

Root Cause Analysis Report
Martinez Refining Company LLC
November 24, 2022 Spent Catalyst Incident

Date of Incident:

November 24, 2022

Date Investigation Began:

November 25, 2022

Material Released:

Approximately 20-24 tons of spent catalyst was released from the Martinez Refining Company LLC (MRC) Martinez Refinery (Refinery) Catalytic Cracking Unit (CCU).

Agency Notifications:

The Bay Area Air Quality Management District was notified of the incident on November 25, 2022 and the Contra Costa County Health Services was notified of the incident on November 26, 2022.

Emergency Response:

No emergency response was required.

Community Impact:

Catalyst was released into the community to the West and Northwest near the Refinery. On November 25, 2022, MRC personnel responded to community calls and collected information, and where relevant, took samples of the material.

Incident Summary:

During the re-introduction of feed to the CCU, catalyst was released into the community.

Event Summary:

On November 21, 2022, there was a feed diversion at the CCU due to low air flow to the Regenerator. The feed diversion automatically de-energized the Electrostatic Precipitators (ESPs) at the Carbon Monoxide Boilers (COBs) #1 and #2. The CCU was placed in hot standby.

The process to re-introduce feed to the CCU began at 00:10 on November 23, 2022 with the introduction of torch oil to the Regenerator. At 12:32 on November 24, 2022, feed was re-introduced to the Reactor. In the late afternoon and early evening of November 24, 2022, as more feed was introduced, the pressure in the Reactor began to rise, resulting in a shift in the pressure balance between the Reactor and the Regenerator. The pressure shift in turn caused the catalyst bed level in the Regenerator to rise. At 19:27, to counteract the Regenerator bed level increase,

MRC personnel began opening the Regenerator slide valve and closing the Stripper slide valve. However, these steps were unsuccessful in reducing the Regenerator level.

At 20:05, to rebalance the pressure between the Reactor and the Regenerator, MRC personnel began increasing the pressure in the Regenerator incrementally by adjusting pressure control valve PV171. At 20:07, the catalyst bed level in the Regenerator reached the critical alarm level of 34 feet and continued to rise. Additionally, at 20:09, MRC personnel began dropping catalyst from the Fourth Stage Separator (FSS) into the Spent Catalyst Hopper in anticipation of catalyst carryover from the Regenerator.

At 20:31, the Regenerator bed level reached a high of 36 feet, a level that was high enough to cause additional catalyst carryover to the Third Stage Separator (TSS) and FSS. At 20:34, the FSS differential pressure also exceeded the alarm limit of 2 pounds per square inch (psi), indicating there was a high level of catalyst in the FSS. At 20:59, the Regenerator bed level dropped below the alarm point of 34 feet. By 21:21, the Regenerator bed level came down to 26 feet.

Operators continued to dump catalyst from the FSS, and by 04:03 on November 25, 2022, the FSS differential pressure dropped below the two (2) psi alarm. The ESPs were energized at 06:07, when the CCU was in stable operation.

Based on the above timeline, it is likely that catalyst was released into the community between 20:34 on November 24, 2022 and 04:03 on November 25, 2022.

Root Cause Analysis:

Root Cause No. 1: As the Reactor pressure increased, the setpoint changes to Regenerator pressure control valve PV171 were being made manually and did not effectively offset the increased Reactor pressure and the resulting flow of catalyst from the Reactor and Stripper into the Regenerator.

Root Cause No. 2: As the Regenerator catalyst bed level increased, the changes to the position of the Stripper slide valve were being made manually and were insufficient to prevent the Regenerator catalyst bed level from continuing to increase.

Contributing Factor: During the re-introduction of feed to the CCU, the Wet Gas Compressor (WGC) was near surge conditions and required the injection of propane into the Main Fractionator (MF) Overhead Accumulator to increase the molecular weight of the gas and prevent flaring. The MF overhead pressure, which ultimately controls the Reactor pressure, could not be reduced to help balance Reactor and Regenerator pressures because of low propane inventory in the Refinery.

Human Factors Analysis:

The purpose of the Human Factors analysis was to: (1) examine human factors and/or systemic issues including, but not limited to, employee training, experience, qualifications, fatigue management, operating conditions, procedures, equipment conditions, from when the CCU feed diversion was activated on November 21, 2022 (~01:05) through when the ESPs were energized

on November 25, 2022 (~06:07) and (2) determine and understand if these factors may have contributed to the incident.

This analysis revealed two (2) instances in which MRC personnel did not comply with Refinery policy and procedure during the incident. First, there was a deviation from the Refinery's *Work Schedule Expectations for Staff (Exempt and Non-Exempt)* policy regarding an individual who exceeded his hours limitation. Second, some End of Shift Reports were not properly completed pursuant to the Refinery's *Roles and Responsibilities SOSO* procedure.

