Question 50: What unique challenges do you consider when designing a safety instrumented system (SIS) for a delayed coker heater?

Jeff Lewellen (HollyFrontier)

We are currently constructing two new delayed coker heaters at our El Dorado, Kansas facility. As part of this project, we have performed both a process hazard analysis (PHA) and a safety integrity level (SIL) evaluation. We incorporated experience from other recent heater installations during these evaluations. However, unique differences were noted during these evaluations including:

• Heater tube fouling rates commonly resulting in tube skin temperature increases of 1o F to 4o F per day.

• Higher frequency of loss of process flow incidents

• Daily/hourly changes in heater conditions due to drum cycle impacts

• On line heater pass decoking – spalling

• Frequent off line heater pass decoking – steam air decoking/pigging.

• Bringing a heater off line or restarting a heater while the balance of the unit remains running.

• Multiple velocity steam injection locations into the process coils. However, this is common with other “heavy oil” units.

• Double fired coils utilizing shared burner rows with individual pass controls.

• Extended loss of charge heater firing resulting with incomplete coking of the residuum/asphalt in the coke drum.

With the analysis teams consisting of instrumentation/controls, operations, maintenance, engineering, and outside experts discussing these issues, a better design has evolved. Some of the key issues found through these evaluations include:

• As with all of the facility’s heater designs – the teams utilized API Recommended Practices for Fired Heaters 556 and ANSI/ISA-84.00.01 with good engineering practices to implemented adequate instrumentation and controls to maintain safe operation of the heater.

• Ensure adequate equipment and administrative systems are in place to test SIS to maintain reliability.

• Considered the controls and SIS for all of the operation and startup/shutdown modes. This included spalling, steam-air decoking, and shutdown/startup of heater with the unit online or offline.

• Evaluated best practice instrumentation in the design, level of redundancy, and control technologies to optimize for both shutdown and inadvertent heater trip situations.

• When the heater is shut down by the SIS, insured equipment is designed to help the operator quickly recognize the trip has occurred, understand the cause of the trip, correct the condition, and restart the heater if safe to do so. This includes o Utilize Instrumentation/alarm prioritization for “first out” information.

o Facility design and logical location of HMI panels to aid in operator response.

o Complete and detailed operator and maintenance training on these systems.

o an adequate administrative system (including levels of authority) to implement “By-Pass” of the SIS and/or DCS in the event of a malfunction or for maintenance of system.

• Evaluated operating procedures and equipment is in place to safely address the consequences of a heater trip that cannot or should not be restarted those results in a un-coked residuum (tar ball) event.

Gary Gianzon (Marathon Petroleum Company)

The coker heater is unique since a loss of heat or heater shutdown can result in an unconverted pitch “tar ball” in the drum which in itself creates its own hazard. That being said, MPC’s SIS philosophy is to get the heater in the safe state and address the “tar ball” issue through our emergency procedure.

The flame of the low duty burners used in the coker heater can be hard to detect and have caused unnecessary heater trips. This issue was remedied by using a combination of flame rods and flame scanners to prevent spurious shutdowns or trips. We also have emergency steam automatically activated on low pass flow to prevent the heater tubes from plugging which is unique to the coker furnace SIS.

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Delayed Coking

Fouling

Operations

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Process

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Safety Instrumented Systems (SIS)

Start-up

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