| **Document:** 17AA0022A; 17AA0022E; 17AA0026C; 17AA0024B; 17AA0031; 17AA0022C; 17AA0024A; 17AA0026B; 17AA0039; 17AA0040 | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 1. Feed Surge Drum | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | PV1420A fails/set open or bypass inadvertently open (P&ID 22A)  LOPA Scenario - Initiating Event: 1.1.1 | | |  |  | | --- | --- | | 1. | Higher than normal pressure in the 17V005 Feed Surge Drum. Potential overpressure of drum (up to maximum of 150 psig), Potential to exceed MAWP (>2X MAWP), Potential LOPC of reduced crude via rupture, Potential ignition/pool fire. Potential personnel injury (Fatality), environmental release (Negligible), and equipment damage ($100k-$1MM).  LOPA Scenario: 1.1 | | |  |  | | --- | --- | | 1. | 17PSV006 Relief Valve on 17V005 Feed Surge Drum set @ 50 psig | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for 17PI1420 Pressure Indicator on the 17V005 Feed Surge Drum with Low Alarm as it is not independent of the cause | |
| E | 4 | 4 | 4 |
| C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 2. | High Pressure in the 17V005 Feed Surge Drum. Potential to back out reduced crude from No. 2 Crude Unit. Potential to send more feed to Vacuum Unit No. 3 or spill to coker charge tank. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | PV1420B fails/set closed or upstream/ downstream manual block valves inadvertently closed (P&ID 22A)  LOPA Scenario - Initiating Event: 1.2.1 | | |  |  | | --- | --- | | 1. | Higher than normal pressure in the 17V005 Feed Surge Drum. Potential overpressure of drum (up to maximum of 150 psig), Potential to exceed MAWP (>2X MAWP), Potential LOPC of reduced crude via rupture, Potential ignition/pool fire. Potential personnel injury (Fatality), environmental release (Negligible), and equipment damage ($100k-$1MM).  LOPA Scenario: 1.2 | | |  |  | | --- | --- | | 1. | 17PSV006 Relief Valve on 17V005 Feed Surge Drum set @ 50 psig | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for 17PI1420 Pressure Indicator on the 17V005 Feed Surge Drum with Low Alarm as it is not independent of the cause | |
| E | 4 | 4 | 4 |
| C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 2. | High Pressure in the 17V005 Feed Surge Drum. Potential to back out reduced crude from No. 2 Crude Unit. Potential to send more feed to Vacuum Unit No. 3 or spill to coker charge tank. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Inadvertent closure of 17P011A/B Reduced Crude Charge Pump discharge valve or check valve sticks closed (individual outlet on P&ID 22A)  LOPA Scenario - Initiating Event: 1.10.1 | | |  |  | | --- | --- | | 1. | Low Flow resulting in deadheading the 17P011A/B Reduced Crude Charge Pumps. Overpressure of pipe not expected based on deadhead pressure of 230 psig. Potential damage to 17P011A/011B due to deadheading and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.10 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 9. | 17FSL1129/1130/1153/1154 with Low Flow Trip of fired heater to minimum firing (Credit taken as per SAF-200-05-208; this PLC SIF assumed to be independent of cause) [DCS PLC] | | CTP | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 4. | 17LC1315 with high level alarm may afford operator response | |  |
| |  |  | | --- | --- | | 3. | Potential high level in the 17V005 Feed Surge Drum. Potential High Pressure in drum up to normal operating pressure of reduced crude supply pressure as flow may continue to Vac 3 unit. Potential overfill of reduced crude to flare header via PV1420B. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Inadvertent closure of 17P011A/B Reduced Crude Charge Pump discharge valve (common outlet upstream of 17E001A/B Reduced Crude/HVGO Exchangers on P&ID 22E)  LOPA Scenario - Initiating Event: 1.11.1 | | |  |  | | --- | --- | | 1. | Low Flow resulting in deadheading the 17P011A/B Reduced Crude Charge Pumps. Overpressure of pipe not expected based on deadhead pressure of 230 psig. Potential damage to 17P011A/011B due to deadheading and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.11 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 9. | 17FSL1129/1130/1153/1154 with Low Flow Trip of fired heater to minimum firing (Credit taken as per SAF-200-05-208; this PLC SIF assumed to be independent of cause) [DCS PLC] | | CTP | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 4. | 17LC1315 with high level alarm may afford operator response | |  |
| |  |  | | --- | --- | | 3. | Potential high level in the 17V005 Feed Surge Drum. Potential High Pressure in drum up to normal operating pressure of reduced crude supply pressure as flow may continue to Vac 3 unit. Potential overfill of reduced crude to flare header via PV1420B. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Cold side (ts) isolated with continued heat input from hot side (ss) of 17E001A/B (P&ID 22E) | | |  |  | | --- | --- | | 1. | Scenario considered but not deemed credible as HVGO will cool on loss of reduced crude feed. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Inadvertent closure of 17P011A/B Reduced Crude Charge Pump discharge valve (common outlet downstream of 17E001A/B Reduced Crude/HVGO Exchangers and upstream of 17E013 take off) or tubes become plugged in 17E001A/B  [P&ID 22E/26C]  LOPA Scenario - Initiating Event: 1.12.1 | | |  |  | | --- | --- | | 1. | Low Flow resulting in deadheading the 17P011A/B Reduced Crude Charge Pumps. Overpressure of pipe not expected based on deadhead pressure of 230 psig. Potential damage to 17P011A/011B due to deadheading and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.12 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 9. | 17FSL1129/1130/1153/1154 with Low Flow Trip of fired heater to minimum firing (Credit taken as per SAF-200-05-208; this PLC SIF assumed to be independent of cause) [DCS PLC] | | CTP | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 4. | 17LC1315 with high level alarm may afford operator response | |  |
| |  |  | | --- | --- | | 3. | Potential high level in the 17V005 Feed Surge Drum. Potential High Pressure in drum up to normal operating pressure of reduced crude supply pressure as flow may continue to Vac 3 unit. Potential overfill of reduced crude to flare header via PV1420B. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Cold side (ss) isolated with continued heat input from hot side (ts) on 17E005A (P&ID 26C) | | |  |  | | --- | --- | | 1. | Potential for temperature up to hot side approach temperature of 17E005A (650°F). Potential thermal expansion and LOPC via leaks. Potential for ignition, fire, injury to personnel (SDI). Potential damage to equipment ($2k-$100k). Potential environmental impact (Minimal). | | |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | P | 3 | 4 | 4 |  |  |
| E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 8. | Cold side (ss) isolated with continued heat input from hot side (ts) on 17E013 (P&ID 31) | | |  |  | | --- | --- | | 1. | Potential for temperature up to hot side approach temperature of 17E013 (650°F). Potential thermal expansion and LOPC via leaks. Potential for ignition, fire, injury to personnel (SDI). Potential damage to equipment ($2k-$100k). Potential environmental impact (Minimal). | | |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | P | 3 | 4 | 4 |  |  |
| E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | PV1420A fails/set closed or upstream/downstream manual valve inadvertently closed or check valve sticks closed (P&ID 22A) | | |  |  | | --- | --- | | 1. | Potential lower than normal pressure in 17V005 Feed Surge Drum. Potential operability issue but no hazardous consequence identified. Team considered low pressure during level draw down but no consequence identified as system is not expected to pull vacuum. Team notes that this system previously operated without nitrogen blanket. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | PV1420B fails/set open or bypass inadvertently opened (P&ID 22A) | | |  |  | | --- | --- | | 1. | Reduced Pressure on 17V005 Feed Surge Drum. Potential to send hydrocarbon vapors to the flare leading to an environmental release (Minimal). | | |  |  | | --- | --- | | 5. | Operator rounds - Flare monitoring may afford operator response | |  | E | 5 | 2 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for 17PI1420 Pressure Indicator on the 17V005 Feed Surge Drum with Low Alarm as it is not independent of the cause | |
| |  |  | | --- | --- | | 3. | Plugged screen or inadvertent closure of block valve on inlet to 17P011A/B (individual line) (P&ID 22A)  LOPA Scenario - Initiating Event: 1.13.1 | | |  |  | | --- | --- | | 1. | Low Flow resulting in cavitation of the 17P011A/B Reduced Crude Charge Pumps. Potential damage to 17P011A/011B due to cavitation and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.13 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 9. | 17FSL1129/1130/1153/1154 with Low Flow Trip of fired heater to minimum firing (Credit taken as per SAF-200-05-208; this PLC SIF assumed to be independent of cause) [DCS PLC] | | CTP | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 3. | Potential high level in the 17V005 Feed Surge Drum. Potential High Pressure in drum up to the normal operating pressure of reduced crude supply pressure as flow may continue to Vac 3 unit. Potential overfill of reduced crude to flare header via PV1420B. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Inadvertent closure of block valve on inlet to 17P011A/B (common line) (P&ID 22A)  LOPA Scenario - Initiating Event: 1.14.1 | | |  |  | | --- | --- | | 1. | Low Flow resulting in cavitation of the 17P011A/B Reduced Crude Charge Pumps. Potential damage to 17P011A/011B due to cavitation and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.14 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 9. | 17FSL1129/1130/1153/1154 with Low Flow Trip of fired heater to minimum firing (Credit taken as per SAF-200-05-208; this PLC SIF assumed to be independent of cause) [DCS PLC] | | CTP | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 3. | Potential high level in the 17V005 Feed Surge Drum. Potential High Pressure in drum up to the normal operating pressure of reduced crude supply pressure as flow may continue to Vac 3 unit. Potential overfill of reduced crude to flare header via PV1420B. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | 17P011A/B trip/fails (P&ID 22A)  LOPA Scenario - Initiating Event: 1.4.1 | | |  |  | | --- | --- | | 1. | Potential high level in the 17V005 Feed Surge Drum. Potential High Pressure in drum up to the normal operating pressure of reduced crude supply pressure as flow may continue to Vac 3 unit. Potential overfill of reduced crude to flare header via PV1420B. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.4 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 9. | 17FSL1129/1130/1153/1154 with Low Flow Trip of fired heater to minimum firing (Credit taken as per SAF-200-05-208; this PLC SIF assumed to be independent of cause) [DCS PLC] | | CTP | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | FV1129/30/53/54 fails/set open or bypass inadvertently opened (individual pass) (P&ID 24B) | | |  |  | | --- | --- | | 1. | Potential uneven pass flow. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | FV1129, FV1130, FV1153, and FV1154 Fail Open simultaneously due to LC1315 false high or local instrument air failure (P&ID 24B) | | |  |  | | --- | --- | | 1. | Low Flow resulting in cavitation of the 17P011A/B Reduced Crude Charge Pumps. Potential damage to 17P011A/011B due to cavitation and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 10. | 17FC1129/1130/1153/1154 with high flow alarm may afford operator response (Independent of level control loop). | |  | E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 3. | FV1321 fails/set open or bypass inadvertently open (when HVGO recycle is required) (P&ID 22A) | | |  |  | | --- | --- | | 1. | During startup or one set of exchangers in hot standby mode, failure open of this valve results in recirculation of HVGO or reduced crude to feed surge drum, but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Only used during in Startup and Shutdown. | |
| |  |  | | --- | --- | | 2. | During normal operation, this scenario is considered but not deemed credible as upstream/downstream valves are manually isolated at the gas oil rundown line. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | 8" inlet valve to 17E005A inadvertently fully opened when intended to be in warm up only (P&ID 26C) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | 4" manual valve on inlet/outlet of 17E013 inadvertently fully open when intended to be in warm up (P&ID 31) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | 6" valve at feed inadvertently closed (P&ID 22A|B5) | | |  |  | | --- | --- | | 1. | Low Flow resulting in cavitation of the 17P011A/B Reduced Crude Charge Pumps. Potential damage to 17P011A/011B due to cavitation and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 10. | 17FC1129/1130/1153/1154 with high flow alarm may afford operator response (Independent of level control loop). | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 11. | 17LC1315 with low level alarm may afford operator response | |  | C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Either 8" valve on inlet to 17E005A inadvertently closed (P&ID 26C)  LOPA Scenario - Initiating Event: 1.15.1 | | |  |  | | --- | --- | | 1. | Low Flow resulting in deadheading the 17P011A/B Reduced Crude Charge Pumps. Overpressure of pipe not expected based on deadhead pressure of 230 psig. Potential damage to 17P011A/011B due to deadheading and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Team notes that only one set of exchangers is utilized at a time with the spare exchanger set only having minimum flow to keep warm. | |
| |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.15 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 9. | 17FSL1129/1130/1153/1154 with Low Flow Trip of fired heater to minimum firing (Credit taken as per SAF-200-05-208; this PLC SIF assumed to be independent of cause) [DCS PLC] | | CTP | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 3. | Potential high level in the 17V005 Feed Surge Drum. Potential High Pressure in drum up to normal operating pressure of reduced crude supply pressure as flow may continue to Vac 3 unit. Potential overfill of reduced crude to flare header via PV1420B. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Team notes that only one set of exchangers is utilized at a time with the spare exchanger set only having minimum flow to keep warm. | |
| |  |  | | --- | --- | | 3. | Either 8" valve on inlet to 17E005A inadvertently fully closed when intended to be in warm up only (P&ID 26C) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | 4" manual valve on inlet/outlet of 17E013 inadvertently closed (P&ID 31/24B)  LOPA Scenario - Initiating Event: 1.16.1 | | |  |  | | --- | --- | | 1. | Low Flow resulting in deadheading the 17P011A/B Reduced Crude Charge Pumps. Overpressure of pipe not expected based on deadhead pressure of 230 psig. Potential damage to 17P011A/011B due to deadheading and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Team notes that only one set of exchangers is utilized at a time with the spare exchanger set only having minimum flow to keep warm. | |
| |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | E | 4 | 4 | 4 |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.16 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 9. | 17FSL1129/1130/1153/1154 with Low Flow Trip of fired heater to minimum firing (Credit taken as per SAF-200-05-208; this PLC SIF assumed to be independent of cause) [DCS PLC] | | CTP | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 3. | Potential high level in the 17V005 Feed Surge Drum. Potential High Pressure in drum up to normal operating pressure of reduced crude supply pressure as flow may continue to Vac 3 unit. Potential overfill of reduced crude to flare header via PV1420B. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Team notes that only one set of exchangers is utilized at a time with the spare exchanger set only having minimum flow to keep warm. | |
| |  |  | | --- | --- | | 5. | 4" manual valve on inlet/outlet of 17E013 inadvertently fully closed when intended to be in warm up (P&ID 31) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | FV1129 fails/set closed or upstream/ downstream manual block valves inadvertently closed (individual pass) (P&ID 24B)  LOPA Scenario - Initiating Event: 1.3.1 | | |  |  | | --- | --- | | 1. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.3 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 7. | FV1130 fails/set closed or upstream/downstream manual block valves inadvertently closed (individual pass) (P&ID 24B)  LOPA Scenario - Initiating Event: 1.5.1 | | |  |  | | --- | --- | | 1. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.5 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 8. | FV1153 fails/set closed or upstream/downstream manual block valves inadvertently closed (individual pass) (P&ID 24B)  LOPA Scenario - Initiating Event: 1.6.1 | | |  |  | | --- | --- | | 1. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.6 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 9. | FV1154 fails/set closed or upstream/downstream manual block valves inadvertently closed (individual pass) (P&ID 24B)  LOPA Scenario - Initiating Event: 1.7.1 | | |  |  | | --- | --- | | 1. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.7 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 10. | FV1129, FV1130, FV1153, and FV1154 Fail Closed simultaneously due to LC1315 false low (P&ID 24B)  LOPA Scenario - Initiating Event: 1.8.1 | | |  |  | | --- | --- | | 1. | Potential high level in the 17V005 Feed Surge Drum. Potential High Pressure in drum up to normal operating pressure of reduced crude supply pressure as flow may continue to Vac 3 unit. Potential overfill of reduced crude to flare header via PV1420B. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Team notes that only one set of exchangers is utilized at a time with the spare exchanger set only having minimum flow to keep warm. | |
| |  |  | | --- | --- | | 2. | Low Flow resulting in deadheading the 17P011A/B Reduced Crude Charge Pumps. Potential to exceed design pressure of pipe (<1.5X MAWP). Potential damage to 17P011A/011B due to deadheading and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Team notes that only one set of exchangers is utilized at a time with the spare exchanger set only having minimum flow to keep warm. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  |
| |  |  | | --- | --- | | 3. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.8 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 11. | FV1321 fails/set closed or upstream/downstream manual valves inadvertently closed during startup/recycle (P&ID 22A) | | |  |  | | --- | --- | | 1. | [Startup] No Flow resulting in Low Level in the 17V005 Feed Surge Drum during startup/recycle. Potential for delayed startup operations. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Only used during in Startup and Shutdown. | |
| |  |  | | --- | --- | | 2. | [Normal Operation] No consequence of interest identified as this valve is normally closed (manually isolated) during normal operation. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | HVGO Recycle valve FV1321 inadvertently opened when not required (P&ID 22A/C) | | |  |  | | --- | --- | | 1. | Misdirect HVGO to Reduced Crude resulting in recycling HVGO or reduced crude and reducing charge rate. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Misdirect Reduced Crude to HVGO resulting in off spec HVGO. Potential FCCU upset. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 6" bypass valve around 17V005 inadvertently opened (P&ID 22A|G4) | | |  |  | | --- | --- | | 1. | Potential bypass of feed surge drum. Potential reduced ability to regulate flow to vacuum distillation column. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | 2" CSC valve on 17V005 vapor outlet inadvertently opened (P&ID 22A) | | |  |  | | --- | --- | | 1. | Per CVR guidance, inadvertent operation of CSO/CSC valves not evaluated. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Inadvertent opening of the steam line to the 17P011A/B Reduced Crude Charge Pump discharge line (P&ID 22A) | | |  |  | | --- | --- | | 1. | When operating at maximum charge rates (FV1129/1130/1154/1155 nearly full open), misdirect 150-psig steam into the reduced crude resulting in a process upset. Potential operability issue due to loss of vacuum but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | When operating with FV1129/1130/1154/1155 at reduced charge rates, reverse reduced crude into the 150-psig steam system. Potential release of hydrocarbons in the steam leading to process upsets. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | 17P011A/B Reduced Crude Charge Pump primary seal failure (P&ID 22A) | | |  |  | | --- | --- | | 1. | Potential carryover of nitrogen to suction of pump. Refer to pump failure cause in low flow deviation. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Inadvertent opening of 2" Slop line upstream of 17E001A/B Reduced Crude/HVGO Exchangers (P&ID 22E) | | |  |  | | --- | --- | | 1. | Scenario considered but no hazardous consequence without a second independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Tube Leak in 17E001A/B Reduced Crude/HVGO Exchangers (P&ID 22E) | | |  |  | | --- | --- | | 1. | Misdirect reduced crude to HVGO, resulting in off spec product. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | 8" bypass valve around 17E005A inadvertently opened (P&ID 26C) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | 3/4" start up slop oil line inadvertently opened when not required (P&ID 31) | | |  |  | | --- | --- | | 1. | Potential to misdirect reduced crude into tar rundown to storage. Potential operability issue but no hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No additional causes | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | Crude Unit Heater Trip | | |  |  | | --- | --- | | 1. | [Impact to temporary repairs which may leak prior to 50 psi] Light material in the reduced crude resulting in overloading vacuum tower overhead system. Potential increased Pressure leading to higher than normal pressure at vacuum overheads, but not expected to exceed MAWP of vessel or original rating of steam ejectors. Team notes that vacuum ejectors have been repaired multiple times with Belzona wrap, and exceeding normal operating pressure (substantial loss of vacuum) may result in leakage at temporary repairs. Potential LOPC via leakage at steam ejector, potential ignition with jet fire. Potential personnel injury (SDI), environmental release (Moderate), and equipment damage ($100k-$1MM). | | |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Cause occurs outside of the Node upstream at the Crude Units. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 3 | 3 | |  |  | | --- | --- | | 2. | Only single credit taken for 38PC1147/1147A/1146 high pressure alarms as operators may not have adequate time to properly respond before leakage occurs at temporary repairs | |
| |  |  | | --- | --- | | 15. | Operator rounds - Temporary repairs to steam ejectors are being actively monitored. | |  | C | 4 | 3 | 4 | |  |  | | --- | --- | | 3. | No credit taken for 17PSV002A Relief Valve on Vac Jug (17T001A Vacuum Tower) as temporary repairs may leak at pressures less than the set point of the relief device (set at 50 psig.) | |
| |  |  | | --- | --- | | 90. | 37TI5008B with Crude 2 Charge Heater Outlet low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 4. | **2018 HAZOP Recommendation**  Evaluate adding crude unit low temperature heater alarms (Crude 1 RADCO, Crude 1 OPF, and Crude 2 main charge heater) to the vacuum board operator's panel to afford adequate response time to a loss of heat input from the crude unit. Team notes that high pressure alarms currently exist on the vacuum tower. However, those alarms may not afford adequate response time to prevent damage to temporary repairs (Belzona wrap) on the vacuum jet ejectors.  Team notes that these ejectors are scheduled for replacement during next plant turnaround, but addition of alarm from crude unit would be beneficial long term in aiding prevention of high pressure scenarios within the vacuum systems in both Vac#2 and Vac#3 units.  Alternatively, team notes that this yellow (3 - medium) risk may be endorsed by management team.  **2022 Vac 2 HAZOP Update:**  Team notes this recommendation has been closed. No further action proposed by team. | |
| |  |  | | --- | --- | | 91. | 07TI503B with Crude 1 OPF Heater outlet low temperature alarm may afford operator response | |  |
| |  |  | | --- | --- | | 92. | 07TI584B with Crude 1 Radco Heater outlet low temperature alarm may afford operator response | |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | LV1453 fails/set open or bypass inadvertently opened (P&ID 22A) | | |  |  | | --- | --- | | 1. | More Flow resulting in High Level in the 17V005 Feed Surge Drum. Potential to carry over to the V0348 Flare KO Drum via PV1420B. No Significant Consequences, as upstream pressure is limited to normal discharge pressure. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | LV1453 fails/set closed or upstream/ downstream manual block valves inadvertently closed (P&ID 22A)  LOPA Scenario - Initiating Event: 1.9.1 | | |  |  | | --- | --- | | 1. | Low Flow resulting in cavitation of the 17P011A/B Reduced Crude Charge Pumps. Potential damage to 17P011A/011B due to cavitation and potential loss of seal, leading to release of reduced crude, potential ignition and pool fire, potential injury to personnel (SDI), potential economic impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 2. | Plan 53A dual seals on 17P011A/B Reduced Crude Charge Pumps with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 3. | 17FC1129/1130/1153/1154 with low flow alarm on 17FH001A Vacuum Charge Heater coil inlets may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 17. | 17FI1316 with low flow alarm may afford operator response. | |  | C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Low-low heater pass flow could result in loss of heat transfer in heater tubes and increase in tube temperatures. This could also result in coking in the tube. There is potential to exceed the maximum temperature rating of the tubes, which could result in loss of mechanical integrity, potential tube rupture and release of process fluids. An uncontrolled fire could occur inside the firebox and possibly escape and result in a fire outside the firebox.  [HeaterCrossCheck]  LOPA Scenario: 1.9 | | |  |  | | --- | --- | | 6. | 17TI1186/1188/1190/1192 with high skin temperature alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 5 | |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP | |  |  | | --- | --- | | 2. | Fire escaping firebox could potentially impact personnel that are in the immediate area of the firebox. Most credible consequence is serious injury. | |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | Steam trap fails/set closed, manual isolation valve inadvertently closed, or check valve sticks closed on 150# steam condensate return line (P&ID 22A) | | |  |  | | --- | --- | | 1. | Potential carryover of water into steam injection line. Potential operability issues within vacuum column, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | 3/4" start up slop oil line isolation valve inadvertently closed when required to be open (P&ID 31) | | |  |  | | --- | --- | | 1. | Potential delayed maintenance/startup operation. Potential prolonged startup. No hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | 17PSV006 relieves as designed (P&ID 22A) | | |  |  | | --- | --- | | 1. | Potential relief to flare system. No hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 17PSV006 spuriously lifts or bypass manual valve inadvertently opened (P&ID 22A) | | |  |  | | --- | --- | | 1. | Potential lower than desired pressure within 17V005 and carryover of nitrogen to flare, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0023; 17AA0024A; 17AA0024B; 17AA0024C; 17AA0025A; 17AA0038 | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 2. No. 2 Vacuum Charge Heater | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | PCV1076 Fails/set open (P&ID 24C)  LOPA Scenario - Initiating Event: 2.4.1 | | |  |  | | --- | --- | | 1. | During Normal operation - Excess flow of Pilot Gas to the 17FH001A Heater. Potential lift off of pilot flame and pilot loss but no consequence of interest without second independent initiating event. Continuous pilot is a safeguard. This is considered a revealed failure as operations rounds confirm pilot each round. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | High-high pilot gas pressure could result in loss of pilot burner flame due to increase in gas pressure above stable flame limit. Loss of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. heater puff] or, at a worst-case a firebox explosion. This hazard is only present during light-off and pilot-only operation  [HeaterCrossCheck]  LOPA Scenario: 2.4 | | |  |  | | --- | --- | | 18. | Procedural - Start up - Visual checks/startup procedure includes LEL check prior to attempt to light | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 4 | |
