Manual Pigging with Improved Safety using Microcontroller based Passcode Lock

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ABSTRACT:Pigging, the pipeline cleaning process in oil and gas industries is very risky. Pig, a line size plug is propelled in the pipeline to remove the scales and debris. So many fatal accidents happened so far during the removal of pig from the pipeline. Safety is very important than anything. This paper deals about providing a cost effective simple easily adaptable solution to avoid accidents during the removal of pig. A passcode open lock is provided at the closure for safety. The passcode will be generated using a microcontroller reading the safe conditions like position of the valves and pressure in the receiver using proximity and pressure sensors. The passcode will randomly change and will be displayed when the condition is safe. The closure cannot be opened without passcode. Thus we can improve the safety and avoid accidents.

KEYWORDS: Pigging, pig, passcode generator, electro pneumatic lock, proximity sensor, pressure sensor, microcontroller

I.INTRODUCTION

In oil and gas industries the pipeline cleaning is mandatory as there is constant deposition of scales and debris in the pipeline. This may block the pipeline and affect the flow. For cleaning they adapt a process called pigging. In pigging process they send a line size swab inside the pipeline to remove the scales and debris. Most of the time, pigging is an online process. The pipeline flow fluid is used as the propelling fluid for the pig. The pipeline pressure is in the order of several 1000 psi. To remove the pig from the pipeline, the pipeline handling several 1000 psi pressure should be opened. Hence it's a dangerous process. Some carelessness may lead to fatal accidents. So far so many accidents have happened. There are so many smart techniques available in the market to provide smart pigging. But still manual pigging is done in most industries. Hence we plan to provide a cost effective simple solution which can be easily adapted by the operator without any need for special training to prevent the accidents.

II.RELATED WORK

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 the pig involves a number of sequential valve operations in combination with opening and closing the closure door.
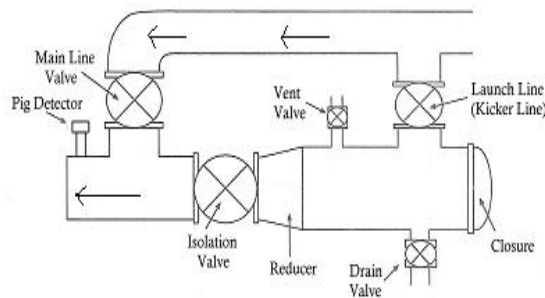
A. Launching Procedure

Fig 1. PigLauncher

1. Ensure isolation and launch-line (kicker line) valves are closed.

2. Open vent and drain valves to allow liquid displacement or vent to atmospheric pressure.

3. When the pressure gauge on launcher reads zero psi, and with drain and vent valves in open position, open closure.

4. Insert pig and push forward until nose or front of the pig is firmly in contact with the reducer

5. Close and secure closure

6. Close the drain valve and gradually open kicker valve, venting through vent valve.

7. When launcher is full, close vent valve and allow pressure to equalize.

8. Open isolation valve.

9. Gradually close main line valve, thereby increasing flow behind pig.

10. Monitor pig detector for pig passage.

11. Once pig has entered main line completely, open main line valve fully.

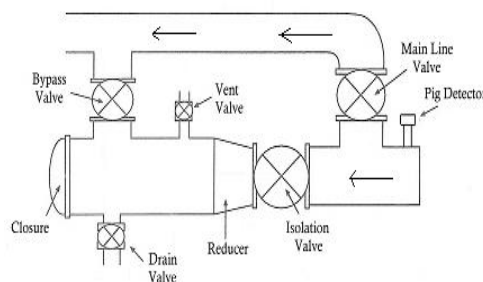12. Close kicker and isolation valves.

B.Receiving Procedure

Fig 2. Pig Receiver

1. Open bypass and isolation valves.

2. Partially close main line valve.

3. Monitor pig detector for pig reception.

4. When pig is received, open main line valve.

5. Close bypass and isolation valves.

6. Open vent and drain valves.

7. .By checking pressure gauge for zero psi, ensure receiver is depressurized.

