Benicia Refinery • Valero Refining Company - California
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PSM Major Incident 90-Day Report

May 5, 2025 F-701 Incident
Report Completion Date: August 1, 2025

ATTENTION: Fire Chief
Benicia Fire Department
250 East L Street
Benicia CA, 94510
hazmatliaison@ci.benicia.ca.us

RE: May 5, 2025 F-701 Incident

Please see the attached Incident investigation report that is to be submitted to Solano County by Valero Refining Company – California (Valero) to meet the obligations for a Major Incident report. In addition to the typical Root Cause Analysis information, Valero identified that the new City of Benicia Industrial Safety Ordinance (ISO) also requested this information.

IDENTITY OF MATERIAL RELEASED, PHYSICAL STATE AND ESTIMATED OR KNOWN QUANTITIES

After the fire was reported and confirmed, Valero initiated an unplanned emergency shutdown of the Fluid Catalytic Cracking Unit (FCCU). This shutdown resulted in flaring of excess hydrocarbons and a release of approximately 840 pounds of sulfur dioxide (gas), which is over the Reportable Quantity (RQ) of 500 pounds. All required notifications were made.

In the 7-day CalOES (Office of Emergency Services) report submitted to Solano County and the City of Benicia, Valero included only the material that was over a RQ.

Based on the confirmed location of the loss of containment in the F-701 area and the equipment involved, Valero validated that hydrocarbon material was released, most of which was combusted (producing smoke) during the fire. Approximately 19.8 barrels of Cat Cracker Feedstock (gas oil) was released.

COMMUNITY IMPACT, including number of off-site complaints, air sampling data during event, etc.

The City of Benicia Fire Department as part of the Emergency Operations Center (EOC), declared a precautionary shelter-in-place for the entire city of Benicia at approximately 9:33 a.m., and it was subsequently lifted at 10:50 a.m.

The shelter-in-place was declared out of an abundance of caution to avoid any potential exposure to particulate matter from smoke.

There was no offsite property damage associated with this event. All claims sent to the Valero claims department have been resolved.

As part of Valero's response, air monitoring was conducted at various locations. Air sampling data was included in the 72-hour report and all areas monitored outside of the refinery were below regulated limits. Valero's fenceline air monitoring data reports for 2Q2025 will be sent to the Bay Area Air District (BAAD) in late August.

The BAAD indicated they also did air monitoring, and Valero has requested air sampling data from them.

METEOROLOGICAL CONDITIONS AT THE TIME OF EVENT, including wind speed, direction, and temperature

During the morning of May 5, 2025, the wind was predominantly from the north/northeast blowing towards southwest/south. The refinery wind gauge data was over 34 miles per hour (mph) at 8:39 a.m. and reached 35.2 mph at 8:44 a.m. Temperatures ranged from approximately 57-77 degrees Fahrenheit with weather being mostly clear throughout the morning.

The area / streets and neighborhood affected for the city report were downwind to the southwest/south as the wind was predominately coming from the north/northeast.

The initial investigation was reviewed at the June 2025 Community Advisory Panel (CAP) and minutes can be found here: https://www.beniciacap.com.

In addition, the flaring causal report was submitted to BAAD on July 30, 2025. https://www.baaqmd.gov/en/about-air-quality/research-and-data/flare-data/flare-causal-reports

Please contact me if you have any questions regarding this document.

Sincerely,

MM Fimbres

Melissa Manke Fimbres
Director – HSE & Regulatory Affairs, Benicia
Office (707) 745-7377

Report Completion Date: August 1, 2025

INCIDENT DATE: 05/05/25 INCIDENT TIME: 08:45 AM

I. DESCRIPTION OF INCIDENT

At approximately 8:45 a.m. on Monday, May 5, 2025, the Benicia Refinery experienced a fire near Furnace 701 (F-701), the Fluid Catalytic Cracking (FCC) Unit's Pre-Heat Furnace.

Valero immediately began responding by mobilizing the Valero Emergency Response Team (ERT) and providing communication to the City of Benicia's Fire Department (BFD) and different regulatory agencies. Valero activated the Emergency Alarm and initiated an emergency shutdown of the FCC Unit.

The Emergency Operations Center (EOC) was activated at approximately 9:00 a.m., which included representation from BFD and Solano County's Hazardous Material Division which is the Certified Unified Program Agency (CUPA).

The furnace was isolated, and water was put on the fire at 9:05 a.m. which resulted in the fire being minimized. Upstream process feed streams were isolated as of 10:12 a.m. An all clear notification was sounded with the refinery alarm at 10:38 a.m.

