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PIG LAUNCHERS AND RECEIVERS OPERATIONAL SECURITY

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Abstract

This article presents a simple way to increase security in PIG launchers and receivers operation using mechanical interlock devices for manually operated valves in the operations of sequential processes to ensure that work procedures are followed by operators. So, these devices with their coded keys can ensure the operational safety of persons and installation, because they will obligate the people following the complete and correct procedure to use PIG launcher and receivers. To prove that it is possible to do this, will show some examples of applications that can be easily found in the oil and gas, pipelines and systems such as PIG launchers and receivers, by-pass systems, and another's.

1. Introduction

As initial premise we can define that any valve that is in any process industry of oil and gas can cause problems when operated in inappropriate or incorrectly way. In cases where a predetermined sequence to be followed a valve in the incorrect position may cause serious damage to businesses and even operators. The oil and gas industry has over the years, its practice of disciplined design projects, governed by international standards that are applied by regulators and certification authorities.

"Although a good start with a good project, others are as much a hostage of the "human factor".

Global statistics report that on average, 70% of accidents reported in the oil industry are attributable to human error, whether from lack of a safety culture in the organization, procedures, inadequate or unclear, disobedience to the procedures pre determined, problems in maintenance, inadequate training operators and inadequate supervision. 70% of these accidents, reflected in 90% of financial losses for the industry.

The purpose of a PIG launcher or receiver is to introduce or retrieve PIGs, spheres or inspection tools a pipeline. PIG launchers and receivers are designed to meet the specific requirements of a pipeline. They are designed for a wide range of operating pressures, following international standards as ASME, API or other applicable under particular specifications.

All PIG launchers and receivers have a certain number of stop valves, a rapid door opening, and an operating procedure to be followed so that the door's opening only takes place in conditions of total safety for both plant and for operators. In operating the launchers and receivers of PIG's some basic conditions must be checked, and if someone of them will be ignored some risks should be presented.

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2. Mechanical interlocking systems

The mechanical interlocking system consist of interlock devices to be added to the existing equipment (valves, doors, pumps) of the plant in order to perform a defined function, such as the release or not of the operation of these devices through a sequence event logic. The purpose of the mechanical interlock system is to manually provide the correct and predictable working procedure in order to avoid errors in plant operations.

2.1. Operations and recommendations

Mechanical interlocking devices are operated by a mechanical transfer key used in controlling the procedure of the equipment to be operated. This type of device is now used worldwide as a tool for security management and are being adopted by most major carriers worldwide oil, gas and chemicals.

Interlocking devices was used at first time for a French rail systems company in 1890's, to control track maneuvers. The use of interlocking systems in oil and gas, chemical processing and pipeline systems emerge in early 1980s.

After the recognition of its effectiveness and the increased safety, levels of usage and recommendations as international standards and codes of practice was also increased. The hardware is relatively simple and relies on a mechanical device specifically designed to be simply added to the main machine.

The interlocking devices are usually applied to valves, caps, switches or any type of equipment that can be operated by human intervention. The status of 'open' or 'closed' in the valve operation, or status 'on' or 'off' switch that uses a device that can only be amended by the insertion of a unique coded key, insert the key unlocks the operating mechanism (eg a wheel or a push button) which allows the release operation of the valve or the switch.

The operation of the equipment is released immediately upon insertion of a coded key, and when the operation is completed, a second key (which had been trapped within the device can then be released, locking the equipment at the new position. This secondary key also is encoded with the locking device in the next sequence. For this simple principle of transferring a coded key, it creates a system of 'mechanical logic', which denies any possibility of operator error.

Systems that employ the use of mechanical interlock switches are ideal for use in conjunction with procedures that require a work permission, in effect, the Report Cullen public inquiry report on the disaster offshore platform Piper Alpha (1990) recommends the use of highly integrated systems interlock PT procedures, especially where routine procedures cannot be performed in time scale within a single work shift.

In this same line of surveillance, the chemical industry in the UK by the Health & Safety Executive (HSE) revealed that a third of all accidents in the chemical industry were related to maintenance - and most important factor is the lack of, or insufficient, systems to identify the issue PT.

In addition to the standards listed above, the Technical Guidance (published by HSE) support the interpretation of safety regulations in the UK Pipeline (1996) Act [PSR 1996] advocate the mechanical keyed interlock systems as the most suitable security system operation of launchers and receivers of PIG.

Interlocks are recommended in a series of internationally recognized standards for specific process applications including:

- API RP 14E - Design & Installation of Offshore Production Platform Piping Systems (Para 5.8.b2) Relief Device Piping.
- API RP 520 - Pressure Relieving Systems for Refinery Services (Part II: Section 4 - Isolation Valve Requirements).
- NFPA 12 - National Fire Protection Association (USA) - Carbon Dioxide Extinguishing Systems - 1993 Edition.
- BS 5306 - British Standard - Part 4 1 986 - Specification for Carbon Dioxide Systems.
- BS 8010 - Code of Practice for Pipelines (Part 2 1992 - Sect. 2.8).
- BS 8010 - Code of Practice for Pipelines (Part 3 1993 - Sect. 6.6).
- 1996 No. 825 - (UK) The Pipelines Safety Regulations (Section 6 - To. 37th of Guidance on Regulations - published by UK Health & Safety Executive).