However, it was concluded that these deviations do not appear to have directly contributed to the root causes of the incident because the individual who exceeded his hours limitation was not directly involved in the pressure and catalyst bed regulations discussed above; and because the End of Shift Reports are unlikely to have had any effect on the incident.

Incident Notification Analysis:

The purpose of this analysis was to determine the reason(s) why MRC personnel did not notify the appropriate regulatory agencies, community, and other stakeholders of the incident at the time of the incident. The analysis revealed that:

1. During the incident, because there was nothing seen on Refinery units and equipment or inside the Refinery property and there were no calls from the community, MRC personnel were unaware that the opacity event resulted in any release into the community. After receiving community calls reporting visible particles the morning after Thanksgiving, MRC personnel began investigating whether the material originated from a reported nearby fire or was related to the refinery. MRC communicated with regulatory agencies on Friday night and Saturday.
2. There was (and currently is) no mechanism to alert MRC personnel to the potential that an opacity event might result in a release of catalyst into the community. As a result, there is a lack of awareness among MRC personnel that a high differential pressure in the FSS could result in catalyst carryover that could be released into the community. Additionally, visual observations by MRC personnel of opacity events from the COB stacks are unreliable for determining the potential for a catalyst release into the community. There were no community monitoring requirements during opacity events from the COB stacks.
3. After the February 2015 ESP over-pressurization incident at the ExxonMobil Oil Corporation Torrance Refinery, the Martinez Refinery's CCU startup process was modified to leave the ESPs de-energized until the unit establishes stable operation to prevent a similar incident. As a result, CCU opacity events became more frequent during startups because the ESPs were de-energized, particularly when the CCU is transitioning from hot standby.

Corrective Actions from Root Cause Analysis:

MRC is proposing to implement the following corrective actions at this time, and looks forward to discussing whether any additional actions are appropriate:

Corrective Action No. 1: Based on the learnings from this incident, develop a control strategy for automating the differential pressure control between the Regenerator and Reactor during startup and feed re-introduction.

Projected Date of Corrective Action: July 31, 2023

Corrective Action No. 2: Based on the learnings from this incident, CCU Operator alarm actions for Regenerator/Reactor differential pressure and Regenerator catalyst bed level will be updated to provide additional alarms and response guidance to MRC personnel in the event of such alarms.

Projected Date of Corrective Action: July 31, 2023

Corrective Action No. 3: Based on the learnings from this incident, develop additional operator training on steps to take to address high Reactor/Regenerator differential pressure as well as high or low Regenerator catalyst bed level.

Projected Date of Corrective Action: July 31, 2023

Corrective Action No. 4: Based on the learnings from this incident, modify Operating Procedure CCU-1110 and other relevant procedures to provide additional instructions on when to put the Stripper slide valve into level control to regulate the flow of catalyst to the Regenerator.

Projected Date of Corrective Action: July 31, 2023

Corrective Action from Contributing Factor:

Corrective Action No. 5: Based on the learnings from this incident, evaluate options to increase the molecular weight of wet gas sent to the WGC during CCU startup and feed re-introduction.

Projected Date of Corrective Action: July 31, 2023

Corrective Actions from Human Factors Analysis:

Corrective Action No. 6: Based on the learnings from this incident, reiterate to MRC personnel the expectations and requirements to comply with the Refinery's *Work Schedule Expectations for Staff (Exempt and Non-Exempt)* policy.

Projected Date of Corrective Action: March 31, 2023

Corrective Action No. 7: Based on the learnings from this incident, reiterate to MRC personnel the expectations and requirements to complete End of Shift Reports and audit to ensure compliance with the Refinery's *Roles and Responsibilities SOSO* procedure.

Projected Date of Corrective Action: March 31, 2023

Corrective Action No. 8: Based on the learnings from this incident, develop additional tools to increase the effectiveness of oversight of staff employee work schedules and fatigue management.

Projected Date of Corrective Action: July 31, 2023

Corrective Actions from Notification Analysis:

Corrective Action No. 9: Based on the learnings from this incident, add an indication of the CCU FSS pressure differential to the Utilities Console with the appropriate alarm and response guidance to MRC personnel to better assess the potential for release.

Projected Date of Corrective Action: March 31, 2023

Corrective Action No. 10: Based on the learnings from this incident, update the MRC community monitoring procedures to include activation and MRC personnel response for defined opacity events.

Projected Date of Corrective Action: March 31, 2023

Additional Corrective Actions:

Corrective Action No. 11: Based on the learnings from this incident, evaluate Operating Procedure CCU-1110 and other relevant procedures to determine if the ESPs can be safely activated in the CCU startup process.

Projected Date of Corrective Action: July 31, 2023