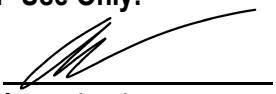
ATTACHMENT C
30-DAY FOLLOW-UP NOTIFICATION REPORT FORM
CONTRA COSTA HEALTH SERVICES HAZARDOUS MATERIALS PROGRAMS

INSTRUCTIONS: A hardcopy and an electronic copy of this report is to be submitted for all Public Health Advisory – Level 2 and Public Protective Actions Required – Level 3 incidents or when requested by CCHSHMP. See Attachment C-1 for suggestions regarding the type of information to be included in the report. Attach additional sheets as necessary. This form is also to be used for update reports after the initial 30-day report has been submitted. Forward the completed form to:

For CCHSHMP Use Only:
Received By: 
Date Received: 9/18/24
Incident Number: 231119-01
Copied To:
Event Classification Level: 2

ATTENTION:
Hazardous Materials Programs Director
Contra Costa Health Services Hazardous Materials Programs 4585 Pacheco Boulevard, Suite 100
Martinez, CA 94553

INCIDENT DATE: Sunday, November 19, 2023
INCIDENT TIME: 12:21 AM
FACILITY: Martinez Renewables

PERSON TO CONTACT FOR ADDITIONAL INFORMATION

Kenneth Bloch Phone number 925-370-3326

PROVIDE ANY ADDITIONAL INFORMATION THAT WAS NOT INCLUDED IN THE 72- HOUR REPORT WHEN THE 72-HOUR REPORT WAS SUBMITTED, INCLUDING MATERIAL RELEASED AND ESTIMATED OR KNOWN QUANTITIES, COMMUNITY IMPACT, INJURIES, ETC.:

A TapRooT investigation into the F20 furnace fire is still underway in accordance with the Industrial Safety Ordinance section 450-8.016 (c)(1), "Root Cause Analysis and Incident Investigation," and Section C guidance. Investigation report timing and communication with CCHSHMP will be in compliance with ISO section 450 8.016, Section C guidance, and the Hazardous Materials Incident Notification Policy.

I. **INCIDENT INVESTIGATION RESULTS**

Is the investigation of the incident complete at this time? X Yes ___ No If the answer is no, submit a 30 day final or interim report.

If the answer is no, when do you expect completion of the Investigation?

If the answer is yes, complete the following:

SUMMARIZE INVESTIGATION RESULTS BELOW OR ATTACH COPY OF REPORT:
The investigation summary report is attached.

SUMMARIZE PREVENTATIVE MEASURES TO BE TAKEN TO PREVENT RECURRENCE INCLUDING MILESTONE AND COMPLETION DATES FOR IMPLEMENTATION:
Please see the 'Root Causes and Corrective Actions' section of the attached incident report.

STATE AND DESCRIBE THE ROOT-CAUSE(S) OF THE INCIDENT:
Please see the 'Root Causes and Corrective Actions' section of the attached incident report.

Martinez Renewables 2HDO Recycle Furnace Fire

Location: Martinez Renewables Facility
Date of Incident: November 19, 2023
Time of Incident: 00:21 Pacific Standard Time
Investigation Began: November 19, 2023
Date of Report: September 13, 2024
Name of Incident: 2HDO 004-F-20 Fire
Investigation Method: TapRoot™ Root Cause Analysis

Summary of the Incident

On November 19, 2023, at approximately 00:21, a furnace tube ruptured in the 004-F-20 Recycle Furnace resulting in a fire. A Field Operator was in the process of shutting off fuel gas flow to burners in the Recycle Furnace, 004-F-20, when a furnace tube ruptured. The Field Operator was able to leave the area and make his way to the Field Operator Shelter. The injured operator was life flighted to a nearby hospital for medical care.

Immediate Corrective Actions and Interim Measures Implemented

The Operators and Shift Supervisor initiated the emergency response system. Emergency response personnel activated local fire monitors and suppressed the fire. Simultaneously, the Console Operator depressured the unit. Emergency response personnel isolated plot limit valves to mitigate any further potential leaks.

