Incident Title	**Charge Heater Convection Tube Rupture**	
Incident Type	Fire	
Date	19th November 2023	
Country	USA	
Location	Martinez (formerly Avon/Golden Eagle), CA	
Fatalities	**Injuries**	**Cost**
0	1	US$ 350 m – Ref. 1

Incident Description

Credit: US Chemical Safety Board

The incident occurred during startup of an idled diesel hydrotreating (DHT) unit which had been repurposed as a hydrodeoxygenation (HDO) unit to produce renewable diesel from agricultural and meat processing wastes.

HDO reactions remove oxygen from the organic waste feedstocks and are exothermic, so a portion of renewable diesel product is continuously recycled to the reactor to help control the exotherm. In normal operation, fresh feed is routed direct to the reactor while recycled product is mixed with makeup hydrogen (H_2), preheated in a series of heat exchangers and further heated in a 4-pass "cabin-type" fired heater comprising horizontal 321 stainless steel radiant and convection tubes and 11 floor-fired natural draft burners. Recycle H_2 is routed to the reactor (bypassing the heater) via an open diverter valve and a preheat exchanger. Two jumpover lines with manual isolation valves connect the recycle H_2 system to the heater inlet (upstream or downstream of the main preheat exchangers) when the diverter valve is closed at startup.

At startup, the HDO unit is first warmed with a mix of recycle and makeup H_2 (no diesel) so the diverter valve was closed and both recycle H_2 jumpover valves were opened (only 1 required). When fresh feed was introduced, the diverter valve was opened but only 1 of the 2 jumpover valves was closed. Convection tube metal temperatures were rising, so a field operator was sent to investigate and shut down individual burners. A convection tube ruptured, releasing renewable diesel and H_2, resulting in a fire that seriously injured the attending operator. The unit remained shut down for around 1 year.

Incident Analysis

Basic cause of the fire was rupture of a 321 stainless steel convection tube due to short term overheating caused by low process fluid flow through the heater tubes combined with fuel gas afterburning in the heater firebox.

Critical factors included: 1) Startup jumpover lines tied in downstream of the liquid feed and makeup gas flow meters (defeating low flow trip), 2) A valve on one startup jumpover line was left open (diverting flow away from heater), 3) Air inlets to 2 of 4 in-service burners were blocked by cover plates (leading to flameout/afterburn), 4) An operator was sent out to heater to troubleshoot high temperature alarms while it was in unsafe condition (hazard exposure).

Root causes included: 1) inadequate process hazard analysis (risk of reverse flow through startup line not recognised), 2) inadequate monitoring of burner operation (absence of flame detectors, combustibles analyser), 3) inadequate operating procedures (valve lineups), 4) inadequate operator training (cover plates), 5) failure to implement fired heater design standards (safe tube metal temperature limit), 6) failure to learn (multiple similar incidents in industry).

Lessons Learned

1) Fired heaters should have safe operating (not-to-exceed) tube metal temperature (TMT) limits with alarms to alert personnel of an unsafe state requiring them to move away from the heater and shut it down remotely.
2) Fired heaters should have automatic low process flow trips to shut down all burners (including in misdirected and reverse flow scenarios); hence flow sensors should be located downstream of any process pipe connections.

More Information

1) "Fired Heater Tube Rupture and Fire at Marathon Martinez Renewables Facility", US Chemical Safety and Hazard Investigation Board, Report No. 2024-01-I-CA (2025): US CSB Investigation Report

Industry Sector	Process Type	Incident Type
Oil & Gas	Renewable Diesel Hydrotreating	Fire
Equipment Category	**Equipment Class**	**Equipment Type**
Mechanical	Heaters & Boilers	Direct-fired Heater

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