| |  |  | | --- | --- | | 19. | 17PAHH1150 with high-high pressure trip of pilot gas to heater (P&ID 17AA0024C)  [HeaterCrossCheck] | | CTP | |  |  | | --- | --- | | 2. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 20. | 17PAHH1158 with high-high pressure trip of pilot gas to heater (P&ID 17AA0024C) | |  | |  |  | | --- | --- | | 3. | Failure must occur during startup. This would be a revealed failure during normal operations and as such frequency reduction may potentially be afforded (72 hours/year). | |
| |  |  | | --- | --- | | 4. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 5. | 2014 HAZOP REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 6. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | Inadvertent closure of block valve in natural gas line (P&ID 24C)  LOPA Scenario - Initiating Event: 2.5.1 | | |  |  | | --- | --- | | 1. | During Normal operation - Pilot loss but no consequence of interest without second independent initiating event. (Pilot failure is considered a revealed failure as PI1158 will alarm on high/low pressure and operations confirms presence of pilot during each round and would expected to be corrected - team experience indicates that pilot failure has not been an issue) | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low-low pilot gas pressure could result in loss of pilot burner flame due to decrease in gas pressure above stable flame limit. Loss of flame with continued introduction of fuel into the firebox could result in accumulation of unburned pilot gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. heater puff] or, at a worst-case a firebox explosion. This hazard is only present during light-off and pilot-only operation  [HeaterCrossCheck]  LOPA Scenario: 2.5 | | |  |  | | --- | --- | | 18. | Procedural - Start up - Visual checks/startup procedure includes LEL check prior to attempt to light | |  | P | 2 | 5 | 4 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 3 | |
| |  |  | | --- | --- | | 21. | 17PALL1150 with low-low pressure trip of pilot gas to heater (P&ID 17AA0024C) | | CTP | |  |  | | --- | --- | | 2. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 22. | 17PALL1158 with low-low pressure trip of pilot gas to heater (P&ID 17AA0024C) | |  | |  |  | | --- | --- | | 3. | Failure must occur during startup. This would be a revealed failure during normal operations and as such frequency reduction may potentially be afforded (72 hours/year). | |
| |  |  | | --- | --- | | 4. | 2014 HAZOP REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 5. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 2. | PCV1076 fails/set closed, or any in-line manual valve inadvertently closed during normal operations (P&ID 24C/24A)  LOPA Scenario - Initiating Event: 2.9.1 | | |  |  | | --- | --- | | 1. | During Normal operation - Pilot loss but no consequence of interest without second independent initiating event. (Pilot failure is considered a revealed failure as PI1158 will alarm on high/low pressure and operations confirms presence of pilot during each round and would expected to be corrected - team experience indicates that pilot failure has not been an issue) | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low-low pilot gas pressure could result in loss of pilot burner flame due to decrease in gas pressure above stable flame limit. Loss of flame with continued introduction of fuel into the firebox could result in accumulation of unburned pilot gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. heater puff] or, at a worst-case a firebox explosion. This hazard is only present during light-off and pilot-only operation  [HeaterCrossCheck]  LOPA Scenario: 2.9 | | |  |  | | --- | --- | | 18. | Procedural - Start up - Visual checks/startup procedure includes LEL check prior to attempt to light | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 3 | |
| |  |  | | --- | --- | | 21. | 17PALL1150 with low-low pressure trip of pilot gas to heater (P&ID 17AA0024C) | | CTP | |  |  | | --- | --- | | 2. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 22. | 17PALL1158 with low-low pressure trip of pilot gas to heater (P&ID 17AA0024C) | |  | |  |  | | --- | --- | | 3. | Failure must occur during startup. This would be a revealed failure during normal operations and as such frequency reduction may potentially be afforded (72 hours/year). | |
| |  |  | | --- | --- | | 4. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 5. | 2014 HAZOP REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 6. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 3. | XV1151/1196 fails/set closed, (P&ID 24C) | | |  |  | | --- | --- | | 1. | Potential loss of pilot to fired heater, no consequence without second independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | FV1140 fails/set open or bypass inadvertently opened (P&D 24A)  LOPA Scenario - Initiating Event: 2.2.1 | | |  |  | | --- | --- | | 1. | High-high fuel gas pressure could result in loss of main burner flame due to increase in gas pressure above stable flame limit. Loss of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. heater puff] or, at a worst-case a firebox explosion  [HeaterCrossCheck]  LOPA Scenario: 2.2 | | |  |  | | --- | --- | | 24. | 17AI1141 with low O2 alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 2 | |
| |  |  | | --- | --- | | 25. | 17PAHH1176 with high-high pressure trip of heater (P&ID 17AA0024C) | |  | |  |  | | --- | --- | | 2. | TI1145 with low temperature indication and alarm may afford operator response (no credit afforded as this is tied to the same loop as that flow control valve) | |
| |  |  | | --- | --- | | 26. | 17PAHH1160 with high-high pressure trip of fuel to heater (P&ID 17AA0024C)  [HeaterCrossCheck] | | CTP | |  |  | | --- | --- | | 3. | No credit taken for alarms as it is not clear if they provide adequate response time. | |
| |  |  | | --- | --- | | 27. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 4. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 5. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 6. | 2014 HAZOP REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 7. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 2. | High vapor line Temperature resulting in increased coking in heater tubes. Potential plugging and/or tube damage leading to tube failure, ingress flue gas into the tube resulting in a loss of vacuum in the 17T001A Vacuum Tower leading to a process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential overheating of 17FH001A Heater tubes. Damage to the tubes in the 17FH001A Heater. Coking of tubes in the 17FH001A Heater. Potential tube failure with release of Reduced Crude, potential fire, personnel injury (SDI). | | |  |  | | --- | --- | | 28. | 17TI1108 with high temperature alarm may afford operator response | |  | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 7. | 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | CTP |
| |  |  | | --- | --- | | 8. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with high temperature alarm may afford operator response | |  |
| |  |  | | --- | --- | | 24. | 17AI1141 with low O2 alarm may afford operator response | |  |
| |  |  | | --- | --- | | 2. | Bypass valves around XV1151/1196 inadvertently opened (P&ID 24C) | | |  |  | | --- | --- | | 1. | Per CVR guidance, inadvertent operation of CSO/CSC valves not evaluated. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | AC1141 O2/Comb Controller malfunction causing AV1141 to open (P&ID 23) | | |  |  | | --- | --- | | 1. | Potential increased air flow resulting in inefficient operation. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | PV1157 Fails/set open (P&ID 23) | | |  |  | | --- | --- | | 1. | Potential increased air flow resulting in inefficient operation. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | FV1140 Fails/set closed or upstream/ downstream manual valves inadvertently closed (P&ID 24A)  LOPA Scenario - Initiating Event: 2.1.1 | | |  |  | | --- | --- | | 1. | Low vapor line Temperature resulting in process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Minimum flame on the fuel gas side of 17FH001A. Loss of heating to the Vacuum column feed, total unit upset due to loss of heat in the 17T001A Vacuum Tower. Operability issues only. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Minimum travel stop adjusted at startup to ~3 psi. | |
| |  |  | | --- | --- | | 2. | Pilots are still lit and keep fire in the firebox to prevent accumulation of unburned vapors. | |
| |  |  | | --- | --- | | 3. | Low-low fuel gas pressure could result in loss of main burner flame due to decrease in gas pressure below stable flame limit. Los of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. heater puff] or, at worst-case a firebox explosion.  [HeaterCrossCheck]  LOPA Scenario: 2.1 | | |  |  | | --- | --- | | 23. | Inherent safeguard - Continuous pilot | | CTP | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 1 | |
| |  |  | | --- | --- | | 29. | 17PALL1160 with low-low pressure trip of fuel to heater  [HeaterCrossCheck] | | CTP | |  |  | | --- | --- | | 2. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 79. | Main fuel gas control valve mechanical minimum stop (not shown on P&ID) | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 30. | 17PALL1176 with low-low pressure trip of fuel to heater | |  | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 2. | Inadvertent closure of block valve in fuel gas supply  LOPA Scenario - Initiating Event: 2.7.1 | | |  |  | | --- | --- | | 1. | Low vapor line Temperature resulting in process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Minimum flame on the fuel gas side of 17FH001A. Loss of heating to the Vacuum column feed, total unit upset due to loss of heat in the 17T001A Vacuum Tower. Operability issues only. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Minimum travel stop adjusted at startup to ~3 psi. | |
| |  |  | | --- | --- | | 2. | Pilots are still lit and keep fire in the firebox to prevent accumulation of unburned vapors. | |
| |  |  | | --- | --- | | 3. | Low-low fuel gas pressure could result in loss of main burner flame due to decrease in gas pressure below stable flame limit. Los of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. heater puff] or, at worst-case a firebox explosion.  [HeaterCrossCheck]  LOPA Scenario: 2.7 | | |  |  | | --- | --- | | 23. | Inherent safeguard - Continuous pilot | | CTP | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 1 | |
| |  |  | | --- | --- | | 29. | 17PALL1160 with low-low pressure trip of fuel to heater  [HeaterCrossCheck] | | CTP | |  |  | | --- | --- | | 2. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 30. | 17PALL1176 with low-low pressure trip of fuel to heater | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 3. | Plugged elements in 17FR001 Fuel Gas Coalescer  LOPA Scenario - Initiating Event: 2.8.1 | | |  |  | | --- | --- | | 1. | Low vapor line Temperature resulting in process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Minimum flame on the fuel gas side of 17FH001A. Loss of heating to the Vacuum column feed, total unit upset due to loss of heat in the 17T001A Vacuum Tower. Operability issues only. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Minimum travel stop adjusted at startup to ~3 psi. | |
| |  |  | | --- | --- | | 2. | Pilots are still lit and keep fire in the firebox to prevent accumulation of unburned vapors. | |
| |  |  | | --- | --- | | 3. | Low-low fuel gas pressure could result in loss of main burner flame due to decrease in gas pressure below stable flame limit. Los of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. heater puff] or, at worst-case a firebox explosion.  [HeaterCrossCheck]  LOPA Scenario: 2.8 | | |  |  | | --- | --- | | 23. | Inherent safeguard - Continuous pilot | | CTP | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 1 | |
| |  |  | | --- | --- | | 29. | 17PALL1160 with low-low pressure trip of fuel to heater  [HeaterCrossCheck] | | CTP | |  |  | | --- | --- | | 2. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 30. | 17PALL1176 with low-low pressure trip of fuel to heater | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 4. | XV1169/1161 fail/set closed (P&ID 24C) | | |  |  | | --- | --- | | 1. | Low vapor line Temperature resulting in process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Minimum flame on the fuel gas side of 17FH001A. Loss of heating to the Vacuum column feed, total unit upset due to loss of heat in the 17T001A Vacuum Tower. Operability issues only. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Minimum travel stop adjusted at startup to ~3 psi. | |
| |  |  | | --- | --- | | 2. | Pilots are still lit and keep fire in the firebox to prevent accumulation of unburned vapors. | |
| |  |  | | --- | --- | | 3. | Potential loss of fuel gas to fired heater, however not expected to result in accumulation of fuel gas. Potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | 2" manual valve on individual fuel gas line to 17FH001A's burner inadvertently closed (P&ID 24A) | | |  |  | | --- | --- | | 1. | Potential loss of a single burner, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | AC1141 O2/Comb Controller malfunction causing AV1141 to close (P&ID 23)  LOPA Scenario - Initiating Event: 2.6.1 | | |  |  | | --- | --- | | 1. | Potential flame out with continued feed of fuel gas. Potential loss of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. "heater puff"] or, at worst-case a firebox explosion. Potential commercial impact ($1MM-$5MM).  LOPA Scenario: 2.6 | | |  |  | | --- | --- | | 31. | Operator rounds - Smoke release from the 17FL001A Charge Heater Flue Gas Stack may afford operator response | |  | P | 2 | 3 | 2 |  | |  |  | | --- | --- | | 1. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 32. | Inherent Safeguard - 17F003A ID Fan removing fuel from firebox. | |  | C | 3 | 2 | 2 | |  |  | | --- | --- | | 2. | Scenario likelihood accounts for probability of reignition of fuel gas mixture within burner. | |
| |  |  | | --- | --- | | 33. | 17PI1142 with low pressure alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No credit taken for alarms as team did not believe there was sufficient time for operator response. | |
| |  |  | | --- | --- | | 24. | 17AI1141 with low O2 alarm may afford operator response | |  | |  |  | | --- | --- | | 4. | 2014 HAZOP REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  Action item was closed March 6, 2018 | |
| |  |  | | --- | --- | | 27. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 5. | 2014 LOPA REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 34. | 17TC1145 with low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 6. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:** Implement additional safeguards/IPLs to protect against flame out events related to loss of airflow through heater - specifically:  \* AC1141 O2/Comb Controller malfunction causing AV1141 to close (P&ID 23)  \* 17F002A Forced Draft Fan shuts down (P&ID 23)  \* PC1157 malfunction causing PV1157 to close (P&ID 23)  \* 17F003A ID Fan shuts down (P&ID 23)  \* HC1155 malfunction causing HV1155 Stack Damper to close when required open (P&ID 23) during startup  [Note that SAF 200-05-208 does not document BMS requirements regarding loss of airflow through the heater; no credit taken for alarms as response time not expected to be adequate]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation has been closed, however, the scenario of "AC1141 O2/Comb Controller malfunction causing AV1141 to close" results in an RRF gap of 10. Refer to new LOPA recommendation. | |
| |  |  | | --- | --- | | 7. | 17F002A Forced Draft Fan shuts down (P&ID 23)  LOPA Scenario - Initiating Event: 2.10.1 | | |  |  | | --- | --- | | 1. | Potential flame out with continued feed of fuel gas. Potential loss of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. "heater puff"] or, at worst-case a firebox explosion. Potential commercial impact ($1MM-$5MM).  LOPA Scenario: 2.10 | | |  |  | | --- | --- | | 31. | Operator rounds - Smoke release from the 17FL001A Charge Heater Flue Gas Stack may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 32. | Inherent Safeguard - 17F003A ID Fan removing fuel from firebox. | |  | C | 3 | 3 | 3 | |  |  | | --- | --- | | 2. | Scenario likelihood accounts for probability of reignition of fuel gas mixture within burner. | |
| |  |  | | --- | --- | | 33. | 17PI1142 with low pressure alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 24. | 17AI1141 with low O2 alarm may afford operator response | |  | |  |  | | --- | --- | | 4. | 2014 HAZOP REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  Action item was closed March 6, 2018 | |
| |  |  | | --- | --- | | 27. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 5. | 2014 LOPA REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 34. | 17TC1145 with low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 6. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:** Implement additional safeguards/IPLs to protect against flame out events related to loss of airflow through heater - specifically:  \* AC1141 O2/Comb Controller malfunction causing AV1141 to close (P&ID 23)  \* 17F002A Forced Draft Fan shuts down (P&ID 23)  \* PC1157 malfunction causing PV1157 to close (P&ID 23)  \* 17F003A ID Fan shuts down (P&ID 23)  \* HC1155 malfunction causing HV1155 Stack Damper to close when required open (P&ID 23) during startup  [Note that SAF 200-05-208 does not document BMS requirements regarding loss of airflow through the heater; no credit taken for alarms as response time not expected to be adequate]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation has been closed, however, the scenario of "AC1141 O2/Comb Controller malfunction causing AV1141 to close" results in an RRF gap of 10. Refer to new LOPA recommendation. | |
| |  |  | | --- | --- | | 35. | 17ICR1156 with low amp trip opens HV-1155 and HV-1159 | | CTP |
| |  |  | | --- | --- | | 8. | PC1157 malfunction causing PV1157 to close (P&ID 23)  LOPA Scenario - Initiating Event: 2.11.1 | | |  |  | | --- | --- | | 1. | Potential flame out with continued feed of fuel gas. Potential loss of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. "heater puff"] or, at worst-case a firebox explosion. Potential commercial impact ($1MM-$5MM).  LOPA Scenario: 2.11 | | |  |  | | --- | --- | | 36. | 17PI1142 with high pressure alarm may afford operator response | |  | P | 2 | 3 | 2 |  | |  |  | | --- | --- | | 1. | 2014 HAZOP REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  Action item was closed March 6, 2018 | |
| |  |  | | --- | --- | | 24. | 17AI1141 with low O2 alarm may afford operator response | |  | C | 3 | 2 | 2 | |  |  | | --- | --- | | 2. | 2014 LOPA REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 27. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:** Implement additional safeguards/IPLs to protect against flame out events related to loss of airflow through heater - specifically:  \* AC1141 O2/Comb Controller malfunction causing AV1141 to close (P&ID 23)  \* 17F002A Forced Draft Fan shuts down (P&ID 23)  \* PC1157 malfunction causing PV1157 to close (P&ID 23)  \* 17F003A ID Fan shuts down (P&ID 23)  \* HC1155 malfunction causing HV1155 Stack Damper to close when required open (P&ID 23) during startup  [Note that SAF 200-05-208 does not document BMS requirements regarding loss of airflow through the heater; no credit taken for alarms as response time not expected to be adequate]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation has been closed, however, the scenario of "AC1141 O2/Comb Controller malfunction causing AV1141 to close" results in an RRF gap of 10. Refer to new LOPA recommendation. | |
| |  |  | | --- | --- | | 34. | 17TC1145 with low temperature alarm may afford operator response | |  |
| |  |  | | --- | --- | | 9. | 17F003A ID Fan shuts down (P&ID 23)  LOPA Scenario - Initiating Event: 2.12.1 | | |  |  | | --- | --- | | 1. | Potential flame out with continued feed of fuel gas. Potential loss of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. "heater puff"] or, at worst-case a firebox explosion. Potential commercial impact ($1MM-$5MM).  LOPA Scenario: 2.12 | | |  |  | | --- | --- | | 36. | 17PI1142 with high pressure alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 24. | 17AI1141 with low O2 alarm may afford operator response | |  | C | 3 | 4 | 4 | |  |  | | --- | --- | | 2. | 2014 HAZOP REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  Action item was closed March 6, 2018 | |
| |  |  | | --- | --- | | 27. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 3. | 2014 LOPA REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 34. | 17TC1145 with low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 4. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:** Implement additional safeguards/IPLs to protect against flame out events related to loss of airflow through heater - specifically:  \* AC1141 O2/Comb Controller malfunction causing AV1141 to close (P&ID 23)  \* 17F002A Forced Draft Fan shuts down (P&ID 23)  \* PC1157 malfunction causing PV1157 to close (P&ID 23)  \* 17F003A ID Fan shuts down (P&ID 23)  \* HC1155 malfunction causing HV1155 Stack Damper to close when required open (P&ID 23) during startup  [Note that SAF 200-05-208 does not document BMS requirements regarding loss of airflow through the heater; no credit taken for alarms as response time not expected to be adequate]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation has been closed, however, the scenario of "AC1141 O2/Comb Controller malfunction causing AV1141 to close" results in an RRF gap of 10. Refer to new LOPA recommendation. | |
| |  |  | | --- | --- | | 37. | 17ICR1157 with low amp trip opens HV-1155 and HV-1159 | |  |
| |  |  | | --- | --- | | 10. | HC1155 malfunction causing HV1155 Stack Damper to close when required open (P&ID 23) during startup | | |  |  | | --- | --- | | 1. | Potential loss of combustion air during startup, potential flame out considered but not deemed credible due to the short amount of time (approximately 2 mins) between lighting main burners and starting forced draft/induced draft fans which would introduce combustion air flow. Potential delayed startup but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Tubes become plugged in 17FH001A  (P&ID 24A) | | |  |  | | --- | --- | | 1. | Potential reduced flow through single pass due to coking over an extended duration. Potential to exceed design temperature of heater tubes with tube failure considered but not deemed credible due to the extended duration of time it would take to result in over temperature, potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Failure to purge with Snuffing Steam prior to lighting 17FH001A Heater (P&ID 24A) | | |  |  | | --- | --- | | 1. | During Normal operations - Normally blocked in. Used to purge the fire box before introducing fuel. Operability issues only. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | During Start up - Potential to attempt to light pilot during cold start with fuel rich environment, potential ignition and fire/explosion, potential injury to personnel (fatality). | | |  |  | | --- | --- | | 18. | Procedural - Start up - Visual checks/startup procedure includes LEL check prior to attempt to light | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario not taken to LOPA as this is a control of work activity | |
| |  |  | | --- | --- | | 2. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 13. | HV1149 set fully closed (P&ID 23) | | |  |  | | --- | --- | | 1. | Potential to send full combustion airflow through 17E004A, potential reduced temperatures, potential reliability issues but no immediate hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Malfunction causing HV1159 Natural Draft Door to close During natural draft mode (P&ID 23) | | |  |  | | --- | --- | | 1. | Scenario considered but not deemed credible as scenario requires DCS and human failure (draft door requires power from DCS as well as manual actuation from operator to close). | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Fouling of combustion air preheater 17E004A (P&ID 24A) | | |  |  | | --- | --- | | 1. | Gradual restriction of air flow into furnace. Potential inability to meet O2 target. Potential inefficiency of burner. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Inadvertent opening of the steam to the 17FH001A Vacuum Charge Heater coil inlets (P&ID 24B) | | |  |  | | --- | --- | | 1. | Misdirect 275 psig steam into the reduced crude resulting in loss of vacuum and process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Failure to close either bypass valve on 17FR001 Fuel Gas Coalescer (P&ID 24A) | | |  |  | | --- | --- | | 1. | Bypass fuel gas around the coalescer resulting in liquid droplets remaining in the fuel gas. Potential to foul burner tips over an extended duration of time, potential operability issue but no immediate hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Scenario developed based on team experience of running fired heater without the fuel gas coalescer installed. This led to more frequent cleaning of burner tips but no hazardous consequence. | |
