KLM Technology Group

Solutions, Standards and Software

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KLM Technology Group
Practical Engineering Solutions

Based in USA since 1995,

KLM is a technical consultancy group, providing specialized services and equipment to improve process plant operational efficiency, profitability and safety.

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Practical Engineering Solutions

We believe that Every Person in Every Organization should have specific training and knowledge in these Safety Areas;

1. Hazard Identification

2. Pressure Relief Valve and Flaring System Design and Operation

3. Guide Lines for Safe Commissioning of Process Units

KLM and our key partners can provide regional or localized "in house" on site training for operations, maintenance or engineering personnel in specialized areas, as well as training videos.

Training

Today we are discussing

Introduction To Process Flares

We also offer,

1. Advanced Process Flares Design, Operation and Troubleshooting with Case Studies

2. Advanced Relief Valve Design, Operation and Troubleshooting with Case Studies

3. Advanced Flaring System Design, Operation and Troubleshooting with Case Studies

As well as other process units and equipment groups. They can be found on the website.

www.klmtechgroup.com/training

3. Advanced Flaring System Design, Operation and Troubleshooting with Case Studies

A. Relief Valve
B. Flare Header
C. Flare Knock Out Pot
D. Process Flare

There is a chapter for each of these topics in the Kolmetz Handbook of Process Equipment Design.

Advance Course Syllabus

- Flare System Introduction
- Design Factors & Design Consideration
- Selection methods of a flare system used in the typical process industries
- Sizing theory and formulations for the flare systems design
- Case Studies

Flare

- The flare is the fourth line of defence in the safe emergency release system in a refinery or chemical plant.

- It is used to dispose of purged and wasted products from refineries, unrecoverable gases emerging with oil from oil wells, vented gases from blast furnaces, unused gases from coke ovens, and gaseous water from chemical industries.

