Question 44: Describe your procedures for placing and operating the FCC in hot standby/safe park mode. What safety concerns do you consider and what safeguards should be in place?

ALEC KLINGHOFFER (Coffeyville Resources)

The first question you should ask when considering what "safe park" mode means would be is the air blower running or not?

If the air blower is not running, things you should consider are ensuring all ignition sources are shutdown, bypassed or isolated (ESP, torch oil, DFAH, CO Boiler). Verify all hydrocarbon sources to the reactor, riser and regenerator are closed (fresh feed, any recycles, torch oil, fuel gas purges, LCO quench, etc.) and all sources of air are not being injected (main air, plant instrument air, fluffing air, etc.). Consider isolating by blocking in, DBB or blind as a stabilizing action. Confirm slide valves are closed and maintaining a positive ?P (3-5+ psig). Close fuel gas to furnaces unless feed or fractionator bottoms oil circulation is maintained. Confirm you have steam to air blower(s) discharge, feed riser, feed & torch oil nozzles. Verify steam purging of reactor to the fractionator is controlling the reactor pressure greater than the fractionator and greater than the regenerator by 2+psi. Verify steam to MAB discharge is being injected at the prescribed rate. Verify steam to feed nozzles matches design curve specification. *If steam is not available, then use nitrogen (very large volumes of nitrogen will be required for cooling, due to its very low heat capacity). If neither steam, nor site nitrogen are available, then source a contract nitrogen vaporizer as soon as practical. Verify that the MAB discharge line is clear, and that MAB check valve has closed. Check status of Wet Gas Compressor (WGC) — in some units the WGC auto trips on blower shutdown, the reactor pressure must be higher than the fractionator and the regenerator to prevent flow reversal. If unit has a power recovery turbine, ensure that flue gas quench system is preventing the PRT inlet temperatures from exceeding limits. The vapor spaces of the regenerator and flue gas system must be purged before restarting the MAB. Use N2 or steam in enough quantities for 3 volume changes from the purge point to the stack. Sample gas in regenerator and flue gas system for combustibles. Ensure steam is dry, preferably superheated. Oil soaked on catalyst will crack to form explosive gases. In addition, steam passing through catalyst at temperatures above 1000°F will make HYDROGEN and CO via the water gas shift reaction. When purge is complete, and gases are verified to be free of combustibles, air can be introduced to the unit and catalyst circulation restarted. This must be done as SLOWLY as possible. Temperatures must be monitored to ensure no rapid rises. If there are rapid temperature rises, must go back and repeat purge and combustible check.

MINAZ MAKHANIA (UOP)

If the air blower is running, confirmation feed has been bypassed with isolation valves closed, again DBB or blind as a stabilizing action. De-energize ESP. ESP should not be re-energized until the flue gas has been verified to contain no combustibles and is below the acceptable CO levels. Nitrogen or steam to Riser at rates adequate to keep Reactor as high-pressure point (Reactor>Main Fractionator and Regenerator). Set Reactor at the highest pressure in the system. We specify pressure differential because required flow rates will be different under varied conditions. Pressure conditions are constant

under all scenarios. Steam to feed nozzles at design curve specification (feed nozzles are very prone to plugging in the posture). Monitor vessel velocities to prevent exceeding velocity and temperature limits. Confirm slide valves are closed and maintaining a positive ?P (3-5+ psig). Main Fractionator to steam pressure control. Use torch oil to control regenerator temperature. Maintain levels in Main Fractionator and GRU. Conduct extensive catalyst loss monitoring.

TIFFANY CLARK (BASF)

Standby #3, in a situation where the air blower is running, and catalyst circulation is being maintained, this can be a difficult operation to control long term and has significant risk associated. A big risk being detonation of ESPs that has occurred in the industry.

Major things to consider in this mode of operation to ensure safety are:

De-energizing ESPs until stable operation is reached, and monitoring the flue gas system upstream of the ESP regularly for hydrocarbon and CO.

While circulating catalyst, you should always maintain isolation between the Regenerator and Reactor/Main Fractionator by pressure balance.

And then, while most ESD systems will trip the feed isolation valves closed for you, you should always verify feed has been bypassed and that the isolation valves are closed and not leaking by.

Other things to verify include that you have adequate oil flow through Main Fractionator bottoms system so as not to build up catalyst. A sufficient level in the Main Fractionator should be maintained at all with adequate flush to tankage.

Nitrogen or steam to riser/stripper should be maintained at rates adequate to hold Reactor pressure as the highest pressure in the system by at least 2+psi. You should closely monitor the Reactor-Regenerator pressure balance, fluidization and catalyst circulation stability to prevent oxygen from entering the Reactor. The Main Fractionator should be on steam or nitrogen pressure control and adequate steam to the feed nozzles is required to prevent plugging the nozzles and should be consistent with design specifications.

You also want to monitor velocities and catalyst levels to prevent excessive catalyst carryover during this mode of operation. Monitor your slurry ash content and Regen fines or Scrubber solids content frequently and conduct extensive catalyst loss monitoring.

While torch oil is being used to maintain Regenerator temperature, it should be monitored very closely to prevent exceeding temperature design limitations and significant catalyst de-activation. You should adjust catalyst circulation rates to prevent temperature excursions or excessive thermal cycles in Reactor. The Main Fractionator overhead system should be monitored routinely for excessive oxygen buildup and steam condensate acidity. Also, maintaining levels in the VRU will help tremendously on unit startup.

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