Investigation Update

February 2024

On November 19, 2023, at approximately 12:21 a.m., a metal tube ruptured within a reactor charge furnace during a unit startup at the Martinez Renewables facility in Martinez, California. The ruptured tube released renewable diesel and hydrogen, resulting in a fire that seriously injured one Marathon employee (**Figure 1**). This document provides an update on the ongoing CSB investigation of this incident.

Background Information

- The Martinez Renewables facility is a 50/50 joint partnership between Marathon Petroleum ("Marathon") and Neste,[a] operated by a subsidiary[b] of Marathon [1]. The facility previously operated as a petroleum refinery for more than 100 years under various owners until 2020, when Marathon ceased production at the site. Marathon converted the site to a renewable fuels facility, which began production in early 2023 with plans to increase operation to full design capacity by the end of 2023 [2].
- Renewable diesel and hydrogen were released during the incident. Renewable diesel, a biomass-based diesel made from plant oils and animal fats [3, 4], is a flammable liquid with a flash point ranging between 135-168 °F [5]. Hydrogen is a colorless, odorless, highly flammable gas [6].

Figure 1. Surveillance footage of furnace fire. (Credit: Marathon)

[a] Neste is a renewable diesel and sustainable fuel supplier headquartered in Espoo, Finland [9, 10].

[b] The Martinez Renewables facility is operated by Tesoro Refining & Marketing Company LLC, a subsidiary of Marathon [11].

- The incident occurred during the initial startup of a hydrodeoxygenation (HDO) unit, a process unit that was converted from a diesel hydrotreater unit in the original petroleum refinery. The HDO process catalytically removes oxygen from the renewable feedstock before it is processed further in downstream units to make renewable diesel, an alternative to conventional diesel fuel [7]. Marathon repurposed equipment from its original diesel hydrotreater unit, reconfigured the process piping, and introduced new equipment to convert the existing unit into the new HDO unit.

- The HDO unit was designed with a furnace to pre-heat renewable feedstock, recycled renewable diesel, and hydrogen before subsequent processing. Within the furnace, up to eleven fuel-gas fired burners heated the process materials, which flowed through stainless steel tubes inside the furnace (**Figure 4**). During the HDO conversion project, Marathon installed new, reconfigured tubes in the furnace. Documentation indicates that the new tubes were constructed of ASTM A312 Grade 321 stainless steel.

Incident Description

- On the night shift of November 18, 2023, Marathon was in the process of starting up the HDO unit. Personnel had established renewable diesel and hydrogen circulation in the unit and had begun using the furnace to heat up the process materials.

- During the hour leading up to the incident, Marathon operations staff were attending to furnace temperature control issues. Temperature instruments inside the furnace indicated excessive temperatures on the furnace tube surfaces, triggering audio and visual high temperature alarms at 1,100 °F on computer control system screens inside the control room. Minutes before the rupture, all tube temperature indicators were in excess of the high-temperature alarm setpoints, with 8 out of 10 instruments indicating temperatures ranging from approximately 1,490 °F to 1,710 °F.

- To reduce temperatures within the furnace, Marathon operations staff increased the flow of material through the furnace and directed a field operator to turn off two of the furnace burners. At the furnace, the field operator closed manual fuel gas valves to turn off two of the four burners that were lit at the time. Around 12:21 a.m., just after the field operator had completed this action, a tube ruptured within the furnace, releasing hot renewable diesel and hydrogen. The materials released from the furnace and ignited, causing a fire (**Figure 1**). The field operator was seriously injured by the release and fire, suffering third-degree burns to most of his face and body. Despite his severe injuries, he made his way approximately 80 yards from the furnace area to the field operator shelter, where he was discovered by fellow operators and air-lifted to a nearby hospital. The fire was extinguished by approximately 1:15 a.m., and an all-clear was sounded at approximately 2:00 a.m. [8].