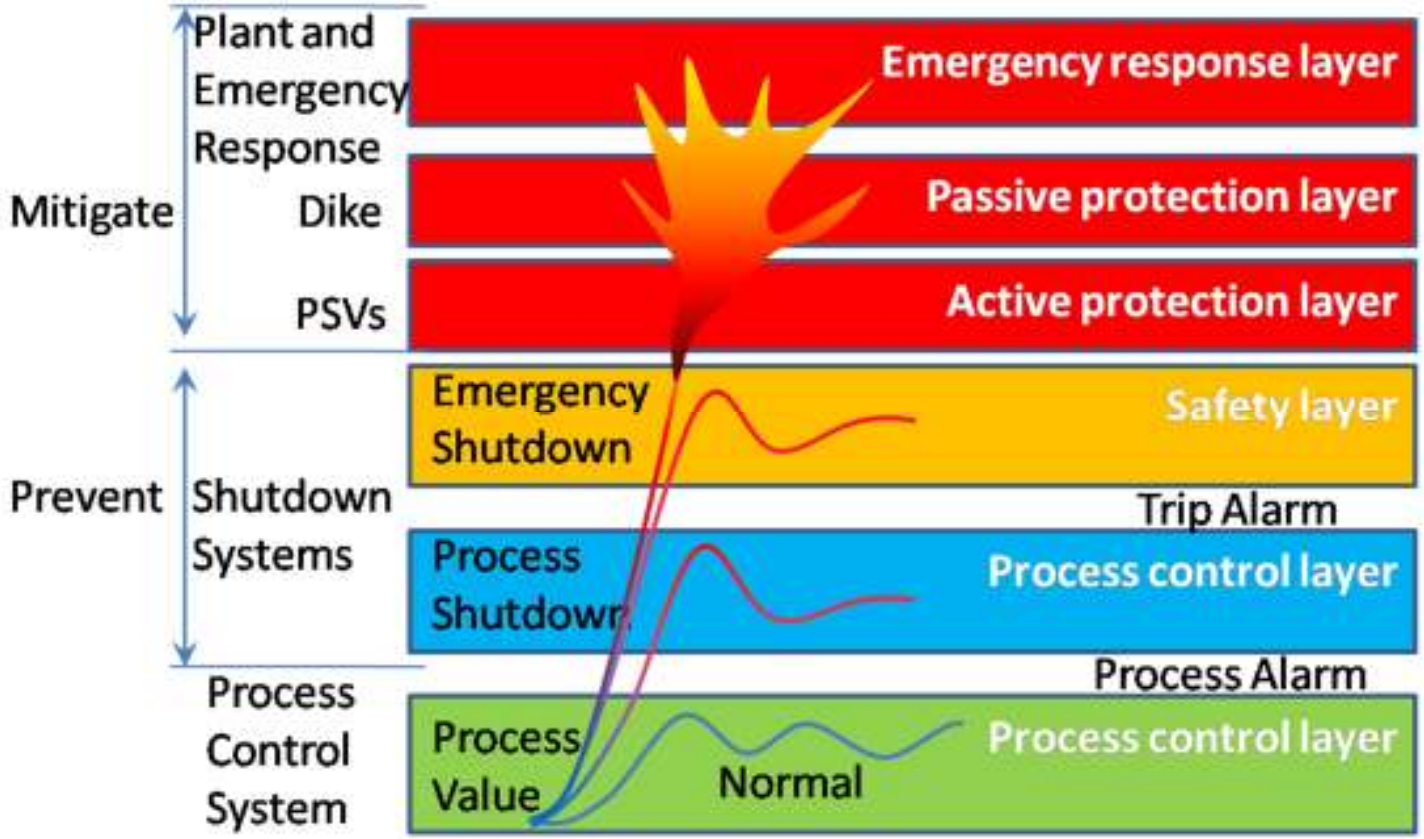
Flare

Current plant designs use a “layer of protection” approach.

1. **Process Design**
2. **Alarms and Operator Intervention**
3. **Emergency Shutdown Systems (ESD and SIL)**
4. **Pressure Safety Valves and Flares**
5. **Physical Dikes**
6. **Emergency Response**

Flare

Current designs use a layer of protection approach.



Flare

- Flares are also used for burning waste gases from sewage digesters process, coal gasification, rocket engine testing, nuclear power plants with sodium, water heat exchangers, heavy water plants, and ammonia fertilizer plants.

- The flare provides a means of safe disposal of the vapor streams from its facilities, by burning them under controlled conditions such that adjacent equipment or personnel are not exposed to hazards, and at the same time obeying the environmental regulation of pollution control and public relations requirements.

Flare

- The chemical process used for flaring is a high temperature oxidation reaction to burn combustible components, mostly hydrocarbons, or waste gases from industrial operations.

- In combustion, the gaseous hydrocarbon (natural gas, propane, ethylene, propylene, butadiene, butane and etc) reacts with atmospheric oxygen to form carbon dioxide (CO_2) and water.

Flare

- Several by products formed will be carbon monoxide, hydrogen and others dependent upon what is being burned.

- Efficiency of hydrocarbon conversion is generally over 98%.

Flare Type

- In industrial, the most common utilized flare systems are elevated flares and ground flares.

