



DEPARTMENT OF THE NAVY
NAVAL SUPPLY SYSTEMS COMMAND
5450 CARLISLE PIKE
MECHANICSBURG, PA 17050

5830
Ser SUP00/078
14 Oct 21

FINAL ENDORSEMENT on (b) (6) ltr 5830 of 15 Sep 21

From: Commander, Naval Supply Systems Command

To: Commanding Officer, NAVSUP Fleet Logistics Center Pearl Harbor

Subj: COMMAND INVESTIGATION INTO THE FUEL SPILL AT THE RED HILL BULK FUEL STORAGE FACILITY ON OR ABOUT 6 MAY 2021

1. Reviewed and approved.

2. I am forwarding this investigation to you for review, corrective action and any administrative and/or disciplinary action(s) that you may deem appropriate. I direct that fuel personnel at Red Hill shall review the established procedures and conduct training where needed. Additionally, I direct you to collaborate with Navy Petroleum Office, Naval Facilities Engineering and Expeditionary Warfare Center, Defense Logistics Agency Energy and Defense Logistics Agency J6 to address contributing factors to the 6 May event, as described in paragraph 5 of the enclosed investigation. Report back directly to me when these actions are complete.

3. My point of contact concerning this matter, and specifically for anyone requesting a copy of this investigative report, is (b) (6). He may be reached at commercial:

(b) (6)

(b) (6)

P. G. STAMATOPOULOS

Copy to:
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5830
15 Sep 21

From: Deputy Officer in Charge, NAVSUP Naval Petroleum Office
To: Commander, NAVSUP

Subj: AMENDMENT TO COMMAND INVESTIGATION INTO THE FUEL SPILL AT THE
RED HILL BULK FUEL STORAGE FACILITY ON OR ABOUT 6 MAY 2021

Ref: (a) Investigation appointing order and modifications
(b) Report of Command Investigation into the Fuel Spill at the Red Hill Bulk Fuel Storage
Facility on or about 6 May 2021, dated 25 Jun 21
(c) Report of Root Cause Analysis of the JP-5 Pipeline Damage, dated 7 Sep 21

1. In accordance with reference (a), reference (b) is amended as follows to incorporate review of reference (c) and consolidate conclusions based on engineering analysis provided in that document.

2. Reference (c) supports the investigator's initial impression that a dynamic transient surge damaged the JP-5 pipeline system in Red Hill on 6 May. Engineering analysis and modeling explains that the root cause of the incident was the Control Room Operator's (CRO) failure to follow the valve opening and closing sequence delineated in FLCPH's Specific Operations Orders. Due to this failure, fuel passed by a pair of closed butterfly valves in the Underground Pumphouse, allowing a vacuum to form within the JP-5 pipeline. When the skin valve for Red Hill Tank 12 (RH12) was subsequently opened, the inrush of fuel from the tank into the pipeline collapsed the vacuum and created a dynamic transient surge.

3. Reference (c) explains that multiple contributing factors existed:

(a) Use of butterfly valves, (b) (3) (A), as isolation valves was a contributing factor. For several minutes, in violation of Specific Operations Orders for the evolution, these two butterfly valves were the only closed valves between RH12 and Surge Tank (b) (3) (A). During that time, under the weight of the contents of the (b) (3) (A) JP-5 line, these valves allowed fuel to leak past them. This allowed formation of a vacuum that later collapsed, resulting in the rapid compression of air and creation of a dynamic transient surge.

(b) The set point of the out-of-balance alarm in AFHE was a contributing factor. An out-of-balance alarm in AFHE warns the CRO that the amount of fuel moving into the destination tank is not equal to the amount moved out of the source tank. On 6 May, the out-of-balance alarm was set at (b) (3) (A) gallons (gal) for both Evolutions 3 and 4. AFHE recordings of fuel tank inventories show that 966 gal flowed into the destination tank, STK^(b), during Evolution 3 without a corresponding decrease in RH12, the source tank, or Red Hill Tank 20 (RH20). In Evolution 4, another 672 gal moved from the JP-5 pipeline into STK^(b) without a corresponding decrease in a Red Hill tank. This total of 1,638 gal of fuel that moved out of the JP-5 pipeline into STK^(b) was below the out-of-balance alarm set point. However, that fuel movement was significant because it contributed to forming the vacuum whose later collapse resulted in a dynamic transient surge.