This shutdown resulted in flaring of excess hydrocarbons and a release of approximately 840 pounds of sulfur dioxide (gas), which is over the Reportable Quantity of 500 pounds. Valero validated that hydrocarbon material was released, most of which was combusted (producing smoke) during the fire. Approximately 19.8 barrels of Cat Cracker Feedstock (gas oil) was released. All required notifications were made.

II. INVESTIGATION METHOD AND TEAM

At noon on May 5, 2025, Valero convened a team to begin investigating the root cause of the Incident using a causal analysis method consistent with applicable state and federal regulations and the Benicia Refinery's Incident Investigation Reporting Procedures. The investigation team included refinery personnel with expertise in Process Safety, Operations, including hourly personnel, Maintenance, Inspection, and other pertinent areas. The investigation team also consulted with third-party and Valero technical experts. A root cause method of casual analysis was performed.

The investigation team reviewed various materials in connection with the investigation into the Incident, including, but not limited to: Process Safety Information (equipment drawings and mechanical integrity data), FCC Unit Process Hazard Analysis, the FCC Unit Damage Mechanism Review (DMR), and furnace operating conditions.

The investigation team determined findings and developed recommended corrective actions for the event.

III. PROCESS AND DESIGN OVERVIEW

Process units relevant to the Incident include the FCC Unit. This unit has a preheat furnace to heat the FCC Unit feed to temperatures required for the desired chemical cracking reactions to occur. The furnace is fired by refinery fuel gas and natural gas. The FCC Unit Feed (gas oil) flows from piping and enters tubes inside the furnace at the edge of the firebox. The flue gases from this furnace flow to the stack (ST-701) which is located just north of the furnace firebox. This stack includes continuous emissions monitoring system (CEMS) control consistent with state and federal environmental requirements.

Depending on the heat input needs of the FCC Unit, it is not required to operate the preheat furnace for all modes of operation. Conditions that will allow FCC Unit operations without the furnace include more hot/warm feed flow from upstream units (Cat Feed Hydrofiner) and/or flow directed through preheat exchangers (E-703 and E-702).

ST-701 is 239 feet tall, standing on its own foundation, and is adjacent to and receives flue gas from the FCC Unit pre-heat furnace (F-701) through horizontal ducting at the 68-foot level. The stack is internally insulated up to the 60-foot level. ST-701 was fabricated with five sections of successively thinner rolled carbon steel plate, with the thinnest making up the upper 55 feet. ST-701 has a series of original assembly flanges and stiffening rings, roughly every 16 feet vertically.

IV. EQUIPMENT INSPECTION ANALYSIS

After the unit was safely shutdown, entry was made into the furnace. Visual inspection confirmed that the failure occurred at the top 37 feet of the stack. Based on the external inspection data, this part of the stack ultimately thinned due to corrosion, caused by low temperatures in the upper section. No significant corrosion was found in the bottom majority of the stack when inspected post-Incident in May 2025. When the stack was last externally inspected in 2022, no issues were identified.

After the Incident, coupons were removed from the upper stack components. The third-party testing analysis utilized ultrasonic testing to document the thickness of the carbon steel. The investigation team reviewed the results of this analysis.

Figure 1: Stack where coupons were removed

The investigation team observed that thinning was present at the upper stiffening rings. The stack failure occurred at the third stiffening ring from the top.

Accessible areas in the bottom half of the stack indicated no accelerated or localized corrosion in those areas. The investigation team identified that the corrosion rate was two to four times higher at the stiffening rings and flanges. The corrosion was about two times higher measured near the top of the stack, relative to the bottom areas. Dew point is experienced more frequently at higher elevations in the stack, and the areas less accessible for inspections.

American Petroleum Institute (API) Standard 560 - Fired Heaters for General Refinery Service and API Recommended Practice 573 - Inspection of Fired Boilers and Heaters provide general guidance for the inspection of furnace stacks, but do not provide requirements for interval assignment.

ST-701 has been inspected on an approximately eight-year interval. Recent pre-Incident inspections focused on external signs of corrosion and areas accessible by ladders and platforms (up to 110 feet which is about half of the entire stack height).

The last inspection was an external inspection performed in May 2022.

In the April 2010 and 2022 external inspections, the stiffening ring was noted to be in place and no defects were found. In addition, the external coating was found to be in good condition in 2022.