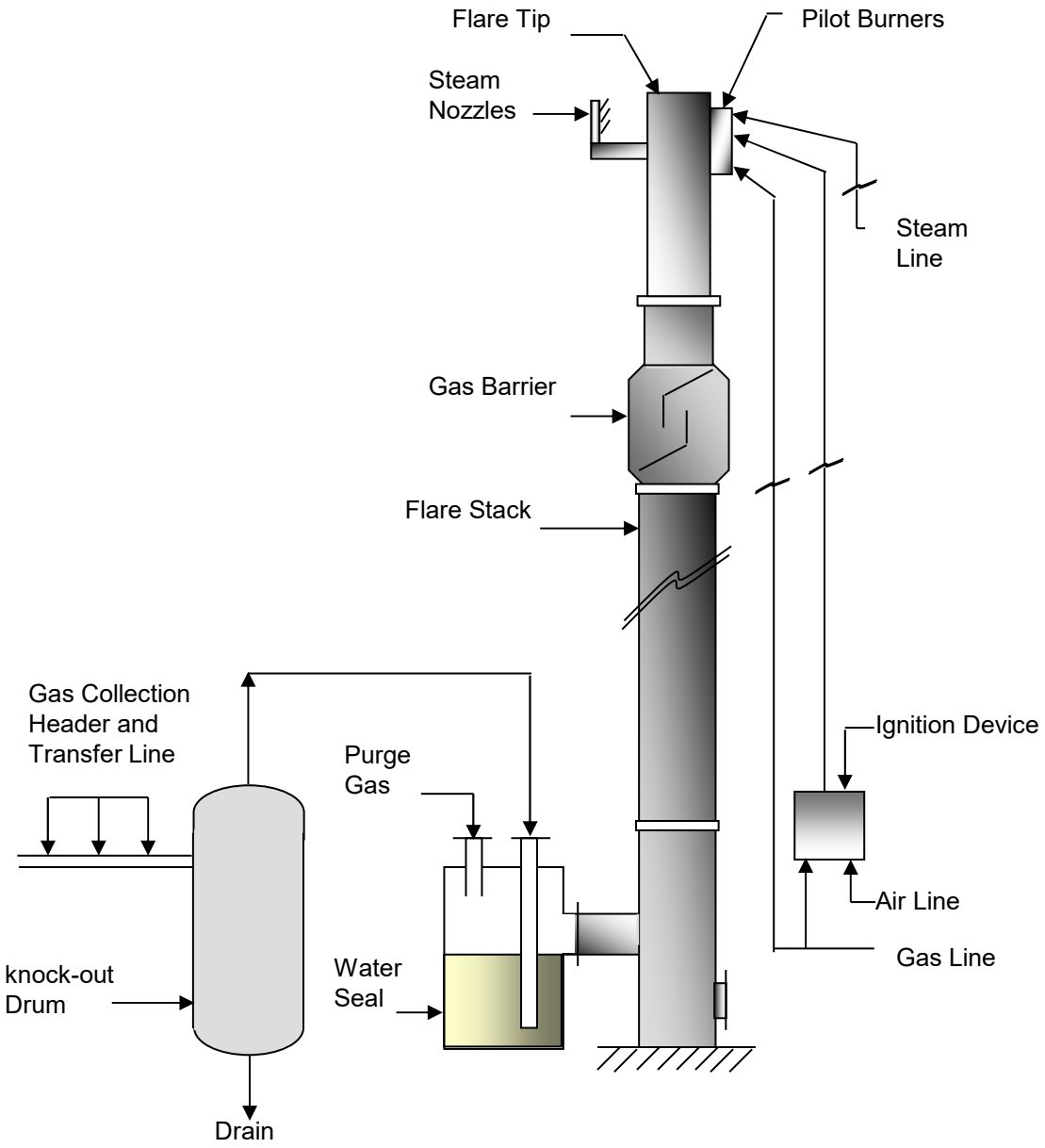
- Selection of the type of flare is influenced by several factors, such as
  - availability of space;
  - the characteristics of the flare gas (composition, quantity and pressure);
  - economics;
  - investment and operating costs;
  - public relations and regulation.

Flare System

Typical flare system consists of:

1. **gas collection header and piping for collecting gases from processing units,**
2. **a knockout drum to remove and store condensable and entrained liquids,**
3. **a proprietary seal, water seal, or purge gas supply to prevent flash-back**
4. **a single or multiple burner unit and a flare stack,**
5. **gas pilots and an ignitor to ignite the mixture of waste gas and air and**
6. **a provision for external momentum force (steam injection or forced air) for smokeless flaring.**

Elevated Flare- Steam Assisted



Elevated Flare

- Is the most commonly used type in refineries and chemical plants.
- Have larger capacities than ground flares.
- The waste gas stream is fed through a stack from 32ft (10m) to over 320ft (100m) tall and is combusted at the tip of the stack.
- The elevated flare, can be steam assisted, air assisted or non-assisted.