| |  |  | | --- | --- | | 3. | Bypass valves around XV1161/1169 inadvertently opened (P&ID 24C) | | |  |  | | --- | --- | | 1. | Per CVR guidance, inadvertent operation of CSO/CSC valves not evaluated. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | XV1168 fails/set open (P&ID 24C) | | |  |  | | --- | --- | | 1. | Potential venting of fuel gas to atmosphere at safe location. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | XV1152 fails/set open (P&ID 24C) | | |  |  | | --- | --- | | 1. | Potential venting of natural gas to atmosphere at safe location. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Malfunction causing HV1155 Stack Damper to open (P&ID 23) | | |  |  | | --- | --- | | 1. | Loss of energy efficiency. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Malfunction causing HV1159 Natural Draft Door to open (P&ID 23) | | |  |  | | --- | --- | | 1. | Loss of energy efficiency. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Malfunction causing HV1149 Air Preheater Bypass to open (P&ID 23) | | |  |  | | --- | --- | | 1. | Loss of energy efficiency. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Snuffing steam valve inadvertently opened when not required (P&ID 38) | | |  |  | | --- | --- | | 1. | Potential loss of flame (main and pilot). Potential loss of temperature in heater. Potential operability issue but no hazardous consequence identified without second independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | Failure to drain 17V010 Fuel Gas KO Drum | | |  |  | | --- | --- | | 1. | Potential carryover of liquid (water) to burners resulting in liquid droplets remaining in the fuel gas. Potential to foul burner tips over an extended duration of time, potential operability issue but no immediate hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Failure to drain 17FR001 Fuel Gas Coalescer | | |  |  | | --- | --- | | 1. | Potential carryover of liquid (water) to burners resulting in liquid droplets remaining in the fuel gas. Potential to foul burner tips over an extended duration of time, potential operability issue but no immediate hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | Failure to close drain valve on 17V010  (P&ID 24A) | | |  |  | | --- | --- | | 1. | Potential to blow fuel gas to atmosphere. Potential ignition and fire leading to personnel injury (SDI), environmental release (Minimal), and equipment damage ($100k-$1MM). | | |  |  | | --- | --- | | 39. | Operator training and procedures. | |  | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 80. | Auto-reclosing valve | | CTP | E | 5 | 4 | 4 |
| C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Failure to close drain valve on 17FR001  (P&ID 24A) | | |  |  | | --- | --- | | 1. | Potential to blow fuel gas to atmosphere. Potential ignition and fire leading to personnel injury (SDI), environmental release (Minimal), and equipment damage ($100k-$1MM). | | |  |  | | --- | --- | | 39. | Operator training and procedures. | |  | P | 3 | 3 | 3 |  | |  |  | | --- | --- | | 1. | Team deemed risk inherent to the operation. No recommendation proposed by team. | |
| E | 5 | 3 | 4 |
| C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | Sudden increase in hydrogen concentration in the fuel gas | | |  |  | | --- | --- | | 1. | Potential lower than normal temperature in fired heater, potential operability issue, but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Sudden lowering of hydrogen concentration in the fuel gas | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Nitrogen inadvertently added to fuel gas | | |  |  | | --- | --- | | 1. | Potential lower than normal temperature in fired heater, potential operability issue, but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | High H2S in fuel gas | | |  |  | | --- | --- | | 1. | Excessive corrosion in the heater duct work and stack. | | |  |  | | --- | --- | | 40. | Operator Intervention - HC1149 manual bypass around Air Preheater to maintain stack Temperature above SO2 dew point. | |  | C | 4 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 5. | Plugged burners sufficient to cause high pressure and unstable flame in remaining burners  [HeaterCrossCheck]  LOPA Scenario - Initiating Event: 2.3.1 | | |  |  | | --- | --- | | 1. | High-high fuel gas pressure could result in loss of main burner flame due to increase in gas pressure above stable flame limit. Loss of flame with continued introduction of fuel into the firebox could result in accumulation of unburned fuel gas in the heater firebox. If a source of ignition is contacted, there is a potential for ignition and uncontrolled combustion, potentially resulting in a weak deflagration [i.e. heater puff] or, at a worst-case a firebox explosion  [HeaterCrossCheck]  LOPA Scenario: 2.3 | | |  |  | | --- | --- | | 24. | 17AI1141 with low O2 alarm may afford operator response | |  | P | 2 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Scenario based on SAF-200-05-208 Appendix C Hazard ID 2 | |
| |  |  | | --- | --- | | 25. | 17PAHH1176 with high-high pressure trip of heater (P&ID 17AA0024C) | |  | |  |  | | --- | --- | | 2. | Heater firebox explosion could result in personnel injury. Fatality is possible, but very unlikely because probability of explosion (versus weak deflagration) is low. Area is not normally occupied (occupancy <10%). Most credible typical consequence is serious injury | |
| |  |  | | --- | --- | | 26. | 17PAHH1160 with high-high pressure trip of fuel to heater (P&ID 17AA0024C)  [HeaterCrossCheck] | | CTP | |  |  | | --- | --- | | 3. | TI1145 with low temperature indication and alarm may afford operator response (no credit afforded as this is tied to the same loop as that flow control valve) | |
| |  |  | | --- | --- | | 27. | 17TI1106/1107/1170/1171 Temperature Indicators on coil outlets with low temperature alarm may afford operator response | |  | |  |  | | --- | --- | | 4. | No credit taken for alarms as it is not clear if they provide adequate response time. | |
| |  |  | | --- | --- | | 5. | No recommendation required. Scenario meets LOPA TEF. | |
| |  |  | | --- | --- | | 6. | 2014 HAZOP REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 7. | 2014 LOPA REC #1 Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility. | |
| |  |  | | --- | --- | | 8. | **2014 HAZOP and LOPA REC #1**  Ensure that the corporate burner management system (BMS) is implemented on heater based on relative priority to other heaters in facility.  **2018 Recommendation:**  Gaps were identified against CVR BMS requirements of CVR BMS Standard SAF-200-05-208. Notably:  Ensure the following SIFs meet SIL-1/2 requirements by either documenting or upgrading the existing design:  \* 17PALL1158 - Low pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PAHH1158 - High pilot gas burner pressure (close pilot safety shutoff valves)  \* 17PALL1160 - Low fuel burner pressure (close main fuel safety shutoff valves)  \* 17PAHH1160 - High fuel burner gas pressure (close main fuel safety shutoff valves)  \* 17FSL1154 - Low process flow (close main fuel safety shutoff valves)  [CVR BMS standard SAF 200-05-208 requires SIFs meeting a SIL-1/2 rating per section 5.2 for the above instruments; however, PHA Team was unable to locate documentation related to these SISs. Reference ISA S84.01 Section 19.2 for minimum documentation requirements for a Safety Instrumented System.]  **2022 Vac 2 Reval Update:**  Team notes that this recommendation is still open. However, this recommendation will be closed by planned upgrades to the fired heaters which will bring them into alignment with SAF 200-05-208. No further action proposed by team. | |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No additional causes identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No additional causes identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No additional causes identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | See comment | | |  |  | | --- | --- | | 1. | No overpressure protection on 17V010 or 17FR001 (previous recommendation) | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | PHA\_HAZO\_17-Vacuum 2\_2016\_1\_3: Verify ASME VIII Code requirements for relief protection for V0862 and FR0274 and install as required.  2018 HAZOP team notes that this recommendation is still open. No further recommendations by team.  2022 HAZOP team notes that a pressure relief study was performed on 17V010 and 17FR001 and determined that these vessels do not require pressure relief, no further action proposed by team. | |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No additional causes identified. | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0025A; 17AA0025D; 17AA0025E; 17AA0025I; 17AA0030B; 17AA0039 | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 3. No. 2 Vacuum Tower | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | 12" manual valve inadvertently closed on outlet of 17T001A (P&ID 25A)  LOPA Scenario - Initiating Event: 3.1.1 | | |  |  | | --- | --- | | 1. | Potential loss of vacuum with subsequent accumulation of vapor within No. 2 vacuum tower 17T001A. Potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 3.1 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 | |  |  | | --- | --- | | 2. | Initiating event likelihood based on team experience with limited access to this valve. | |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 2. | PV1351 Fails/set open or bypass valve inadvertently opened (P&ID 25D) | | |  |  | | --- | --- | | 1. | Potential increased flow of steam resulting in reduced efficiency of condensers. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | PV1342 fails/set open (P&ID 25D) | | |  |  | | --- | --- | | 1. | Recycle vapor from the 17EJ001A/B 1st Stage ejectors to their suction resulting in loss of vacuum. Potential process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | PV1146 fails/set open or bypass inadvertently opened (P&ID 25D) | | |  |  | | --- | --- | | 1. | Scenario considered but not deemed credible as valve is no longer utilized and is isolated from process via normally closed manual valves. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Cold side (ts) isolated with continued heat input from hot side (ss) of 17E010 (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential vaporization of tube side of 17E010. Potential for increased pressure up to 15 psig based on saturated steam pressure at 250°F (17T001A overheads temperature). Potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Cold side (ts) isolated with continued heat input from hot side (ss) of 17E011 (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential vaporization of tube side of 17E011. Potential for increased pressure up to 15 psig based on saturated steam pressure at 250°F (17T001A overheads temperature). Potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Cold side (ts) isolated with continued heat input from hot side (ss) of 17E012 (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential vaporization of tube side of 17E012. Potential for increased pressure up to 15 psig based on saturated steam pressure at 250°F (17T001A overheads temperature). Potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Manual vapor valve on outlet of 17E012 (ss) inadvertently closed (upstream of receiver tie in on P&ID 25E)  \*\*one valve not CSO | | |  |  | | --- | --- | | 1. | Potential loss of vacuum with subsequent accumulation of vapor within No. 2 vacuum tower 17T001A. Potential to push liquid out of 17E012 into 17V006 Overheads Receiver. Potential for vapor as liquid is loss is 17E012 vapor will blow through 17V006 and out the vapor outlet which ties into the vent gas recovery system downstream of the closed 3" valve. Potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Scenario developed based on team experience with this line plugging up with wax which resulted in loss of vacuum and operability issues. | |
| |  |  | | --- | --- | | 9. | 6" Manual vapor valve on outlet of 17E012 (ss) & 17V006 inadvertently closed (P&ID 25D | I5/6)  \*\*one valve not CSO  LOPA Scenario - Initiating Event: 3.2.1 | | |  |  | | --- | --- | | 1. | Potential loss of vacuum with subsequent accumulation of vapor within No. 2 vacuum tower 17T001A and overhead receiver 17V006. Potential to exceed MAWP of No. 2 vacuum tower and overhead receiver (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 3.2 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | Initiating event likelihood based on team experience with limited access to this valve. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | PV1351 Fails/set closed or upstream/ downstream manual block valves inadvertently closed on common line (P&ID 25D) | | |  |  | | --- | --- | | 1. | No Flow resulting in reduced vacuum. Potential process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | CSO steam valve inadvertently closed to 17EJ001A/B (P&ID 25D) | | |  |  | | --- | --- | | 1. | Per CVR guidance, inadvertent operation of CSO/CSC valves not evaluated. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | CSO steam valve inadvertently closed to 17EJ001C (P&ID 25D) | | |  |  | | --- | --- | | 1. | Per CVR guidance, inadvertent operation of CSO/CSC valves not evaluated. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | CSO steam valve inadvertently closed to 17EJ001D (P&ID 25D) | | |  |  | | --- | --- | | 1. | Per CVR guidance, inadvertent operation of CSO/CSC valves not evaluated. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | PV1342 fails/set closed or upstream/ downstream manual block valves inadvertently closed (P&ID 25D) | | |  |  | | --- | --- | | 1. | If needed to reduce vacuum, No Flow resulting in increase vacuum. Potential off spec products. (Normally this valve is kept closed.) No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | PV1146 fails/set closed or upstream/ downstream manual block valves inadvertently closed (P&ID 25D) | | |  |  | | --- | --- | | 1. | Normally this valve is kept closed. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | Failure to close XV1352 on restart of vent gas compressors during restart after plant outage (P&ID 25D) | | |  |  | | --- | --- | | 1. | If Vent Gas Compressor is running, reverse flow of flare sweep gas into the inlet of the Vent Gas Compressor. Potential loss of vacuum, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2014 HAZOP RECOMMENDATION #6 Review fail position of valve and determine if it is currently correct. If not, consider converting valve to fail-close. | |
| |  |  | | --- | --- | | 2. | Team notes that this was previously routed to atmosphere but is now routed to flare. | |
| |  |  | | --- | --- | | 2. | If Vent Gas Compressor is not running, release vent gas to flare. Potential environmental release (negligible). | | |  |  | | --- | --- | | 44. | ZLO1352 Position Indicator on XV1352 with Alarm | |  | E | 4 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 2. | XV1352 fails open during normal operation (P&ID 25D) | | |  |  | | --- | --- | | 1. | Potential reverse flow of flare sweep gas into the inlet of the Vac 2 Tower Overheads. Potential minor loss of vacuum, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2014 HAZOP RECOMMENDATION #6 Review fail position of valve and determine if it is currently correct. If not, consider converting valve to fail-close. | |
| |  |  | | --- | --- | | 2. | Team notes that this was previously routed to atmosphere but is now routed to flare. | |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | Internal packing in 17T001A becomes plugged (P&ID 25A) | | |  |  | | --- | --- | | 1. | Potential operability issue and offspec product but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Individual 14" CSO valve on either 17EJ001A/B outlet inadvertently closed (P&ID 25D) | | |  |  | | --- | --- | | 1. | Per CVR guidance, inadvertent operation of CSO/CSC valves not evaluated. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Tubes become plugged in 17E010 (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential higher than normal pressures in vacuum column. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Tubes become plugged in 17E011 (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential higher than normal pressures in vacuum column. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Tubes become plugged in 17E012 (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential higher than normal pressures in vacuum column. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Vent gas compressor trips/fails (P&ID 38AA0065A)  LOPA Scenario - Initiating Event: 3.3.1 | | |  |  | | --- | --- | | 1. | Potential accumulation of vapor within No. 2 vacuum tower 17T001A. Potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 3.3 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | Initiating event likelihood based on team experience with limited access to this valve. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 81. | XC-1352 opens XV-1352 on high-high pressure from PT-1354/1356 | |  |
| |  |  | | --- | --- | | 7. | Loss of neutralizer injection (P&ID 25D) | | |  |  | | --- | --- | | 1. | No Flow resulting in low pH in the OVHD system. Potential increase corrosion. Potential reduced life of equipment. No immediate hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential to overpressure tubing of neutralizer pump discharge, resulting in release of pH neutralizer to grade. Potential injury to personnel (first aid). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 45. | Internal relief device on PD pump | |  | P | 5 | 4 | 4 |  |  |
| E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 8. | Manual valve inadvertently closed on 1" cooling water min flow line (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Tube leak in 17E010/011/012 OVHD Condensers (P&ID 25E) | | |  |  | | --- | --- | | 1. | Leak cooling water into Vacuum Tower OVHD system resulting in increased water production. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 2" 150# steam blowdown valve inadvertently opened when not required (P&ID 25D|I5)  LOPA Scenario - Initiating Event: 3.5.1  LOPA Scenario - Initiating Event: 3.6.1 | | |  |  | | --- | --- | | 1. | Potential misdirected flow of 150 psig steam into Vac 3 system, potential overpressure of 38V007/38E013 (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 3.5 | | |  |  | | --- | --- | | 82. | PSV-016 set at 50 psig on 38E013 with no credit taken as relief sizing documentation indicates this relief device has insufficient capacity for this case. | |  | P | 1 | 4 | 3 |  | |  |  | | --- | --- | | 1. | Initiating event likelihood based on team experience with limited access to this valve. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 2. | Potential misdirected flow of 150 psig steam into Vac 2 overheads. Potential overpressure of 17T001A, (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 3.6 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | Initiating event likelihood based on team experience with limited access to this valve. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | Cooling water bypass valves around 17E010 inadvertently left lined up (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential reduced vacuum in vacuum tower. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | TV1326 fails/set open or bypass inadvertently open (P&ID 25D)  LOPA Scenario - Initiating Event: 3.7.1 | | |  |  | | --- | --- | | 1. | Potential misdirected flow of 150 psig steam into Vac 2 overheads. Potential overpressure of 17T001A (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 3.7 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 3. | 10" OR 12" OR 16" block valve on inlet/outlet of cooling water for 17E010 inadvertently closed. (P&ID 30B/25E)  LOPA Scenario - Initiating Event: 3.4.1 | | |  |  | | --- | --- | | 1. | No Flow resulting in loss of steam condensation. Potential loss of vacuum with subsequent accumulation of vapor within No. 2 vacuum tower 17T001A. Potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 3.4 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | Initiating event likelihood based on team experience with limited access to this valve. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Either 6" manual valve on inlet/outlet of cooling water for 17E011/012 inadvertently closed (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential reduced vacuum in vacuum tower. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | TV1326 fails/set closed or upstream/ downstream manual valve inadvertently closed (P&ID 25D) | | |  |  | | --- | --- | | 1. | No Flow resulting in reduced vacuum. Potential process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Cold ambient Temperatures | | |  |  | | --- | --- | | 1. | No hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | Condensate steam trap fails/set closed, manual isolation valve inadvertently closed, or check valve sticks closed on 150# steam condensate return line (P&ID 25D) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Steam ejectors on vacuum distillation column nearing end of life with temporary repairs currently in place. | | |  |  | | --- | --- | | 1. | Refer to Node 1 Low Temperature deviation | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | 17PSV002A relieves as designed (P&ID 25A) | | |  |  | | --- | --- | | 1. | Potential relief to flare. No hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 17PSV002A spuriously lifts or fails to reseat (P&ID 25A) | | |  |  | | --- | --- | | 1. | Potential misdirected flow of flare sweep gas into Vac 2 system, potential operability issues but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0025I; 17AA0022C; 17AA0025B; 17AA0022E; 17AA0022B; 17AA0025A; 17AA0039 | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 4. LVGO Pump Around | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | PV1126 fails/set closed, manual isolation valve inadvertently closed, or check valve sticks closed (P&ID 25B) | | |  |  | | --- | --- | | 1. | Potential loss of LVGO to storage, Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked LVGO outlet would take 257 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 2. | Manual discharge valve inadvertently closed or check valve sticks closed on 17P004A/005A (P&ID 25I)  LOPA Scenario - Initiating Event: 4.1.1 | | |  |  | | --- | --- | | 1. | Potential to deadhead the 17P004A LVGO pump leading to seal failure, LOPC of LVGO via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 46. | 17PC1126 with high pressure alarm may afford operator response (P&ID 17AA0025B) | |  | P | 3 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 47. | Plan 53A dual seals on 17P004A/17P005A LVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | E | 4 | 5 | 4 |
| |  |  | | --- | --- | | 49. | 17FC1134 with low flow alarm may afford operator response | |  | C | 4 | 5 | 4 |
| |  |  | | --- | --- | | 2. | Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of pressure on LVGO due to loss of flow from 17P004A/005A. As pressure drops PV-1126 will open to maintain pressure as part of its normal process control. As PV-1126 opens potential reverse flow of HVGO into LVGO considered but not deemed credible based on system hydraulics and elevation. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Potential loss of LVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 4.1 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 5. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | [17P005A lined up to storage] Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. Deadhead considered but not deemed credible as outlet remains open to hot LVGO to storage | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Manual discharge valve inadvertently closed on common pump around outlet of 17E003A and 17E002A (P&ID 25I | H2/ 25B)  LOPA Scenario - Initiating Event: 4.2.1 | | |  |  | | --- | --- | | 1. | Potential to deadhead the 17P004A LVGO pumps leading to seal failure, LOPC of LVGO via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 46. | 17PC1126 with high pressure alarm may afford operator response (P&ID 17AA0025B) | |  | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Deadhead credible on 17P004A only - rundown to storage immediately downstream of 17P005A via 2"-P2512-151 | |
| |  |  | | --- | --- | | 47. | Plan 53A dual seals on 17P004A/17P005A LVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 48. | 17TC1123 with high temperature alarm may afford operator response | |  | C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Potential overpressure of 17E003A considered but not deemed credible as upstream deadhead pressure (445 ft-hd) not expected to exceed MAWP (225 psi) | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Potential loss of pressure on LVGO due to loss of flow from 17P004A/005A. As pressure drops PV-1126 will open to maintain pressure as part of its normal process control. As PV-1126 opens potential reverse flow of HVGO into LVGO considered but not deemed credible based on system hydraulics and elevation. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Potential loss of LVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 4.2 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 6. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | [17P005A lined up to storage] Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. Deadhead considered but not deemed credible as outlet remains open to hot LVGO to storage | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Manual discharge valve inadvertently closed on 17P004A/17P005A common outlet downstream of 17E002A (P&ID 22E/25B)  LOPA Scenario - Initiating Event: 4.3.1 | | |  |  | | --- | --- | | 1. | Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of pressure on LVGO due to loss of flow from 17P004A/005A. As pressure drops PV-1126 will open to maintain pressure as part of its normal process control. As PV-1126 opens potential reverse flow of HVGO into LVGO considered but not deemed credible based on system hydraulics and elevation. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of LVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 4.3 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | [17P005A lined up to storage] Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. Deadhead considered but not deemed credible as outlet remains open to hot LVGO to storage. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Potential deadhead of 17P004A/005A considered but not deemed credible as LVGO is lined up to storage via PV-1126. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | PV1126 fails/set open or manual bypass valve inadvertently opened (P&ID 25B) | | |  |  | | --- | --- | | 1. | Potential loss of level at LVGO tray. Potential to cavitate the 17P004A/17P005A LVGO pumps leading to seal failure, LOPC of LVGO via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 47. | Plan 53A dual seals on 17P004A/17P005A LVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 48. | 17TC1123 with high temperature alarm may afford operator response | |  | E | 4 | 3 | 4 |
| |  |  | | --- | --- | | 49. | 17FC1134 with low flow alarm may afford operator response | |  | C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 2. | Either suction manual valve inadvertently closed on inlet line to 17P004A/17P005A (P&ID 25I)  LOPA Scenario - Initiating Event: 4.4.1 | | |  |  | | --- | --- | | 1. | Potential to cavitate the 17P004A LVGO pump leading to seal failure, LOPC of LVGO via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 46. | 17PC1126 with high pressure alarm may afford operator response (P&ID 17AA0025B) | |  | P | 3 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 47. | Plan 53A dual seals on 17P004A/17P005A LVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | E | 4 | 5 | 4 |
| |  |  | | --- | --- | | 49. | 17FC1134 with low flow alarm may afford operator response | |  | C | 4 | 5 | 4 |
