

Ensure Relief System Adequacy of Ethylene plants for SAFER operations

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Introduction : Pressure Relief System

Pressure relief is a dedicated system to protect life and property from the dangers of overpressure

- Overpressure is result of an imbalance or disruption of the normal flows of material and energy that causes the material or energy, or both, to build up in the system
- Overpressure is prevented by relieving fluid from an over-pressurized equipment or equipment system
- The pressure relief system comprises of physical relief device & the associated downstream disposal system (KO drum, Flare) to safely handle the material relieved

Layers of Protection

Relief system is the last line of preventive defense against catastrophic failure of equipment



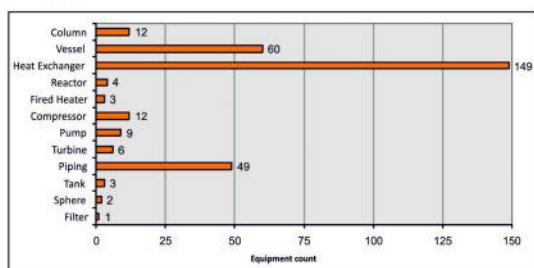
The physical relief devices should be capable of operating at all times

Ethylene Plant - Relief System Adequacy

- Ethylene plants go through continuous modifications to enhance capacity or efficiency, often without due attention being given to the existing relief safety system, which increases the risks of major accidents.
- Relief system is the last line of preventive defence against equipment failure and subsequent damage to the plant assets and surrounding environment.
- This is a case study of an Ethylene plant, which explains the need for on-going and rigorous revalidation of relief system, to ensure safer plant operation as well as economical design/upgrades reducing the capital expenditure.

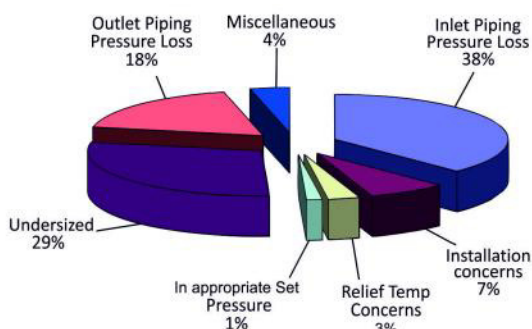
Case Example – Ethylene Plant

Equipment based PRA performed for Ethylene plant involving variety of equipment



Case Example – Ethylene Plant

PRA study reported relief device inadequacy concerns for 78% of total equipment systems



When is Pressure Relief Required?

In processing plants, overpressure can happen due to various individual or combined triggers

- Blocked outlet
- Control valve failure
- Exposure to fire
- Utility failure
- Exchanger Tube rupture
- Thermal expansion
- Operational errors, etc...

The overpressure can lead to a major incident if the pressure relief system is not in place/not functional/not adequate

Industry Incident – Example 1

Unforeseen incidents have caused damage to assets and surrounding environment

Refinery in Texas (USA)
March 23, 2005

Vessel overfilling, vapor cloud through atmospheric blowdown system

Fifteen fatalities, 170 injured



Key findings: Various pressure relief system related citations (inadequate relief system, inadequate header design info, equipment not protected..)

Industry Incident – Example 2

Unforeseen incidents have caused damage to assets and surrounding environment

Processing Plant ,
Louisiana (USA)
March 4, 1998

Catastrophic
Vessel over-pressurization

Four fatalities



Key findings: Third stage separator was not equipped with any pressure relief device as mandated by API specification

Case Example – Ethylene Plant

Revalidation of pressure relief system needed for Ethylene plant due to changes in feed and capacity

- A detailed pressure relief analysis for Ethylene plant was performed in safety analysis environment, integrated within latest versions of Aspen Hysys software.
- API overpressure scenarios were documented within Hysys & sized with rigorous sizing methods in the software
- The safety analysis environment enabled efficient analysis and eliminates the manual data transfer & the errors associated with it
- The relief sizing results were effectively utilized for mitigation and flare analysis

Case Example – Ethylene Plant

PRA performed based on respective applicable standards and codes

APPLICABLE STANDARDS AND CODES		
Equipment	Design	Relief analysis
Pressure Vessels	ASME sec VIII	ASME sec VIII, API STD 520, API STD 521
Piping System	ASME B31.3	API STD 520, API STD 521
Low Pressure Storage Tanks	API STD 620, API STD 650, API 12	API 2000, NFPA
Power Boilers	ASME sec I	ASME sec I
Fired Heaters	API STD 530, API STD 560	API STD 520, API STD 521
Exchanger Tubular	API STD 660, API STD 661, TEMA	API STD 520, API STD 521

Conclusion

Process safety (relief system) information is key element of Process Safety Management

- Ensure all equipment within the facility are protected for various overpressure scenarios per standards and codes
- Commercially various tools are available to document overpressure scenarios, estimate relief rates, relief device sizing and flare header sizing
- Effectively utilize tools in the design of relief systems to ensure safer plant operation and economical design at the same time reducing the capital expenditure
- Robust Management of Change (MOC) process must be in place to keep relief systems documentation updated

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