Elevated Flare

- Elevated can utilize steam injection / air injection to made smokeless burning and with low luminosity up to about 20% of maximum flaring load.

- The disadvantage of steam injection / air injection is it introduces a source of noise and cause noise pollution.

- If adequately elevated, this type of flare has the best dispersion characteristics for malodorous and toxic combustion products.

- Capital costs are relatively high, and an appreciable plant area may be rendered unavailable for plant equipment, because of radiant heat considerations.

Ground Flare

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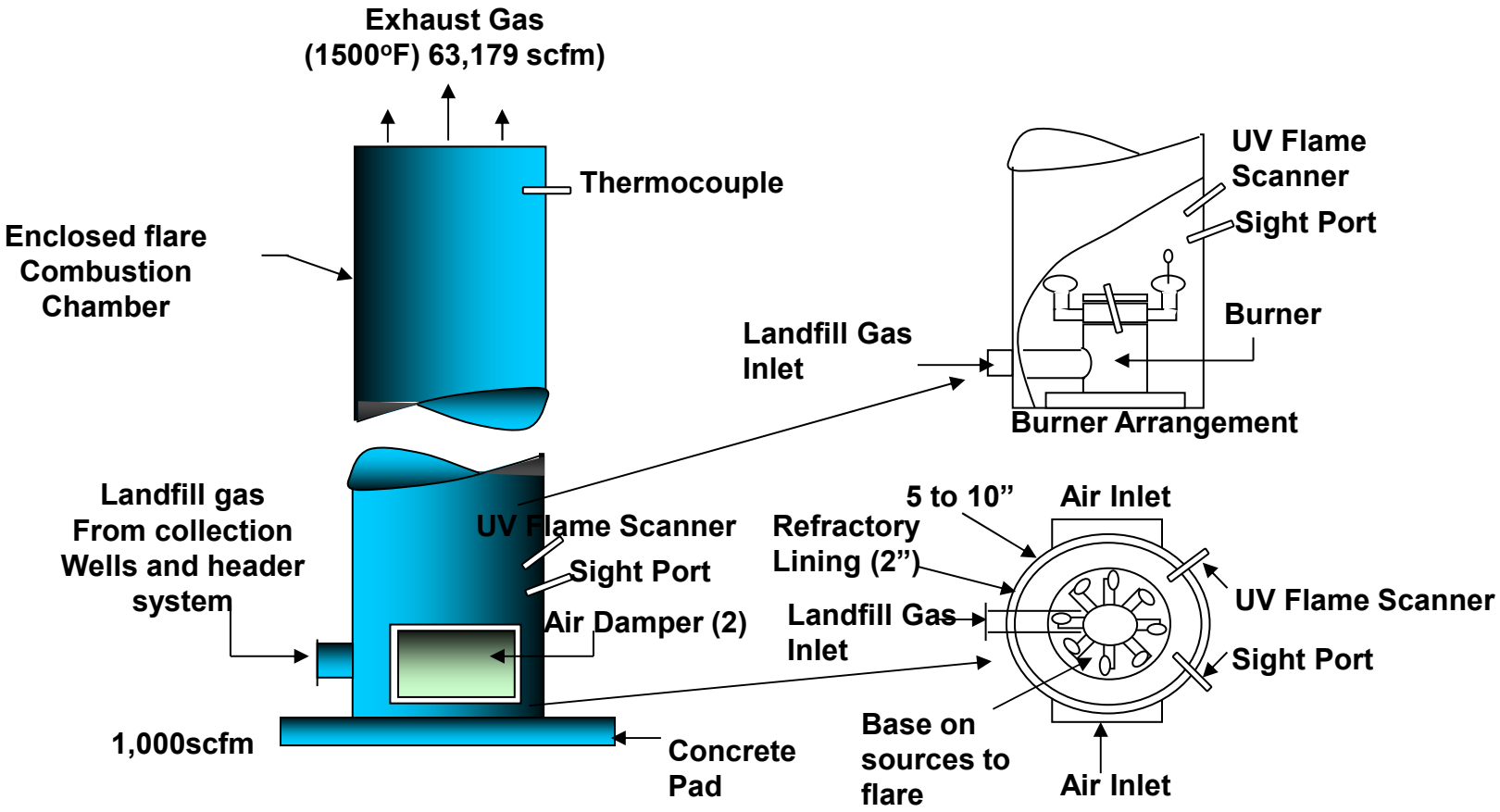

Typical Enclosed Ground Flare

Ground Flare

- A ground flare is where the combustion takes place at ground level.