| |  |  | | --- | --- | | 2. | Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of pressure on LVGO due to loss of flow from 17P004A/005A. As pressure drops PV-1126 will open to maintain pressure as part of its normal process control. As PV-1126 opens potential reverse flow of HVGO into LVGO considered but not deemed credible based on system hydraulics and elevation. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Potential loss of LVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 4.4 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 5. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | FV1134 fails/set open or manual bypass inadvertently open (P&ID 25B) | | |  |  | | --- | --- | | 1. | Potential increased pump around to the top of 17T001A, potential reduced temperature in the tower, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | During certain modes of operation FV-1134 may be near 100% open depending on temperature. | |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | FV1134 fails/set closed OR upstream/ downstream manual valve inadvertently closed OR Strainer plugged (P&ID 25B/25A)  LOPA Scenario - Initiating Event: 4.5.1 | | |  |  | | --- | --- | | 1. | Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of pressure on LVGO due to loss of flow from 17P004A/005A. As pressure drops PV-1126 will open to maintain pressure as part of its normal process control. As PV-1126 opens potential reverse flow of HVGO into LVGO considered but not deemed credible based on system hydraulics and elevation. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of LVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 4.5 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | [17P005A lined up to storage] Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. Deadhead considered but not deemed credible as outlet remains open to hot LVGO to storage. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Potential deadhead of 17P004A/005A considered but not deemed credible as LVGO is lined up to storage via PV-1126. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 17P004A/005A LVGO Pump shuts down (P&ID 25I)  LOPA Scenario - Initiating Event: 4.6.1 | | |  |  | | --- | --- | | 1. | Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of pressure on LVGO due to loss of flow from 17P004A/005A. As pressure drops PV-1126 will open to maintain pressure as part of its normal process control. As PV-1126 opens potential reverse flow of HVGO into LVGO considered but not deemed credible based on system hydraulics and elevation. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of LVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 4.6 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | [17P005A lined up to storage] Potential high Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. Deadhead considered but not deemed credible as outlet remains open to hot LVGO to storage. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | 2" manual in discharge of 17P005A to storage inadvertently closed  (P&ID 25I / 25B) | | |  |  | | --- | --- | | 1. | No Flow resulting in High Level on LVGO Collection Tray. Potential for LVGO to overflow to the HVGO section leading to process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Tube Leak in 17E002A/003A LVGO Coolers (P&ID 22C) | | |  |  | | --- | --- | | 1. | Potential release of LVGO to atmosphere via leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential environmental impact (Negligible). Potential commercial impact ($100k-$1MM). | | |  |  | | --- | --- | | 38. | Procedural - Mechanical integrity program with regular inspection of heater tubing | |  | P | 3 | 4 | 4 |  |  |
| E | 4 | 3 | 4 |
| C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 2. | 2" steam connection valve to 17P004A/17P005A discharge line inadvertently left lined up after turnaround (P&ID 25I | D3/E3) | | |  |  | | --- | --- | | 1. | Potential inability to create a vacuum in the vacuum system, potential delayed startup, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | 6" bypass valve around 17E003A inadvertently opened (P&ID 25I | H3) | | |  |  | | --- | --- | | 1. | Potential reduced cooling to reflux. Potential higher than normal temperature within column leading to loss of vacuum. Potential offspec product. Potential operability issue but no hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | 2" steam valve inadvertently opened to 17E003A (P&ID 39) | | |  |  | | --- | --- | | 1. | Carryover of steam to Vacuum#2 column from 2" steam header, operability issues, but no hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | 6" bypass valve around 17E002A inadvertently opened (P&ID 25B | F2) | | |  |  | | --- | --- | | 1. | Potential reduced cooling to reflux. Potential higher than normal temperature within column leading to loss of vacuum. Potential offspec product. Potential operability issue but no hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | 2" OOS steam valves inadvertently opened to 17E002A (P&ID 22C) | | |  |  | | --- | --- | | 1. | No hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Inadvertent opening of 3" bypass line on pump 17P004A to storage (via FT1138 on P&ID 25B | D4) | | |  |  | | --- | --- | | 1. | Operability issues, but no hazardous consequence of interest identified | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Drain valve on LVGO basket strainer inadvertently left open to LVGO after being place back in service as active filter (P&ID 25B) | | |  |  | | --- | --- | | 1. | Inadvertent draining of pump around to sewer. Higher than normal rundown of oil to closed oily water system. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | TC1144 malfunction causing the louvers on 17E003A to close (P&ID 22C) | | |  |  | | --- | --- | | 1. | High Temperature pump around resulting in process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 17E003A Fan Failure (P&ID 22C) | | |  |  | | --- | --- | | 1. | High Temperature pump around resulting in process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | TC1143 malfunction causing the louvers on 17E002A to close (P&ID 22C) | | |  |  | | --- | --- | | 1. | High Temperature pump around resulting in process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | 17E002A Fan Failure (P&ID 22C) | | |  |  | | --- | --- | | 1. | High Temperature pump around resulting in process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Power failure resulting 17E002A/003A both failing off  (P&ID 22C)  LOPA Scenario - Initiating Event: 4.7.1 | | |  |  | | --- | --- | | 1. | Potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 4.7 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 | |  |  | | --- | --- | | 2. | Team experience indicates that overpressure is unlikely to occur; however relief sizing document for 17PSV002A lists this as a potential relief case. Therefore scenario was developed to worst case of overpressure. | |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 2. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential high temperature in 17T001A, potential to send high temperature material to 17A002A/003A which are rated for 200°F, potential over temperature and LOPC of LVGO via leaks, potential ignition, fire, injury to personnel (SDI), potential damage to equipment ($2k-100k), potential environmental impact (Minimal). | | |  |  | | --- | --- | | 83. | TI-1121 with high temperature alarm may afford operator response. | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 84. | TC-1143 with high temperature alarm may afford operator response. | |  | E | 4 | 3 | 4 |
| |  |  | | --- | --- | | 85. | TC-1144 with high temperature alarm may afford operator response. | |  | C | 5 | 3 | 4 |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | TC1144 malfunction causing the louvers on 17E003A to open (P&ID 22C) | | |  |  | | --- | --- | | 1. | No hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | TC1143 malfunction causing the louvers on 17E002A to open (P&ID 22C) | | |  |  | | --- | --- | | 1. | No hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | Failure to sample | | |  |  | | --- | --- | | 1. | Potential offspec product, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0025E; 17AA0025F; 17AA0025G; 17AA0022A | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 5. Overhead Receiver | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | Demister pad on vapor outlet of 17V006 becomes plugged (P&ID 25F) | | |  |  | | --- | --- | | 1. | Potential blocked vapor outlet out of vacuum tower No. 2 overhead receiver. Potential to build higher than normal liquid head in liquid lines, but no hazardous consequence identified. Complete pluggage of demister not considered credible. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | Plugged 17P010A/B suction line vortex breaker in 17V006 OVHD Receiver to 17P010A/B, plugged cone strainer, or manual valve inadvertently closed (P&ID 25F/G) | | |  |  | | --- | --- | | 1. | Potential to cavitate the 17P010A/B OVHD Water Pumps leading to seal failure, loss of containment, release of OVHD water requiring removal from service for repairs. Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 50. | Operator Intervention - Spare 17P010A/B OVHD Water Pump | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 51. | 17FI1365 Flow Indicator on OVHD Water to SWS | |  |
| |  |  | | --- | --- | | 52. | 17LC1358 with high level alarm on water side of 17V006 OVHD receiver may afford operator response | |  |
| |  |  | | --- | --- | | 53. | Operator Intervention - Ability to steam suction line back to 17V006 OVHD Receiver to dislodge pluggage | |  |
| |  |  | | --- | --- | | 2. | No Flow resulting in high water Level in the 17V006 OVHD Receiver. Potential to overflow the water to the oil side of receiver. Potential operability issue in downstream units but no hazardous consequence identified as downstream units have water draws. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Plugged 17P009A/B suction line vortex breaker in 17V006 OVHD Receiver to 17P009A/B, plugged cone strainer, or manual valve inadvertently closed (P&ID 25F/G)  LOPA Scenario - Initiating Event: 5.1.1 | | |  |  | | --- | --- | | 1. | Potential to overfill overhead receiver to vent gas compressors. Potential operability issue but no hazardous consequence identified as these are liquid ring compressors. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential to cavitate 17P009A/B overhead oil pump leading to seal failure. Potential LOPC via seal leak. Potential ignition/fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 54. | 17LC1361 with high level alarm may afford operator response | |  | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 55. | Plan 53A dual seals on 17P009A/B overhead receiver oil pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | C | 5 | 3 | 4 |
| |  |  | | --- | --- | | 56. | 17FI1362 with low flow alarm may afford operator response (No credit taken as alarm could not be verified) | |  |
| |  |  | | --- | --- | | 3. | Potential to carryover oil to vapor outlet and subsequent blocked vapor outlet on 17T001A. Potential loss of vacuum with subsequent accumulation of vapor within No. 2 vacuum tower 17T001A and overhead receiver 17V002A. Potential to exceed MAWP of No. 2 vacuum tower and overhead receiver (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 5.1 | | |  |  | | --- | --- | | 54. | 17LC1361 with high level alarm may afford operator response | |  | P | 1 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | 17P009A/B run simultaneously | | |  |  | | --- | --- | | 1. | Potential increased discharge pressure on 17P009A/B, potential deadhead of 17P009A/B overhead oil pump leading to seal failure. Potential LOPC via seal leak. Potential ignition/fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 55. | Plan 53A dual seals on 17P009A/B overhead receiver oil pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 2. | 17P010A/B run simultaneously | | |  |  | | --- | --- | | 1. | Potential increased discharge pressure on 17P010A/B, potential to deadhead the 17P010A/B OVHD Water Pumps leading to seal failure, loss of containment, release of OVHD water requiring removal from service for repairs. Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 51. | 17FI1365 Flow Indicator on OVHD Water to SWS | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | 17P009A/B OVHD Oil Pump shuts down  LOPA Scenario - Initiating Event: 5.2.1 | | |  |  | | --- | --- | | 1. | Low Flow resulting in high oil Level in the 17V006 OVHD Receiver. Potential to send oil to the QQQ system with the OVHD water. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential to overfill overhead receiver to vacuum vent gas compressors. Potential operability issue but no hazardous consequence identified as these are liquid ring compressors. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential to carryover oil to vapor outlet and subsequent blocked vapor outlet on 17T001A. Potential loss of vacuum with subsequent accumulation of vapor within No. 2 vacuum tower 17T001A and overhead receiver 17V002A. Potential to exceed MAWP of No. 2 vacuum tower and overhead receiver (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 5.2 | | |  |  | | --- | --- | | 54. | 17LC1361 with high level alarm may afford operator response | |  | P | 1 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 2. | 17P010A/B OVHD Water Pump shuts down | | |  |  | | --- | --- | | 1. | No Flow resulting in high water Level in the 17V006 OVHD Receiver. Potential to overflow the water to the oil side of receiver. Potential operability issue in downstream units but no hazardous consequence identified as downstream units have water draws. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | 3/4" globe valve on overhead water min flow recycle back to 17V006 inadvertently opened too far (P&ID 25G) | | |  |  | | --- | --- | | 1. | Potential reduced capacity of pump to SWS. Potential to overflow the water to the oil side of receiver. Potential operability issue in downstream units but no hazardous consequence identified as downstream units have water draws. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 3/4" manual valve on 17P009A/B bypass line left opened after running pumps in series (P&ID 25G) | | |  |  | | --- | --- | | 1. | Scenario considered but not deemed credible as these valves are normally closed and not used for any normal operation. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | 2" manual bypass globe valve downstream of 17P009B inadvertently opened too far (P&ID 25G).  LOPA Scenario - Initiating Event: 5.4.1 | | |  |  | | --- | --- | | 1. | Potential high level in overhead receiver. Potential carryover of oil to vent gas compressors. Potential operability issue but no hazardous consequence identified as these compressors are liquid ring compressors. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential recirculation back to suction of 17P009A/B resulting in overfill of 17V006 Potential to carryover water to vapor outlet and subsequent blocked vapor outlet on 17T001A. Potential loss of vacuum with subsequent accumulation of vapor within No. 2 vacuum tower 17T001A. Potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 5.4 | | |  |  | | --- | --- | | 52. | 17LC1358 with high level alarm on water side of 17V006 OVHD receiver may afford operator response | |  | P | 1 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Oil pumps 17P009A/B run in series when not required | | |  |  | | --- | --- | | 1. | Potential increased discharge pressure on 17P009A/B, potential deadhead of 17P009A/B overhead oil pump leading to seal failure. Potential LOPC via seal leak. Potential ignition/fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 55. | Plan 53A dual seals on 17P009A/B overhead receiver oil pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | LV1361 fails/set closed or manual isolation valve on common discharge line of 17P009A/B inadvertently closed (P&ID 25G)  LOPA Scenario - Initiating Event: 5.3.1 | | |  |  | | --- | --- | | 1. | Potential to overfill overhead receiver to vent gas compressors. Potential operability issue but no hazardous consequence identified as these are liquid ring compressors. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential to deadhead 17P009A/B overhead oil pump leading to seal failure. Potential LOPC via seal leak. Potential ignition/fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 55. | Plan 53A dual seals on 17P009A/B overhead receiver oil pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | **2018 HAZOP Recommendation**  Evaluate adding low flow alarm to FI1362 to safeguard against blocked discharge leading to Potential deadhead of 17P009A/B overhead oil pump leading to seal failure due to LV1361 failing closed. Team notes that during review this alarm was confirmed as not being alarmed within DCS.  Alternatively, team notes that this yellow (3 - medium) risk may be endorsed by management team.  **2022 Vac 2 Reval Update:**  Team notes that 2018 team did not apply an occupancy factor to this scenario. Upon applying an occupancy factor, this scenario passed risk ranking. Additionally this alarm was added but it was subsequently removed from the MADB. This recommendation has been closed no further action proposed by team. | |
| |  |  | | --- | --- | | 56. | 17FI1362 with low flow alarm may afford operator response (No credit taken as alarm could not be verified) | |  | C | 5 | 3 | 4 |
| |  |  | | --- | --- | | 3. | Potential to carryover oil to vapor outlet and subsequent blocked vapor outlet on 17T001A. Potential loss of vacuum with subsequent accumulation of vapor within No. 2 vacuum tower 17T001A and overhead receiver 17V002A. Potential to exceed MAWP of No. 2 vacuum tower and overhead receiver (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 5.3 | | |  |  | | --- | --- | | 54. | 17LC1361 with high level alarm may afford operator response | |  | P | 1 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 2. | Manual valve inadvertently closed or check valve sticks closed on individual discharge of 17P009A/B (P&ID 25G)  LOPA Scenario - Initiating Event: 5.5.1 | | |  |  | | --- | --- | | 1. | Potential to overfill overhead receiver to vent gas compressors. Potential operability issue but no hazardous consequence identified as these are liquid ring compressors. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential to deadhead 17P009A/B overhead oil pump leading to seal failure. Potential LOPC via seal leak. Potential ignition/fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 55. | Plan 53A dual seals on 17P009A/B overhead receiver oil pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 56. | 17FI1362 with low flow alarm may afford operator response (No credit taken as alarm could not be verified) | |  | C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 54. | 17LC1361 with high level alarm may afford operator response | |  |
| |  |  | | --- | --- | | 3. | Potential to carryover oil to vapor outlet and subsequent blocked vapor outlet on 17T001A. Potential loss of vacuum with subsequent accumulation of vapor within No. 2 vacuum tower 17T001A and overhead receiver 17V002A. Potential to exceed MAWP of No. 2 vacuum tower and overhead receiver (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 5.5 | | |  |  | | --- | --- | | 54. | 17LC1361 with high level alarm may afford operator response | |  | P | 1 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 3. | LV1358 fails/set closed or manual isolation valve on common discharge line of 17P010A/B inadvertently closed (P&ID 25G) | | |  |  | | --- | --- | | 1. | Potential to deadhead the 17P010A/B OVHD Water Pumps leading to seal failure, loss of containment, release of OVHD water requiring removal from service for repairs. Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 50. | Operator Intervention - Spare 17P010A/B OVHD Water Pump | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 51. | 17FI1365 Flow Indicator on OVHD Water to SWS | |  |
| |  |  | | --- | --- | | 53. | Operator Intervention - Ability to steam suction line back to 17V006 OVHD Receiver to dislodge pluggage | |  |
| |  |  | | --- | --- | | 2. | No Flow resulting in high water Level in the 17V006 OVHD Receiver. Potential to overflow the water to the oil side of receiver. Potential operability issue in downstream units but no hazardous consequence identified as downstream units have water draws. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Manual valve inadvertently closed or check valve sticks closed on individual outlet of 17P010A/B (P&ID 25G) | | |  |  | | --- | --- | | 1. | Potential to deadhead the 17P010A/B OVHD Water Pumps leading to seal failure, loss of containment, release of OVHD water requiring removal from service for repairs. Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 50. | Operator Intervention - Spare 17P010A/B OVHD Water Pump | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 51. | 17FI1365 Flow Indicator on OVHD Water to SWS | |  |
| |  |  | | --- | --- | | 53. | Operator Intervention - Ability to steam suction line back to 17V006 OVHD Receiver to dislodge pluggage | |  |
| |  |  | | --- | --- | | 52. | 17LC1358 with high level alarm on water side of 17V006 OVHD receiver may afford operator response | |  |
| |  |  | | --- | --- | | 2. | No Flow resulting in high water Level in the 17V006 OVHD Receiver. Potential to overflow the water to the oil side of receiver. Potential operability issue in downstream units but no hazardous consequence identified as downstream units have water draws. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Manual valve inadvertently closed or check valve sticks closed on overhead water min flow recycle back to 17V006 (P&ID 25G/F) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | 6" manual valve from 17E010 inadvertently closed (P&ID 25E) | | |  |  | | --- | --- | | 1. | Potential to overload downstream second and third stage jets. Potential loss of vacuum in tower. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 2" CSO manual valve from 17E012 inadvertently closed (P&ID 25E) | | |  |  | | --- | --- | | 1. | Per CVR guidance, inadvertent operation of CSO/CSC valves not evaluated. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | LV1361 fails/set open or manual bypass valve inadvertently opened (P&ID 25G) | | |  |  | | --- | --- | | 1. | Potential loss of hydrocarbon level in upstream 17V006. Potential to cavitate 17P009A/B overhead oil pump leading to seal failure. Potential LOPC via seal leak. Potential ignition/fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 55. | Plan 53A dual seals on 17P009A/B overhead receiver oil pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | **2018 HAZOP Recommendation**  Evaluate adding low flow alarm to FI1362 to safeguard against blocked discharge leading to Potential deadhead of 17P009A/B overhead oil pump leading to seal failure due to LV1361 failing closed. Team notes that during review this alarm was confirmed as not being alarmed within DCS.  Alternatively, team notes that this yellow (3 - medium) risk may be endorsed by management team.  **2022 Vac 2 Reval Update:**  Team notes that 2018 team did not apply an occupancy factor to this scenario. Upon applying an occupancy factor, this scenario passed risk ranking. Additionally this alarm was added but it was subsequently removed from the MADB. This recommendation has been closed no further action proposed by team. | |
| |  |  | | --- | --- | | 56. | 17FI1362 with low flow alarm may afford operator response (No credit taken as alarm could not be verified) | |  | C | 5 | 3 | 4 |
| |  |  | | --- | --- | | 4. | LV1358 fails/set open or manual bypass valve inadvertently opened (P&ID 25G) | | |  |  | | --- | --- | | 1. | Potential loss of level in 17V006. Potential to cavitate the 17P010A/B OVHD Water Pumps leading to seal failure, loss of containment, release of OVHD water requiring removal from service for repairs. Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). | | |  |  | | --- | --- | | 50. | Operator Intervention - Spare 17P010A/B OVHD Water Pump | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 51. | 17FI1365 Flow Indicator on OVHD Water to SWS | |  |
| |  |  | | --- | --- | | 53. | Operator Intervention - Ability to steam suction line back to 17V006 OVHD Receiver to dislodge pluggage | |  |
| |  |  | | --- | --- | | 2. | Potential carryover of oil to SWS. Potential operability issue at downstream separation but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of vacuum in upstream tower system when water drains below dip leg elevation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | Failure to sample when required | | |  |  | | --- | --- | | 1. | Potential offspec product or delayed identification of accelerated corrosion, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | 17PSV004 relieves as designed (P&ID 25F) | | |  |  | | --- | --- | | 1. | Potential relief to flare. No hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 17PSV004 spuriously lifts or fails to reseat (P&ID 25F) | | |  |  | | --- | --- | | 1. | Potential misdirected flow of flare sweep gas into Vac 2 system, potential operability issues but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0025A; 17AA0025K; 17AA0022E; 17AA0026E; 17AA0022B; 17AA0022C; 17AA0025B; 17AA0025I | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 6. HVGO pump around | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | Manual valve inadvertently closed or check valve sticks closed on 17P006A/B HVGO Pumps outlet line  (P&ID 25K)  LOPA Scenario - Initiating Event: 6.1.1 | | |  |  | | --- | --- | | 1. | Potential to deadhead the 17P006A/B HVGO pump leading to seal failure, LOPC of HVGO via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | P | 3 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 57. | Plan 53A dual seals on 17P006A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | E | 4 | 5 | 4 |
| |  |  | | --- | --- | | 58. | 17FC1133 with low flow alarm may afford operator response | |  | C | 4 | 5 | 4 |
| |  |  | | --- | --- | | 2. | Potential high Level on HVGO Collection Tray. Potential for HVGO to overflow to the Slop Wax section considered but not deemed credible as the Slop Wax section is no longer in service. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of spray flow and pump around cooling to vacuum column. Loss of spray flow results in coking of packing grid. Potential offspec product, potential commercial impact ($100k-$1MM) due to repair/replacement of packing grid. | | |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 58. | 17FC1133 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Loss of flow through the Wash Oil distributor nozzles. Potential coking of the bed leading to High Pressure drop, off spec products, requiring shut down to replace bed. Potential commercial impact due to repair/replacement ($100K-$1MM). | | |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 62. | Operator Rounds - Monitored and log FV1132 position 8 times per day | |  |