(c) The lack of an AFHE indication of a pressure drop was a contributing factor. The low-pressure alarm for the pressure indicator transmitter (PIT) in the vicinity of the two butterfly valves was set to alarm at -9 psig. When pressure in the pipeline dropped rapidly from 125 down to 31 psig,

AFHE did not sound an alarm to notify the CRO, although the drop in pressure was another indicator of a problem.

(d) The use of expansion couplings in sections of piping affected by maintenance projects was the final contributing factor. At the time of the event, multiple pipeline and fuel tank maintenance projects were underway, and the JP-5 piping system included temporary modifications to accommodate those projects. Modifications included expansion couplings in cross-tunnel pipeline sections nearest Tanks (b) (3) (A). No arrangements had been made to restrain the pipeline motion on either side of the expansion couplings during maintenance. Unified Facilities Code, UFC 3-460-01, *Design: Petroleum Fuel Facilities* 9-3.3 recommends that permanent pipes be arranged so that they have in-line restrained sliding pipe supports or other method of maintaining alignment on each side of the expansion joint. Because the expansion couplings in Red Hill were not restrained, they were free to move in multiple dimensions when the surge hit, thus exacerbating the resulting damage.

4. (b) (5) [Redacted]

5. (b) (5) [Redacted]

(b) (6)

5830
25 Jun 21

From: (b) (6), Deputy Officer in Charge, NAVSUP Naval Petroleum Office
To: Commander, Naval Supply Systems Command (NAVSUP)

Subj: COMMAND INVESTIGATION INTO THE FUEL SPILL AT THE RED HILL BULK
FUEL STORAGE FACILITY ON OR ABOUT 6 MAY 2021

Ref: (a) JAGINST 5800.7G

- Encl:
- (1) Appointing order and modifications
 - (2) (b) (6) interview summary dated 11 Jun 2021
 - (3) (b) (6) interview summary dated 10 Jun 2021
 - (4) (b) (6) interview summary dated 10 Jun 2021
 - (5) (b) (6) interview summary dated 10 Jun 2021
 - (6) Operation, Maintenance, Environmental, and Safety Plan for Defense Fuel Support Point Pearl Harbor Bulk Terminal
 - (7) (b) (6) interview summary dated 10 Jun 2021
 - (8) (b) (6) interview summary dated 14 Jun 2021
 - (9) AFHE event and alarm logs for 6 May 2021
 - (10) 6 May 2021 specific operations order for transferring JP-5 from Red Hill Tank 12 to Tank 20
 - (11) 6 May 2021 specific operations order for transferring JP-5 from Red Hill Tank 12 to Tank 9
 - (12) Investigator observations and analysis
 - (13) (b) (6) interview summary dated 14 Jun 2021
 - (14) (b) (6) interview summary dated 14 Jun 2021
 - (15) (b) (6) interview summary dated 11 Jun 2021
 - (16) (b) (6) interview summary dated 11 Jun 2021
 - (17) (b) (6) interview summary dated 9 Jun 2021
 - (18) Red Hill Fuel Release Management Inquiry

PRELIMINARY STATEMENT

1. As directed by enclosure (1) and conducted in accordance with reference (a), this is a command investigation into the facts and circumstances surrounding the fuel spill that occurred on or about 6 May 2021 at the Red Hill Bulk Fuel Storage Facility.
2. The focus of this investigation is on determining the cause of the 6 May fuel spill, how much was released, and the impact of the release on the environment.
3. Reference (a) was reviewed and enclosures (2) through (18) are submitted to support the finding of facts, opinions, and recommendations reported in this investigation.

4. All reasonably available evidence required for this investigation was collected and each objective of the appointing order has been met except validating NAVFAC EXWC efforts, since those efforts are still ongoing. When their final report, including root cause analysis, is made available, this report may be updated to reflect their results.

5. My investigation did not reveal a directly attributable cause for the fuel release that occurred on or about 6 May at the Red Hill Bulk Fuel Storage Facility. Additional engineering analysis is needed.

