

**OIL INDUSTRY SAFETY DIRECTORATE
NOIDA**

SAFETY ALERT

Process and Engineering

No.: **P&E:18/05**

Title: Fire incident in FCC Unit of a Refinery in India

Incident: A fire broke out around the area of Feed Bottom exchangers, HCN cooler (A/B) and Primary absorber column, while the unit was running normally. The fire was put off after 1 hour.

Feed Bottom Exchangers (A/ B/ C/ D/E/F):

- Comprised of 3 stacked exchangers i.e. A/B, C/D & E/F.
- CLO is in the tube side and Hydro-treated VGO is in the shell side.
- CLO and VGO in each stack is in series whereas the three stacks are in parallel. As per design, only two sets shall be in line to meet the process requirements.
- Double isolation valves with a Low Point drain (LPD) in between has been provided at the I/L and O/L of CLO (tube side) and O/L of VGO (shell side) for each twin stacked exchanger. However, single globe valve has been provided at the VGO I/L (shell side).

History:

After replacement of tube bundle and successful hydro-test, clearance was issued for de-blinding of Exchanger I/L & O/L of stacked exchangers (E/F), which were under maintenance. Also, Exchangers (C/D) were out of service (shell side was bypassed due to tube leak problem). The unit was running with only one set of stacked Pre-Heat Feed Bottom exchangers (A/B).

During de-blinding jobs of Exchanger (E/F), after removing the blind at the VGO I/L, workers went back to get appropriate Gasket. On return they observed fire in the area. At the time of de-blinding only nominal quantity of oil was found to be dripping as informed.

DCS Trends:

- VGO Feed flow before the exchanger observed to be increased from 436 TPH to 524 TPH within 2 minutes during the incident time. The feed pump was tripped from panel and the VGO feed flow through stacked exchangers (A/B) i.e. at the outlet of exchanger reduced from 115 TPH to 0 TPH at the incident time. Further, the common flow at the outlet of exchanger (A/B/C/D/E/F) to furnace also reduced from 425 TPH to almost 0 TPH during the same period. The pressure at the outlet of the furnace dropped from almost 6 kg/cm² to 0.91 kg/cm².
- The common VGO I/L temperature for all stacked exchangers was observed to be 171 Deg C.
- CLO temperature at the Inlet of all stacked exchangers was around 345 deg C.

Observations:

- The flange of the shell side I/L of Feed Bottom Exchanger was found to have a gap with neither the blind nor spacer in position.
- All isolation valves of Feed Bottom Exchanger were found to be in closed position.

- The feed inlet line globe valve is provided with a stopper indicator to indicate the valve position (Open/ Close/ in between). In field, the stopper found to be in closed position.

Analysis:

- Sudden increase of feed inlet flow from 445 TPH to 550 TPH along with drop of flow through stacked exchanger 23-E-11N B suggests high volume passing (maybe some abnormality/ damage with valve) at high pressure from Exchanger (E/ F) VGO feed inlet valve at the time of de-blinding of the line.

Passing of the valve may have been restricted in the beginning due to congealing of the line from Header to feed inlet valve as the equipment was out of service for a long time.

- As the tube side of the exchanger (C/ D) was charged with CLO at temperature in the range of 340 Deg C, the source of ignition seems to be the contact of VGO feed with hot exposed shell/ piping flanges of the exchanger.
- No provision exists to check the passing of the VGO inlet globe valve at the time of de-blinding of VGO feed inlet line of the stacked exchanger.

Conclusion:

- **Source of hydrocarbon:** Passing Globe valve at the shell side inlet of (E/F) caused leakage of VGO feed from open flange after removal of blind at the downstream of the valve.
- **Source of Ignition:** Spray of Hot hydro-treated VGO (Temp. of around 170 Deg C) on nearby hot surface, possibly exposed flanges of adjoining stacked exchanger (C/D) which allowed the VGO to reach auto ignition temperatures.

Suggested Measures to avoid such incidents in future:

- As indicated by DCS trends, almost the entire flow of around 450 TPH (for two minutes) may have passed through the VGO I/L globe valve. This may not be the case of mere passing of the valve but valve might have stuck up in partially open position or damaged inside. The valve should be checked completely for its healthy condition at the earliest opportunity. As the valve was found in closed position, the stopper position with respect to valve opening / shut off condition to be checked and confirmed.
- Blinding / de-blinding of the VGO feed inlet line of any of the exchanger stacks A/B, C/D or E/F to be done, only after ensuring that VGO feed inlet globe valve is not passing.
- An additional isolation valve with LPD to be provided in the VGO Feed inlet lines of all three sets of stacked exchangers.
- The issues and the identified gaps (single valve at VGO I/L to shell side of each set of exchangers) in the plant for which precautions to be taken needs to be known and shared with all the operation and maintenance personnel of the unit.
- The criticalities involved therein also needs to be well understood by all the operating and maintenance personnel.

This alert is based on the Investigation report submitted by Refinery and published for information purpose only. This information should be evaluated to determine its applicability in your operations, to avoid reoccurrence of such incidents.