Kern Oil & Refining Co.
Incident Investigation of the February 28, 2020
Platformer Reboiler Heater (H-5) Fire

1 BACKGROUND

1.1 Introduction and Overview

On February 28, 2020, the Platformer, including Platformer Splitter Reboiler Heater H-5, was down for maintenance. An operator was in the process of bleeding the pressure down to 1.5 psig via the Platformer Splitter Overhead water boot drain line in preparation for maintenance to break the flange for gasket replacement. The operator pinched down on the bleed to the flare and opened the nitrogen to equalize and keep a small positive pressure on H-5. The operator informed maintenance personnel that they could start work after reviewing applicable Work Orders and the Job Safety Analysis ("JSA"). The work was occurring 35 to 40 feet above ground level on an ungrounded manlift, using hand tools (steel wrenches). No hot work was underway. As the workers were removing the fourth bolt, a hydrocarbon leak began. Immediately after that, a fire initiated and the workers began to get themselves to safety on ground-level.

Response Actions: Operators and the Shift Supervisor immediately took responsive action. Personnel assumed their emergency response duties to stop the nitrogen purge and start snuffing steam into the box of H-5. During the fire, Kern Operators activated fire monitor ("FM") P-7 and fire hose stations P-4 and N-2 and pointed them towards the heater. Kern County Fire Department ("KCFD") arrived at approximately 2:50 p.m. The incident was controlled and the fire extinguished in approximately 20 minutes. One individual received burn injuries as a result of the event.

Agency Notification and Response: Notification was made to Cal OES, Cal OSHA PSM Unit, and Kern County Environmental Health ("CUPA").

1.2 Investigation Team Composition

Kern initiated the incident investigation at approximately 3:30 pm by taking witness statements following the emergency response, and by taking photographs of the scene. For the purposes of the incident investigation, Kern treated this incident as a major incident under 8 C.C.R. § 5189.1(o). Multidisciplinary investigation team members included representatives with knowledge of the refinery's operation, including individuals from Kern's Safety, Engineering, Operations, and Maintenance departments.

1.3 Root Cause Analysis Methodology and Materials Reviewed

Kern personnel started evidence gathering immediately following the emergency response. Photographs were taken, security camera videos were secured, and written statements and interviews of eyewitnesses were conducted by Kern on February 28, 2020, and subsequent days. The site of the fire (H-5) was secured to enable the investigation team to take photographs and gather evidence. In connection with its investigation, the team reviewed relevant Platformer Process Safety Management ("PSM") information, including Damage Mechanism Review ("DMR") information, Hierarchy of Hazard Controls Analysis ("HCA") information, and Process Hazards Analysis ("PHA") information. The team also reviewed other documentation associated with the incident, including engineering drawings of the Platformer Unit, work orders, and operations, maintenance, and engineering notes.

The investigation team applied Process Improvement Institute's Root Cause Chart methodology, which is a modified 5 Whys? technique. This approach was conducted in line with the guidance provided by the Center for Chemical Process Safety (CCPS) for root cause analyses.

2 ROOT CAUSE ANALYSIS, CONCLUSIONS, AND RECOMMENDATIONS

2.1 Analysis and Findings

To develop its findings, the investigation team relied primarily on witness statements and interviews, security camera footage, visual inspection, and documentation and records pertaining to the equipment and actions associated with the incident.

The fire started in external piping of H-5 called the "Transition Section," which connects the radiant and convection section heater tubes in H-5. It appears as though there was a low spot in this Transition Section that allowed liquid hydrocarbons to pool. As it was designed, effective and complete drainage of the hydrocarbon liquid in this section of piping did not appear to be feasible, even when adding a nitrogen purge to the system. This design created the opportunity for hydrocarbon to collect and find an ignition source. The ignition source is believed to be either static electricity from flowing hydrocarbons, and/or a spark from a steel hand tool, as discussed further, below. Autoignition was eliminated as a potential cause because the process was at ambient temperature.

2.2 Conclusion and Root Causes

The investigation team identified the following factors that caused or contributed to the incident:

- The manlift used by Maintenance workers had rubber tires and was not equipped with a grounding strap to conduct static electricity from the metal manlift parts to the ground. Additionally, a bonding strap was not installed that would have equalized the electrical charge between the heater and the manlift. Without grounding and bonding straps, static electricity could build up on the metal frame of the manlift and would not be conducted to the ground or to another metal surface.

- Maintenance workers used a steel ¾-inch wrench with a modified extension handle, a socket and ratchet, Master Mechanic (lubricant) for the bolts, and no hammer. Steel hand tools may produce sparks that can be an ignition source around flammable substances.

- Heater H-5 had a low spot in the transition section of piping that connected the convection and radiant section of heater tubes, which created the opportunity for hydrocarbon to collect and find an ignition source. When the flange was loosened, the system became depressurized, and discharged the hydrocarbons from the transition piping to the atmosphere near the workers. The pressurized hydrocarbon escaping the flange and onto the manlift may have caused flow electrification of the hydrocarbons. Since the manlift was not grounded, static electricity or a spark may have been generated near the manlift, either of which may have ignited the hydrocarbon and air mixture escaping from the flange after 10 seconds of flow.

- Not all parties involved in overseeing or conducting the work had the same basic understanding of the scope of work or the hazards. The Safe Work Practices for Line and Equipment Breaking and the Lock Out Tag Out program were not fully followed.

2.3 Interim Measures and Recommendations

Interim Measures: Kern implemented the following interim measures to address the causes identified above:

- Redesigned and reconstructed the transition piping between the heater convection section and radiant section piping so that there was no longer a place for hydrocarbons to pool.

- Repaired the heater.

- Provided refresher training regarding Lock Out Tag Out, Safe Work Practices for Line and Equipment Breaking, and Emergency Response training to Operations and Maintenance employees.

Recommendations: The investigation team developed the following recommendations to address incident investigation findings:

- Provide Safe Work Practices for Line and Equipment Breaking refresher training to employees. [Completed in March 2020]

- Provide Lock Out Tag Out refresher training to employees. [Completed in March 2020]

- Develop a practice whereby the Outside and Inside Operators discuss the job scope of a Work Order and the JSA before work is initiated.

- Update the JSA to include non-sparking hand tool considerations, static electricity, and grounding and bonding considerations for equipment. Include a requirement to review the potential hazards associated with the pooling of liquid in process piping in the JSA checklist and line break procedure to help prevent personnel from opening flanges with residual volumes of flammable liquid remaining in the piping prior to performing maintenance, which could lead to a release of flammable hydrocarbon. In addition, provide training to affected Operations and Maintenance personnel concerning the updated information.

- Review the Platformer Unit operating procedures, specifically, the section concerning steamout in preparation for maintenance, and consider updating the steamout section to include hazards caused by pooling of flammable hydrocarbon liquid in process piping if not properly cleared prior to line breaking. In addition, provide refresher training to affected Operations and Maintenance personnel concerning the importance of steamout when there is potential liquid pooling in the process piping.

- Require that manlifts brought on site for maintenance activities be equipped with grounding and bonding straps to help prevent accumulation of static charge. Develop a Safe Work Practice ("SWP") that addresses manlift specifications and operation requirements. Ensure that the safe work practice includes a section addressing grounding and bonding, and provide training to employees. Confirm that contractors working with such equipment can demonstrate training on same.

- Develop a SWP addressing hand tools. Ensure that the SWP includes a section on the use of non-sparking tools. Provide training to employees and confirm that contractors working with such equipment can demonstrate training on same.