| |  |  | | --- | --- | | 63. | Procedural - Weekly Pressure survey on Wash Oil distributor nozzles | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 5. | Potential loss of HVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 6.1 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 6. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Manual valve inadvertently closed on 17P006A/B HVGO Pumps common outlet line upstream/downstream of 17E001A/B OR 17E009 plugged  (P&ID 22E/26E)  LOPA Scenario - Initiating Event: 6.2.1 | | |  |  | | --- | --- | | 1. | Potential loss of preheat to reduced crude. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential high Level on HVGO Collection Tray. Potential for HVGO to overflow to the Slop Wax section considered but not deemed credible as the Slop Wax section is no longer in service. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of spray flow and pump around cooling to vacuum column. Loss of spray flow results in coking of packing grid. Potential offspec product, potential commercial impact ($100k-$1MM) due to repair/replacement of packing grid. | | |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 58. | 17FC1133 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Potential loss of HVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 6.2 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 5. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | PV1125 fails/set closed, upstream/ downstream manual valve inadvertently closed, or check valve sticks closed (P&ID 22C)  LOPA Scenario - Initiating Event: 6.3.1 | | |  |  | | --- | --- | | 1. | Potential high Level on HVGO Collection Tray. Potential for HVGO to overflow to the Slop Wax section considered but not deemed credible as the Slop Wax section is no longer in service. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of preheat to reduced crude. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of HGVO to storage, potential high level in 17T001A, potential liquid carryover to condensers, potential overfill of condensers, potential blocked outlet 17T001A. Potential overpressure (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 6.3 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | 3" manual valve downstream of PV1125/1126 inadvertently closed (P&ID 25B) | | |  |  | | --- | --- | | 1. | Potential loss of all gas oil storage flow. Potential carryover of gas oil to TAR. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential high Level on HVGO Collection Tray. Potential for HVGO to overflow to the Slop Wax section considered but not deemed credible as the Slop Wax section is no longer in service. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of preheat to reduced crude. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Potential loss of flow to storage PV-1125/1126, refer to high pressure PV-1125 fails closed this node and high pressure PV-1126 fails closed in Node 4. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | Manual valve inadvertently closed on 17P006A/B HVGO Pumps inlet line OR Strainer Plugged  (P&ID 25A)  LOPA Scenario - Initiating Event: 6.4.1 | | |  |  | | --- | --- | | 1. | Potential to cavitate the 17P006A/B HVGO pump leading to seal failure, LOPC of HVGO via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | P | 3 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 57. | Plan 53A dual seals on 17P006A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | E | 4 | 5 | 4 |
| |  |  | | --- | --- | | 58. | 17FC1133 with low flow alarm may afford operator response | |  | C | 4 | 5 | 4 |
| |  |  | | --- | --- | | 2. | Potential high Level on HVGO Collection Tray. Potential for HVGO to overflow to the Slop Wax section considered but not deemed credible as the Slop Wax section is no longer in service. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of spray flow and pump around cooling to vacuum column. Loss of spray flow results in coking of packing grid. Potential offspec product, potential commercial impact ($100k-$1MM) due to repair/replacement of packing grid. | | |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 58. | 17FC1133 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Loss of flow through the Wash Oil distributor nozzles. Potential coking of the bed leading to High Pressure drop, off spec products, requiring shut down to replace bed. Potential commercial impact due to repair/replacement ($100K-$1MM). | | |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 62. | Operator Rounds - Monitored and log FV1132 position 8 times per day | |  |
| |  |  | | --- | --- | | 63. | Procedural - Weekly Pressure survey on Wash Oil distributor nozzles | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 5. | Potential loss of HVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 6.4 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 5 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 5 | 4 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 6. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | PV1125 fails/set open (P&ID 22C)  LOPA Scenario - Initiating Event: 6.5.1 | | |  |  | | --- | --- | | 1. | Potential low level on HVGO tray leading to potential cavitation of the 17P006A/B HVGO pump. Potential LOPC of HVGO via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 57. | Plan 53A dual seals on 17P006A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 58. | 17FC1133 with low flow alarm may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 61. | 17TI1116 with low temperature alarm may afford operator response | |  | C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Potential loss of spray flow and pump around cooling to vacuum column. Loss of spray flow results in coking of packing grid. Potential offspec product, potential commercial impact ($1MM-$5MM) due to repair/replacement of packing grid and deferred production due to unplanned shutdown. | | |  |  | | --- | --- | | 58. | 17FC1133 with low flow alarm may afford operator response | |  | C | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 3. | Loss of flow through the Wash Oil distributor nozzles. Potential coking of the bed leading to High Pressure drop, off spec products, requiring shut down to replace bed. Potential commercial impact due to repair/replacement ($100K-$1MM). | | |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 62. | Operator Rounds - Monitored and log FV1132 position 8 times per day | |  |
| |  |  | | --- | --- | | 63. | Procedural - Weekly Pressure survey on Wash Oil distributor nozzles | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Potential loss of HVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 6.5 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 5. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | FV1132 fails/set open or bypass inadvertently open (P&ID 25A) | | |  |  | | --- | --- | | 1. | More Flow through the Wash Oil distributor nozzles will start to atomize and reduce wetting of the Slop Wax packed bed. Potential coking of the bed leading to High Pressure drop, off spec products, operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | FV1132A fails/set open and left lined up to vacuum tower after startup (P&ID 25A) | | |  |  | | --- | --- | | 1. | Scenario considered but no hazardous consequences identified without secondary independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | FV1133 fails/set open or bypass inadvertently opened (P&ID 25A) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | 17P006A/B HVGO Pump shuts down (P&ID 25K)  LOPA Scenario - Initiating Event: 6.6.1 | | |  |  | | --- | --- | | 1. | Potential high Level on HVGO Collection Tray. Potential for HVGO to overflow to the Slop Wax section considered but not deemed credible as the Slop Wax section is no longer in service. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of spray flow and pump around cooling to vacuum column. Loss of spray flow results in coking of packing grid. Potential offspec product, potential commercial impact ($100k-$1MM) due to repair/replacement of packing grid. | | |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 58. | 17FC1133 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 3. | Loss of flow through the Wash Oil distributor nozzles. Potential coking of the bed leading to High Pressure drop, off spec products, requiring shut down to replace bed. Potential commercial impact due to repair/replacement ($100K-$1MM). | | |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 62. | Operator Rounds - Monitored and log FV1132 position 8 times per day | |  |
| |  |  | | --- | --- | | 63. | Procedural - Weekly Pressure survey on Wash Oil distributor nozzles | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | Potential loss of HVGO pump around to 17T001A, potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 6.6 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 5. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Plugged 17BS002B/ 003B Wash Oil Strainers or manual valve inadvertently closed on active strainer (P&ID 25K/25A) | | |  |  | | --- | --- | | 1. | Potential loss of spray flow and pump around cooling to vacuum column. Loss of spray flow results in coking of packing grid. Potential offspec product, potential commercial impact ($100k-$1MM) due to repair/replacement of packing grid and deferred production due to unplanned shutdown. | | |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 63. | Procedural - Weekly Pressure survey on Wash Oil distributor nozzles | |  |
| |  |  | | --- | --- | | 64. | Operator rounds with check of differential pressure three times per shift (PDI338) | |  |
| |  |  | | --- | --- | | 3. | FV1132 fails/set closed or upstream/ downstream manual valve inadvertently closed(P&ID 25A) | | |  |  | | --- | --- | | 1. | Loss of flow through the Wash Oil distributor nozzles. Potential coking of the bed leading to High Pressure drop, off spec products, requiring shut down to replace bed. Potential commercial impact due to repair/replacement and deferred production ($100k-$1MM). | | |  |  | | --- | --- | | 62. | Operator Rounds - Monitored and log FV1132 position 8 times per day | |  | C | 4 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 63. | Procedural - Weekly Pressure survey on Wash Oil distributor nozzles | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 4. | FV1132A fails/set closed, manual valve inadvertently closed or check valve stuck closed (P&ID 25A) | | |  |  | | --- | --- | | 1. | Normally blocked in and not used. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | FV1133 fails/set closed or upstream/ downstream manual block valve inadvertently closed (P&ID 22B/25A) | | |  |  | | --- | --- | | 1. | Potential loss of reflux back to 17T001A. Potential operability issue but no hazardous consequence identified. Pumps will not deadhead as flow is still available to wash spray header and product outlet. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of preheat to reduced crude. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of spray flow and pump around cooling to vacuum column. Loss of spray flow results in coking of packing grid. Potential offspec product, potential commercial impact ($100k-$1MM) due to repair/replacement of packing grid. | | |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 4 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 58. | 17FC1133 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 59. | 17FC1132 with low flow alarm may afford operator response | |  |
| |  |  | | --- | --- | | 60. | 17PT1198 with low pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 6. | Plugged 17BS004A/B HVGO PA Strainers or manual isolation valve inadvertently closed (P&ID 22B) | | |  |  | | --- | --- | | 1. | Potential loss of reflux back to 17T001A. Potential operability issue but no hazardous consequence identified. Pumps will not deadhead as flow is still available to wash spray header and product outlet. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of preheat to reduced crude. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | 6" manual bypass valves around 17E001A/B inadvertently opened (P&ID 22E) | | |  |  | | --- | --- | | 1. | Potential loss of heat exchange to reduced crude/HVGO exchangers. Potential reduced efficiency at charge heater. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 6" vacuum gas oil crossover valve from 17E001A/B outlet to 17E002A outlet inadvertently opened (P&ID 22E | F6) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | 4" manual bypass valve around 17E009 inadvertently opened (P&ID 26E) | | |  |  | | --- | --- | | 1. | Potential bypass of 17E009 fin fans resulting in loss of HVGO reflux cooling. Potential operability issues within the vacuum unit, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential increased temperature of product rundown to storage. Vacuum 2 product mixes with vacuum 3 product downstream as well as other rundowns to cat feed storage tank. Potential higher temperature rundown to storage. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Tube Leak in 17E009 HVGO Product Cooler (P&ID 26E) | | |  |  | | --- | --- | | 1. | Potential release of HVGO to atmosphere via leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential environmental impact (Negligible). Potential commercial impact ($100k-$1MM). | | |  |  | | --- | --- | | 38. | Procedural - Mechanical integrity program with regular inspection of heater tubing | |  | P | 3 | 4 | 4 |  |  |
| E | 4 | 3 | 4 |
| C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 5. | 4" manual valve inadvertently opened to Vac 1 manifold trough drain (P&ID 25B) | | |  |  | | --- | --- | | 1. | No consequence identified. This is a sample loop and is normally cracked open. Closing this valve results in the inability to sample. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | 17E009 HVGO Product Cooler fan shuts down (P&ID 26E)  LOPA Scenario - Initiating Event: 6.7.1 | | |  |  | | --- | --- | | 1. | Potential increased temperature of product rundown to storage. Vacuum 2 product mixes with vacuum 3 product downstream as well as other rundowns to cat feed storage tank. Potential higher temperature rundown to storage. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 6.7 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 3. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | TC1400 malfunction causing the 17E009 HVGO Product Cooler louvers to close (P&ID 26E)  LOPA Scenario - Initiating Event: 6.8.1 | | |  |  | | --- | --- | | 1. | Potential increased temperature of product rundown to storage. Vacuum 2 product mixes with vacuum 3 product downstream as well as other rundowns to cat feed storage tank. Potential higher temperature rundown to storage. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential high temperature in 17T001A, potential overpressure, potential to exceed MAWP of No. 2 vacuum tower (>2X MAWP). Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($5MM-$10MM). Potential environmental impact (Moderate).  LOPA Scenario: 6.8 | | |  |  | | --- | --- | | 16. | 17PSV002A Relief Valve on 17T001A Vacuum Tower set @ 45 psig. | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | No credit taken for operator response to high pressure alarm as overpressure is expected to occur faster than an operator could respond. | |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  | C | 2 | 4 | 3 |
| |  |  | | --- | --- | | 41. | 17PT1198 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 42. | 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 3. | Potential high temperature in 17T001A, potential over temperature of condensers considered but not deemed credible as condensers still have cooling water flow, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | TC1400 malfunction causing the 17E009 HVGO Product Cooler louvers to open (P&ID 26E) | | |  |  | | --- | --- | | 1. | Potential cooler than normal reflux back to column. Potential offspec product. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | Failure to sample when required | | |  |  | | --- | --- | | 1. | Potential offspec product. Potential operability issue but no hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | 17E001A/B HVGO/Reduced Crude Exchangers do not have relief protection | | |  |  | | --- | --- | | 1. | See comment | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2014 HAZOP RECOMMENDATION #X Verify ASME VIII Code requirements for relief protection for E1661/E1662 HVGO/Reduced Crude Exchangers and install as required to reduce the likelihood of overpressure.  2018 HAZOP team does not propose any new recommendation. Team notes that this recommendation is still open in action tracking.  **2022 Vac 2 HAZOP Update:**  Blocked in heat on condition of 17E001A/B was determined not to result in safety hazard as loss of charge feed to the unit would result in loss of HVGO flow to the shell side of this exchanger. In addition tube leak was not determined to result in a safety hazard. This recommendation has been closed, no further action proposed by team. | |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0025A; 17AA0025H; 17AA0022A; 17AA0031; 17AA0026C; 17AA0022C | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 7. Slop Wax | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | Previous recommendation | | |  |  | | --- | --- | | 1. | See comment | | |  |  | | --- | --- | | 1. |  | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | **2018 HAZOP Recommendation**  Evaluate upgrading slop wax seal pot and/or pump system design to safeguard against seal failures and injury to personnel (single disabling injury). Alternatively, consideration may be given to removal of slop wax system. Team notes that failure rate of existing slop wax pump seals occurs on a regular basis (multiple replacements per month).  This recommendation is related to all causes resulting in deadhead/cavitation of the slop wax pumps.  Alternatively, team notes that this yellow (3 - medium) risk may be endorsed by management team.  Team notes there is a project in development to address reliability issues associated with slop wax pumps.  **2022 Vac 2 PHA Update:**  This recommendation has been closed. Team notes that this system has not been used in approximately 4 years and is currently locked out of service and requires an MOC to bring back in to service. In addition MOC # 17-Vacuum 2\_4\_2022\_2 is currently in implementation step to demo the Slop Wax System. No further action proposed by team. | |

| **Document:** 17AA0025A; 17AA0025C; 17AA0026C; 17AA0031; 17AA0032; 17AA0026B; 17AA0022C | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 8. Vacuum Tower Bottoms | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | Manual valve inadvertently closed or check valve sticks closed on 17P007A/B individual discharge line (P&ID 25C) | | |  |  | | --- | --- | | 1. | Potential to deadhead the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 2. | Potential loss of steam generation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked VTB outlet would take 97 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | HV1474 fails/set closed (P&ID 25A) | | |  |  | | --- | --- | | 1. | Scenario considered but not deemed credible as this valve is managed open via removal of hand wheel and mechanical stop. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Plugged VTB Pump Suction Strainers or manual isolation valve inadvertently closed on individual or common suction line to 17P007A/B (P&ID 25C) | | |  |  | | --- | --- | | 1. | Potential to cavitate the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | E | 4 | 3 | 4 |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 2. | Potential loss of steam generation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked VTB outlet would take 97 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | FV1135 fails/set open or manual bypass valve inadvertently opened (P&ID 26C) | | |  |  | | --- | --- | | 1. | More Flow resulting in Low Level in the 17T001A Vacuum Tower. Potential to cavitate the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | E | 4 | 3 | 4 |
| |  |  | | --- | --- | | 86. | 17LC1124 with low level alarm may afford operator response. | |  | C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 2. | FC1177 or LC1124 Malfunction causing FV1177 to open or manual bypass valve inadvertently opened (P&ID 26C) | | |  |  | | --- | --- | | 1. | More Flow resulting in Low Level in the 17T001A Vacuum Tower. Potential to cavitate the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | E | 4 | 3 | 4 |
| C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 3. | FC1476 or TC1335 Malfunction causing FV1476 to open or manual bypass valve inadvertently opened (P&ID 25A) | | |  |  | | --- | --- | | 1. | Potential increased quench flow, potential reduced temperature VTB, potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | 17P007A/B VTB Pump shuts down (P&ID 25C) | | |  |  | | --- | --- | | 1. | Potential loss of steam generation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked VTB outlet would take 97 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 2. | Either manual valve on line to coker inadvertently closed (P&ID 25C) | | |  |  | | --- | --- | | 1. | Potential loss of hot tar flow to coker. Potential high level in 17T001A considered but not deemed credible as LC-1124 will control level as part of its normal process control. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | FV-1135 OR FV-1177 OR upstream/downstream manual valve inadvertently closed OR manual valve in the inlet/outlet of 17E005A/17E013A inadvertently closed OR plugged tubes in 17E005A/013A  (P&ID 26C) | | |  |  | | --- | --- | | 1. | [When flowing hot tar to coker] Deadhead considered but not deemed credible as hot tar flow out to coker is still available. Potential operability issue, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of steam generation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | [When not flowing hot tar to coker] Potential to deadhead the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | E | 4 | 3 | 4 |
| C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 4. | Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked VTB outlet would take 97 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 4. | 3" Manual valve inadvertently closed on the outlet of 17E005A  (P&ID 26C | D1) | | |  |  | | --- | --- | | 1. | Potential loss of quench to 17T001A vacuum tower No.2. Potential to cavitate the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 5. | Either manual valve (3"/4"/6") inadvertently closed on inlet/outlet to 17E006A (P&ID 26B) | | |  |  | | --- | --- | | 1. | Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked VTB outlet would take 97 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 6. | Plugged tubes in 17E006A/13E015A (P&ID 26B/32) | | |  |  | | --- | --- | | 1. | [When flowing hot tar to coker] Deadhead considered but not deemed credible as hot tar flow out to coker is still available. Potential operability issue, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of steam generation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | [When not flowing hot tar to coker] Potential to deadhead the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | E | 4 | 3 | 4 |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 4. | Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked VTB outlet would take 97 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 7. | Manual valve on outlet of 13E015A upstream of storage line split inadvertently closed (P&ID 32|H4) | | |  |  | | --- | --- | | 1. | Potential loss of steam generation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | [When flowing hot tar to coker] Deadhead considered but not deemed credible as hot tar flow out to coker is still available. Potential operability issue, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | [When not flowing hot tar to coker] Potential to deadhead the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 4. | Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked VTB outlet would take 97 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 8. | Manual valve on outlet of 13E015A to storage inadvertently closed  (P&ID 32|I4/J4) | | |  |  | | --- | --- | | 1. | [When lined up to both VTB Storage Tanks]Potential operability issue but no hazardous consequence identified as flow will run to alternate rundown line to storage. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of steam generation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | [When flowing hot tar to coker] Deadhead considered but not deemed credible as hot tar flow out to coker is still available. Potential operability issue, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | [When not flowing hot tar to coker] Potential to deadhead the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 5. | Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked VTB outlet would take 97 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 9. | 3" manual valve back to the tower bottoms quench inadvertently closed (P&ID 32|C2) | | |  |  | | --- | --- | | 1. | Potential loss of quench to 17T001A vacuum tower No.2. Potential to cavitate the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. |  | |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 10. | FC1476 or TC1335 Malfunction causing FV1476 to close or manual isolation valve inadvertently closed (P&ID 25A) | | |  |  | | --- | --- | | 1. | Potential loss of quench to 17T001A vacuum tower No.2. Potential to cavitate the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | E | 4 | 3 | 4 |
| C | 4 | 3 | 4 |
| |  |  | | --- | --- | | 11. | 6" manual valve from 17E006A to outlet of 13E015A inadvertently closed  (P&ID 32 | H5/C2) | | |  |  | | --- | --- | | 1. | Potential loss of steam generation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | [When flowing hot tar to coker] Deadhead considered but not deemed credible as hot tar flow out to coker is still available. Potential operability issue, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | [When not flowing hot tar to coker] Potential to deadhead the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  | C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 4. | Potential high level in 17T001A, potential overfill and overpressure of 17T001A considered but not deemed credible as this is a slow developing event with multiple opportunities for operator response. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2022 management review team considered overfill to be non-credible as blocked VTB outlet would take 97 minutes to result in overfill based on 17PSV002A/004 relief sizing documentation. | |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | 2" recirculation valve from 17P007A/B and/or 17BS005A/B back to 17T001A inadvertently opened (P&ID 25A|G6) | | |  |  | | --- | --- | | 1. | Scenario considered but no hazardous consequences identified without secondary independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Inadvertent bypassing 17E005A/013 (P&ID 26C|E3 / 31|G3) | | |  |  | | --- | --- | | 1. | High VTB rundown Temperature. Potential to exceed Storage Tank design Temperature considered but not deemed credible as this is expected to take an extended amount of time. Potential to increase naphthenic acid corrosion rates on rundown piping. Potential accelerated corrosion but no immediate hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Inadvertent opening of 3" valve to VTB at 17E013 Charge/VTB Exchanger (P&ID 31|F2) | | |  |  | | --- | --- | | 1. | Misdirect reduced crude to TAR, resulting in off spec product and process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Inadvertent opening of wash lines at 17E013 Charge/VTB Exchanger (P&ID 31|F6)-1" line | | |  |  | | --- | --- | | 1. | Misdirect reduced crude to tar or VTB to reduced crude, resulting in off spec product and process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Tube Leak in 17E006A/13E015A (P&ID 26B/32) | | |  |  | | --- | --- | | 1. | Leak steam/BFW into the VTB and Flow to Storage Tanks TK8011/8015/10A1. Potential to overpressure storage tank. Potential LOPC via tank seam failure. Potential commercial impact due to repair/replacement ($1MM-$5MM). Potential ignition and pool fire considered but not deemed credible based on tank temperatures. Potential thermal burn hazard and injury to personnel (SDI). Potential environmental impact (Moderate) | | |  |  | | --- | --- | | 69. | Roof vents on Storage Tanks | |  | P | 3 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 70. | 17LV1148/1127 product variable alarm on BFW to the E0974/0818 may afford operator response | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 71. | 17TI1113 with high temperature alarm may afford operator response | |  | C | 3 | 4 | 4 |