V. DAMAGE MECHANISM

Flue Gas Dew Point Corrosion refers to corrosion resulting from condensation of acid gases such as sulfur dioxide within the products of combustion. At temperatures below dew points, these gases and the water vapor in the flue gas will condense to form acids such as sulfurous, sulfuric, and carbonic acids which can lead to severe corrosion of carbon steel.

An open stack is susceptible to uncontrollable ambient conditions and Flue Gas Dew Point Corrosion occurs when the metal surface temperature falls below the dew point temperature of a flue gas.

All fired process heaters or furnaces that burn fuels containing even trace amounts of hydrogen sulfide from refinery fuel gas reprocessing have the potential for sulfuric acid dew point corrosion in the economizer sections and in the stacks. The stack is the most susceptible section because it is difficult to control the final exhaust temperature of the furnace as it encounters the atmospheric conditions. Lower throughput or flue gas temperatures from the furnace can also further increase the amount of time a dew point temperature is experienced.

In the review of the Damage Mechanism Review, furnace tubes rather than the furnace stacks were the area of focus. This is because there is not an industry standard (API) for stack inspection requiring thickness monitoring. The potential for significantly different corrosion rates at different stack elevations was not appreciated at the site. Additionally, thickness measurements at different elevations are not required in industry inspection standards for furnace stacks.

VI. CAUSAL ANALYSIS

The root cause of the fire was caused by a loss of containment. This was the result of part of the furnace stack falling to grade, striking equipment and causing a loss of containment. Approximately 32 feet of the large diameter stack impacted furnace process piping, leading to the release of gas oil and an associated fire.

The investigation identified that the stack had experienced preferential, internal metallurgical corrosion in the upper part of the stack, above the section that is refractory lined. The stiffening rings surrounding the circumference of the stack acted as a cooling sink, causing the flue gas to condense and cause localized corrosion at the stack. The stack operates 25-50 degrees Fahrenheit cooler at the top as compared to the highest point accessible by ladder. Due to access challenges, Ultrasonic Thickness (UT) data is not often taken above ladder height during inspections.

Infra-red (IR) furnace inspections have been performed on two-year intervals, and each has included the stack. Stack operating temperature (measured at the convection section outlet) varies from 300-600 degrees Fahrenheit, in accordance with furnace fired duty. IR surveys show F-701 stack skin temperatures at or below dew point (~140 degrees Fahrenheit). IR surveys showed stack skin temperatures losing up to 50 degrees Fahrenheit per 100 feet of stack height. ST-701 is noticeably cooler near its assembly flanges and stiffening rings per the IR scans.

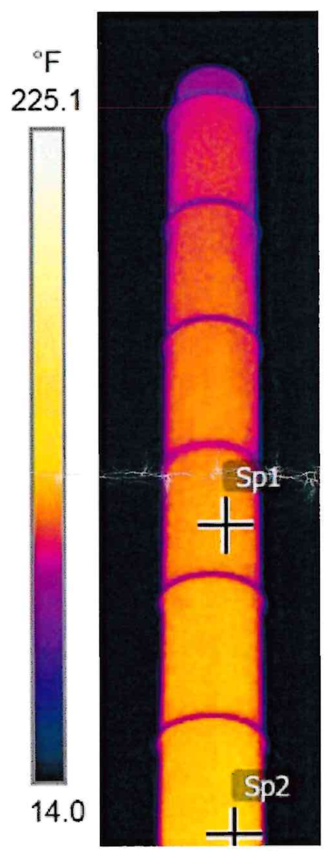

Figure 2: IR scan of F-701

VII. FINDINGS AND RECOMMENDED ACTIONS

The investigation team identified direct and indirect causes and findings and developed corresponding actions.

Findings	Recommended Actions
Localized Flue Gas Dew Point Corrosion occurred at the top of the stack.	Interim Measure: Review other furnace stack IR scans to identify if any other stack flue gas is running below dew point temperatures and might be at a risk for accelerated corrosion.
	Recommended Action: Based on the results of the IR scan review, implement inspection on required stacks. Recommended Action: Update inspection policy to include thickness monitoring for stacks.
There is not an industry standard (API) for stack inspection requiring thickness monitoring.	Recommended Action: Develop site-specific policy for stack inspection.
Furnace tubes rather than the furnace stacks were the area of focus in the DMR.	Recommended Action: Include analysis of damage mechanisms specific to furnace stacks in future DMRs (Flue Gas Dew Point Corrosion of upper stack).
It is difficult to control the final exhaust temperature of the furnace stack as it encounters the atmospheric conditions.	Recommended Action: Evaluate the stack operating temperature and include low temperature limit in process trend monitoring.