
Question 5: What is the shortest possible time between oil out and entry for maintenance on large inventory, high capacity FCC units? How is this achieved?

HOWELL (Holly Refining)

With FCCs at 27,000 bpd and 9,000 bpd capacity, neither of our units really qualifies for high throughput or large capacity. However, in discussions amongst the members of the panel, we found that throughput and inventory are not necessarily good indicators of how quickly you can move oil-out to maintenance-in.

Historically, Holly has obtained our first entry permits for vessels in the FCC complex 36 to 48 hours from oil-out. During a recent unplanned outage in one of our units, we were still able to open the external manways within 48 hours of oil-out. We were able to do a visual inspection, which was our first-entry in the complex, about 24 hours later at 72 hours from oil-out. We were unable to enter the reactor for three more days, however, mostly due to coke buildup in the reactor vessel. In fact, we were not able to steam because of the circumstances of the shutdown.

With our infrequent FCC shutdowns, we found that the best method for getting into the vessels rapidly is using a set of Evergreen procedures. The latest version of those procedures is stored electronically on the company Internet. Several days prior to any shutdown, operators conduct a Safety Task Review with the engineers, Operations management, and shift supervisors. The procedure is read through with a critical eye. We make any changes necessary at that time. As the unit is shut down, procedures are checked off and annotated so that after the shutdown, we can go back and incorporate those into the most current, correct version of those procedures.

WARDINSKY (ConocoPhillips)

ConocoPhillips operates four FCCs with more than 450 tons inventory. The largest in our system is 650 tons. Three of these run more than 80,000 bpd throughput. The shortest period between oil-out and regenerator maintenance that we have been able to achieve is 48 hours. Getting into position to isolate the converter section from the main fractionator is a first key step. There are several steps that can facilitate the shutdown time elements, as shown on the list. First, you want to make sure you have a lock-out/tag out location list and plot limit blind list well in advance of the shutdown. Assign teams to go out and get those blinds in and positions tagged out. Reduce feed rates to a minimum. Reduce catalyst inventory to a minimum. Circulate catalysts just long enough to burn off the coke and cool it down. Again, one of the main factors in gaining access is getting catalyst out. Keep the regenerator pressure high enough to facilitate catalyst withdrawal. You might want to look at supplemental compressors for that. And then, get your boiler makers working on the manways, hot bolting them as you are blinding.

THOMPSON (Chevron)

FCC shutdown timing is set by requirements to isolate the equipment and remove the catalyst and oil. We have considered three days as pacesetter. Unfortunately, our larger units tend to be a little longer than that. We find that the roadblocks to rapid entry are typically catalyst withdrawal and isolation. That includes reaction mix blind installation.

To speed the catalyst withdrawal, we have gone to either multiple withdrawal points or we use of external catalyst coolers to basically allow us to withdraw catalysts at accelerated rates. As far as getting the reaction mix blind in, we have a couple of units that have the Zimmermann and Jansen mix valves that allow us to isolate the fractionator from the reactor. However, you still have to put a blind in because those systems will not allow you to get entry with just the closed valves.

ASDOURIAN (Sunoco Inc.)

Sunoco successfully opened the doors for entry into the reactor regenerator on one occasion within 30 hours of pulling feed on an FCCU. This particular unit has a 750-ton inventory and runs in excess of 80,000 bpd. However again, this was just one occasion. Typical for us is 48 to 60 hours. The timing associating with catalyst de-inventorying is probably the single greatest contributor to being able to expeditiously gain access. Other factors contributing to expediting the process are dumping catalyst via multiple nozzles and the experience level of the Operations staff that are on duty at the time when this is occurring.

KEVIN PROOPS (Solomon Associates)

We do not have data on the oil-out/oil-in or oil-out to mechanical entry, but we do have data available for what is Best Practice on FCC turnaround duration overall. This data is from 278 FCC turnarounds between 2000 and 2006. Out of those 278, we have seen 10 or 12 units of all scale—from less than 25,000 bpd to well over 100,000 bpd—that define Best Practice. This is a line that is defined as three times the unit capacity of 1,000 bpd plus 290, which gives you hours of downtime; so again, three times capacity plus 290. What that equates to is for a 50,000 bpd unit, you are looking at about 18 days of downtime. For a 100,000 bpd unit, it is about 25 days of downtime. So clearly, we do see scale effects on this. Since we have many clients that have small refineries and small units that worry that they cannot achieve the same performance as big refiners do, I would like to reinforce that there are some things smaller refineries and smaller units do seem to do better. One of them is shorter FCC turnarounds.

MATT BAILEY (Valero Energy)

I have a question on resid crackers. Are people seeing more issues with high CO levels in the reactors

upon initial manway openings and what are people doing if this is encountered?

WALKER (UOP)

CO is a combustion flue gas. That should all be gone early in the shutdown. Am I missing something here?

MATT BAILEY (Valero Energy)

Yes. We have had this experience and I have talked about it with some other folks in the industry. On initial breaks on the reactor, you go to sniff that reactor at that manway. And despite having a good ventilation on the reactor, if there is a lot of coke inside the reactor due to either a breach in the riser termination device or some other mechanical failure that is occurred, there is a lot of coke contained inside that reactor. There is actually some smoldering that goes on inside that reactor as a result of maybe not cooling down the reactor during the decommissioning step. I am just wondering if anyone else has had that experience.

WALKER (UOP)

I understand the question now. We are talking about on the reactor side. Yes, I have heard of this scenario and yes, you do have to be very careful, particularly with resid units or other units that have a history of building up coke in the reactor. You do need to be cognizant of this when you first break open the manways. You also need to be ready to snuff that out with steam or close the manways back up again until you can get further cooling.