| |  |  | | --- | --- | | 72. | Procedural - Mechanical integrity program with regular inspection of exchanger tubing | |  |
| |  |  | | --- | --- | | 2. | potential leak of steam/BFW into tube side, potential flashing of BFW and overpressure up to 232 psig based on saturated steam pressure at 400°F (>1.3-2.0x MAWP), potential LOPC of VTB via leaks, potential ignition, fire, injury to personnel (SDI). Potential environmental impact (Minimal). Potential commercial impact due to repair/replacement ($2k-$100k). | | |  |  | | --- | --- | | 72. | Procedural - Mechanical integrity program with regular inspection of exchanger tubing | |  | P | 3 | 4 | 4 |  |  |
| E | 4 | 3 | 4 |
| C | 5 | 3 | 4 |
| |  |  | | --- | --- | | 6. | Tube Leak in 17E005 or 17E013  (P&ID 26C/31) | | |  |  | | --- | --- | | 1. | Misdirect reduced crude to Tar, resulting in off spec product. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Inadvertent bypassing 17E006A/13E015A (P&ID 26B|G1 for 006A & either 26B|E3 or 32|C2 for 015A) | | |  |  | | --- | --- | | 1. | High VTB rundown Temperature. Potential to exceed Storage Tank design Temperature considered but not deemed credible as this is expected to take an extended amount of time. Potential to increase naphthenic acid corrosion rates on rundown piping. Potential accelerated corrosion but no immediate hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | 6" VTB rundown valve inadvertently opened (P&ID 32|H5) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | System lined up to flow through both exchanger trains when not required | | |  |  | | --- | --- | | 1. | Potential increased fouling in exchangers. potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | Drain valve on VTB basket strainer inadvertently left open to VTB after being place back in service as active filter (P&ID 25C) | | |  |  | | --- | --- | | 1. | Potential to pull air into vacuum drum. Potential operability issue but no hazardous consequence identified as it is not credible to get above LEL within tower system due to a manual bleed/drain left open. | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Team deemed risk inherent to the operation. No recommendation proposed by team. | |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | Loss of steam tracing to VTB lines | | |  |  | | --- | --- | | 1. | Potential delayed startup. Potential operability issue but no hazardous consequence identified. Refer to deadheading of pump in high pressure deviation in this node. No consequence of interest if pump is already running. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Failure to flush with LVGO prior to basket strainer change | | |  |  | | --- | --- | | 1. | Potential for flash fire on opening 17B005A/B. Potential injury to personnel (OSHA recordable). | | |  |  | | --- | --- | | 43. | Procedural - Operating procedure details safe work practice | | CTP | P | 4 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 12. | PPE | |  |
| |  |  | | --- | --- | | 2. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | Sampling hazards (P&ID 25A) | | |  |  | | --- | --- | | 1. | Failure to sample at closed loop station may result in offspec product, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | Tube side (process) of 17E006A Steam Generator does not have relief protection and does not meet the 2/3 rule (P&ID 26B). | | |  |  | | --- | --- | | 1. | See comment | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Verify ASME VIII Code requirements for relief protection for E0974 Steam Generator Tube Side and install as required to reduce the likelihood of overpressure.  2018 HAZOP team notes that this action item is still open. No new recommendations proposed by team.  **2022 Vac 2 PHA Update:**  Team notes that pressure on the steam/BFW side is controlled down to 50 psig which is below the MAWP of the shell side (208 psig). | |
| |  |  | | --- | --- | | 2. | 17E005A/006A VTB/Reduced Crude Exchanger does not have relief protection (P&ID 26C/31) | | |  |  | | --- | --- | | 1. | See comment | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Verify ASME VIII Code requirements for relief protection for E0821/E0985 VTB/Reduced Crude Exchanger and install as required to reduce the likelihood of overpressure.  2018 HAZOP team notes that this action item is still open. No new recommendations proposed by team. | |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0025I; 17AA0022B; 17AA0021A; 17AA0025C; 17AA0025H; 17AA0022E; 17AA0022C; 17AA0039; 17AA0025B | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 9. Oil Wash and Slop Headers | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low Pressure | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low / No Flow | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Inadvertent opening of LVGO Flush Lines to HVGO (P&ID 25I) | | |  |  | | --- | --- | | 1. | Mix HVGO and LVGO. Streams are normally rundown together to storage. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Inadvertent opening of HVGO Flush Lines to LVGO (2" valve on P&ID 22E) | | |  |  | | --- | --- | | 1. | Mix HVGO and LVGO. Streams are normally rundown together to storage. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Inadvertently opening a valve on the wash lines to the inlet line of 17BS005A/B (P&ID 25C) | | |  |  | | --- | --- | | 1. | Misdirect LVGO to VTB tar pump suction. Potential to cavitate the 17P007A/B tar pumps leading to seal failure, LOPC of tar via seal leak. Potential ignition and fire. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement of pump seals ($2k-$100k). Potential environmental impact (Negligible). | | |  |  | | --- | --- | | 66. | Plan 53A dual seals on 17P007A/B HVGO pump with Low Pressure and Low Level Alarms on Seal Pots | | CTP | P | 3 | 4 | 4 |  |  |
| |  |  | | --- | --- | | 67. | 17LC1124 with high level alarm may afford operator response | |  | E | 4 | 4 | 4 |
| |  |  | | --- | --- | | 14. | 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A) | | CTP | C | 4 | 4 | 4 |
| |  |  | | --- | --- | | 13. | 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A) | |  |
| |  |  | | --- | --- | | 68. | 17FC1476 with low flow indication may afford operator response | |  |
| |  |  | | --- | --- | | 2. | Potential accumulation of level within vacuum tower No.2 however not expected to result in overfill due to limited flow from 1" flush lines. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Inadvertent opening of LVGO Flush Line to Reduced Crude (P&ID 22E/26B 2" manual valve) | | |  |  | | --- | --- | | 1. | Misdirect Reduced Crude to LVGO resulting in off spec LVGO. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Inadvertent opening of wash lines at 17E005A VTB/Reduced Crude Exchanger (P&ID 26C) | | |  |  | | --- | --- | | 1. | Misdirect reduced crude to tar, resulting in off spec product and process upset. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Misdirect Reduced Crude to VTB. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Misdirect VTB to Reduced crude. Potential to recirculate VTB in the unit reducing charge rate. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Inadvertent opening of LVGO Flush Lines to Slop Wax Pump discharge line (P&ID 25H) | | |  |  | | --- | --- | | 1. | Scenario considered but no hazardous consequence identified as Slop Wax is no longer in service. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Inadvertent opening of HVGO Flush Lines (P&ID 22C|F3) | | |  |  | | --- | --- | | 1. | (To VTB through slop wax manifold) Misdirect HVGO to VTB. No hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | (To Slop header) Potential offspec product. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Inadvertent opening of Slop lines to VTB through slop line manifold (P&ID 22C|F3,H3,G5,H4) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Flush 17P008A/B Slop Wax with 150°F LVGO using hoses. | | |  |  | | --- | --- | | 1. | See comment | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | 2014 HAZOP RECOMMENDATION #X Consider installing hard pipe flush lines to P3486/3387 Slop Wax Pumps to provide operations means to flush pumps for maintenance.  2018 HAZOP team notes that this recommendation has been closed.  See action item #PHA\_HAZO\_17-Vacuum 2\_4\_2016\_1\_8 | |
| |  |  | | --- | --- | | 2. | Scenario considered but no hazardous consequence identified as Slop Wax is no longer in service. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | Inadvertently opening a valve on the wash lines to the Hot tar line to the coker (P&ID 25C) | | |  |  | | --- | --- | | 1. | Potential reverse flow of tar back into LVGO. Potential operability issue at Coker due to reduced hot tar feed, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Slop manifold valves inadvertently opened (P&ID 22C|I3,I4) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | 2" crossover valve from 17E006A inlet to VTB storage inadvertently opened (P&ID 32|H5) | | |  |  | | --- | --- | | 1. | Potential misdirected flow of LVGO to tar storage, potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low / No Level | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition / Contamination / Phase Change | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up / Shutdown / Abnormal Operations | | |  |  | | --- | --- | | 1. | Failure to flush pump on shutdown/isolation of pump | | |  |  | | --- | --- | | 1. | Potential delayed cleaning operation. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Failure to run down to slop header during startup | | |  |  | | --- | --- | | 1. | Potential carryover of water to downstream storage tanks TK8011/8015/10A1. Potential to overpressure storage tank. Potential LOPC via tank seam failure. Potential commercial impact due to repair/replacement ($1MM-$5MM). Potential ignition and pool fire considered but not deemed credible based on tank temperatures. Potential thermal burn hazard and injury to personnel (SDI). Potential environmental impact (Moderate) | | |  |  | | --- | --- | | 69. | Roof vents on Storage Tanks | |  | P | 3 | 5 | 4 |  |  |
| |  |  | | --- | --- | | 70. | 17LV1148/1127 product variable alarm on BFW to the E0974/0818 may afford operator response | | CTP | E | 3 | 4 | 4 |
| |  |  | | --- | --- | | 71. | 17TI1113 with high temperature alarm may afford operator response | |  | C | 3 | 4 | 4 |
| |  |  | | --- | --- | | 72. | Procedural - Mechanical integrity program with regular inspection of exchanger tubing | |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0032; 17AA0026B; 17AA0026A; 17AA0025D | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 10. 50 psi steam | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | PV1478 fails/set close or upstream/downstream manual block valves inadvertently closed (P&ID 26A) | | |  |  | | --- | --- | | 1. | Potential increased backpressure on 50 psig steam supply, potential increased pressure of 50 psig steam to vacuum ejectors, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of 50 psig steam supply to steam header, potential operability issue but no hazardous consequences identified as the 50 psig steam header is supplied by multiple sources. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | PV1478 Fails/set open or bypass inadvertently open (P&ID 26A) | | |  |  | | --- | --- | | 1. | Potential reduced pressure within Vac 2 50 psig steam header. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential reduced pressure of 50 psig steam to vacuum ejectors, however as pressure is expected to be made up by 50 psig steam supply, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | 3" manual valve on boiler feed water line supplying 13E015A and 17E006A BFW inadvertently closed (P&ID 32) | | |  |  | | --- | --- | | 1. | No Flow resulting in Low Level in the 13E015A Steam Generator. Potential loss of heat removal from the VTB. Not expected to exceed tube design Temperature. Potential high temperature rundown to Storage Tanks TK8011/8015/10A1. Potential operability issue but no consequence of interest identified as these are hot service storage tanks. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | No Flow resulting in Low Level in the 17E006A Steam Generator. Potential loss of heat removal from the VTB. Not expected to exceed tube design Temperature. Potential high temperature rundown to Storage Tanks TK8011/8015/10A1. Potential operability issue but no consequence of interest identified as these are hot service storage tanks. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Potential loss of steam generation, potential reduced 50 psig steam header pressure and reduced pressure to steam ejectors, however 150 psig stream is expected to make up this pressure to the ejectors, potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Either 3" manual block valve at battery limits of boiler feed water inadvertently closed (P&ID 32|K6) | | |  |  | | --- | --- | | 1. | Potential loss of boiler feed water to downstream users. Refer to downstream boiler feed water users consequence in relevant PHAs. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Blocked-in heat-on condition in 17E006A (P&ID 26A)  LOPA Scenario - Initiating Event: 10.1.1 | | |  |  | | --- | --- | | 1. | Potential overpressure of 17E006A. Potential increased pressure up to bubble point of steam at ~515°F. Potential overpressure of 17E006A (>2.0x MAWP), Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($100k-$1MM).  LOPA Scenario: 10.1 | | |  |  | | --- | --- | | 87. | 17PSV003A set at 300 psig | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | Team notes that blocked in heat on condition after start up would not result in this overpressure case as the Steam Generator would have no liquid prior to startup. This scenario would only occur if blocked in heat on occurred when liquid level present. | |
| C | 4 | 5 | 4 |
| |  |  | | --- | --- | | 4. | Blocked-in heat-on condition in 13E015A (P&ID 32)  LOPA Scenario - Initiating Event: 10.2.1 | | |  |  | | --- | --- | | 1. | Potential overpressure of 13E015A. Potential increased pressure up to bubble point of steam at ~515°F. potential overpressure of 13E015A (>2.0x MAWP), Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($100k-$1MM).  LOPA Scenario: 10.2 | | |  |  | | --- | --- | | 88. | 13PSV007A set at 300 psig | | CTP | P | 1 | 5 | 4 |  | |  |  | | --- | --- | | 1. | Team notes that blocked in heat on condition after start up would not result in this overpressure case as the Steam Generator would have no liquid prior to startup. This scenario would only occur if blocked in heat on occurred when liquid level present. | |
| C | 4 | 5 | 4 |
| |  |  | | --- | --- | | 5. | Inadvertent closure of 6" manual valve on outlet of 17E006A (P&ID 26A)  LOPA Scenario - Initiating Event: 10.3.1 | | |  |  | | --- | --- | | 1. | Potential overpressure of 17E006A. Potential increased pressure up to bubble point of steam at ~515°F. potential overpressure of 17E006A (>2.0x MAWP), Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($100k-$1MM).  LOPA Scenario: 10.3 | | |  |  | | --- | --- | | 87. | 17PSV003A set at 300 psig | | CTP | P | 1 | 5 | 4 |  |  |
| C | 4 | 5 | 4 |
| |  |  | | --- | --- | | 6. | Inadvertent closure of 6" manual valve on outlet of 13E015A (P&ID 32)  LOPA Scenario - Initiating Event: 10.4.1 | | |  |  | | --- | --- | | 1. | Potential overpressure of 13E015A. Potential increased pressure up to bubble point of steam at ~515°F. potential overpressure of 13E015A (>2.0x MAWP), Potential LOPC via rupture. Potential for ignition, fire, and explosion. Potential injury to personnel (Fatality). Potential damage to equipment ($100k-$1MM).  LOPA Scenario: 10.4 | | |  |  | | --- | --- | | 88. | 13PSV007A set at 300 psig | | CTP | P | 1 | 5 | 4 |  |  |
| C | 4 | 5 | 4 |
| |  |  | | --- | --- | | 7. | Failure to blowdown 17E006A/13E015A when required (P&ID 26A/32) | | |  |  | | --- | --- | | 1. | Potential inability to remove solids, high conductivity within generator. Potential fouling of exchanger. Potential reduced heat exchange. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Steam trap on 17AA0025D stuck closed or manual valve inadvertently closed or check valve stuck closed (P&ID 25D) | | |  |  | | --- | --- | | 1. | Potential carryover of generated condensate to vacuum ejectors. Potential loss of vacuum in 17T001A vacuum tower No. 2. Potential operability issues but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Any bleed/vent/drain valve inadvertently opened to atmosphere | | |  |  | | --- | --- | | 1. | Potential unintended venting of steam to grade/atmosphere, potential injury to personnel (OSHA Recordable) | | |  |  | | --- | --- | | 12. | PPE | |  | P | 4 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 2. | Inadvertent opening of 1" blowdown valve from 13E015A when not required (P&ID 32) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Inadvertent opening of 2" valve from 17E006A or 13E015A to 17V007 (P&ID 26B) | | |  |  | | --- | --- | | 1. | Potential blowdown of water to grade via steam trap at 17V007. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Steam trap fails open downstream of PV1351 (P&ID 25D) | | |  |  | | --- | --- | | 1. | Carryover of steam to condensate header. Potential water hammer, potential LOPC of steam via pipe damage, potential injury to personnel (SDI). Potential commercial impact due to repair/replacement ($2k-$100k). | | |  |  | | --- | --- | | 89. | Operator is expected to hear the issue prior to LOPC. | | CTP | P | 3 | 4 | 4 |  |  |
| C | 5 | 3 | 4 |
| |  |  | | --- | --- | | 5. | Inadvertent opening of 6" 275 psig steam manual valve (P&ID 26A) | | |  |  | | --- | --- | | 1. | Scenario considered but not deemed credible as this valve is locked closed per operations. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Inadvertent opening of 6" 150 psig steam manual valve (P&ID 26A) | | |  |  | | --- | --- | | 1. | Potential reverse flow of 150 psig steam to 50 psig steam header. Potential carryover of 150 psig steam to 50 psig steam header. Potential to overpressure users of 50 psig steam. Potential LOPC via rupture within 50 psig steam header. Potential injury to personnel (SDI). Potential commercial impact due to repair/replacement ($2k-$100k). | | |  |  | | --- | --- | | 73. | Check valve in line | |  | P | 3 | 3 | 3 | |  |  | | --- | --- | | 2. | **2018 HAZOP Recommendation**  Evaluate positive isolation of 275 and 150 psig steam header from 50 psig steam header to safeguard against potential reverse flow of 275 and 150 psig steam to 50 psig plant steam header leading to potential injury to personnel due to failure of 50 psig steam header or one of its users.  Team notes that 6" 275 and 150 psig steam header valves have not been used within the last decade.  These lines should be verified as being on a deadleg management list.  **2022 Vac 2 Reval Update:**  Team notes that the 275 psig steam header valve has been locked closed, however the 150 psig steam header valve has not been locked closed or CSC. In addition the 275 psig steam header valve is not currently tracked in the CSC register. This recommendation is still open and valid. Refer to MOC 17-Vacuum 2\_4\_2022\_6 | |  |
| C | 5 | 3 | 4 |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | LV1127 Fails/set Open or manual bypass inadvertently open (P&ID 32) | | |  |  | | --- | --- | | 1. | More Flow resulting in High Level in the 13E015A Steam Generator. Potential to carry over liquid to 17V007. No Significant Consequences as carried over water is expected to be vented at downstream steam traps. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | LV1148 Fails/set Open or manual bypass inadvertently open (P&ID 26B) | | |  |  | | --- | --- | | 1. | More Flow resulting in High Level in the 13E015A Steam Generator. Potential to carry over liquid to 17V007. No Significant Consequences as carried over water is expected to be vented at downstream steam traps. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | LV1127 Fails/set closed or upstream/downstream manual valve inadvertently closed (P&ID 32) | | |  |  | | --- | --- | | 1. | No Flow resulting in Low Level in the 13E015A Steam Generator. Potential loss of heat removal from the VTB. Not expected to exceed tube design Temperature. Potential high temperature rundown to Storage Tanks TK8011/8015/10A1. Potential operability issue but no consequence of interest identified as these are hot service storage tanks. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | LV1148 Fails/set closed or upstream/downstream manual valve inadvertently closed (P&ID 26B) | | |  |  | | --- | --- | | 1. | No Flow resulting in Low Level in the 17E006A Steam Generator. Potential loss of heat removal from the VTB. Not expected to exceed tube design Temperature. Potential high temperature rundown to Storage Tanks TK8011/8015/10A1. Potential operability issue but no consequence of interest identified as these are hot service storage tanks. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | 17PSV003A relieves as designed (P&ID 26B) | | |  |  | | --- | --- | | 1. | No hazardous consequence of interest identified as PSV relieves to safe location | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 17PSV003A spuriously lifts (P&ID 26B) | | |  |  | | --- | --- | | 1. | Potential loss of steam pressure within 50 psig header. Potential loss of steam to vacuum jets. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | 13PSV007A relieves as designed (P&ID 32) | | |  |  | | --- | --- | | 1. | No hazardous consequence of interest identified as PSV relieves to safe location | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | 13PSV007A spuriously lifts (P&ID 32) | | |  |  | | --- | --- | | 1. | Potential loss of steam pressure within 50 psig header. Potential loss of steam to vacuum jets. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Previous recommendation | | |  |  | | --- | --- | | 1. | See comment | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Verify ASME VIII Code requirements for relief protection for V0680 Moisture Separator and install as required to reduce the likelihood of overpressure.  2018 HAZOP team notes this item is still open. No further recommendations proposed by team.  **2022 Vac 2 HAZOP Update:**  Team notes that relief study determined that 17V007 does not require relief protection against the fire case if verification that this vessel does not contain a liquid level is part of a procedure. Team notes that this level verification has not been proceduralized and determined that existing safeguards are sufficient. This recommendation has been closed, no further action proposed by team. | |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0033; 17AA0037; 17AA0038; 17AA0039; 17AA0040; 17AA0022D; 17AA0024A; 17AA0024B; 17AA0025D; 17AA0025I; 17AA0026A | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 11. Steam Distribution | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | No causes identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | No causes identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | Steam trap within header fails open | | |  |  | | --- | --- | | 1. | Carryover of steam to condensate header. Potential water hammer, potential LOPC of steam via pipe damage, potential injury to personnel (SDI). Potential commercial impact due to repair/replacement ($2k-$100k). | | |  |  | | --- | --- | | 89. | Operator is expected to hear the issue prior to LOPC. | | CTP | P | 3 | 4 | 4 |  |  |
| C | 5 | 3 | 4 |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | Inadvertent closure of 8" valve at battery limits (P&ID 39) | | |  |  | | --- | --- | | 1. | No cause of interest identified as the 150 psig steam has multiple feed locations into the vac2 unit. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Inadvertent closure of 6" block valve (P&ID 39|D5) | | |  |  | | --- | --- | | 1. | No cause of interest identified as the 150 psig steam has multiple feed locations into the vac2 unit. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Inadvertent closure of 3" block valve (P&ID 38|F5) | | |  |  | | --- | --- | | 1. | Potential loss of snuffing steam to heater and steam tracing. Potential operability issue but no hazardous consequence identified without second independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Inadvertent closure of 4" block valve (P&ID 38|H5) | | |  |  | | --- | --- | | 1. | Potential loss of snuffing steam to heater and steam tracing. Potential operability issue but no hazardous consequence identified without second independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Inadvertent closure of 4" valve (P&ID 38|I5) | | |  |  | | --- | --- | | 1. | Potential loss of 150 psig steam to vacuum breaker at jets and steam tracing. Potential operability issue but no hazardous consequence identified without second independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Inadvertent closure of 8" valve (P&ID 39|D4) | | |  |  | | --- | --- | | 1. | No cause of interest identified as the 150 psig steam has multiple feed locations into the vac2 unit. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Inadvertent closure of 8" valve (P&ID 39|D5) | | |  |  | | --- | --- | | 1. | No cause of interest identified as the 150 psig steam has multiple feed locations into the vac2 unit. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Inadvertent closure of either 2" valve (P&ID 39 | G3/G4 | | |  |  | | --- | --- | | 1. | Potential loss of steam to steam tracers and utility stations. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Inadvertent closure of 2" valve (P&ID 39|H4) | | |  |  | | --- | --- | | 1. | Potential loss of steam to steam tracers and utility stations. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | Inadvertent closure of 2" valve (P&ID 39|F5) | | |  |  | | --- | --- | | 1. | Potential loss of 275 psig steam to LVGO steam out. No hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Inadvertent closure of 2" valve at (P&ID 39|E5) | | |  |  | | --- | --- | | 1. | Potential loss of 275 psig steam to heater. No hazardous consequence of interest identified, as these connections are not utilized. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Inadvertent closure of 2" valve (P&ID 39|E6) | | |  |  | | --- | --- | | 1. | Potential loss of 275 psig steam to heater. No hazardous consequence of interest identified, as these connections are not utilized. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Any bleed/vent/drain valve inadvertently opened to atmosphere | | |  |  | | --- | --- | | 1. | Potential unintended venting of steam to grade/atmosphere, potential injury to personnel (OSHA Recordable) | | |  |  | | --- | --- | | 12. | PPE | |  | P | 4 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 2. | Inadvertent opening of 2" valve (P&ID 38|I4) | | |  |  | | --- | --- | | 1. | Potential for 275 psig to be carried into 150 psig steam header. Potential hotter than normal temperature to steam tracers and utilities. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Inadvertent opening of 275 psig steam to steam flush jumper to Vac2/3 unit Flush header (P&ID 25I|J6) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequence identified without a second independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Inadvertent opening of 1.5" valve (P&ID 37|B6) | | |  |  | | --- | --- | | 1. | No hazardous consequence identified without a second independent initiating event. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Inadvertent opening of 2" valve to utility pump station at old pump house (P&ID 22D) | | |  |  | | --- | --- | | 1. | Scenario considered but no hazardous consequence as this equipment has been removed from the field. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Inadvertent opening of 275 psig steam header to LVGO flush header (P&ID 39|F6) | | |  |  | | --- | --- | | 1. | Potential for 275 psig steam to be introduced into flush system. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | 13PSV003A relieves as designed (P&ID 39) | | |  |  | | --- | --- | | 1. | Potential for release of steam to atmosphere at safe location. No hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 13PSV003A spuriously lifts (P&ID 39) | | |  |  | | --- | --- | | 1. | Potential reduced steam pressure. Potential reduced steam to users. Potential operability issue but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0040; 17AA0022D; 17AA0033 | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 12. Condensate | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Any bleed/drain/vent valve inadvertently opened or left open | | |  |  | | --- | --- | | 1. | Potential unintended venting of steam and condensate to grade/atmosphere, potential injury to personnel (OSHA Recordable) | | |  |  | | --- | --- | | 12. | PPE | |  | P | 4 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | Low ambient temperature | | |  |  | | --- | --- | | 1. | Potential freezing of dead sections of condensate header. Potential release of condensate to grade. Potential commercial impact due to repair/replacement ($2k-$100k). | | |  |  | | --- | --- | | 65. | No safeguards identified | |  | C | 5 | 2 | 4 |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | See comment | | |  |  | | --- | --- | | 1. |  | |  |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | Team notes that condensate drawings are incomplete. PHA considered general blockages only. Refer to individual users of steam/condensate within the individual user nodes. | |

