Risktopics

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Is your flare ready for hurricane season?

Introduction

If your chemical plant, petrochemical plant or refinery is located in a region prone to tropical storms, you should have a hurricane or typhoon emergency action plan in place. Hurricane or typhoon-prone regions exist around the world, and they are located in the tropical zones north and south of the equator.

Hurricanes can expose a facility to wind speeds up to 240 km/h (150 mph) or more. Rainfall rates can reach 127 mm per hour (5 inches per hour) or more. These conditions will challenge both the wind resistance and the flame stability of flares used to incinerate process waste gases.

This Risktopic addresses the impact of hurricanes upon flares used to incinerate process waste gases. The document considers this topic from a property insurance perspective. There are likely additional concerns related to this topic beyond this property conservation focus.

Discussion

As a hurricane approaches, there are few chemical plants, petrochemical plants and refineries that will actually have the time to reach a hydrocarbon-free state. As such, a primary hurricane response objective should be to stop all processes and isolate products to tanks, columns and other vessels. This idle state should reduce any expected need to rely upon flares for the duration of the hurricane, except for normal venting.

Making the decision to initiate a hurricane plan

Weather satellites provide advance warning of an approaching hurricane, and computer models allow meteorologists to provide its likely path three to five days into the future.

With all of this knowledge, however, there is still much uncertainty whether a hurricane will or will not affect a specific site. This uncertainly may continue until about two days before landfall. Therefore, it is important to understand how much time is actually needed to bring a plant to the intended shutdown state. Action may need to begin before there is certainty that an approaching hurricane will affect your facility.

Flare design

Flares are provided to incinerate gases from pressure relief valves or other process waste gas streams. To help protect personnel and property from the extreme radiant energy produced as gases are incinerated, flares are typically elevated. Flare towers may extend as much as 152 m (500 ft) or more above ground.

API Standard 537, Flare Details for General Refinery and Petrochemical Service, is a recommend practice initially published in 2003. It was the first standard issued to address the mechanical design of flares. While this recommended practice is intended for new installations, it can be applied as a guide for existing flare towers.

Flares, as with any mechanical system, are designed for an intended service life. Structural design should include a corrosion allowance to accommodate the anticipated corrosion rate across the service life along with a suitable factor of safety.

Flare wind resistance

It is understood that flares are frequently required to operate on a continuous basis for extended periods such as 10 years. During this time, flares are exposed to corrosion, mechanical damage and aging. Such wear over time will affect the flare's resistance to loads associated with high winds.

Flares typically have multiple pilot flames to ignite the process waste gases discharging from the stack. At any point in time, some of these pilots may be out of service.

Figure 1. Flare stack
Photo source: John Zink Company, LLC

Flare burner stability

API Standard 537 does address the stability of flare pilots and main flames when exposed to high winds and heavy rains; however, Zurich is not aware of any actual intention of the standard to design flares to perform in an effective and stable manner during hurricane events.

Flare burner management

A flare will be equipped with pilot burners arranged to reliably ignite the main fuel gas stream. A pilot's design will determine how resistant it is to extinguishment by high winds or quenching by heavy rain.

Pilots may be designed for manual ignition or automatic ignition. Automatic ignition systems may also be available to allow pilot reignition attempts immediately following a high-wind event.

If required, the main waste gas stream to a flare is maintained with a minimum Btu content by the introduction of natural gas. This combustible content allows the main flame to be maintained in service continuously as long as wind and rain conditions permit.

During a high-wind and heavy-rain event, it is anticipated that any flare main burner will be exposed to possible extinguishment due to blow-off or quenching.

Systems needed for flare operation

For a flare to operate, there are several systems that need to be available and in service. These can include:

- Electric power provided from an uninterruptible power supply to maintain systems that support the flare

- Pilot logic systems located and protected from physical damage
- Pilot fuel supplies from reliable sources
- Nitrogen, if used, to inert the waste gas header, maintain positive pressure and avoid air infiltration
- Natural gas to provide the minimum combustible content in the waste gas stream and to maintain ignition of the flare pilot system flame
- Compressed air, if used, for pilot ignition
- Steam to cool and protect the flare tip (where needed)

Guidance

Each chemical plant, petrochemical plant or refinery located in a hurricane-prone region should have a comprehensive hurricane emergency action plan in place. This plan should consider the impact of hurricane conditions upon flares.