Meteorological Conditions

Wind Speed:	less than 10 mph
Wind Direction:	West-North-West
Temperature:	53°F
Humidity:	67%
Pressure:	30.23 in Hg
Precipitation:	0 in

Material Released

A mixture of renewable diesel and hydrogen was released from the ruptured tube in the Recycle Furnace. The release resulted in approximately 207,000-lbs of renewable diesel and approximately 2,220-lbs of hydrogen released.

Description of Injuries

One employee suffered burn injuries and was taken to the hospital where he was admitted for treatment.

Environmental and Community Impacts

Ground level monitors and open path fence line monitors did not detect any parameters above background conditions. No off-site complaints were received.

Emergency Response

The Refinery ERT arrived on scene and began defensive maneuvers. The unit was depressured remotely to isolate renewable diesel and hydrogen flow from the release point. The fire was extinguished in approximately 15 minutes.

Agency Notification

The Community Warning System (CWS) was activated, and notifications were made to Contra Costa Health Services (CCHS), Bay Area Air Quality Management District (BAAQMD), Contra Costa County Office of Emergency Services (CCOES), and Contra Costa Fire District. State notifications were made through California Governor's Office of Emergency Services (CalOES) to notify state agencies.
Chemical Safety Board (CSB), Cal/OSHA, and CCHS opened incident investigations for the furnace fire. The

investigation team collaborated with CSB, Cal/OSHA, and CCHS on evidence collection, laboratory selection and testing methodology.

Incident Investigation Team

Preservation of the process unit was completed immediately following the conclusion of the emergency response activities. The investigation started November 19, 2023, with the photo evidence collection, Distributed Control System (DCS) data collection, and review of operating data. Physical evidence was collected according to Cal/OSHA and CSB guidelines.

The investigation team was assembled, and a kick-off meeting was held on November 20, 2023, at 13:00. The investigation team was led by a trained root cause incident investigator. The team consisted of corporate and local operations professionals, and USW representatives.

Background on the 2HDO Unit

The facility previously operated as a petroleum refinery. The refinery was idled, and a unit previously functioning as a Diesel Hydrodesulfurization (HDS) unit was converted to a Renewable Diesel Hydrodeoxygenation (HDO) unit. Now referred to as 2HDO, its function is to improve the quality of renewable feedstocks. It does this by removing oxygen via chemical reaction with hydrogen over a carbon-based metal catalyst. Unit feed, renewable diesel recycle, and hydrogen are combined and sent through a series of feed/effluent exchangers, then heated to reactor bed temperature in the Recycle Furnace - where the failure occurred.

Background on the 004-F-20 Recycle Furnace

The Recycle Furnace, 004-F-20, is a cabin heater with 11 burners located on the floor in a single row. Process fluid flows in parallel through four parallel passes comprised of 5-inch diameter tubes. Each pass flows horizontally across the convection section and then through the radiant section. The convection section is the upper part of the heater. Flue gas heat is transferred through the tube's wall by conduction. The convection section includes six rows of finned tubes above three rows of bare tubes. The radiant section is the lower section of the furnace closest to the 11 burners. The radiant tubes are located along the walls in the radiant section and receive radiant heat directly from the burners.

Event Description

On November 15, 2023, the 2HDO startup began. As part of unit startup, hydrogen is brought into the unit to establish circulation and establish unit pressure. Hydrogen is introduced to the 004-F-20 Recycle Furnace through the start-up line to increase unit temperature. The start-up line is a 6" pipe that provides flow into the Recycle Furnace either through a 6" valve at grade upstream of the 004-E-4358 and 004-E-4375 Feed Preheat Exchangers (Valve A) or through a 6" chain-operated valve downstream of the Feed Preheat Exchangers (Valve B). This start-up line is colloquially known as the "Taylor Bypass". Feed into the unit was heated until the reactor bed temperature reached 200-275°F.

On November 17, 2023, five (5) of the 11 burners in 004-F-20 were in operation. At midday, 2HDO field personnel installed cover plates on the air registers for the burners on six (6) burners that were not in operation. The air register plates were installed as part of troubleshooting efforts to manage excess Nitrogen Oxide (NOx) formation measured in the combined stack shared with 004-F-19 Reboiler Heater.

