Incident Description

A factory phase start-up occurred during which off-gas from other plant processes was routed to the Steam plant stack. Off-gas consists mainly of carbon dioxide (CO_2) but contains hazardous concentrations of other gases such as hydrogen sulphide (H_2S). On the day of the incident, there was a gas release that triggered the gas alarms at the Steam plant.

Personnel from a different area of responsibility working in a proximate pipe rack (adjacent to the Steam plant), however, remained unaware of the hazard and continued to work, despite an evacuation order having been given at the Steam plant. The execution of the work in the pipe rack was not subject to continuous gas monitoring, as is required under permit to work conditions, when applicable. A service provider employee (spray painter) was later found unconscious in a pipe rack between the Steam and sulphur recovery west plants. Emergency protocol was immediately initiated, and the service provider employee was admitted to the Highveld Mediclinic. On 31 May 2020, the service provider employee passed away due to complications.

Key learnings and control improvement recommendations

For purposes of providing context to the contents below, to be read with the incident description above, the applicable process is explained below.
Process description:

Off-gas from some plant processes (e.g. Rectisol) is routed to the Steam plant stack to be vented to atmosphere at a safe height above personnel through the transport provided by hot gas from the boilers at several hundred degrees centigrade.

Without the presence of hot combustion gases from the boilers to create upward draft in the flue, the off-gas would remain close to ground level, presenting an occupational risk to personnel. The stack in question has 4 internal flues, and it is required that the flue, to which off-gas will be routed is heated by boiler combustion gases before off-gas release through that flue.

Key learnings and control improvement recommendations

Key learnings and control improvement recommendations:

- Continued focus is required on improving the quality of incident investigations (to interrogate the existence, adequacy and efficacy of existing controls) and embedding identified corrective actions and learnings to prevent repeat incidents. This is considered key for improvement of risk management.

- Continued focus on all levels of assurance, specifically management oversight of risk controls (critical controls) and operating procedures to ensure safe execution of tasks.

- Risk assessments should consider the possible impact on adjacent areas. Consider, for example, that pipe racks can easily be affected by adjacent plant emergencies. Owners of plants and pipe racks must consider this as part of their respective risk assessment processes.

- Apply the process hazard analysis (PHA) as a key tool to identify and initiate a process to put controls in place to prevent high risk scenarios occurring. During this process, understanding of the different scenarios that can lead to an emergency (including deviation from established practices and procedures) and how to manage the situation effectively should be explored in detail. Key personnel involvement and thorough analysis of high risks during PHA's must be ensured by management. Knowledge and learnings of previous incidents or near misses should be included in the scenario considerations.

Key learnings and control improvement recommendations

Key learnings and control improvement recommendations:

- Ensure a robust PHA by involving experienced management with extensive knowledge of or experience with the production process and associated risks and conduct the process to ensure that this knowledge is extensively leveraged. Consider aspects broader than equipment and maintenance integrity risks (with due regard to the bowtie), including scenarios of abnormal operation/different line connections, routing of off-gas under cold(er) flue conditions with associated verification of the adequacy of existing operating procedures to mitigate the risks identified in the PHA.

- The PHA peer review should test the robustness of the process in achieving the objectives particularly to assess whether all potential causes of loss of containment had been identified in the PHA.

- Consider the applicable process safety management procedure regulating safe operating procedures that requires a plant to develop and implement written SOP's providing clear instructions for safe operation of any process. Management must ensure that SOP's are in place as required by the process safety management procedure.

Key learnings and control improvement recommendations

Key learnings and control improvement recommendations:

- Enable implementation through regularly updated learner manuals (in this case a stack learner manual).
- Consider the plant retraining process is a critical activity. Strengthen implementation of and adherence to the SOP's by ensuring appropriate/regular line management, supervisor and operator refresher training on plant operating procedures in accordance with the requirements in the process safety procedure on training. The retraining not only ensures plant personnel to be trained on the most recent plant training material, but also assists plant management to ensure that training material and procedures are kept up to date.
- Ensure all new line managers undergo a formal onboarding-program when appointed.
- Ensure that a management of change (MOC) process is conducted when process changes are made, for example when removing process monitoring equipment and ensure that this is updated to be aligned with information in a corresponding learner manual.
- When plant alarms are triggered, it should be treated as a real and immediate emergency. It should not be left to the discretion of individuals on how serious the emergency is, and if an area emergency declaration (including for adjacent areas) is necessary. A clear and agreed process must be in place regarding testing and maintenance of gas alarms and to ensure audibility. Ensure that there is clarity regarding the responsibility to initiate corrective action on deviations.