- It varies in complexity, and may consist either of conventional flare burners discharging horizontally with no enclosure or of multiple burners in refractory-lined steel enclosures.

- The type, which has been used almost exclusively, is the multijet flare (enclosed type).

Ground Flare

- Compare to elevated flare, ground flare can achieved smokeless operation as well, but with essentially no noise or luminosity problems, provided that the design gas rate to the flare is not exceeded.

- However, it have poor dispersion of combustion product because it stack is near to ground, this may result in severe air pollution or hazard if the combustion products are toxic or in the event of flame-out.

- Capital, operating and maintenance requirements cost are high.

Design Factors

- **Is very important for the flare designer to understand several factors which can affect his flaring system design, the major factors influencing flare system design are:**

  - **Flow rate;**
  - **Gas composition;**
  - **Gas temperature;**
  - **Gas pressure available;**

  Depends on the gas stream released

  - **Utility costs and availability;**
  - **Safety requirements;**
  - **Environmental requirements;**
  - **Social requirements.**

  Related to regulatory mandates

Design Consideration

- When design the flare system, several important parameters have to be consider, there are
  - flare head / tip design,
  - flare exit velocity,
  - VOC heating value, and
  - the flame is assisted by steam or air

Design Consideration

- **The design should be base on consideration bellow as well,**

1. Flare Spacing, Location, and Height

- **radiant heat**
- **burning liquid fall out**
- **pollution limitations**

Safety Requirements

- The main safety concern for the flaring system is thermal radiation issues.

- The allowable radiation from the flare flame to a given point is frequently specified based on the owner's safety practices by following the safety regulation.

- Special consideration should be given to radiation limits for flares located close to the plant boundary.

Environmental Requirements

- The primary environmental requirement is the need for smokeless burning to protect the environment from pollution, it is necessary to inject an assist medium such as steam in order to achieve smokeless burning.

- Unfortunately the injection of the steam and the turbulence created by the mixing of steam to solve the smoke burning problem causes the emission of sound.

- The sound level at inside and outside the plant boundary is often limited by regulation.

Social Requirements

- Although the plant operation has complied with the environmental regulation, sometime the outcome resulting flare system may not meet the expectations of the plant's neighbors.

- Example: A smokeless flame may meet the regulatory requirements, but the neighbours may complaint due to light and noise from flare system.

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KLM Core Business

Training

Kolmetz Handbook of Process Equipment Design

Process Optimization Studies

HAZOP Facilitation

Engineering Support

An Engineering Resource

KLM Technology Group Practical Engineering Guidelines for Processing Plant Solutions	KLM Technology Group SOLUTIONS, STANDARDS AND SOFTWARE www.klmtechgroup.com	Page : 1 of 58 Rev: 04 Rev 01 Jan 2007 Rev 02 May 2012 Rev 03 Sept 2012 Rev 04 Nov 2013
KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	Kolmetz Handbook of Process Equipment Design Piping Hydraulics Fluid Flow Line Sizing and Material Selection (ENGINEERING DESIGN GUIDELINE)	Co Author Rev 01 Ling Ai Li Rev 02 K Kolmetz Rev 03 Aprilia Jaya Rev 04 Aprilia Jaya Editor / Author Karl Kolmetz

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Training

KLM has a group of very senior associates and trainers that can assist your team. We teach at regional seminars, at your facility and in Webinars.

We have a very large group of courses that we offer on the website;

www.klmtechgroup.com\training

Thank You