On November 18, Renewable Diesel (RD) was brought into the stripper tower to establish circulation. The day shift encountered difficulties establishing RD circulation due to the loss of stripper tower level, which would trip the RD recycle pumps. At 16:15, RD circulation was attempted and Hydrogen flow to the furnace dropped to zero. At approximately 16:30, RD recycle pumps tripped and the flow to the 004-F-20 furnace stopped. Skin temperatures within the furnace began rising at approximately 13°F per minute, exceeding the design temperature of 1100 °F for approximately 20 minutes.

After shift change, the night crew focused on addressing the high furnace temperature by correcting flow imbalances and reestablished hydrogen flow to the furnace. Within 25 minutes, furnace skin temperatures returned to under 400°F.

At 22:13 on November 18, the RD circulation was lined up to 004-F-20. Over the next 30 minutes, additional burners were placed online in the furnace to bring the furnace effluent up to the target 400 °F; four burners in total were in use when the furnace tripped at 22:44. Skin temperatures were increasing at approximately 15°F per minute prior to the furnace trip.

Shortly thereafter, a Field Operator relit the furnace, placing four (4) burners online. At 23:39, two (2) of the eight (8) tube skin temperature indicators alarmed high. In response to the alarms, the Console Operator increased RD circulation from 12 MBPD to 13 MBPD to pull heat out of the furnace, consistent with the alarm troubleshooting guide. At 23:47, two (2) additional skin temperature indicators alarmed high and further moves to address the high temperatures were made by the Console Operator. Tube skin temperatures continued to increase at approximately 30°F per minute.

At approximately 20 minutes after midnight on November 19, the Console Operator radioed the Field Operator to take burners in the furnace offline. The Field Operator was in the process of taking two (2) burners offline when a tube ruptured, releasing RD into the furnace firebox, which subsequently ignited. The Field Operator was able to leave the area and make their way to the Field Operator Shelter. The injured operator was life flighted to a local hospital for medical care.

Timeline

A timeline of events was established using recorded DCS data that stored process variables and status of alarms, as well as witness statements and interviews.

Date Time (PST)	Description
11/16 11:19	Initiated procedure to establish Hydrogen circulation to 004-F-20 and heat up to defined reactor temperature
11/17 12:11	Air register plates were installed on burners not in use to reduce excess air in the firebox to manage NOx
11/18 06:30	Procedure to establish RD circulation was initiated
11/18 16:15	RD circulation is started
11/18 16:32	RD circulation trips off on low stripper level
11/18 16:50	Burner #3 in 004-F-20 is lit
11/18 17:35	Hydrogen flow is reestablished to 004-F-20
11/18 17:39	004-F-20 Pass Outlet Temperature alarm annunciates
11/18 17:45	Burner #3 is blocked in
11/18 21:01	RD circulation to 004-F-20 is started
11/18 21:11	RD circulation trips
11/18 21:49	Attempt to light Burner #3
11/18 22:23	RD circulation to 004-F-20 is started at 12 MBPD
11/18 22:45	004-F-20 trips
11/18 23:11	Burner #1 in 004-F-20 is lit
11/18 23:19	Burners #5, 6, and 8 in 004-F-20 are lit
11/18 23:30	RD flow is increased to 14 MBPD
11/18 23:37	Two 004-F-20 skin temperatures high temp alarms annunciate
11/18 23:47	Three additional 004-F-20 skin temperature high temp alarms annunciate
11/18 23:50	RD flow is increased to 15 MBPD
11/18 23:57	RD flow is increased to 17 MBPD
11/19 00:01	Make-up compressor is started to increase hydrogen flow to 004-F-20
11/19 00:16	RD flow is increased to 18 MBPD
11/19 00:20	Burners #5 and 6 are removed
11/19 00:21	Tube ruptures in 004-F-20 resulting in a fire

Post Incident Data Review

The investigation team conducted a post-incident unit walkdown and identified the following items for additional

investigation:

- Ruptured furnace tube for metallurgical analysis,
- Valve B was found in the open position; however, this valve is intended to be in the closed position during operation,
- Operation of 004-F-20, including air register plates present on six burners of 004-F-20 and fuel gas and pilot gas valves not being in the expected position, and
- 004-F-20 Burner testing.

