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Process Safety Forum
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Learning Brief: #024

Date: 22/06/2022

Incinerator Fire

This learning brief is shared in order to promote learning and improve safety. You should seek appropriate guidance regarding the relevance, accuracy, and completeness of this alert to your circumstances prior to implementation.

Theme

Hazard & Risk Assessment
Management of Change
Human Factors & Procedures

Summary of Learning

Assessing hazards from process changes that have the potential to impact the operation of instrumentation is essential in maintaining safe operations, including assessing the impacts of creeping changes due to age and new field processes that may not be considered as part of the Management of a Change process.

The use of inhibits and overrides should be carefully monitored, and a greater focus should be placed on the resolution of known process control defects rather than 'work-arounds' being adopted.

Description

A field flow rate trial to an incinerator at a process plant was initiated, increasing the flow rate from 40 million standard cubic feet per day to 44 million standard cubic feet per day. The trial support team engaged with the shift team on duty and with Control Room Operators to collect data on the trial.

11:00 a rise in incinerator temperature (temperature excursion) was noted by a Control Room Operator, this was followed immediately by flame failure detection from 2 of the 3 operational burners. Inhibits were applied.

> On local inspection, the presence of liquids around the incinerator led to drainage to closed drains, via the incinerator bund.
>
> The source of the liquids (which were miscellaneous streams feed to the incinerator including condensate) was identified and isolated until the flow of liquid gradually reduced to a stop.

13:15 three shift instrument technicians requested permission to inspect igniters.

14:00 Incinerator restarted.

14:45 the miscellaneous streams feed to the incinerator was opened. A second temperature excursion occurred with smoke and flame present emerging from the top of the incinerator stack.

Miscellaneous streams were immediately isolated and the flame and smoke stopped.

14:40 liquids containing high levels of condensate again drained down into the incinerator bund, where the shift instrument technicians were standing.

Due to the temperature excursion at 14:45 it is highly likely that the adjacent equipment was above the auto-ignition temperature of the condensate (~260 Deg C), there was no ignition.

Primary findings (refer also to Appendix 1 – details of barrier failures)

1. Failure to control level in condensate collection drum methanol boot. Bypass was left open and failed to activate at genuine low methanol level, resulting in unchecked flow of liquid to collection drum (barriers 1 & 2), leading to:

    a. Failure to detect an increase in level on both aqueous and condensate sides of the methanol flash drum due to compromised level instrumentation, followed by failure of level gauge to activate upon genuine high condensate level in the vessel, resulting in a significant vessel-overfill within pipework (barriers 3, 4 & 5), leading to:

        i. Filling of the miscellaneous streams line between methanol flash drum and incinerator with condensate. The inhibition of isolation valve led to a flow of condensate into the incinerator (barrier 6), resulting in conflagration of hydrocarbon condensate and black smoke.

2. There were simultaneous distractions and loss of focus / attention within the control room arising from ongoing audits, maintenance and the flow rate trial.

3. The sequence of compromised barriers uncovered was so unforeseeable as to be unplanned for, although the findings acknowledge the existence of latent failure. Final barrier analysis did not consider the presence of condensate at a high level in the methanol flash drum.

Key Learnings

1. There should be an improved approach to assessing hazards from changes in process fluids which have the potential to impact operation of instrumentation, including the impacts of creeping changes due to age and new field processes not considered as part of the Management of Change process. It was noted that:

    a. there had been a 14% increase in condensate density since specification of level instruments
    b. there had been particulate contamination of liquid streams coming from the inlet facilities
    c. previous process stability had led to a lack of process monitoring; change in density was not visible; change in particulates was visible

2. There should be an improvement in written handovers which had missed key pieces of information (for example the open bypass)

3. There should be an improvement in the management, use and control of incinerator inhibits (and inhibits more generally)

4. A greater focus should be placed on the resolution of process control defects which lead to ‘work-arounds’ being adopted (for example Level Control Valves; Sight Glasses) which echo Texas City event.

5. The anticipated impacts and focus on the flow rate increase trial led to a mind-set that created unconscious bias and led to a failure to fully evaluate the operational data.

6. There should be a review of the maintenance strategy for Safety Instrumented Functions (SIF). The strategy was inappropriate due to a historical stretch in maintenance activity.

7. There should be a review and improvement of non-SIF & SIF maintenance instructions to ensure that they are adequate.

8. Control room access should be better managed. The incident was impacted by distractions and a high level of activity associated with audit and trials. Recovery from the incident was also impacted because of these distractions.

Appendix 1 Details of Barrier Failures

What happened

Level gauge was in bypass as control valve was non-functional.

