used to pressurize the pig launcher by opening the kicker line. After the kicker line is opened, the throttle valve is used to restrict the flow in the mainline, by slowly closing it. This causes the pressure behind the pig to rise until the pig is launched into the mainline. After opening the throttle again, the kicker line and the main valve are closed, releasing **key A**, which will be used again to depressurize the vessel?



STEP 3: depressurizing the vessel

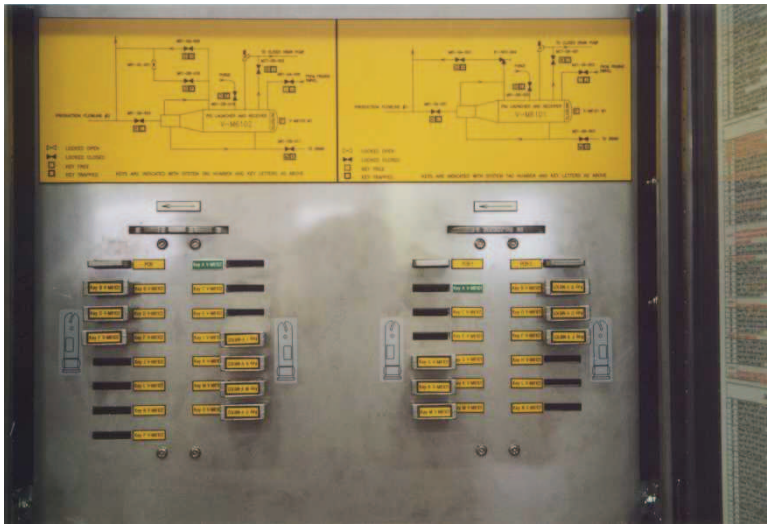
After the pig is launched, the vessel must be depressurized again to avoid hazardous situations. This sequence is mostly the same as **step 1**, except that it's not necessary to open the door.
After the drain is opened and closed again, the PSV must be opened and the vent must be closed to release **key A**, which is returned to the control room as an indication that the pig is launched and the system is back on normal operation.



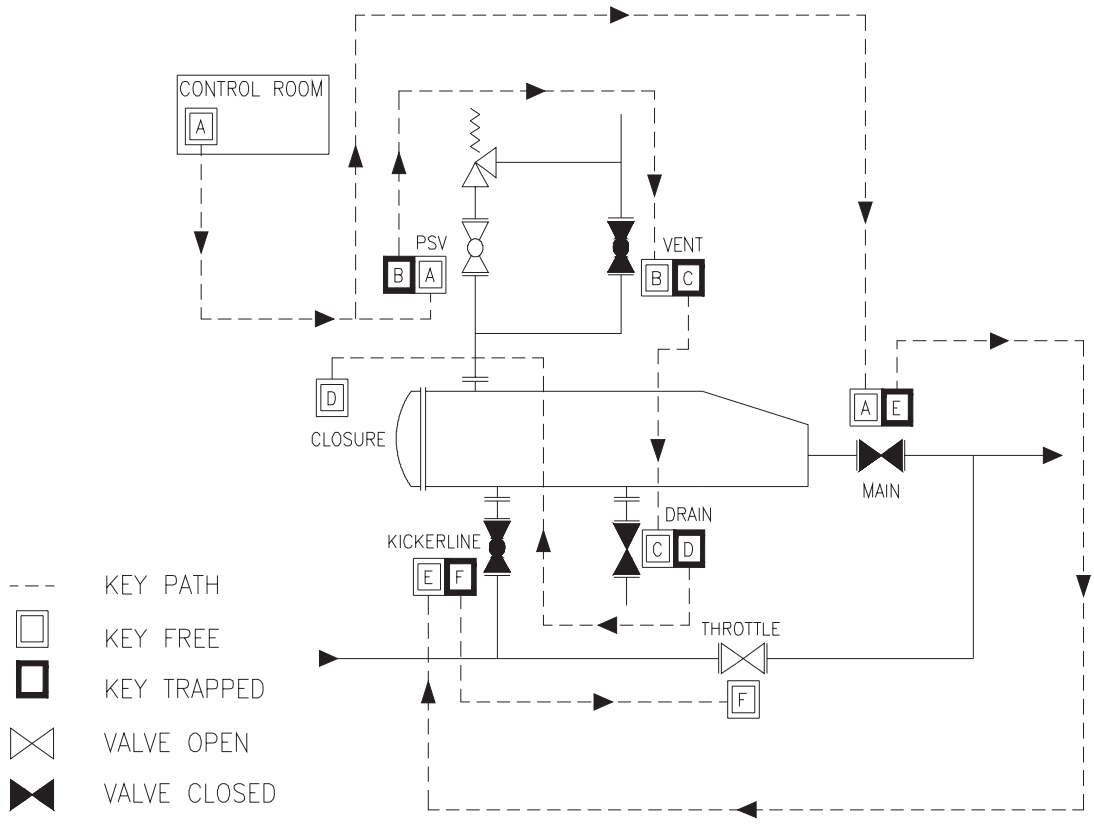
Please Note: It is also possible to interlock the throttle valve, into the above sequence. An MPCU device would be used in the above sequences to guide and check that the correct sequence of events is or has taken place.