As part of the incident investigation, the most recent PHA for the 2HDO unit was reviewed, including the associated Safeguard Protection Analysis (SPA) and Hierarchy of Hazard Control Analysis (HCA).

Metallurgical Analysis

Measurements of the furnace tube pipe outside diameter were collected following the incident to determine the extent of the damage. Tube damage was limited to the convection section of the 004-F-20 furnace. Damaged tubes were sent to a third-party lab for metallurgical analysis.

The tube that ruptured was identified as Row 7 Pass C in the convection section of the furnace. The appearance of the failed tube and the appearance of the metallography are consistent with a stress rupture failure due to short-term overheating under pressurized conditions. No material or original dimensional non-conformances were observed. No other potential damage mechanisms in 321 SS were observed in the samples examined.

No Flow Scenario to 004-F-20

A post-incident field walkdown found one valve on the process in the incorrect orientation. The normally closed 6" chain-operated valve downstream of the Feed Preheat Exchangers (Valve B) was found misaligned, which could create an unmeasured flow bypass around the furnace, reducing the overall flowrate of RD to 004-F-20. Process simulation modeling of the unit was completed by internal experts. The simulation model determined the following:

- A steady state model tuned with operating conditions within the hour prior to the tube rupture predicted furnace temperatures lower than what was recorded during the incident. The heat balance is consistent with low liquid flow through the furnace, with most of the flow being diverted away from the furnace through the misaligned valve.

- The steady state model predicted most of the RD would be sent to 004-F-20, with little to no flow bypassing the furnace. Simplified hydraulic models may not adequately predict the elevation changes in a system, only accounting for the total pressure drop. The simplified hydraulic model results are inconsistent with the heat balance, predicting that approximately 90% of the liquid RD would flow towards the furnace.

Field walks and isometric drawings confirmed three (3) separate high points in the system including between Valve B, 004-F-20, and the recombining "T" to the reactor. The required pressure drop to overcome the elevation difference is 22 psig, compared to the backpressure available of alternate path of 11.2 psig. The back pressure generated from friction and elevation through the alternate path is not high enough to push the liquid uphill through the "P" traps, causing reduced flow to 004-F-20.

004-F-20 does have a safety instrumented system (SIS) that will shut down the furnace when RD flow to the furnace is measured to be less than 4,000 BPD for 3 seconds by flow meter 004:HS0571A. At the time of the incident, the RD flow was above the low flow trip and was not able to detect a bypass scenario because of the location of the flow meter.

For a no or low flow scenario, potential damage is expected in the region with the highest amount of heat flux, i.e., in the radiant section. However as discussed in the Metallurgical Analysis section of this report, inspection of the tube found no tube diameter growth in the radiant section. Tube damage was limited to the convection section of the 004-F-20 furnace. The investigation team concluded that the no or low flow scenario contributed but did not cause the tube rupture.

Recycle Furnace Performance

A post-incident field walkdown found burners 1 and 8 with fuel gas valves in the open positions and air register covers in place on burners 1, 2, 6, and 9-11. Operator interviews indicated fuel gas valves to burners 5 and 6 were opened following the furnace trip that occurred on November 18 at 22:45. Computational Fluid Dynamic (CFD) modeling of 004-F-20 firebox was conducted by a third-party consultant to understand impact of operating burners with air registers blocked. The model was tuned using process data and the new fuels burner curve to evaluate the flame pattern with fuel gas flowing to burners 1, 5, 6, and 8 and air registers blocked on burners 1, 2, 6, and 9-11.

The model showed that burner 1 and 6 flames were extinguished due to lack of oxygen at the burner, but excess oxygen was available in the firebox that prevented a fuel rich atmosphere. The fuel gas continued to flow into the firebox and would ignite when sufficient oxygen was available. The model predicts heat release, i.e., afterburn, in the convection section tubes consistent with the physical evidence. The investigation team concluded that the tube rupture was caused by afterburn that occurred after burners 1 and 6 self-extinguished while in operation with air register plates blocking air flow to the burner.