Work around solution culturally driven

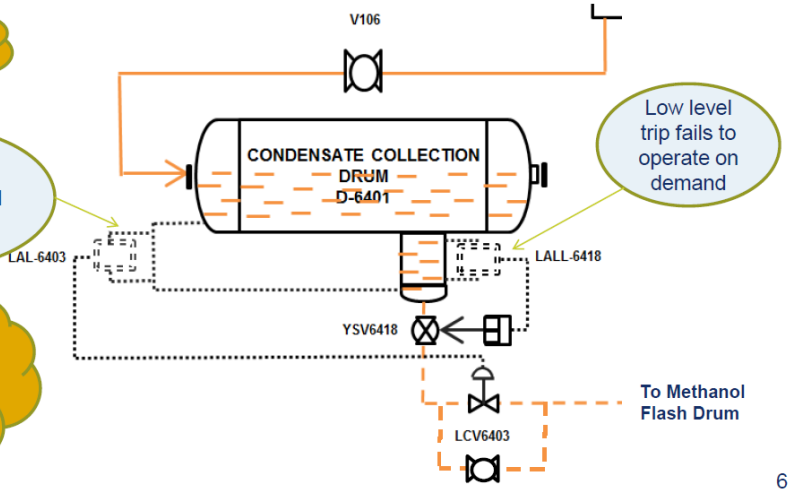
Barrier 1

Low level alarm did not activate (alarm set at 10%)

Barrier 2

Low level trip failed to operate, allowing condensate to leave drum via the open bypass.

Status at shift handover



Failed due to particulates and 14% in S>G

Low level trip fails to operate on demand

Meanwhile CRO is engaged in flow rate increase trial and safety audit…!!

What happened

Barrier 3

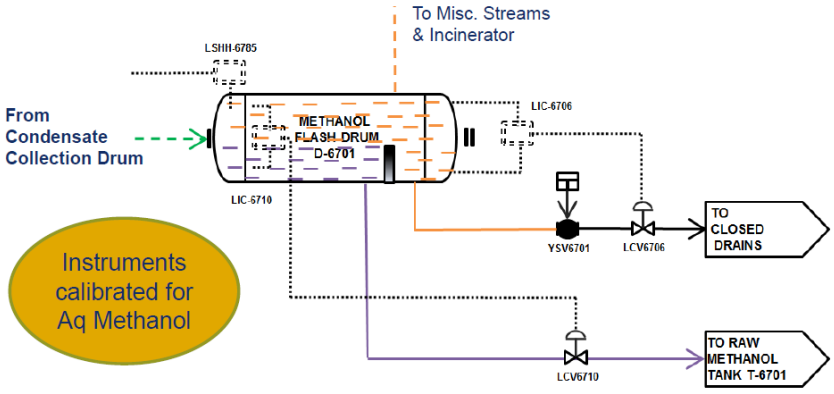
Level control (aqueous side) failed to contain the rising level in the vessel.
High alarm activated at an indicated 85% - trend remained level

Barrier 4

Level control (condensate side) was not in auto control being in manual and control valve was latched closed
High alarm activated, level indicated 75% - trend remained level

Barrier 5

High High level trip failed to operate due to being specified for methanol, not condensate.



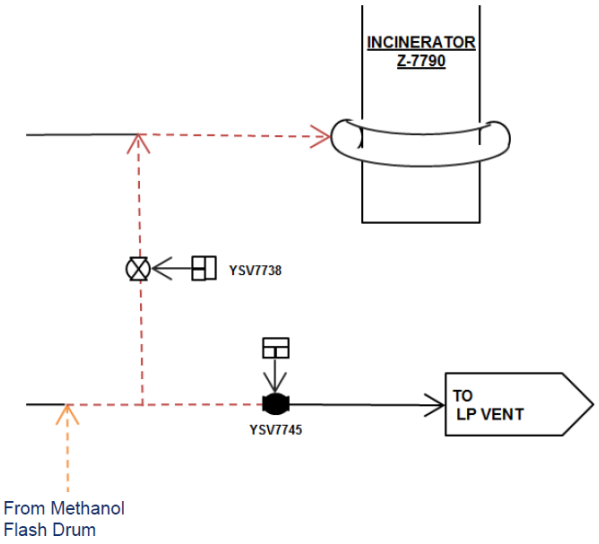
Instruments calibrated for Aq Methanol

What happened

Barrier 6

Isolation valve was manually inhibited on first sign of process upset in the incinerator

Result was that miscellaneous stream was not isolated when incinerator tripped



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The Process Safety Forum has been set up to provide an industry association platform whereby initiatives, best practice, lessons from incidents and process safety strategy can be distilled and shared across sectors, to influence our stakeholders (including the Regulators), and to drive the process safety management agenda. The Process Safety Forum consists of representatives from across industry, refer to the website for details

The website is www.p-s-f.org.uk..