8. Open closure.

9. Remove pig.

10. Close and secure closure.

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 cannot be fully automated since there is manual labour involved in loading and offloading the pig. According to statistics, "70% of the reported incidents in the oil and gas industry worldwide are attributable by human error". People can be trained to follow procedures and informed about potential danger but a mistake cannot be excluded.

III. PROPOSED METHODOLOGY

My project is to provide a solution to minimize the human error during the pig reception. As discussed in the introduction, before opening the closure safely, there are several basic safety criteria that need to be met.

1. The vessel must be drained and depressurized.
2. The vessel must be isolated from the process pipeline by closing the Kicker lines and the main valves.
3. In case of a closed drain systems and/or vent headers the vessel must also be isolated by closing the drain and vent valves.
4. The vessel needs to be free from toxic gasses like H2S.
5. At the same time the vessel must remain isolated when the door is open
6. When the launching or receiving procedure starts the closure should be properly closed.

This paper deals about providing a cost effective simple easily adaptable solution to avoid accidents during the removal of pig. A passcode open lock is provided at the closure for safety. The passcode will be generated using a microcontroller reading the safe conditions like position of the valves and pressure in the receiver using proximity and pressure sensors. The passcode will randomly change and will be displayed when the condition is safe. The closure cannot be opened without passcode. Thus we can improve the safety and avoid accidents.
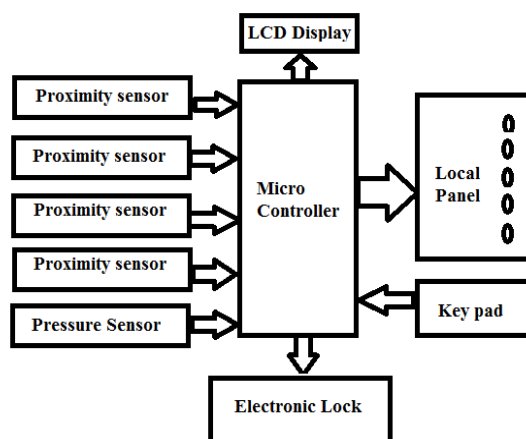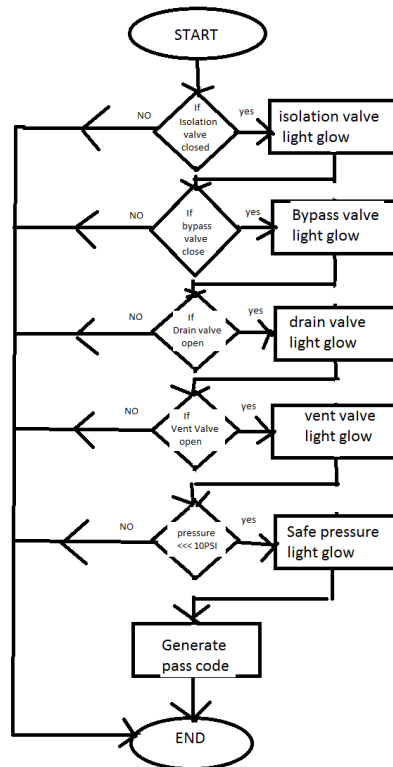
IV.EXPERIMENTAL RESULTS

Fig.3.Block Diagram

Fig.4.Flow Chart

Pressure sensor at the receiver - If there is pressure behind the pig while opening the pig will come out with high speed which is not safe. We place a sensor behind the pig to read the pressure behind the pig. When the pressure is at the safe level the sensor will give an output, and the light in the local check list panel will be on.

Proximity sensor at bypass valve - The bypass valve should be closed so that the receiving end will be disconnected from main line. A proximity sensor will be placed at the bypass valve. When the valve is closed the sensor will send signals and the light in the local check list panel will be on.

Proximity sensor at Isolation valve - The isolation valve should be closed so that the receiving end will be disconnected from main line. A proximity sensor will be placed at the bypass valve. When the valve is closed the sensor will send signals and the light in the local check list panel will be on.

Proximity sensor at Drain valve - The Drain valve should be opened so that the pressure inside the receiving end will be drained. A proximity sensor will be placed at the drain valve. When the valve is opened the sensor will send signals and the light in the local check list panel will be on.

