SAFE PIGGING OPERATION

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Safe operation on pig launchers/receivers

The use of pig launcher and receiver stations for pipeline cleaning, inspecting and maintenance is a method seen world wide. The main benefit of this type of maintenance is that is can be carried out without interrupting the process in operation. The drawback is that it is also a high risk event.

A launcher or receiver station is typically a vessel connected in parallel to the existing pipeline. This makes it possible to launch or receive the pig using the pipeline's normal operating pressure and without interrupting the flow or stopping production.

The vessel is equipped with a closure door to load or offload a pig. By leading the process through the launcher station, the pig will be launched and pushed through the pipeline to be received at the other end in the receiver station.

Receiving or launching the pig involves a number of sequential valve operations in combination with opening and closing the closure door. One mistake in this operation could easily cause severe injury, even death, to the operator or a bystander.

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 launcher / receiver 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 / receiver station again.

Several safety measures can be taken on the closure doors to prevent opening under pressure and by using written procedures but this is no guarantee that all of the above is taken into consideration.

Throughout the years many accidents happened all over the world during this dangerous maintenance operation. Even though some larger valves are equipped with a MOV the process can not be fully automated since there is manual labor involved in loading and offloading the pig. According to statistics, "70% of the reported incidents in the oil and gas industry world wide are attributable by human error". People can be trained to follow procedures and informed about potential danger but a mistake cannot be excluded.

Mechanical key interlocks

Mechanical key interlocks are introduced in the 1890's when they were used on the French railway systems to control track switching operations. Key interlock systems for the oil and gas, chemical and pipeline systems did not emerge until the early 1980's.

The installation and use of key interlocks has the potential to eliminate the possibility of human error in the operation of critical valves such as the ones involved in a pig launcher / receiver system. Both manual as motor operated valves and the closure door can be equipped with a key Interlock and the key transfer principle is used to guide the operator through the predetermined sequence equal to the written procedures.

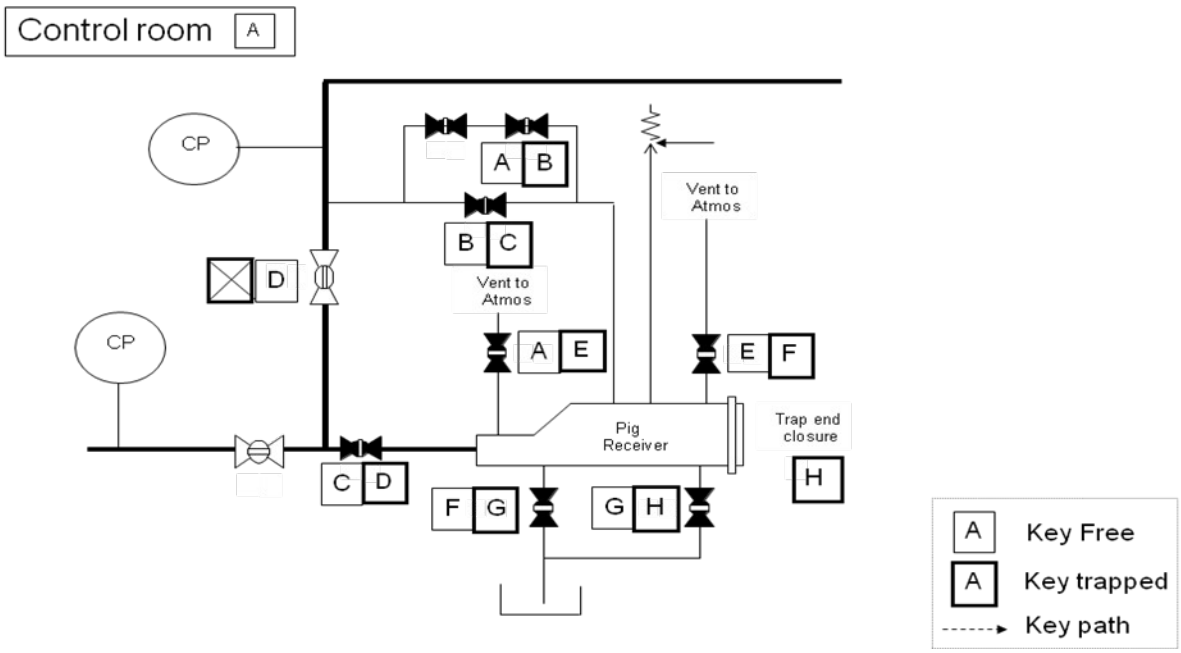
The locking system prevents the operator from operating a valve when it is not allowed and the valve can only be operated with the designated key. Each lock is operated by two keys, one released in the open position and one in the closed position. By using unique keys that travel between locks the key codes can be designed to guarantee the steps of operation and guide the operator through the sequence.

