RELIEF & FLARE SYSTEMS

PCE205
Process and Chemical Engineering

TRAINIT ACADEMY

COURSE TITLE

RELIEF & FLARE SYSTEMS

COURSE DATE/VENUE

10 – 14 May 2021

London, UK

COURSE REFERENCE

PCE205

COURSE DURATION

05 Days

DISCIPLINE

Process and Chemical Engineering

COURSE INTRODUCTION

Pressure-Relief Systems

Pressure-relief systems control vapors and liquids that are released by pressure-relieving devices and blow-downs. Pressure relief is an automatic, planned release when operating pressure reaches a predetermined level. Blowdown normally refers to the intentional release of material, such as blowdowns from process unit startups, furnace blowdowns, shutdowns, and emergencies. Vapor depressuring is the rapid removal of vapors from pressure vessels in case of fire. This may be accomplished by the use of a rupture disc, usually set at a higher pressure than the relief valve.

Safety Relief Valve Operations

Safety relief valves, used for air, steam, and gas as well as for vapor and liquid, allow the valve to open in proportion to the increase in pressure over the normal operating pressure. Safety valves designed primarily to release high volumes of steam usually pop open to full capacity. The overpressure needed to open liquid-relief valves where large-volume

discharge is not required increases as the valve lifts due to increased spring resistance. Pilot-operated safety relief valves, with up to six times the capacity of normal relief valves, are used where tighter sealing and larger volume discharges are required. Nonvolatile liquids are usually pumped to oil-water separation and recovery systems, and volatile liquids are sent to units operating at a lower pressure.

Flare Systems

A typical closed pressure release and flare system includes relief valves and lines from process units for collection of discharges, knockout drums to separate vapors and liquids, seals, and/or purge gas for flashback protection, and a flare and igniter system which combusts vapors when discharging directly to the atmosphere is not permitted. Steam may be injected into the flare tip to reduce visible smoke.

Safety Considerations

Liquids should not be discharged directly to a vapor disposal system. Flare knockout drums and flares need to be large enough to handle emergency blowdowns. Drums should be provided with relief in the event of over pressure. Pressure relief valves must be provided where the potential exists for overpressure in refinery processes due to the following causes: Loss of cooling water, which may greatly reduce pressure in condensers and increase the pressure in the process unit. Loss of reflux volume, which may cause a pressure drop in condensers and a pressure rise in distillation towers because the quantity of reflux affects the volume of vapors leaving the distillation tower. Rapid vaporization and pressure increase from injection of a lower boiling-point liquid including water into a process vessel operating at higher temperatures. Expansion of vapor and resultant over-pressure due to overheated process steam, malfunctioning heaters, or fire.Failure of automatic controls, closed outlets, heat exchanger failure, etc.Internal explosion, chemical reaction, thermal expansion, or accumulated gases. Maintenance is important because valves are required to function properly. The most common operating problems are listed below.

- Failure to open at set pressure, because of plugging of the valve inlet or outlet, or because corrosion prevents proper operation of the disc holder and guides.

- Failure to reseat after popping open due to fouling, corrosion, or deposits on the seat or moving parts, or because solids in the gas stream have cut the valve disc.
- Chattering and premature opening, because operating pressure is too close to the set point.

Liquid knockout facilities are examined and appropriate system requirements identified to prevent liquid carryover to the flare. Liquid disposal methods and the appropriate target levels for maximum carryover drop size are presented. The effects of liquid carryover on various flare types are considered.
Seal pot systems, often used in flare staging, are considered and alternative methods of providing and disposing of the seal water are compared. The uses and advantages of seal pots are reviewed.

Systems for flare gas recovery are examined and types of compressor are compared. The need for elevated flare stack purging is considered and alternative approaches using fuel and inert gases are compared. The economics and recommended sizing of the flare gas recovery system are studied via an extended group exercise.
At each stage of the course, recommendations regarding essential maintenance and repair of the components of the flare system will be developed. Throughout the course the relevant contents of established specifications for flare systems, such as API 520 and API 521, will be developed and related to the balance of the course content.