FINDINGS OF FACT

1. At 0800 on 6 May 2021, (b) (6), assumed Day Shift watch as Control Room Operator (CRO) in NAVSUP FLC Pearl Harbor Fuel Department, (b) (6) assumed duties as Red Hill Rover (RHR) with (b) (6) as RHR under instruction, and (b) (6) assumed duties as Kuahua Rover (KR), responsible for visually checking valves, piping, and other facilities in the Underground Pumphouse (UGPH) and the aboveground portions of the fuel terminal. [Encls. (2)-(6)]

2. At 1600, (b) (6) relieved (b) (6) as CRO for the Swing Shift. (b) (6) likewise relieved (b) (6) as RHR and (b) (6) took over as KR. [Encls. (7) and (8)]

3. At 1800, (b) (6) noted in fuels control system, AFHE, that Evolution 3 was finished. (b) (6) had started Evolution 3 during the previous watch; it included transferring JP-5 from Red Hill Tank 12 (RH12) to Surge Tank (b) (3) (A) and then pumping that JP-5 back up to Red Hill Tank 20 (RH20). [Encl. (9)]

4. In the same minute, (b) (6) marked Evolution 4 as started in AFHE; this evolution involved transferring JP-5 from RH12 to (b) (3) (A) and then pumping that JP-5 up to Red Hill Tank 9 (RH9). [Encl. (9)]

5. The Specific Operations Order for Evolution 3 directed that the CRO close all valves and return the piping system to its normal configuration once the transfer was complete. (b) (6) closed some but not all of the JP-5 pipeline valves specified before starting the second evolution. [Encls. (9) through (11)]

6. On or about 1817, (b) (6) heard an explosion from his watch station in Red Hill's lower tunnel. He stepped out of the room and observed fuel spilling into the tunnel from the RH20 area. He called the CRO. [Encl. (8)]

7. The CRO verified that RH20 valves were closed and the fuel level in RH20 was not changing. He determined that the spill was from the JP-5 pipeline and not a fuel tank, so he closed valves for RH12 which was in use at the time and began to slack the JP-5 pipeline by allowing it to drain into STK (b) (6) adjacent to UGPH. [Encls. (7) and (9)]

8. The CRO initiated notifications to his chain of command. [Encl. (7)]
9. As part of the fuel spill response that ensued, a water wash-down of the lower Red Hill tunnel was conducted to flush fuel into the floor drains that led to sumps where the fuel collected for transfer to Fuel Oil Reclaimed (FOR) Tank (b) (3) (A). Some amount of fuel-water mixture entered the soil vapor monitoring vaults at RH20 and Red Hill Tank 18 (RH18). [Encl. (12)]
10. The estimated amount of JP-5 released in the lower Red Hill tunnel on 6 May is 1,618 gallons. 1,580 gallons were recovered, for a difference of approximately 38 gallons. [Encl (12)]
11. Air samples pulled from soil vapor monitoring wells near Red Hill Tank 17, RH18, and RH20 after 6 May showed elevated readings for total volatile organic compounds (VOC). [Encl (12)]
12. No increase in fuel has been detected in the Red Hill groundwater monitoring wells since the 6 May event. This includes the nearest groundwater monitoring well in the vicinity of Red Hill Tanks 18 and 20. [Encl (12)]


OPINIONS

1. No malicious intent is suspected.
2. NAVSUP FLC Pearl Harbor Fuel Department's training program, recordkeeping, Specific Operations Orders, and Operations Manual are adequate.
3. It is unlikely that either throttle valve used in the transfer evolution, (b) (3) (A), allowed significant fuel flow past them while they were closed.
4. Even if (b) (3) (A) did allow significant flow of fuel past them while closed, it is unlikely that the 55 seconds it took for ball valve (b) (3) (A) to close and stop all flow was fast enough to cause a dynamic hydraulic surge (hammer) capable of reflecting up the hill and blowing off the expansion couplings at RH18 and RH20.
5. Additional engineering analysis beyond the capability of the investigator is needed to determine the root cause of the 6 May pipeline event.
6. None of the small amount of JP-5 that entered the soil vapor monitoring vaults at Red Hill Tanks 18 or 20 has migrated downward to the basal aquifer approximately 100 feet below the bottom of the tanks.

Recommendations

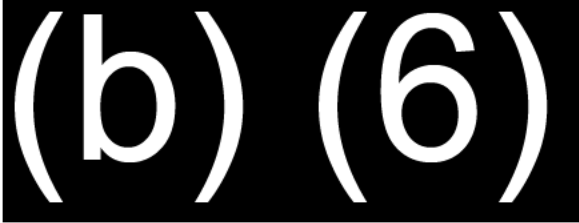
1. Revisit this investigation report upon promulgation of NAVFAC EXWC's root cause analysis of the 6 May pipeline event.

2. (b) (5)

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7/2/2021

(b) (6)

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