- The morning after the incident, Marathon employees discovered that a normally closed manual bypass valve upstream of the furnace was open (misaligned), which created a potential flow path around the furnace. The flowmeter intended to monitor diesel flow through the furnace was located upstream of the open bypass valve, and had been indicating flow at the time of the incident. Although safety interlocks existed to automatically shut down the furnace during low renewable diesel flow to the furnace and high temperatures downstream of the furnace, none of these conditions were detected by the instrumentation, and the interlocks did not activate (**Figure 2**). Any flow being bypassed around the furnace would have fed back into the process piping upstream of the high temperature safety interlock instrumentation.

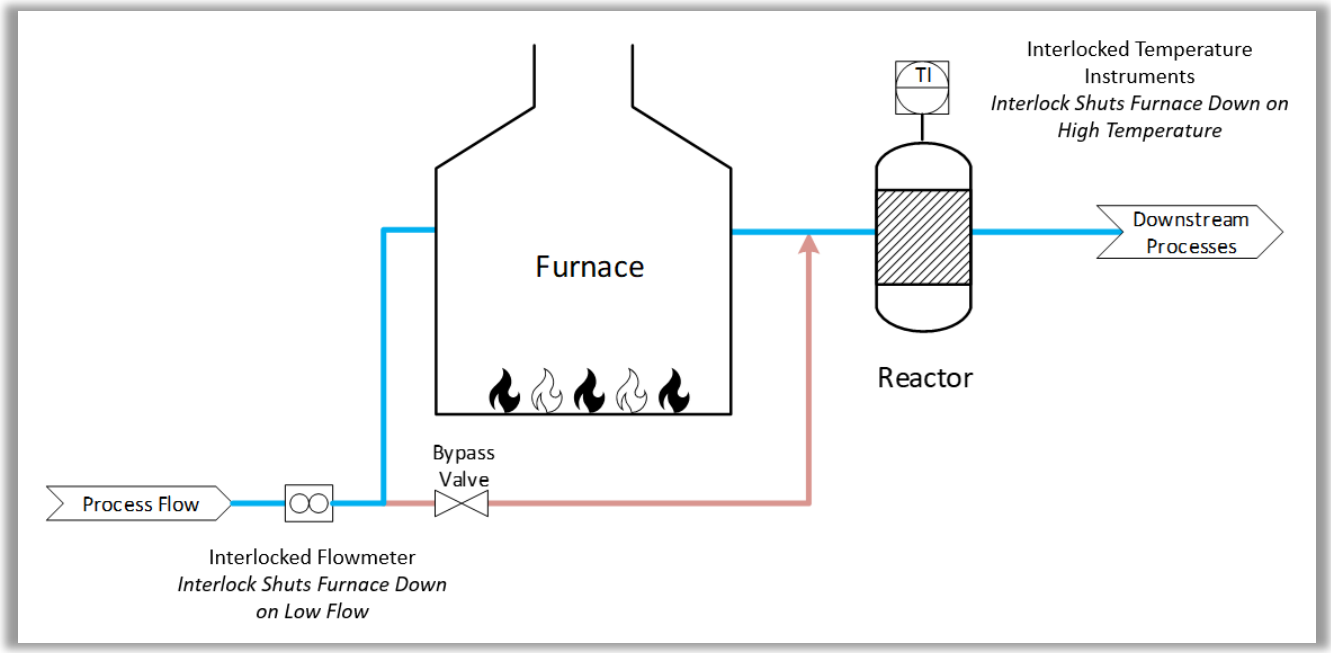

Figure 2. Simplified process flow diagram depicting furnace safety interlock instrument configurations relative to the bypass valve found open after the incident. Note: Not all instruments and interlocks are depicted. (Credit: CSB)

Furnace Tube Failure

- A post-incident examination of the furnace identified the release point as a ruptured tube in the convection section of the furnace (**Figure 3** and **Figure 4**). Further investigation of the furnace tubes is ongoing.

