

Refining and Gas Processing Community presents

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Abstract



Title: Innovation in Control System Design for Coke Drum Switching

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Joined Bantrel in 2004, has thirty-one years of total experience in instrumentation and controls design, specification, installation, commissioning and maintenance within the oil and gas industry both in Canada, and international. Experience in instrumentation and control systems modernization projects, detailed engineering design, project coordination and the preparation of engineering deliverables and documentation for large EPC projects. Specifically in the Coker Technology recently led the I&C discipline on a mega Coker project in Alberta.

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The Hazards of inadvertent mal-operation of Coker valves is well known and some of our clients are only too well aware, having faced incidents of their own at their plants. In particular valve switching operations for Coke drum pairs were most critical as the majority of incidents had occurred during inadvertent valve operation. Examining these installations it was evident that the safety/permissive interlocks were insufficient.

To help understand the reasons for mal-operation of valves that could lead to catastrophic results, a video excerpt from the US Chemical Safety and Hazard Investigation Board (CSB) provides an animated reconstruction of the consequences associated with inadvertent valve

operation in hazardous service. The process in the video is based on polyvinyl chloride production, and not coke production, but both are highly flammable and potentially explosive hydrocarbons that are produced in batch operations. One can identify with events that led to this disaster as they are a very real possibility in the Coker plants due to similarities in hazards, layouts, etc. The CSB findings zeroed in on control system design issues as well as Operator human errors as causes of the accident and a very important finding was that the operator even bypassed an interlock by replacing the normal motive air with emergency air by physically changing the air line to the valve.

Bantrel in an on-going project and in partnership with the client, have addressed the above issues and more to mitigate consequences of such errors to a great extent taking into account the client's specific needs. This involves the plugging of gaps in operating procedures supported by innovating design of the control system for Coke drum switching. This design addresses the issue of insufficient safety/permissive interlocks, operator errors, project control systems and costs, in its innovativeness.

- In the past, valves were purely manual relying totally on the operator's due diligence in ensuring the right valve was being operated at the right time. In evolving design over the years, these valves have been provided with actuators allowing for the inclusion of control system monitoring and safety/permissive interlocking with "inhibit" signals to prevent the operator from mal-operating a valve by inhibiting its movement. These inhibits as they came in were primarily focussed on the Drum Feed isolation valves and switching valve with permissives from the correct line-up of other valves, pressure & temp of the process for the mode of operation of the associated drum. Further, it is difficult to achieve full range of operation of valves to actuate discrete switches in interlocks due to coke build up (inherent to this process) and operators were then forced to bypass these inputs to achieve their production targets that compromised safety.
- In our current design we have looked at criticality of ALL valves and added more inhibits as required which includes the Coke drum drain and vapour valves.
- This design has replaced discrete switches with analog signals and logic over a reasonable range to determine the required position reducing the need to execute any operator bypasses.
- The design now provides enhanced functionality for operator/maintenance bypasses executed in the control system that can be monitored and controlled eliminating the need of the difficult alternative of physically forcing a bypass such as replacing of an air line. The bypass philosophy used to implement the logic incorporates the concerted action of both the control room operator and field operator whereby they are required to execute "enable by drum" and "bypass specific valve" together thus reducing human error. This eliminates inadvertent bypassing of a valve on a wrong drum.
- Finally the design has sufficient hardware and in some cases the application software to move the operator off the deck with remote switching, Unheading and cutting operations.