| **Document:** 17AA0030A; 17AA0030B; 17AA0025E | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 13. Cooling Water | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | Inadvertent closure of manual block valve or check valve stuck closed on discharge of single cooling tower pump (P&ID 30B) | | |  |  | | --- | --- | | 1. | Potential deadhead of cooling tower pump 17P014/15/16. Potential pump damage. Potential commercial impact due to repair/replacement ($2k-$100k). | | |  |  | | --- | --- | | 65. | No safeguards identified | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 2. | Loss of cooling water to OVHD Condensers. See Node 3/5 for consequences. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Loss of cooling water to other units. See individual unit PHAs for consequences. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | Manual valve in suction of 17P014/015/-16 inadvertently closed (P&ID 330B) | | |  |  | | --- | --- | | 1. | Potential cavitation of cooling tower pump 17P014/15/16. Potential pump damage. Potential commercial impact due to repair/replacement ($2k-$100k). | | |  |  | | --- | --- | | 65. | No safeguards identified | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 2. | Loss of cooling water to OVHD Condensers. See Node 3/5 for consequences. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Loss of cooling water to other units. See individual unit PHAs for consequences. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | Any one of the following 17P014/015/016 Cooling Tower Pumps shuts down (P&ID 30B) | | |  |  | | --- | --- | | 1. | Lower cooling water header pressure. Potential operability issue in downstream units, but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Trip of all three Cooling Tower Pumps 17P014/015/016 (P&ID 30B) | | |  |  | | --- | --- | | 1. | Loss of cooling water to OVHD Condensers. See Node 3/5 for consequences. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Loss of cooling water to other units. See individual unit PHAs for consequences. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Inadvertent closure of any one of the 12" distribution headers within the cooling water return within cooling tower (P&ID 30A) | | |  |  | | --- | --- | | 1. | Potential poor cooling tower efficiency. Potential gradual increase of cooling tower water temperature. Potential operability issue in downstream units, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | 12" manual block valve supplying vac 2 and 3 inadvertently closed (P&ID 30A) | | |  |  | | --- | --- | | 1. | Loss of cooling water to OVHD Condensers. See Node 3/5 for consequences. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential loss of cooling to Vac 3, refer to 2018 Vac 3 PHA for consequences of loss of cooling water. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | 6" manual block valve to sulfur unit inadvertently closed (P&ID 30B) | | |  |  | | --- | --- | | 1. | Loss of cooling water to sulfur unit. See sulfur unit PHA for details related to loss of cooling water. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | 24" manual block valve to chemical building and Amine #1 inadvertently closed (P&ID 30B) | | |  |  | | --- | --- | | 1. | Potential operability issues and offspec cooling water. Potential long-term accelerated corrosion, but no immediate hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Loss of cooling water to amine unit. See amine unit PHA for details related to loss of cooling water. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | 16" or 24" manual block valve to sulfur and overhead Vac2 exchangers inadvertently closed (P&ID 30B) | | |  |  | | --- | --- | | 1. | Loss of cooling water to sulfur unit. See sulfur unit PHA for details related to loss of cooling water. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Loss of cooling water to OVHD Condensers. See Node 3 for consequences. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Any bleed/drain/vent valve inadvertently opened or left open | | |  |  | | --- | --- | | 1. | Potential to send water to grade, but no hazardous consequence identified | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | Trip of Cooling Tower Fans 17F005/5A/8/9/12/15/13/18/10/11/04/16 (P&ID 30A) | | |  |  | | --- | --- | | 1. | Potential poor cooling tower efficiency. Potential gradual increase of cooling tower water temperature. Potential operability issue in downstream units, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Trip of single cooling tower fan (P&ID 30A) | | |  |  | | --- | --- | | 1. | Potential operability issue but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | Make up water control valve fails/set open (P&ID 30A) | | |  |  | | --- | --- | | 1. | Potential to overfill cooling tower water basin to grade, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | Make up water control valve fails/set closed (P&ID 30A) | | |  |  | | --- | --- | | 1. | Potential loss of cooling water basin level. Potential to cavitate cooling water pumps. Potential loss of cooling water to individual users. Refer to downstream unit PHA loss of cooling water causes. Refer to loss of cooling water supply causes in node 3/5 in this HAZOP. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Potential cavitation of cooling tower pump 17P014/15/16. Potential pump damage. Potential commercial impact due to repair/replacement ($2k-$100k). | | |  |  | | --- | --- | | 65. | No safeguards identified | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | Failure to add treatment chemicals when required | | |  |  | | --- | --- | | 1. | Potential operability issues and offspec cooling water. Potential long-term accelerated corrosion, but no immediate hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | Failure to sample when required | | |  |  | | --- | --- | | 1. | Potential operability issues and offspec cooling water. Potential long-term accelerated corrosion, but no immediate hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | Failure to stop rotation of offline fan prior to startup | | |  |  | | --- | --- | | 1. | Potential high torque on cooling fan shaft, potential damage to cooling fan coupling, potential commercial impact ($2k-$100k) | | |  |  | | --- | --- | | 65. | No safeguards identified | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0034; 17AA0035; 17AA0030A | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 14. Lubrimist - Oil Mist Lubrication System | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | Loss of oil mist to any pumps/fans | | |  |  | | --- | --- | | 1. | Reduce bearing life. Potential for eventual pump/fan motor failure. Refer to pump/fan trip deviation in each node | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/Misdirected Flow | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No cause identified. | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0036; 17AA0024B | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 15. Instrument Air | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | Loss of plant air supply to the unit | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | 1" manual valve inadvertently closed (P&ID 36|H4) | | |  |  | | --- | --- | | 1. | Potential for FV-1135 to fail close and FV-1476 to fail open, refer to Node 8 for consequences. Consequence not expected to be more significant than either of these control valves failing individually. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | 1" manual valve inadvertently closed (P&ID 36|G4) | | |  |  | | --- | --- | | 1. | Potential loss of instrument air to charge heater, charge heater pass flow control valves (fail open), and steam generator level control valves (fail closed). Potential loss of heat input to Vac 2, potential increased flow of reduced crude charge to Vac 2 tower, potential increased level in VAC 2 tower, however this flow is limited by Feed Surge Drum Capacity. Potential loss of BFW to Steam Generators, potential operability issues as Vac 2 unit cools due to loss of heat input, but no hazardous consequences identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Loss of instrument air to individual users | | |  |  | | --- | --- | | 1. | Refer to individual instrument air users in each node | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Inadvertent closure of 2" instrument air supply valve at battery limits (P&ID 36|K4) | | |  |  | | --- | --- | | 1. | Potential loss of instrument air to entire unit. Per operations experience, loss of instrument air to unit results in operability issues and potential shutdown of the unit, but no hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Any bleed/vent/drain valve inadvertently opened | | |  |  | | --- | --- | | 1. | Potential venting of air to atmosphere. No hazardous consequence of interest identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | Low ambient temperature | | |  |  | | --- | --- | | 1. | Potential freezing of any humidity within instrument air header, resulting in loss of instrument air to individual user. Refer to individual user causes in this HAZOP for failure of valve to safe position. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** 17AA0027A | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 16. Pump Seals | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | High Pressure | | |  |  | | --- | --- | | 1. | Failure open of regulator on Plan 53A pump seal regulator (P&ID 27A) | | |  |  | | --- | --- | | 1. | No hazardous consequence of interest identified as seal pots in unit are running at 130 psig with nitrogen supply pressure of 135 psig. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Low/No Pressure | | |  |  | | --- | --- | | 1. | Failure of Regulator closed on Plan 53A pump seal regulator (P&ID 27A) | | |  |  | | --- | --- | | 1. | Potential loss of pressure in seal pot, potential reverse flow of primary seal across secondary seal barrier. Potential loss of seal, leading to LOPC via seal leak, potential ignition and pool fire, potential injury to personnel (SDI), potential commercial impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 74. | PSL on Seal Plan 53A with low pressure alarm may afford operator response. | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Scenario takes into consideration that primary seal fails, and occupancy factor. | |
| |  |  | | --- | --- | | 75. | LSL on Seal Plan 53A with low level alarm may afford operator response. | |  | E | 4 | 3 | 4 | |  |  | | --- | --- | | 2. | Refer to blocked discharge/suction causes and in this node. | |
| C | 5 | 3 | 4 |
| |  |  | | --- | --- | | 3. | High Flow | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Low/No Flow | | |  |  | | --- | --- | | 1. | Inadvertent closure of seal line valves on Plan 11 | | |  |  | | --- | --- | | 1. | Potential loss of water seal on 17P010A/B, potential LOPC of water via seal failure, potential commercial impact ($2K to $100K). | | |  |  | | --- | --- | | 65. | No safeguards identified | |  | C | 5 | 3 | 4 |  |  |
| |  |  | | --- | --- | | 5. | Reverse/ Misdirected Flow | | |  |  | | --- | --- | | 1. | Any bleed/vent/drain valve inadvertently opened | | |  |  | | --- | --- | | 1. | Potential release of barrier seal fluid to grade. Potential loss of pressure in seal pot, potential reverse flow of primary seal across secondary seal barrier. Potential loss of seal, leading to LOPC via seal leak, potential ignition and pool fire, potential injury to personnel (SDI), potential commercial impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 74. | PSL on Seal Plan 53A with low pressure alarm may afford operator response. | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Scenario takes into consideration that primary seal fails, and occupancy factor. | |
| |  |  | | --- | --- | | 75. | LSL on Seal Plan 53A with low level alarm may afford operator response. | |  | E | 4 | 4 | 4 | |  |  | | --- | --- | | 2. | Refer to blocked discharge/suction causes and in this node. | |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 6. | High Temperature | | |  |  | | --- | --- | | 1. | Loss of cooling water flow to seal pot due to inadvertent block valve closure on inlet/outlet block valve | | |  |  | | --- | --- | | 1. | Potential loss of seal, leading to LOPC via seal leak, potential ignition and pool fire, potential injury to personnel (SDI), potential commercial impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 75. | LSL on Seal Plan 53A with low level alarm may afford operator response. | |  | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Scenario takes into consideration that primary seal fails, and occupancy factor. | |
| E | 4 | 4 | 4 | |  |  | | --- | --- | | 2. | Refer to blocked discharge/suction causes and in this node. | |
| C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 7. | Low Temperature | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | High Level | | |  |  | | --- | --- | | 1. | Overfill of seal pot with barrier fluid | | |  |  | | --- | --- | | 1. | No hazardous consequence identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Low/No Level | | |  |  | | --- | --- | | 1. | Failure to refill barrier fluid when required | | |  |  | | --- | --- | | 1. | Potential loss of pressure in seal pot, potential reverse flow of primary seal across secondary seal barrier. Potential loss of seal, leading to LOPC via seal leak, potential ignition and pool fire, potential injury to personnel (SDI), potential commercial impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 74. | PSL on Seal Plan 53A with low pressure alarm may afford operator response. | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Scenario takes into consideration that primary seal fails, and occupancy factor. | |
| |  |  | | --- | --- | | 75. | LSL on Seal Plan 53A with low level alarm may afford operator response. | |  | E | 4 | 4 | 4 | |  |  | | --- | --- | | 2. | Refer to blocked discharge/suction causes and in this node. | |
| |  |  | | --- | --- | | 76. | Operator rounds - check seal pot barrier fluid level three times per shift | |  | C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 10. | High/Low Viscosity | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Composition/Contamination/Phase Change | | |  |  | | --- | --- | | 1. | Refill of seal pot with incorrect barrier fluid | | |  |  | | --- | --- | | 1. | Potential accelerated loss of barrier fluid to process. Potential loss of pressure in seal pot, potential reverse flow of primary seal across secondary seal barrier. Potential loss of seal, leading to LOPC via seal leak, potential ignition and pool fire, potential injury to personnel (SDI), potential commercial impact ($2K to $100K) potential environmental impact (negligible). | | |  |  | | --- | --- | | 74. | PSL on Seal Plan 53A with low pressure alarm may afford operator response. | | CTP | P | 3 | 4 | 4 |  | |  |  | | --- | --- | | 1. | Scenario takes into consideration that primary seal fails, and occupancy factor. | |
| |  |  | | --- | --- | | 75. | LSL on Seal Plan 53A with low level alarm may afford operator response. | |  | E | 4 | 4 | 4 | |  |  | | --- | --- | | 2. | Refer to blocked discharge/suction causes and in this node. | |
| |  |  | | --- | --- | | 76. | Operator rounds - check seal pot barrier fluid level three times per shift | |  | C | 5 | 4 | 4 |
| |  |  | | --- | --- | | 12. | Reaction | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Maintenance | | |  |  | | --- | --- | | 1. | Deadleg piping in system | | |  |  | | --- | --- | | 1. | No deadlegs were identified by the PHA team as potential deadlegs with water or corrosive material or as recently created deadlegs due to an MOC. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Sampling | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Start-up/Shutdown/Abnormal Operations | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Relief | | |  |  | | --- | --- | | 1. | No causes identified | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Other | | |  |  | | --- | --- | | 1. | No additional causes identified | |  |  |  |  |  |  |  |  |  |

| **Document:** | | | | | | | | | | |
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| Node: 17. MOCs | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | Area ? MOC - Permanent | | |  |  | | --- | --- | | 1. | Reviewed all MOCs from past 5 years. Refer to report appendix for list of all MOCs reviewed. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Area ? Operating Procedure MOC | | |  |  | | --- | --- | | 1. |  | | |  |  | | --- | --- | | 1. |  | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Area ? Temporary MOC | | |  |  | | --- | --- | | 1. |  | | |  |  | | --- | --- | | 1. |  | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | General Plant Procedure MOC - if applicable | | |  |  | | --- | --- | | 1. |  | | |  |  | | --- | --- | | 1. |  | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Old Database MOC - if applicable | | |  |  | | --- | --- | | 1. |  | | |  |  | | --- | --- | | 1. |  | |  |  |  |  |  |  |  |  |

| **Document:** | | | | | | | | | | |
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| Node: 18. Previous Recommendations | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | PHA Previous Recommendations - Open | | |  |  | | --- | --- | | 1. | Various 2017 LOPA recommendations were still open at the time of the 2022 PHA. All scenario risk ranking was reevaluated and all applicable recommendations were regenerated. | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | PHA Previous Recommendations - Closed | | |  |  | | --- | --- | | 1. | Refer to comments within each node. All previous closed recommendations from 2017 PHA were reviewed. | |  |  |  |  |  |  |  |  |  |

| **Document:** | | | | | | | | | | |
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| Node: 19. Industry Scenarios | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | Industry Scenarios | | |  |  | | --- | --- | | 1. | Refer to Report appendices for list of industry scenarios reviewed by PHA team | |  |  |  |  |  |  |  |  |  |

| **Document:** | | | | | | | | | | |
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| Node: 20. Previous Incidents | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | Previous Incidents | | |  |  | | --- | --- | | 1. | Reviewed all previous incidents from past 5 years. Refer to report appendix for list of all previous incidents reviewed. | |  |  |  |  |  |  |  |  |  |

| **Document:** | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 21. Human Factors Checklist | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | Human Factors - Field | | |  |  | | --- | --- | | 1. | Are the field instruments that are routinely monitored by operations personnel easily accessible to ensure information is read in accordance with recommended frequency [consider instruments or areas that are difficult to reach, such as climbing 40 feet of ladder or squeezing into close quarters]? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are all operating valves accessible during normal or emergency operation? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Are manually operated valves positioned to allow proper operation without muscle strain? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Is access adequate at all valve manifolds (including battery or plot limit) for both routine and emergency operation and for maintenance? [Review requirements for changing battery or plot limit blinds.] | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Are elevated valves accessible during normal or emergency operation (i.e., access provided by ladders/platform or chain operator)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Are valve chain operators properly maintained? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Can critical valves or equipment be closed or shut off from a safe location in a timely manner? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Have valve manifolds been arranged to reduce the likelihood of mis-manifolding? Has valve mis-manifolding been evaluated? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Do alarm indicators (e.g., lights, horns, or whistles) adequately alert field personnel to upset or emergency conditions? Does the alarm indication alert all potentially affected employees? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | Are emergency shutdown switches guarded against inadvertent operation [consider location, switch operation, and guards or covers]? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Are remote startup/shutdown switches clearly labeled and protected from inadvertent operation? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Are remote switches for different systems separated by sufficient distance to prevent operation of the wrong system during stressful situations? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Is the lighting adequate in the unit [consider local instrument panels, battery or plot limit valve manifold locations, equipment and valves requiring operation during emergency conditions, etc.]? Is the emergency lighting (light fixtures on the emergency power circuit) adequate in the unit? | | |  |  | | --- | --- | | 1. | Operations is provided with flashlights and other light sources during loss of lighting. No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Are drain valves located to allow personnel to monitor levels while draining? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Are the engineering units of similar instruments consistent [e.g., do the pump seal flush rotameters all display flow in either gpm or gph]? | | |  |  | | --- | --- | | 1. | No, units of pressure are inconsistent (mmHg, inH2O, psig, inHg), however operations is familiar with the units in each point of the process and training program enforces this knowledge. In addition, graphics do not indicate units. However units are accessible on demand when viewing process parameters. This is done in order to prevent graphical interface from being too busy. No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | Are field instrument indicators routinely checked for accuracy? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | Are field instrument ranges appropriate for the service [e.g., avoid using a 0-2500 psig pressure gage on a 100 psig system]? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 18. | Are control valves and associated instrumentation accessible for maintenance? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 19. | Are operating ranges for process variables specified in the same engineering units as the instrument read-out or indicator (i.e., mental conversion of units is avoided)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 20. | Are safety critical instruments and instrument loops routinely checked at required frequency? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Human Factors - Control Room | | |  |  | | --- | --- | | 1. | Does the process control system console layout allow for rapid response to upset situations? If required, does the process control system console layout allow for response by multiple personnel? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Do the process control system displays adequately present the process information [consider the logical layout of process or equipment configuration information, consistent presentation of information, visibility of information from various work positions, and the logical linking of information between displays]? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Do the process control system displays for similar equipment (e.g., parallel trains or similar equipment in series) present the information in a unique manner to avoid confusion? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Do the process control system displays provide feedback to operations personnel to confirm operator actions? Does the feedback provide operators with logical information (e.g., is 100% valve output equivalent to valve wide open)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Does the control board layout minimize the possibility of operator error during stressful situations? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Are board-mounted shutdown switches or buttons sufficiently distinguishable/separated from alarm acknowledgment buttons to minimize inadvertent operation? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Are control system display targets (touch screens) spaced adequately to prevent accidental operation? | | |  |  | | --- | --- | | 1. | Not applicable | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Are the control system display symbols consistent and meaningful? Are the control system display symbols standardized (i.e., consistent representation and common use of acronyms, abbreviations, and equipment tags)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Are critical alarms prioritized to alert operations personnel to upset situations that require immediate response? