Introduction
Delayed cokers perform the critical function of converting large volumes of heavy residuum to transportation fuels. Because many refinery processes produce heavy residuum as a by product, feed for the delayed coker is never in short supply. It is also important that the delayed coker be operated continually. Delayed cokers are designed with pairs of coke drums, to facilitate continuous operation. This allows the refiner to produce product in one active drum, while cleaning the other inactive drum.

In order to direct flow to either one of the two coke drums or to a bypass, a special 4-way switching valve is required. Metso Automation manufactures this valve design as well as many others encountered in delayed coker service.

The Process
Coker feed (vapor-liquid combination) exits the coke heater at 510 °C / 950 °F and 7 bar / 100 psi. Residence time in the heater is very short in order to minimize coke accumulation, due to severe thermal cracking, in the heater. The feed then passes through the 4-way switching valve and into the active coke drum.

Once in the drum, the vapor-liquid mixture is separated. Trapped liquid is converted to coke and light hydrocarbon vapors. Vapors rise to the top of the coke drum and are drawn off through the overhead vapor lines. The process continues until the active drum is completely clogged with solid coke. The 4-way switching valve is then required to switch to the second coke drum, deactivating...
the first coke clogged drum, making the second drum active and allowing the process to continue.

Another critical function of the 4-way switching valve is to keep the feed moving either to drum A, drum B, or to bypass. Once heated above the thermal cracking temperature, any valve, pipe, vessel or pump that the fluid is allowed to stop in will fill with solid coke, rendering it useless.

During start up, shut down or an emergency, the 4-way switching valve will be required to bypass the flow back to the bottom of the fractionator.

**Valve solutions**

Metso Automation manufactures the Y4 series 4-way switching valve. The body configuration is bottom inlet with three outlets that are connected to drum A, drum B and the bypass. The outlets are equally spaced 120 degrees apart around the body, perpendicular to the inlet. The ball is top entry. Recommended construction is Y4CH_UHD03N. A typical size is 12". The erosion resistant chrome moly body, usually A217 C5 or A217 C12, is capable of providing long service life in process conditions of heavy residuum at 510 °C / 950 °F and 7 bar / 100 psi.

Hard chrome plate, electro deposited over an A487 CA6NM martensitic corrosion resistant cast steel substrate, has a material hardness of HRC 68 to 70. This presents a surface that is resistant to wear by abrasion and galling as well as providing a low friction surface. This promotes smooth interface of the three seats while exhibiting the lowest possible torque. A surface finish of 8 to 12 RMS minimizes the adhesion of deposits on the ball surface and facilitates their removal by the scraper seat.

Massive solid Stellite seats are located at each of the three outlets. The seats are mechanically loaded to the ball by Inconel 718 convoluted “E” type springs. The loading is set to allow the efficient removal of coke deposits from the ball surface, while presenting the lowest possible required torque to the actuator. This allows for long service life, smooth valve operations, economical actuator selection and reliable tight shutoff.

A steam purge system is required for proper operation of the 4-way switch valve. The purge system keeps the critical areas of the valve flushed free of the coking fluid stream. Purged areas include the seat energizers inside and outside diameters, the body and the packing gland/bearing area. Metso Automation recommends that the purge system be set to a pressure 1.4 bar / 20 psi greater than the process pressure and be operational at all times.
Conclusion

With over 25 years of experience, the series Y4, 4-way switching valve, is another example of Metso Automation’s commitment to technological leadership through design excellence. With our enhanced steam purging system, current Y4 installations have exhibited an extended service life of greater than 5 years. What’s more, Metso Automation Service Centers can efficiently refurbish these 4-way switching valves, furthering your return on investment.