Although padlocks and chains provide an ability to lock the device in a certain position, they provide no control over the sequence of operations, nor guarantee or confirm the state of the equipment is fixed. So, the withdrawal of a key to a padlock not guarantee the equipment is locked, or that is in the "open / closed" or "on / off". While a padlock and chain may even be appropriate and sufficiently robust for low risk applications, there have virtually no mechanical integrity and is a solution that provides at least (at best) a restriction visual restriction against unauthorized operation.

2.2. Pig launchers and receivers

Pig launchers and receivers are commonly used in upstream oil and gas industry for periodic cleaning of pipelines carrying crude oil, natural gas and water from oil wells. A pig is a bullet shaped object which fits the pipeline from inside. The pig launcher launches the pig into pipeline and the upstream pressure pushes the pig to other end of the pipeline where it is received by the pig launcher. Hence generally arrangement for pig launchers and receivers are essentially the same, except for the difference between 'Kicker line' position for launchers and receivers. The sample drawing below presents a general and simple arrangement to pig launchers and receivers.

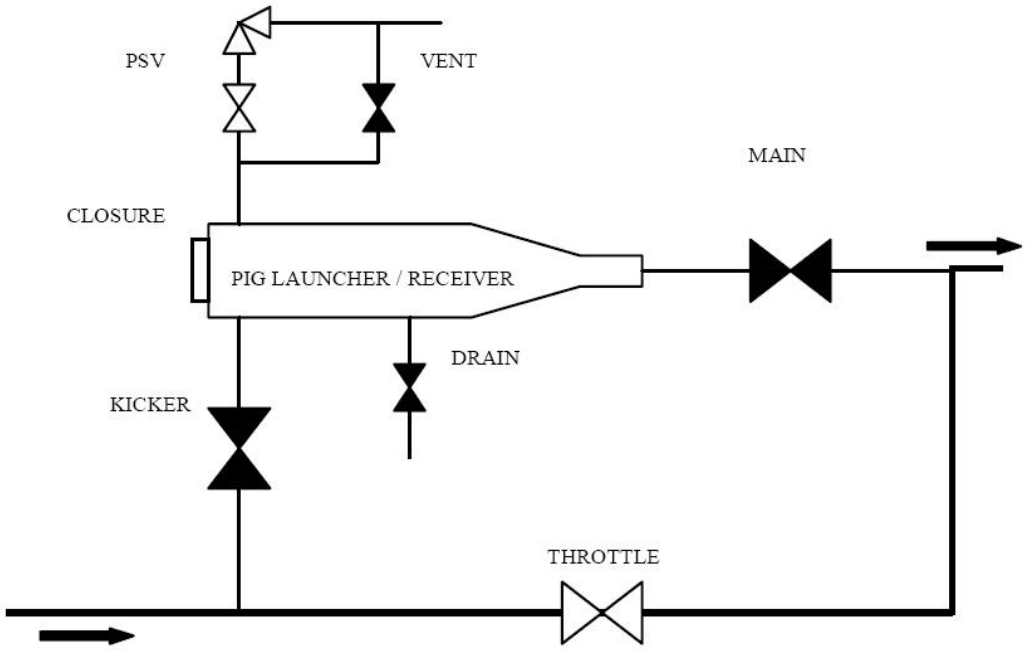

Figure 1. PIG launcher and receiver schematic

2.3 Operation PIG Launchers and receivers

The operations in PIG launchers and receivers should have their sequential procedures followed to avoid problems and damage to plant equipment that can turn into major accidents. Our next application will show us how we can improve safety in operation of PIG launchers and receivers; in this case the sequence to be followed must be obeyed without exceptions, as there is a risk of human lives. If the operators opens the door before draining, airing or depressurize the vessel in case of receipt a PIG he can be hit by jets of pressure, or may inhale toxic fumes that come directly to him.

Using mechanical interlock devices installed the valves together we can ensure that all operations will be performed following each step in your order to complete the process safely. For this system to the following basic assumptions should be followed:

Door can never be opened when the pressure vessel;
Operator cannot have direct contact with the gases inside the vessel;
You cannot open the door with the vessel connected to the process;
The launch and reception must be made with the door closed!

The interlocking system using mechanical interlock devices will allow all operations to be performed with the correct sequencing to ensure that the operator only able to open the door to the launcher or receiver when it is in a safe position, depressurized, drained and isolated of process. Thus operator safety and even the plant are guaranteed.

Operation of a simplified PIG receiver:

Confirm that PIG is inside the receiver:

Confirm that Main and Kicker valves are closed and Throttle valve is opened, because the vessel should be isolated of process to be security opened

Process isolation:

Confirm that Main and Kicker valves are closed and Throttle valve is opened, because the vessel should be isolated of process to be security opened

Drain:

To drain all the liquids inside the PIG launcher and receiver this valve should be opened during a time and closed before open the door.

Venting:

The drain valve should be closed and the vent valve should be opened to keep the vessel free of gases inside it.