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | Is the cause of "nuisance" alarms (repetitive alarms that operations personnel ignore or acknowledge without investigating) determined and repaired in a timely manner? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Are equipment 'run' indicators (running lights or other process indicators) and valve position indicators provided at a continuously staffed location for critical equipment, valves, and instruments? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Are calculations performed by operations personnel documented in a consistent manner and periodically checked for correctness? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | Is the control room lighting adequate [review direct and indirect lighting]? Is the control room emergency lighting (light fixtures on the emergency power circuit) adequate? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | Are the communications facilities between process units adequate for clear and uninterrupted communications during both normal and emergency situations [e.g., telephone land lines, radio, computer network, and E-mail, and are systems redundant and/or secure]? | | |  |  | | --- | --- | | 1. | No new issues. Current project underway to improve radio communication. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | Are the control building air conditioning and pressurization adequate to protect the electronic instrumentation? Are they adequate to prevent intrusion of toxics, flammables, or corrosive contaminants (if applicable)? | | |  |  | | --- | --- | | 1. | No new issues. Team acknowledges there is a current project in place to address air intake into the control room. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Human Factors - Labeling | | |  |  | | --- | --- | | 1. | Are all equipment labels (e.g., vessels, piping, valves, instrumentation, etc.) easy to read (clear and in good condition)? | | |  |  | | --- | --- | | 1. | Continuous improvement project to fix labels that are in need of repair/replacement. No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are all equipment labels correct and unambiguous? | | |  |  | | --- | --- | | 1. | No new issues. Facility is transitioning between asset tags and location tags. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Are all equipment labels located close to the items that they identify? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Do all equipment labels use standard terminology (e.g., acronyms, abbreviations, equipment tags, etc.)? Are the equipment labels consistent with nomenclature used in procedures? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Are all components that are mentioned in procedures (e.g., valves) easily identified? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Do switch labels identify discrete positions (e.g., ON or OFF, OPEN or CLOSE)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Are signs (e.g., emergency exit, restricted entry, etc.) clearly visible [consider location and condition]? Are the signs easy to read [consider letter size and color]? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Are pipelines and electrical conduit clearly labeled at points where they become invisible (e.g., routed underground)? | | |  |  | | --- | --- | | 1. | Continuous improvement project in place to label piping where it becomes invisible. No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Human Factors - Procedures | | |  |  | | --- | --- | | 1. | Do procedures prevent changing alarm set points without proper review and authorization? Are alarm changes (set point or priority) communicated to all affected employees? | | |  |  | | --- | --- | | 1. | MOC procedure and lock down on upcoming C300 controls is being implemented. No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Do procedures prevent changing process control system or safety shutdown system control or logic (software) without proper authorization? Are process control system or safety shutdown system changes communicated to all affected employees? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Do the procedures specify the expected operator response to critical alarms? Do the procedures specify the potential consequences if the alarm set points are exceeded (i.e., consequences of deviation)? Are alarm indicators routinely tested? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Do procedures require routine testing of critical alarms and safety shutdown systems, including primary elements or sensors, shutdown system control and logic, and final elements such as emergency isolation valves or equipment shutdown interlocks [determine the need for on-line testing of safety shutdown systems]? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Do operating crews communicate unusual equipment or instrument status (bypassed or out of service) in writing? Are operating crews provided with written temporary operating procedures when equipment or instruments are bypassed or out of service? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Do procedures require verification that instruments that are deliberately disabled during operation (e.g., shutdown interlocks bypassed to allow testing) are placed back in service? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Human Factors - Workload & Stress Factors | | |  |  | | --- | --- | | 1. | Is the length of a normal shift appropriate given the degree of alertness required and potential for operator fatigue [consider number of manual adjustments required in a single shift, effect of rotating shifts]? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are shift turnover periods sufficient to adequately communicate plant operating conditions from off-shift to on-shift? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Are emergency procedures presented in a clear, step-by-step format to reduce the "stress" factor during upset situations? Are hypothetical drills of emergency situations periodically performed? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Can tasks requiring the operator to perform nearly simultaneous actions be accomplished without traveling large distances (e.g.,  switching unit rundown into an alternate rundown line, lighting furnace burners, etc.)? | | |  |  | | --- | --- | | 1. | Vac 2 unit operators cover a large area (12 units). Board man is sometimes stretched across multiple unit responsibilities. Vulnerability may exist during unit upsets or multiple unit shutdowns where simultaneous tasks become more critical. | | |  |  | | --- | --- | | 77. | Procedural - Alarms and remote shutdown capability. | |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 78. | Procedural - Two board men required at all times | |  |
| |  |  | | --- | --- | | 5. | Are sufficient tasks assigned during low activity operation to minimize the effects of boredom (e.g., possible loss of alertness)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Does the location of emergency equipment (e.g., fire gear, SCBA, acid suits, etc.) allow for rapid access and use? Does the location of first aid supplies allow for rapid access and use? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |

| **Document:** | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 22. Facility Siting Checklist | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | Siting - Spacing between process components | | |  |  | | --- | --- | | 1. | Are there safe exit routes from each unit? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Has equipment been adequately spaced and located to safely permit anticipated maintenance (e.g., pulling heat exchanger bundles, dumping catalyst, lifting with cranes) and hot work? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Is there adequate access for emergency vehicles (e.g., fire trucks)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Can adjacent equipment or facilities withstand the overpressure generated by potential explosions? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Can adjacent equipment and facilities (e.g., support structures) withstand flame impingement? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | When provisions have been made for relieving explosions in process components, are the vents directed away from personnel and equipment locations? | | |  |  | | --- | --- | | 1. | Not applicable. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Siting - Location of large inventories | | |  |  | | --- | --- | | 1. | Are large inventories of highly hazardous chemicals located away from the process area? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Is temporary storage provided for raw materials and for finished products at appropriate locations? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Are the inventories of highly hazardous chemicals held to a minimum? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Have the following been considered in the location of material handling areas: | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | - fire hazards? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | - location relative to important buildings? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | - safety devices (e.g., sprinklers)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | - slope of the area (is it level)? | | |  |  | | --- | --- | | 1. | No new issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Siting - Location of motor control center | | |  |  | | --- | --- | | 1. | Is the motor control center (MCC) located so that it is easily accessible to operators? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are circuit breakers easy to identify? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Can maintenance personnel safely open circuit breakers? Have they been trained? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Is the MCC designed such that it could not be an ignition source? Are the doors always closed? Is a no-smoking policy strictly enforced? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Is the MCC designed and meant to be a safe haven? | | |  |  | | --- | --- | | 1. | No issues. Not designed to be safe haven. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Siting - Location and construction of control room | | |  |  | | --- | --- | | 1. | Is the control room built to satisfy current corporate overpressure and safe-haven standards? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Does the construction basis for the control room satisfy acceptable criteria (e.g., the Factory Mutual recommendations)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Are workers in the control room (or escape routes from the control room) protected from all of the following: | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | - toxic, corrosive, or flammable sprays, fumes, mists, or vapors? | | |  |  | | --- | --- | | 1. | Addressed by emergency response planning. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | - thermal radiation from fires (including flares)? | | |  |  | | --- | --- | | 1. | Addressed by emergency response planning. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | - contamination from spills or runoff? | | |  |  | | --- | --- | | 1. | Addressed by emergency response planning. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | - transport of hazardous materials from other sites? | | |  |  | | --- | --- | | 1. | Addressed by emergency response planning. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | - possibility of long-term exposure of employees to low concentrations of process material? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | - impacts (e.g., from a forklift)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | - flooding (e.g., ruptured storage tank)? | | |  |  | | --- | --- | | 1. | No issues outside of 500-year flood. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Are vessels containing highly hazardous chemicals located sufficiently far from control rooms? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Were the following characteristics considered when the control room location was determined: | | |  |  | | --- | --- | | 1. | No comments from PHA team. These are issues best addressed during initial plant design and layout. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | - types of construction of the room? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | - types/quantities of materials? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 15. | - types of reactions and processes? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 16. | - operating pressures and temperatures? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 17. | - fire protection? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 18. | - drainage? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 19. | If windows are installed, are they of rigid construction with sturdy panes (e.g., woven-wire reinforced glass)? | | |  |  | | --- | --- | | 1. | Not applicable. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 20. | Is at least one exit located in a direction away from the process area? Do exit doors open outward? Are emergency exits provided for multistory control buildings? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 21. | Are the ends of horizontal vessels facing away from control rooms? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 22. | Are critical pieces of equipment in the control room well protected? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 23. | Are open pits, trenches, or other pockets where inert, toxic, or flammable vapors could collect located away from control buildings or equipment handling flammable fluids? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 24. | Where piping, wiring, and conduit enter the building, is the building sealed at the point of entry? Have other potential leakage points into the building been adequately sealed? | | |  |  | | --- | --- | | 1. | No comments from PHA team. These are issues best addressed during initial plant design and layout. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 25. | Is the control room located a sufficient distance from sources of excessive vibration? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 26. | Is a positive pressure maintained in control rooms located in hazardous areas? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 27. | Could any structures fall on the control room in the event of an accident? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 28. | Is the roof of the control room free from heavy equipment and machinery? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Siting - Location of machine shops, welding shops, electrical substations, roads, rail spurs, and other likely ignition sources | | |  |  | | --- | --- | | 1. | Are likely ignition sources (e.g., maintenance shops, roads, rail spurs) located away from release points for volatile substances (both liquid and vapor)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are process sewers located away from likely sources of ignition? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Are all vessels containing highly hazardous chemicals or components containing material above its flash point located away from likely sources of ignition? | | |  |  | | --- | --- | | 1. | No new issues identified. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Are the flare and fired heater systems located to minimize hazards to personnel and equipment? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Siting - Unit Layout | | |  |  | | --- | --- | | 1. | Are large inventories or release points for highly hazardous chemicals located away from vehicular traffic within the plant? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Could specific siting hazards be posed to the site from credible external forces such as high winds, earth movement, utility failure from outside sources, flooding, natural fires, and fog? | | |  |  | | --- | --- | | 1. | No issues. Covered by site emergency response plan. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Are access roads free of the possibility of being blocked by trains, highway congestion, spotting of rail cars, etc.? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Are access roads well engineered to avoid sharp curves? Are traffic signs provided? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Is vehicular traffic appropriately restricted from areas where pedestrians could be injured or equipment damaged? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Is hydrocarbon-handling equipment located outdoors? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Are pipe bridges located such that they are not over equipment, including control rooms and administration buildings? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Is piping design adequate to withstand potential liquid load? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Siting - Location of the unit relative to onsite and offsite surroundings | | |  |  | | --- | --- | | 1. | Is a system in place to notify neighboring units, facilities, and residents if a release occurs? | | |  |  | | --- | --- | | 1. | No issues. Covered by site emergency response plan. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are the detection systems and/or alarms in place to assist in warning neighboring units, facilities, and residents if a release occurs? | | |  |  | | --- | --- | | 1. | No issues. Covered by site emergency response plan. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Do neighbors (including units, facilities, and residents) know how to respond when notified of a release? Do they know how to shelter in place and when to evacuate? | | |  |  | | --- | --- | | 1. | No issues. Covered by site emergency response plan. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Are large inventories or release points for highly hazardous chemicals located away from publicly accessible roads? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Is the unit located to minimize the need for offsite or intra-site transportation of hazardous materials? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Are workers in this unit protected from the effects of adjacent units or facilities for all of the following (and vice versa), and are environmental receptors and the public also protected from the following? | | |  |  | | --- | --- | | 1. | No issues. Covered by site emergency response plan. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | - releases of highly hazardous chemicals? | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | - toxic, corrosive, or flammable sprays, fumes, mists, or vapors? | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | - thermal radiation from fires (including flares)? | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | - overpressure from explosions? | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | - contamination from spills or runoff? | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | - transport of hazardous materials from other sites? | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 13. | - impacts (e.g., airplane crashes, derailments)? | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 14. | - flooding (e.g., ruptured storage tank)? | |  |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Siting - Location of fire water mains and backup (e.g., diesel pumps) | | |  |  | | --- | --- | | 1. | Are firewater monitors and hydrants easily accessible? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are monitors and hydrants located in appropriate places? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Is an adequate supply of water available for firefighting? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Siting - Location and adequacy of drains, dikes, spill basins, and sewers | | |  |  | | --- | --- | | 1. | Are spill containments sloped away from process inventories and potential sources of fire? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Have precautions been taken to avoid open ditches, pits, sumps, or pockets where inert, toxic, or flammable vapors could collect? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Are process sewers that transport hydrocarbon closed systems? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | Are concrete bulkheads, barricades, or berms installed to protect personnel and adjacent equipment from explosion and/or fire hazards? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | Are vehicle barriers installed to prevent impact to critical equipment adjacent to high traffic areas? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Do drains empty to areas where material cannot pool? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Can dikes hold the capacity of the largest tank? | | |  |  | | --- | --- | | 1. | Not applicable. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Is there a means of access in and out of dikes, pits, etc.? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | Siting - Location of emergency stations (showers, respirators, personal protective equipment, etc.) | | |  |  | | --- | --- | | 1. | Are first aid stations prudently located and adequately equipped? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are safety showers heated/freeze protected/wind protected? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Is there a control room alarm for water flow from a safety shower and eyewash station? (Is there a need for such an alarm?) | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Siting - Electrical classification | | |  |  | | --- | --- | | 1. | Are there adequate controls (e.g., a hot work permit system) on repair and construction activities, including work by contractor personnel? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are electrically classified areas clearly identified on an electrical classification drawing? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | Does the electrical classification adequately reflect the effects of different modes of operation (e.g., normal operation, maintenance, startup, infrequent operating modes such as reactor regeneration or operation with a portion of the system bypassed)? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Siting - Contingency planning | | |  |  | | --- | --- | | 1. | Can the unit be maintained without lifting heavy items over operating equipment and piping? | | |  |  | | --- | --- | | 1. | No issues. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | Are calculations, charts, and other documents available that verify facility siting has been considered in the layout of the unit? Do these facility siting documents show that consideration has been given to: | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 3. | - atmospheric dispersion of gases and vapors? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 4. | - estimated radiant heat density that might exist during a fire? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 5. | - estimated overpressure? | | |  |  | | --- | --- | | 1. | Refer to facility siting study. | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 6. | Are appropriate security safeguards in place (e.g., fences, guard stations)? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 7. | Are gates located away from the public roadway so that the largest trucks can move completely off the roadway while waiting for the gates to be opened? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 8. | Where applicable, are safeguards in place to protect high structures against low-flying aircraft? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 9. | Is adequate emergency lighting provided? Is there adequate redundant backup power for emergency lighting? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 10. | Are procedures in place to restrict nonessential or untrained personnel from entering areas deemed to be hazardous? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 11. | Are evacuation plans (from buildings, units, etc.) adequate and accessible to personnel? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 12. | Are evacuation drills routinely conducted? | | |  |  | | --- | --- | | 1. | No issues | |  |  |  |  |  |  |  |  |

| **Document:** | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node: 23. Global | | | | | | | | | | |
| **Deviation** | **Causes** | **Consequences** | **Safeguards** | | **CAT** | **After Risk Reduction** | | **RR** | **HAZOP Recommendations** | **Comment** |
| **Safeguards** | **Comments** | **S** | **L** |
| |  |  | | --- | --- | | 1. | Loss of Utilities | | |  |  | | --- | --- | | 1. | No additional hazardous consequence identified for evaluation in this HAZOP/LOPA. | | |  |  | | --- | --- | | 1. |  | |  |  |  |  |  |  |  |  |
| |  |  | | --- | --- | | 2. | IPLs | | |  |  | | --- | --- | | 1. | See Recommendation | | |  |  | | --- | --- | | 1. |  | |  |  |  |  |  |  | |  |  | | --- | --- | | 1. | **2022 Vac 2 HAZOP Recommendation:**  Ensure that all BPCS and SIF IPLs taken credit for within LOPA have appropriate periodic testing within Maximo and are not on the same I/O Card. No Controls/Alarm IPLs in LOPA assessments took credit for more than 1E-1 BPCS credit. All of the following IPLs should be confirmed to have adequate testing/inspection routines:  \* 17FSL1129/1130/1153/1154 with Low Flow Trip of fired heater to minimum firing (Credit taken as per SAF-200-05-208; this PLC SIF assumed to be independent of cause) [DCS PLC]  \* 17ICR1156 with low current trip of heater to natural draft mode  \* 17ICR1157 with low amp trip opens HV-1155 and HV-1159  \* 17PAHH1160 with high-high pressure trip of fuel to heater  \* 17PALL1150 with low-low pressure trip of pilot gas to heater  \* 17PALL1160 with low-low pressure trip of fuel to heater  \* 17PC1146 with high pressure alarm may afford operator response  \* 17TI1185/1187/1189/1191 with high skin temperature alarm may afford operator response | | |  |  | | --- | --- | | 1. | **2018 HAZOP Recommendation**  Ensure that all BPCS and SIF IPLs taken credit for within LOPA have appropriate periodic testing within Maximo. No Controls/Alarm IPLs in LOPA assessments took credit for more than 1E-1 BPCS credit. All of the following IPLs should be confirmed to have adequate testing/inspection routines and critical alarms action should be detailed within operating procedures:  LOPA BPCS/Alarms/PSVs  \* 17PSV006 Relief Valve on 17V005 Feed Surge Drum set @ 50 psig  \* 17PSV002A Relief Valve 17T001A Vacuum Tower set @ 50 psig  \* 17LC1358 with high level alarm on water side of 17V006 OVHD receiver may afford operator response  \* 17LC1361 with high level alarm may afford operator response  \* 17PC1125 with high pressure alarm may afford operator response (P&ID 17AA0025A)  \* 17PC1146 with high pressure alarm may afford operator response (P&ID 17AA0025A)  \* 17PI1147 with high pressure alarm may afford operator response (P&ID 17AA0025A)  \* 17PAHH1150 with high-high pressure trip of pilot gas to heater (P&ID 17AA0024C)  \* 17PAHH1158 with high-high pressure trip of pilot gas to heater (P&ID 17AA0024C)  **2022 Vac 2 HAZOP Update:**  The recommendation has been closed. No further action proposed by team. | |