Vent to Roof Rainwater Occlusion and Management

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Abstract *— Safety relief devices in a pharmaceutical manufacturing start-up were found to be occluded by rainwater. The number of times these vent lines were found to be occluded varied greatly and depended on weather conditions in the area. After analyzing all the available options, it was found that shifting the responsibility of maintaining these vent lines free of occlusion from the maintenance team to the operations team would decrease completely the chance of using these skids with occluded safety relief devices.*

Key Terms *— pharmaceutical manufacturing, process safety, pressure relief device, engineering design.*

INTRODUCTION

As part of a vaccine manufacturing facility start-up, different processing tanks/skids were designed and installed, as shown in Figure 1. Two of the processing suites in the building are a purification room and a solvent charging room. During processing, these tanks contain hazardous chemicals like ethanol and isopropyl alcohol. In case of a safety incident, it is preferable for the safety relief devices on these skids to vent to the roof instead of venting inside the room, like in other processing suites.

Figure 1
Purification skid [1]

Since these safety relief devices vent to the roof, the issue that operations management was facing was that rainwater was observed in the sight glass of these skids, meaning the vent lines were occluded with rainwater. Figure 2 illustrates a standard sight glass that is attached to a vent line to show the contents inside this line. Since rainwater level can vary depending on weather conditions, if the sight glass at any point was filled with rainwater and a safety incident occurred, there was a great possibility that the safety relief device for the skid would not operate as it was intended to. There was not easy way to drain the rainwater that was going into the sight glass because it was a closed end. There was also not a procedure in place to look at these sight glass regularly or to check if the sight glass was clear and free of any water, other than a preventative maintenance (PM) that the maintenance team scheduled on these skids for every three months. Since the amount of rainwater that can get into these vent lines can vary on the weather, going by the preventative maintenance alone was deemed to not be enough to prevent these safety relief devices from getting occluded.

Figure 2
Sight glass [2]

The main objective of this project was to eliminate the risk of failure of safety relief devices because of vent-to-roof occlusion in a vaccine manufacturing facility. To accomplish this, different options to monitor and drain vent to roof lines based on rainwater level were assessed.

LITERATURE REVIEW

Safety relief devices are installed to avoid safety accidents in case of any system failure or human error. They are designed and installed in any enclosed system to open during abnormal conditions to avoid the vessel or closed system from over pressurizing. These devices have several reasons as to why they are needed in these types of systems. They are designed to protect the equipment, the plant, the environment, and human life [3].

When talking about safety relief devices there are multiple things that must be carefully thought of to avoid any complications. One of these considerations is the set pressure that the relief device is set to be activated. Another consideration would be if more than one safety device is necessary, this would all depend on the criticality of the system [4].

There are numerous relief systems available, some of the ones that can be seen more commonly in the pharmaceutical manufacturing industry are pressure relief valves and rupture discs [5]. It does not matter what type of safety device a system has but it is critical that it is designed correctly and is being properly maintained by the area owner. A relief system can even be an open vent but "an open vent that serves as a relief device should be registered for regular inspection to be assured that it is not obstructed. It is also obvious that any open vent designed for overpressure protection should not be designed so that it can be easily blinded" [6].

It is important to highlight an accident that occurred in Litvinov, Czech Republic where the pressure relief system failed along with other contributing factors and caused the released of propylene vapor resulting in an explosion and fire [7]. This incident highlights the importance of safety relief devices and how proper maintenance of them can prevent property damages, environmental contamination, injuries and/or death.

METHODOLOGY

Two different options were assessed along with the cost and time it would take to implement each option. The first option was to assess the possibility of re-designing or modifying the vent line in a way that it will prohibit rainwater from entering the line without changing its desired use. The second option was to add a part to each vent line that will enable personnel to manually drain the sight glass if it gets visually filled with rainwater. To be able to decide which option was more viable for operations, research into vendors and parts were conducted and quotes were obtained. After assessing these options, the next step was to implement the change selected and ensure that the optimal path forward worked and can be maintained.

RESULTS

The two options mentioned before were considered by the team in charge of this project, composed of a representative from the maintenance, operations, technical operations, and quality department. After going over the downtime of re-designing the vent lines along with the costs and effort needed, the first option was rejected by the team, and it was decided that maintaining these lines free of occlusion as part of day-to-day operations was the optimal solution to ensuring all operations are performed safely.

The safety relief devices that vent to the roof were observed from Monday through Friday for two weeks for the team to understand how frequently these occlusions occurred. The data gathered can be found in Table 1. It was found that the instances where these lines got occluded with rainwater varied greatly with weather conditions in the area. The first day of inspection, the lines were filled with water and the maintenance team scheduled the work to drain these lines. Thursday

of week 1, three days after the lines were drained, the vent lines were observed to be occluded with rainwater again. During that following weekend, the maintenance team scheduled for the lines to be drained. During week 2, the vent lines were observed to be free of occlusion. After December 15th, the manufacturing plant started their winter shutdown, and all employees went away on vacation. During the first week of January, once the shutdown was over and the team went back to work, these vent lines were occluded. This proved that these lines were getting occluded frequently and the preventative maintenance on the skids scheduled for every three months was not enough to ensure the safety relief devices will work as intended in any unforeseen circumstance.

Table 1
Two-week inspection of vent-to-roof lines

	Week 1 (Dec 4-Dec 8)	Week 2 (Dec 11-Dec 15)
Mon	Occlusion found	No occlusion
Tues	No occlusion	No occlusion
Wed	No occlusion	No occlusion
Thur	Occlusion found	No occlusion
Fri	Occlusion found	No occlusion

To be able to manage the maintenance of these lines, the sight glasses on the vent lines where the water was observed were changed from being a closed end to an open end that closed with an endcap and a tri-clamp. This way, during processing activities, a technician is instructed by a standard operating procedure to look at the sight glass for occlusion and, if occlusion is found, to drain according to the procedure.

To continue with the optimal solution selected, a quote was requested to one of the company's external vendors for the endcaps and tri-clamps needed. The work for these sight glass to be changed from closed end to an open end was scheduled and completed during the first week of January. After the work was completed, the standard operating procedures applicable for all skids that vent to the roof were requested and pulled for updates. All necessary updates were made to ensure instructions were added for the draining of these lines and the procedures were reviewed and approved by operations and quality representatives.

CONCLUSION

The change that was made by the team to these processing skids will ensure the effective management of these occlusions. By managing the draining of these vent lines before any processing activity begins will ensure that in case of any unforeseen circumstances these safety relief devices will work as designed and personnel, equipment, and facility will not be affected. The goal of all manufacturing facilities is to be able to work with a safety-first mindset and avoid any reportable injury caused at work. The goal is to ensure all employees can go back to their families with their health intact. Finding a possible unsafe situation and fixing it before an incident can occur is a great win and a good catch for the team and it is something that is promoted every day, for employees to tap in and speak up about unsafe situations they witness in their work areas.

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