Door Opening

Only after the draining and venting, the door could be opened.

Retire the PIG

The PIG can be retired with security.

Operation of a simplified PIG launching:

Process isolation:

Confirm that Main and Kicker valves are closed and Throttle valve is opened, because the vessel should be isolated of process to be security opened

Door Opening

Only after the draining and venting, the door could be opened. Obviously, if the procedure in the received phase was followed, the vessel was already drained and ventilated.

Insert the PIG

The PIG can be inserted with security**:**

Launching the PG:

The Main valve should be opened to permit the vessel be connected to line. After this the Kicker valve should be opened to permit the fluid pass through the vessel to the main line. After confirm these two valves are opened the Throttle valve to force all fluid passage through the vessel pushing the PIG in the pipeline.

In the figure below we can see all the possible operations with the interlocking devices and their respective keys follow the operations guide step by step using the interlocking devices to following the correct procedure and order to open and close the vales and ensuring the security operations.:

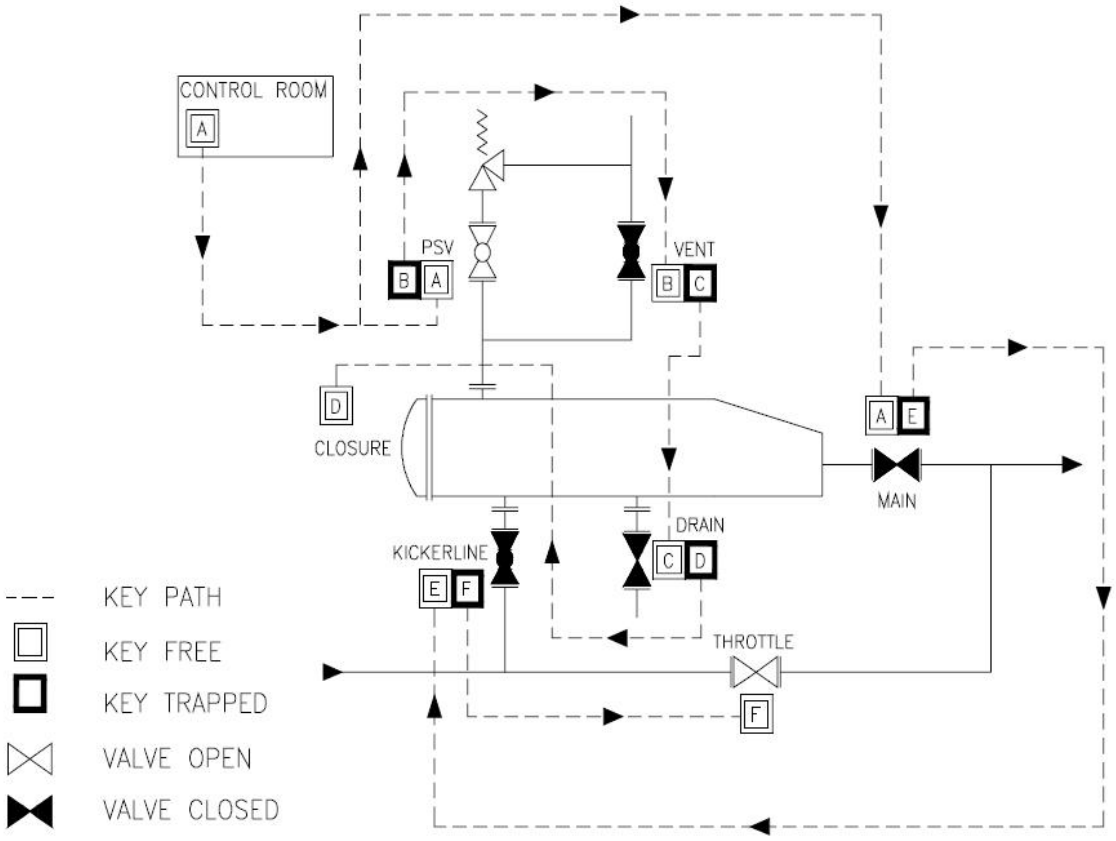

Figure 2. PIG Launcher and Receiver procedure with interlocking devices

2.3 Procedure showed at figure 2

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

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

3. Conclusion

Despite new industrial facilities are designed and built with greater accuracy and precision of modern equipment using all available technological resources, after the start of operation we find very often some gaps in safety and operability. Small human errors can cause major damage to the plant and people. Normally provide changes in the processes of an entire plant at the time shortly after the start-up for improvement is often very complicated and expensive.

Given the above, the use of devices for mechanical interlock fitted with keys and linear encoded can contribute by increasing the operational safety of releases and receipts of PIG with its simple operation and without interrupting production processes, and without the need of stopping the equipment because they are only designed to be added to the valves, whether new or existing, and also to other devices without altering the characteristics of them.

The interlock system comprises a solution which can be fitted to all conceivable devices, even in systems controlled by SDC. There is no limit to the complexity of the proposed operating sequences. Thus, we conclude that this is an excellent solution for use in critical situations and where we should be sure that all steps of each procedure special work were followed strictly without compromising safety equipment and thus preserving lives.

4. References

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