Depending on the layout of the vessel, whether it is a launcher or receiver, whether H2S is present and the degree of safety that is requested the involved critical valves will be selected and the interlocks sequence will be determined. Well designed key interlock systems must be operator friendly and maintenance free, they should require no additional work effort from the operator than the normal procedures would require and keep the process simple and transparent.

The below mentioned sequences are an example, any desired sequence can be integrated in the design.

Basic principle

For a launcher where no H2S is involved, an atmospheric vent and with an open drain the interlocks will ensure that the vent and drain are opened and the main and kicker valve are closed before opening the closure. The key transfer principle used by the interlocks will trap the key to open the isolation valves (kicker and main) as long as the vent and drain are open. At the same time the key to close the vent and drain valves is trapped as long as the door is open. So only after closing the door properly the vent and drain can be closed followed by opening the kicker and main to start the launching and vice versa.



H2S involvement

In a H2S environment there is often a vent connected to a header and a drain connected to a close drain system. This means the drain and vent must still be opened to drain and depressurize but also closed again before opening the closure. Next to that the vessel must also be purged several times in combination with the vent to reduce the level of H2S to guarantee safe opening of the closure.

With the principle of key transfer a "linear sequence" can be guaranteed, 1 step at a time but to guarantee opening and closing of a valve and multiple opening of a valve as for example during purging, a mechanical control box is available to guarantee also "non linear sequences". After each operation the key is returned to this control box confirming the step and releasing a new key, this step could be the same step repeatedly as programmed.

It checks every step and guides the operator through a complicated sequence where launching, receiving, flushing, etc… is controlled and valves are opened and closed repeatedly in a non linear sequence.

Continuous production

The throttle is parallel to the vessel and by closing it slowly the process is diverted through the vessel to launch the pig. As mentioned as a potential risk it is important to open the throttle again before isolating the vessel (closing the bypass) to guarantee continuous production. So optionally a key interlock is installed on the Throttle also and it can only be closed after the kicker and main valves are open. To release the key to close the kicker and main valves the throttle must be fully opened first.

Conclusion

Operating a pig launcher / receiver is a high risk event with people involved and at the same time safe operation depends on these people. Mechanical interlocks take out the human factor of possible mistakes and guide the operator through a safe pre-determined sequence.

Several international companies recognized the potential danger and included or highly recommend interlocks in their design specifications.

- **Shell U.K. Exploration and Production**
  Engineering Reference Document. Design of Pig Launcher & Receiver Systems – Doc. No. EA/061 Rev.1 (1994)
  Addendum to DEP 31.40.10.13 – GEN (Design of a Pig Trap System)

- **ADCO - Abu Dhabi Company for Onshore Oil Operations**.
  Guidelines for preparation of a project health, safety and environmental (HSE) philosophy document (ADCO Doc. No. 30.99.91.003 : Nov. 2005).

- **BP - British Petroleum**
  Guidance on Practice for Pigging, Pig Launchers, and Receivers.
  (Document No. GP 43 – 50 : 27th April 2006).