NETHERLOCKS safety systems

Various Examples of MPCU's
Mechanical Process Control Units



A further sequence schematic example:



Procedure:

Preparing the vessel and loading the pig
Collect key A from the control room
Insert key A in the PSV block valve, close and release key B
Insert key B in the vent valve, open and release key C
Insert key C in the drain valve, open and release key D

Vessel is now depressurized and free of residual fluids

Insert key D into the closure, open and load pig
After loading the pig, close the closure and release key D
Insert key D in the drain valve, close and release key C
Insert key C in the vent valve, close and release key B
Insert key B in the PSV block valve, open and release key A

Procedure Continuation:

Launching the pig
Insert key A in the main isolation valve, open and release key E
Insert key E in the kicker line valve, open and release key F

Vessel is now pressurized and ready for launching

Insert key F in the throttle valve, slowly close until the pig is launched
After the pig is launched, open the throttle valve and release key F

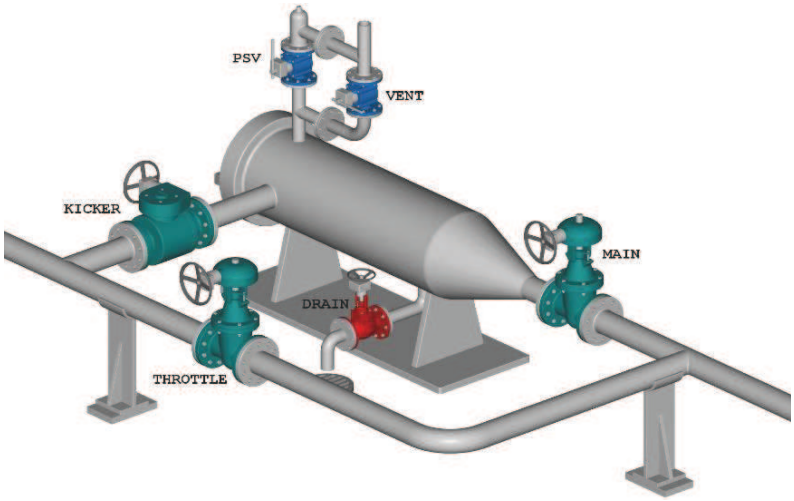
Isolation and depressurizing of the vessel
Insert key F in the kicker line valve, close and release key E
Insert key E in the main isolation valve, close and release key A
Insert key A in the PSV block valve, close and release key B
Insert key B in the vent valve, open and release key C
Insert key C in the drain valve and open
After draining all residual fluids, close the valve and release key C
Insert key C in the vent valve, close and release key B
Insert key B in the PSV block valve, open and release key A

Return key A to the control room

Locks for electric or pneumatic actuators

Above we discussed hand operated valves, however locks are applicable for any type of valve, irrespective the operation; manually, pneumatic, hydraulically or electrically actuated.

In all circumstances locks guarantee that a certain position of a valve or door is reached before the next step can be made. Furthermore, it can be adapted to control the power source. Therefore, when a key is released; the power supply is cut off.



KMS:
To work more efficiently and to assist your plant operators further with the operation of the larger valves or high rotation valves, which can often be found located around a pig launcher/receiver. Netherlocks have the KMS, a hand held portable actuator.

– PORTABLE AIR DRIVEN VALVE ACTUATOR –

The KMS is a time- and cost saving device. For valves taking
Up to 4 man hours to open and close, the KMS actuator will Perform the same work in 10 minutes with only one operator.

Since it's an air driven actuator, it can be used throughout a process plant and even in an offsite location, where a process air supply is available.

The universal mountable driv
plate assures that the actuat
can be used on all types of valves. The actuator has an adjustable air-in twisting handle/valve. It is reversible also (a dead man's handle for HSE).

For a proper storage we can provide a special box with an integrated air filter, lubrication device, automatic hose reel and reduction valve to adjust speed and torque. It is to be stationary stored by the air outlet.

Technical details

Type	Air consumption *(l/min)*	Speed without load (*turns/min)*	Safe operating pressure (*Bar)*	Recomm Pressure *(Bar)*	Torque at recom pressure *(Nm)*
101 100	1860	75	4-7	6,2	480
102 000	780	136	4-7	6,2	120