# Flaring in the Petroleum Industry

## What is flaring?

Flaring is used to consume waste gases in a safe and reliable manner through combustion in an open flame. In the petroleum industry, flaring occurs during well testing and production operations. It is routinely used to dispose of flammable gases that are either unusable or uneconomical to recover. Flaring can also be used to depressurize gas processing equipment during routine maintenance and emergencies.

## What is venting?

Venting is the release of gases directly to the atmosphere either intentionally to get rid of unwanted waste gases or unintentionally through equipment leaks and failures. Venting can occur from the following:

- oil and natural gas production and transport,
- oil and gas well drilling and servicing,
- accidental equipment failures,
- equipment leaks from bleed valves, fuel gas operated pneumatic equipment, and imperfect seals, and
- Surface casing vents, blows, and gas migration.

## Where does flaring occur in the petroleum industry?

Gas flaring can take place during various petroleum industry operations. In the upstream petroleum sector, waste gases are flared at gas plants, natural gas batteries, pipelines, and during well tests.

Gas processing plants produce market ready natural gas by removing water, sands, hydrogen sulphide, carbon dioxide, and natural gas liquids from the natural gas mixture produced at the wellhead. Waste gases, including hydrogen sulphide-rich gases, and gases burned during emergencies are flared at these facilities.

Natural gas batteries collect and process gas collected from one or more wells. Flaring at these facilities and pipelines can occur during emergencies, equipment upsets or failures, and maintenance operations. Flares are located at wells, dehydrators, compressors, and gathering pipelines.

Well tests are used to determine the economic value, pressure, flow, and composition of the petroleum products within a reservoir. The waste gas that is produced during well testing is disposed of in flares, unless the testing occurs "in line", where the test gas is directed to a processing plant through nearby pipelines. The average flare from well testing burns for 2.5 days.

## Flaring Efficiency

## What is the efficiency of a gas flare?

The efficiency of a flare is a measure of how effective that flare is in converting all of the carbon in the fuel to $C0_2$. Previous studies have indicated that flares have highly variable efficiencies, on the order of 62-99%.

## What affects the efficiency of gas flares?

Gas flares are operated in uncontrolled conditions. The tips of the flare can be exposed to wind, humidity, and temperature variations that reduce efficiency and increase variability. Other factors that can adversely affect the efficiency of gas flares are the composition of the waste gas stream entering the flare, which varies from site to site, and improper flaring practices that cause unsteady combustion conditions.

## Flaring Concerns

### What are the products of flaring?

In theory, the complete combustion of pure hydrocarbons produces only water and carbon dioxide. Low efficiency flares do not completely combust all of the fuel gas and unburned hydrocarbons and carbon monoxide are emitted from the flare with the carbon dioxide. If the waste fuel entering the flare contains impurities and/or liquid droplets, many other by-products can also be emitted from the flare stack. These products include:

- particulate matter,
- volatile organic compounds (VOCs) such as benzene, toluene and xylene,
- polycyclic aromatic hydrocarbons (PAH), and
- small quantities of sulphur compounds such as carbon disulphide (CS2) and carbonyl sulphide (COS).

### What are the concerns with gas flaring?

Flaring is both a concern to the public and a government priority because of the potential health risks and environmental concerns associated with the activity and also because it wastes a valuable non-renewable resource. Furthermore, the noise, odor, and smoke produced from flaring activities can interfere with nearby residents and their enjoyment of the outdoors.

Flaring is an environmental concern with regards to global warming and acid deposition. Emissions of carbon dioxide and unburned natural gas from flares contribute to the greenhouse gas effect and global warming.

Acid deposition is the combination of nitrogen, sulphur oxides (released from flaring), and water in the atmosphere to form acids that are deposited either directly or with precipitation. The acids can fall near flaring activities or be carried for hundreds or thousands kilometers before being deposited. Acid deposition can lead to lakes and streams becoming acidified and it is harmful to the environment.

### What is the global impact of gas flaring?

The United Nations Environment Program's (UNEP) Information Unit on Climate Change (IUCC) states that global emissions of $C0_2$ from gas flaring peaked during the mid-1970s and has been declining since. Gas that previously was flared is now increasingly captured for use as a fuel due to improvements in technology, higher gas prices and demand. Global emissions of carbon dioxide for 1989 from gas flaring were estimated at 202 million tonnes, or approximately 0.8 percent of anthropogenic (man made) carbon dioxide emissions. The majority of emissions due to gas flaring are from the oil-producing countries of Africa and Asia, as well as in the former USSR

## Flaring Alternatives

### Why isn't waste gas incinerated rather than flared?

If operated properly, incinerators generally have more efficient combustion than flares because combustion occurs in an enclosed chamber, away from the effects of wind and weather, and the air to

fuel ratio required for complete combustion can be precisely controlled. Although they can be highly efficient, incinerators are mainly used at sour gas processing plants and not for routine waste gas flaring. The reasons for this are that incinerators are more costly to install, they require more frequent maintenance and monitoring, and they are difficult to install and operate in remote locations.

### What are some alternatives to flaring?

As mentioned above, incineration can potentially be a more efficient method to dispose of waste gases, although a more costly and sophisticated one. Research is currently being conducted to make incinerators more adaptable and portable, thus they may become a more viable option in the future.

Other alternatives to flaring include:

- conserving the waste gas for processing at natural gas facilities,
- re-injecting the waste gas underground to maintain reservoir pressure during production,
- connecting well test gases to existing pipeline systems for in-line well testing,
- using the gas to power micro-turbine generators for electricity production,
- ensuring flare systems are properly designed, constructed and maintained through guidelines, codes of practice, or regulation.