Proximity sensor at vent valve - The vent valve should be opened so that the pressure inside the receiving end will be drained. A proximity sensor will be placed at the vent valve. When the valve is opened the sensor will send signals and the light in the local check list panel will be on.

Local Check list panel - The purpose of the local check list panel is for the operator at the receiving end to ensure the safety to open the closure. There will be five lights in the panel. The green lights will blow when the isolation valve and bypass valve are closed, the drain and vent valve are opened, there is no pressure behind the pig and it is safe to open the closure at the receiving end. Before opening the closure of the receiving end the operator has just to look at the check list panel at the receiving end for all the green lights to blow to ensure the safety

Fig.5. Local check list Panel

8051 Micro controller - The 8051 micro controller will make the light in the local panel to on /off according to the sensor output. According to the sensor output, if the condition is safe to remove the pig, the controller will select a passcode and display it in LCD display.

Fig.6. Microcontroller and LCD display

Electronic Lock - Electronic lock will be unlocked when the passcode displayed in the LCD display is given to the electronic lock keypad.
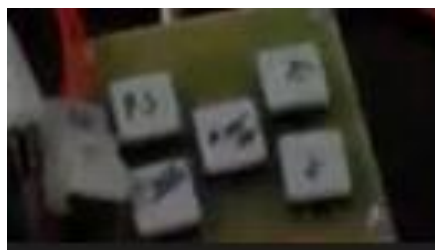

Fig. 7. Keypad for entering passcode to open the lock

Once the drain valve and the vent valve are in open position and the isolation valve and the bypass valve are in the closed position and also the pressure behind the pig is less than the safe level, all the green lights in the check list panel will glow and a passcode will be displayed in the LCD display. The operator will see the passcode and enter the code in the electronic lock's keypad. The passcode given to the electronic lock will be cross checked with the passcode displayed in the LCD display. Now the electronic lock will be unlocked. Now the operator can unthread the closure. Hence a fool proof solution has been provided for the safety of the operators who does pigging.
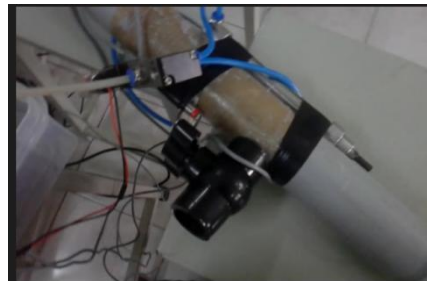
Fig. 8. The closure is secured with the lock

Fig.9. The lock is opened on giving the passcode

V. CONCLUSION

A model of manual pigging is done in a two inch pipeline. The microcontroller is programmed to provide passcode when the valves are the in the safe position and the pressure is safe to operate. When the passcode is entered in the keypad the lock is opened as expected.

VI. FUTURE SCOPE

We have proposed one simple cost effective easy to adapt solution which doesn't need any special training solution for the operator to ensure the safety before opening the closure member at the receiving end. In future we also have to provide same sort of cost effective solution to prevent accident at the launching end of pig.

REFERENCES

[1]   Multi-diameter, bi-directional pigging for pipeline pre-commissioning - Aidan O'Donoghue, PPSA Conference Aberdeen, November 2009
[2]   Pigging as a Flow Assurance Solution Avoiding Slug Catcher Overflows - Aidan O'Donoghue, PPSA Conference Aberdeen, November 2005
[3]   Estimating Pigging Frequency for Dewaxing - Aidan O'Donoghue, Pipelsssine Pigging Conference, Amsterdam, May 2004
[4]   Latest Design Techniques for Dual and Multi diameter pigs - Aidan O'Donoghue, Pipeline Pigging Conference, Houston, January 2001
[5]   Dynamic Simulation of the NorneHeidrun 10" x 16" Dewatering Pig - Aidan O'Donoghue, Pipes and Pipeline International, January/February 2001
[6]   Multi diameter pigging for sgard, Commissioning and pigging the 710km 42" x 28" -sgard Pipeline - Christian Falck, Aidan O'Donoghue, OPT Conference, Oslo, 2000