MARY KAY O'CONNOR PROCESS SAFETY CENTER
TEXAS A&M ENGINEERING EXPERIMENT STATION

20th Annual International Symposium
October 24-26, 2017 • College Station, Texas

Validation of safeguard protection from potential building explosion

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1.0 Introduction

It is common practice to take a full safeguard credit during Hazop or LOPA studies for gas detection in buildings together with using either emergency building ventilation or operator response to an alarm. The basis of this assumption comes from the successful mitigation of a consequence with the use of combustible gas detector alarm and operator response as a safeguard. In most cases these events are from small leaks which do not result in a rapid accumulation of flammable gases. Typically the gas detection alarms only warn operations and/or initiate an increase in air flow from the building ventilation system but do not automatically shut down and isolate the process. The normal design is to follow API RP 505 for enclosed areas, with standard building ventilation rates at approximately 6 air volume changes per hour to prevent accumulation of flammables as a result of fugitive emission in the building and an emergency 12 air volume changes per hour when gas detection is reaching 10 to 25% of lower explosion limit (LEL). It is not common practice to use gas detection to directly trip the operating plant because of the concern with nuisance gas detection alarms interrupting production.

At Suncor, as a result of improvements made to our process safety management program, a facility siting consequence analysis study was undertaken which identified H2 compressor buildings as some of a site's top process safety risks. The specific operation includes high pressure H2 reciprocating compressors which feed a number of hydrotreater plants. The common practice in its northern climate was to house these compressor stations in heated buildings for ease of maintainability. Although there are inherently safer design options available to reduce congestion with an open structure design, it can be cost prohibited to modify existing structures and often modifications do not reduce the congestion of the original piping design.

The initial phase of the evaluation was based on the consequence of a significant leak in the compressor buildings resulting in filling the majority of them prior to ignition. The resulting blasts circles encroached on occupied buildings and it was determined that a treatment plan was needed to mitigate this risk. As part of the treatment plan, further quantitative risk analysis using a detailed dispersion model and computational fluid dynamics (CFD) to model air circulation in building was performed. This model was able to represent the normal air flow in the building while taking into consideration equipment congestion and the function of the building ridge vent to predict flammable gas accumulations and concentrations.

This paper will cover the process taken for identifying risks at our site, evaluating the effectiveness of existing safeguards and finally implementation of additional safeguards and testing requirements to mitigate the risks. Details of a final true test of this process are also shared based on an actual release event which was effectively mitigated by the new safeguard controls.