The hurricane plan

Before hurricane season, be sure that all resources required by the emergency action plan have been identified. In addition, verify that these needed resources are available. This includes personnel, equipment and supplies.

A hurricane plan is of little value if there are no personnel available with the authority to initiate the plan in a timely manner. Once the plan is initiated, all actions that involve bringing the plant to the desired shutdown state should follow careful work plans to help reduce the chance for mistakes that could lead to unintended overpressure conditions during the high-wind event.

Hurricane plan considerations

Resources:	Have the needed staff, materials and implementation time been confirmed?
Availability:	Are the needed resources available at all times during the season?
Authority:	Is a responsible person available to initiate the plan at all times during the season?
Methodical:	Are work plans provided to avoid mistakes in achieving the shutdown state?

Shutdown objective

The shutdown objective should be an idle state that is not expected to generate overpressure conditions or waste gases. In other words, the objective is to avoid the generation of waste gases directed to a flare that is possibly out of service due to the hurricane conditions.

Consultation with flare designer

It is recommended that the flare designer be consulted for guidance regarding periodic inspection needs and performance expectations of a flare.

- Inspections
  - Wind resistance. Has the wind load resistance of the flare been reduced by the affects of normal use?
  - Corrosion allowance. Has actual corrosion approached or exceeded original design allowances?
  - Guy wires. Are guy wires inspected and maintained on a suitable frequency?

At a minimum, flare inspections should occur during each scheduled or unscheduled flare outage. Consultation with the flare manufacturer is recommended several months in advance of a planned outage so

preparations for repair or replacement of the flare equipment, if needed, can be arranged. Actual inspections should be conducted in conjunction with the flare vendor.

- Performance
  - Pilot and main flames. Are they designed to resist the affects of high winds and heavy rain?
  - Pilot and main flames. Can they be restored to service promptly following a high-wind event?
  - Support systems needed for flare operation. Are they protected from the affects of a high-wind event?
  - Operator training. Are flare operators adequately trained in the proper operation of the flare, flare pilots and pilot ignition system?

It would be ideal to have flares in full service during a hurricane to incinerate any unexpected release of waste gas; however, it is considered unrealistic to expect every flare pilot and main waste gas burner to remain lit when exposed to extreme winds and heavy rain.

All systems that support flare operation should be evaluated to verify they will remain in reliable service during and after a hurricane so that they will not expose the facility to unintended risk and will not compromise the restoration of a flare to normal service following a hurricane.

The wind design of towers should be based upon the latest edition of appropriate wind design guidelines such as ASCE 7 Minimum Design Loads for Buildings and Other Structures in the United States or other regional/local design codes as appropriate.

Preparing pilots for extreme weather

As discussed earlier, flares typically have multiple pilot flames to ignite the process waste gases discharging from the stack. At any point in time, some pilots may be out of service. When high-wind events are expected, efforts should be made to have all pilots ignited and in service.

Restoring flares to service following a hurricane

Immediately following a hurricane, assess the condition of a flare once it is safe to do so. Expedite any needed repairs.

If needed, restore the flare to normal service as quickly as possible. Before lighting flare pilots, ensure the flare system is adequately purged to removed air that may have entered the flare stack and header. Maintain the plant in the shutdown mode until flares are available.

Where a manual pilot ignition system is in use, consider upgrading to an automatic pilot ignition system and advanced flame detection technologies. Once again, consult with the flare designer for guidance on such upgrades.

Figure 2. WindProof™ flare pilot
Photo source: John Zink Company, LLC

Conclusion

Hurricanes can expose chemical plants, petrochemical plants and refineries to extreme winds and heavy rains. These conditions will challenge both the wind resistance and the flame stability of flares used to incinerate waste gases.

As flares are not guaranteed to remain in service during hurricane events, a primary objective of the hurricane emergency action plan should be bringing the facility to an idle state where the potential for waste gas generation is significantly reduced.

An additional objective should be expediting the restoration of flares to service before the plant leaves the shutdown mode.

References

1. API 537. Flare Details for General Refinery and Petrochemical Service. Rosslyn, VA: American Petroleum Institute, 2008.
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3. ASCE/SEI 7-05. Minimum Design Loads for Buildings and Other Structures. American Society of Civil Engineers, 2005.
4. Smith, Gwen, Applications Specialist, John Zink Company, LLC. Discussion of June 14, 2010.

Related Risktopics

- Guide to hurricane emergency action plans
- Hurricane-prone wind guide: Risk management handbook for properties in hurricane-prone regions

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