THOMPSON (Chevron)

I want to add that it can also be a problem on the regenerator side if you shut down in an emergency basis and have unregenerated catalyst in the regenerator. You can generate a high CO environment. And when you open the manway, if the catalyst is hot, you could get a detonation. That is something to check very carefully before you fully open things and enter.

JIM WEITH (Mustang Engineering)

I have two comments. Many, many years ago, we had a 5,000 bpd FCC with maybe 40- ton inventory. We have a novel feed nozzle arrangement—Ventory-type—that our licensor had provided for us and it plugged off about every six weeks. So for about the first six months until we replaced those, we were

shutting down every six weeks to pull those nozzles out and clean them. We got pretty adept at that although we did not have to enter the reactor. All we had to do was de-inventory the regenerator. So it was: shutdown, cool down, de-inventory, pull the nozzles, clean them, put them back in, re-inventory, and up again. Feed-out to feed-in was typically 36 hours, as I recall. We got pretty adept at it after the third or fourth time. That was a genesis of an article written in the Oil & Gas Journal some time ago about using diagrams for unit startups, which can be applied to shutdowns as well.

The second example occurred at a Los Angeles refinery. You might anticipate that people were reluctant to have any emissions so they felt they always had to shut the air blower down before the catalyst extend pipes lost their seals. This resulted in a lot of catalyst being left behind in the regenerator. Then, you had to open up and vacuum out, which took a couple days because it was hot. Generally, we had one or two personnel burn incidences each time that happened. This could have easily been rectified by at least putting trickle valves or some sort of a heel device on the secondary cyclones, if not both sets of cyclones so they could run the air blower longer.

PHILLIP NICCUM (KBR)

This is a question for Ralph Thompson or anyone else who would care to answer. For units that have a valve between the reactor and the main fractionator, have there been issues with an inability to close that valve after it has been in service for a while, perhaps, due to coking somewhere in the system?

THOMPSON (Chevron)

I am not aware of the valve coking up to the point where it could not be closed. However, I think that is a potential concern because if you have a long run, you have a lot of coking. And of course, there is a point where you could have heat loss. At least, there is a potential for some coking there. I must admit that we do not have enough run experience on those systems to be able to answer that question one way or another. Certainly, I mentioned that you really do need to be able to install a blind, in addition to the valve, so that is another consideration in that installation.

WARDINSKY (ConocoPhillips)

Phil, I assume you are talking about the multiple-use, isolation blind device valve? Then yes, we have several of those in our system. Thus far, I think we are about two or three years into a run using one of them on one unit and it has worked fine. It has not failed.

WALKER (UOP)

The traditional gate valve-type: You could ask the audience here, but I know a number of people who

have had trouble shutting those at the end of the run due to coke formation. You clear the coke out and you can use it during the startup, but problems closing them are not uncommon.

ASHOK MATHUR (KBR Solutions)

I just want to warn against storing procedures only on the Internet. I have two procedure manuals myself. We had a shutdown during complete power failure. Not even the PC was working so I was very happy that one guy had a hard copy in a drawer. Also, your IP friends can let you down when your server is down. And when you are starting up, you have no access to anything. So I really would like to make a plea: Keep a hard copy of your procedures somewhere in a drawer, even if your Quality people do not like it.

BOB LUDOLPH (Sunoco Inc.)

I would like to address Phil Niccum's question regarding the history of closing these valves and whether it has been a problem. We have one location that had a Zimmermann and Jansen installation. I am aware of one occasion where we had difficulty closing that. We eventually did. I cannot stress enough the maintenance of these valves. When you come down for a turnaround, pack and seal them properly. Go through all the proper procedures and they will be reliable for you. Also, the hydraulic gun that is used for sealing it is a very valuable piece of equipment. There is not really a substitute that you could find in a refinery for one of these devices, so protect it that it does not get misplaced.

SHELLY ROMMELMAN (Washington Group International)

To piggyback off the gentleman's question regarding coke formation in the dilute phase of the reactor: Say your refiner has a few close-couple cyclones and they choose to reduce our water-make by turning off their dome steam. Do you guys have any recommendations to minimize coke formation for startup or shutdown?

WARDINSKY (ConocoPhillips)

If you are not using dome steam on a close-coupled cyclone system, you are probably going to be looking at a lot of coke in the reactor. So the first thing I would say from a maintenance standpoint is prepare to get in there with a crew of people with jackhammers to go at it. It is probably going to add some turnaround time. We have had some failures of closecoupled systems in the crossover ducts where we have not seen any indication of that, in terms of a yield shift. But when you went in on turnaround, there was coke the size of a Volkswagen up in the reactor. I think that is how they phrased it. They got to the point where they were looking at having to dynamite it out. I do not think we got that far along. I think we started using some jackhammers and got it out. It will delay your turnaround time

because if you are doing any work lower down in the reactor or the stripper vessel, it is going to have to wait until you get all that coke out of there.

WARREN LETZCH (Shaw, Stone & Webster)

I would have to say the same thing. I think you would be much more advised to try to reduce the stripping steam or something else if you felt you had a sour water problem and address that issue. I would not have thought that the amount of dome steam you were putting in was all that significant compared to, say, the dispersion and stripping stream that you put through the unit. In my opinion, the coking issue in the top of a reactor like that is such a safety issue that I do not really understand why anyone would even consider doing that, based on the talk we had this morning.

WALKER (UOP)

You could probably get away with less dome steam if you had very clean feed than if you had heavier feed there. My observation is that there is a pretty strong correlation there.

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