COURSE OBJECTIVE

Upon the successful completion of this course, each participant will be able to:-

- Understand the typical arrangement of a refinery and an offshore flare system
- Know how the air requirements for combustion are calculated and provided
- Understand the staging arrangements of flare systems and how this staging is achieved
- Recognize the various types of elevated flare tip and understand how they operate to achieve the necessary performance

- Be aware of the effects of radiation, noise and emissions on personnel and adjacent equipment
- Understand the need for and the methods of achieving adequate liquid knockout in flare systems
- know how seal pots work and understand the options for seal water systems
- Be aware of the use of compressors in flare gas recovery systems and understand the potential economic savings which such a system can offer
- Understand the maintenance and repair needs of an efficient flare system
- Be aware of the recommendations of standard flare system specifications such as API 520/521

COURSE AUDIENCE

- Operations personnel who are involved in the use of the flare and/or who rely upon the flare system to safely dispose of unwanted releases
- Design engineers who are involved in the design, modification or repair of the flare system
- Maintenance personnel who are involved in or responsible for the routine maintenance of the flare system
- Safety engineers who are involved in the continuing assessment of the flare system as a safe means of disposal
- Environmental engineers concerned with emissions and the effect of noise and radiation on personnel.

COURSE CONTENT

Day One:

Function of a Flare System

- Equipment and vessel relief valves and the need for a disposal system
- What do we want from our disposal system?

Components of a Flare System

- Collection main, liquid knockout, back pressure control and disposal

- Group exercise: Develop a performance specification for the total flare system
- Requirements of each item for satisfactory performance Introduction to Combustion of Gas Mixtures
- Typical components, heat of combustion, air demand and combustion
- Products ,Total flare load, total heat and flue gas emission

Day Two:

What do we get out of the flare?

- Possible emissions from the flare system : Radiated heat, smoke, particulates, downwindpollutants, un-burnthydrocarbons, noise
- Possible steps to minimize environmental impact
- Dangers to personnel and limits on emissions

Types of Flare

- Ground and Elevated flares – Construction and Operation
- Combination to form an integrated disposal system
- Staging to achieve back pressure control
- Group exercise: Develop a staging policy for an integrated flare system

Day Three:

Elevated Flare Types

- Burn pits, pipe flares, steam injected and air-blown, sonic flares – performance and typical application
- Radiation, noise, emissions and utility requirements
- Constraints on flare height and types of tower
- Group Risk Assessment – Minimum flare height for safe operation
- Ignition and flame monitoring systems
- Smoke and emissions monitoring
- Radiated heat and sterile area requirements

Day Four:

Liquid Knockout

- Knockout pots – types and typical construction
- Vertical vs. horizontal – advantages and disadvantages

- Target sizes for maximum droplet size
- Disposal of Liquids
- Seal Pot Systems
- Back Pressure control as a prelude to flare gas recovery
- Seal Water systems to maintain the seal
- Minimum purge rates on elevated flare stacks not in use to prevent oxygen ingress

Flare System Maintenance

- Crucial role of the flare system for safe operation
- What can we do between shutdowns?
- Group exercise – How can we make our flare system more easily maintainable while the process is on stream?

Day Five:

Flare Gas Recovery

- System Requirements – equipment arrangement
- Types of compressor
- Methods of capacity control to ensure safe operation
- Group Exercise
- Review of the economics of alternative capacities of
- Flare gas recovery system to identify the optimum solution

COURSE CERTIFICATE

TRAINIT ACADEMY will award an internationally recognized certificate(s) for each delegate on completion of training.

COURSE FEES

$6,150 per Delegate. This rate includes participant's manual, Hand-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

COURSE METHODOLOGY

The training course will be highly participatory and the course leader will present, guide and facilitate learning, using a range of methods including formal presentation, discussions, sector-specific case studies and exercises. Above all, the course leader will

make extensive use of real-life case examples in which he has been personally involved. You will also be encouraged to raise your own questions and to share in the development of the right answers using your own analysis and experiences. Tests of multiple-choice type will be made available on daily basis to examine the effectiveness of delivering the course.

- 30% Lectures
- 30% Workshops and work presentation
- 20% Case studies & Practical Exercises
- 10% Role Play
- 10% Videos, Software or Simulators (as applicable) & General Discussions