Figure 3. Post-incident image showing the failed furnace tube from above. (Credit: Marathon)

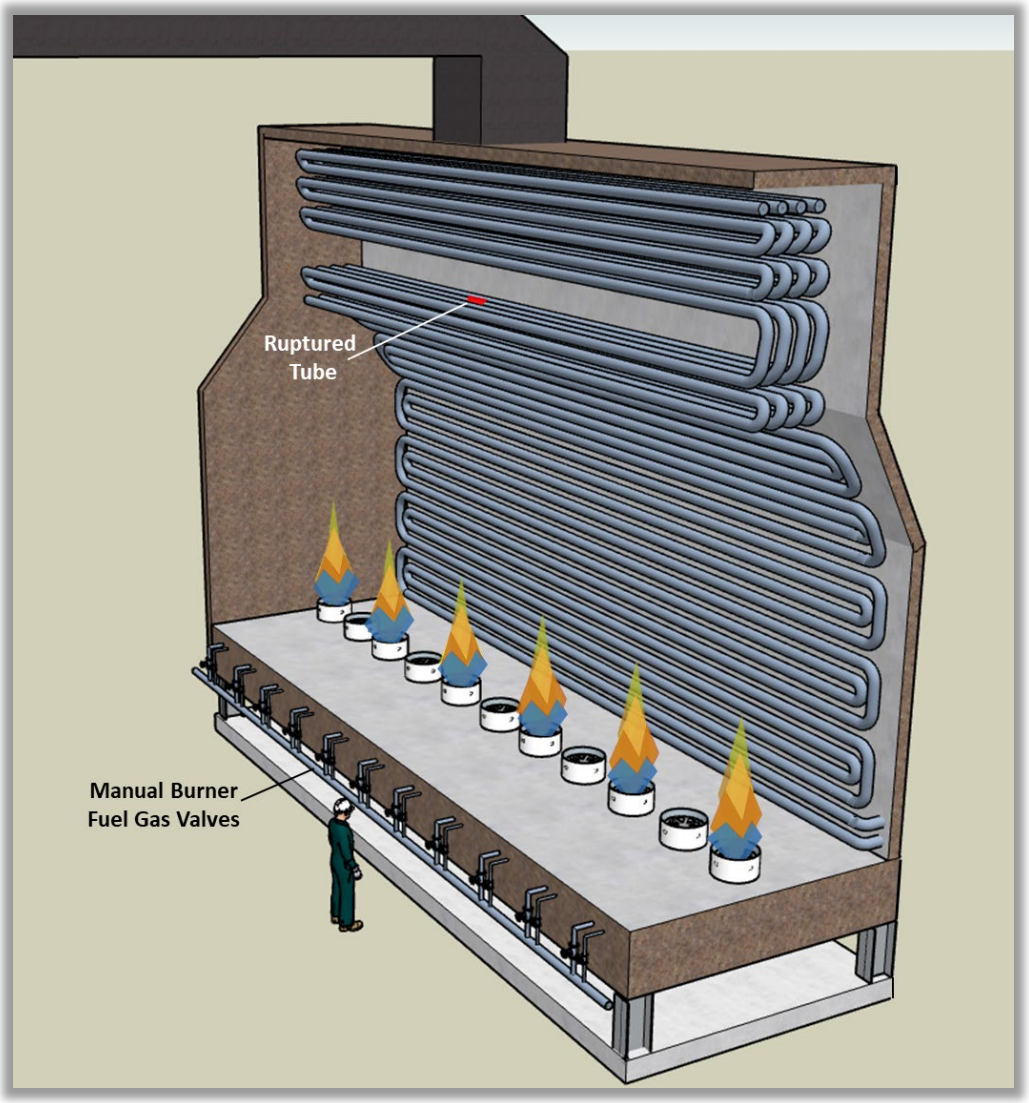

Figure 4. Depiction of the interior of the furnace showing the location of the tube failure. Person shown for scale. The lit burners in the illustration above do not necessarily depict their actual state at the time of the incident. (Credit: CSB)

Path Forward

- The CSB is continuing to gather facts and analyze several key areas, including:
  - Ongoing inspection of furnace internal components
  - Furnace tube metallurgy and failure mode analysis
  - Identification and control of potentially hazardous scenarios
  - Relevant facility, corporate, and industry standards
- The investigation is ongoing. Complete findings, analyses, and recommendations, if appropriate, will be detailed in the CSB's final investigation report.

References

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[11] Contra Costa Country, "Martinez Refinery Renewable Fuels Project," [Online]. Available: https://www.contracosta.ca.gov/7961/Martinez-Refinery-Renewable-Fuels-Projec. [Accessed 15 February 2024].