Burner Bench Testing

Bench testing of the 004-F-20 burners was conducted to evaluate burner performance at various fuel gas compositions. One burner from 004-F-20 was shipped to the burner manufacturer's testing laboratory for evaluation. The burner was installed and centrally located in a test furnace, mounted on the floor. Bench testing confirmed that the 004-F-20 burners can be safely operated with fuel gas with a concentration of hydrogen at a minimum of 15%. Leading up to the incident, the fuel gas hydrogen content was below 15%, which caused flame instability that would have contributed to the incident.

Root Causes and Corrective Actions

The causal analysis for this incident yielded the following root causes and corrective actions:

Causal Factor	Root Cause	Corrective Action	Hierarchy of Controls Analysis	Responsible Person Due Date
Afterburn: CFD modeling confirmed afterburn caused by operating burners with air registers blocked. Burners #1 and #6 were put in service without removing the air register plates. Air register plates are considered an industry best practice to manage NOx in furnace	Equipment Difficulty; Design; Design Specifications; Problem Not Anticipated	Install a multi-gas laser analyzer at the bridge wall of the 004-F-20 for CO and methane. Ensure the analyzer is incorporated into the SIS in conformance with RSP-1172-024 *Heater Application Standard.*	Active	Area Team Engineer November 1, 2024
	Human Performance Difficulty; Standards, Policies, or Administrative Controls (SPAC) Needs Improvement (NI); Confusing or Incomplete	Revise the 004-F-20 startup procedure to include steps to remove the air register plates prior to lighting the burners. Procedure updates are required to be completed prior to 2HDO Unit Startup.	Procedural	Operations Excellence Specialist November 1, 2024
	Human Performance Difficulty; Human Engineering; Human-Machine Interface; Labels NI	Develop management system or procedure to ensure removal of air register plates prior to lighting burners, such as car seal or zip tie close the fuel gas valves to the burners when blanking plates are installed.	Procedural	Operations Excellence Specialist November 1, 2024
		Add warning signs to all furnaces with air register plates that includes the step to light and the hazards of	Procedural	Operations Excellence Specialist

with turndown capacity. The plates were installed to manage NOx at the furnace stack by reducing tramp air into the firebox.		operation with air registers blocked.		November 1, 2024
		Increase visibility of the air register plates: • Paint the plates a high visible, high contrast color and • Ensure air register plates are visible from the fuel gas valves. Consider adding hanging sign plates for added visibility from the fuel gas valves.	Procedural	Operations Excellence Specialist November 1, 2024

The investigation team identified the following contributing factors and corrective actions:

Contributing Factor	**Cause**	**Corrective Action**	**Hierarchy of Controls Analysis**	**Responsible Person Due Date**
Low Flow: Valve misalignment of start-up line Valve A or B can create an unmeasured bypass around 004-F-20 that is not detectable. Scenario was included in the PHA, but the consequence was not recognized.	Equipment Difficulty; Design; Design Review; Independent Review NI; Hazard Analysis NI	Remove the "B Valve" to address the unmeasured bypass potential around 004-F-20.	First-Order (Removal)	Area Team Engineer November 1, 2024
		Install dual diverse check valves in the start-up line (004-P-13959) to prevent reverse flow.	Active	Area Team Engineer November 1, 2024
		Add position indicator to the 6" valve (Valve HV-1856) upstream of the 004-E-4358 and 004-E-4375 Feed Preheat Exchangers. Include a Priority 1 alarm if valve is open when in Oil Mode with operator response to close valve HV-1856).	Procedural	Area Team Engineer Complete
Flame Instability: Fuel gas composition hydrogen was less than the required for flame stability.	Equipment Difficulty; Design; Design Specifications; Problem Not Anticipated	Add a fuel gas hydrogen content low alarm at 15 mol-% at the fuel gas analyzer (003-AI-4985J1).	Procedural	Technical Service Complete