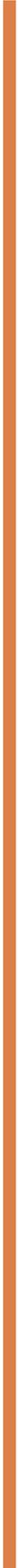




AERIAL FLARE SURVEY & INSPECTION



Ref:
Activity: Aerial Inspection of Flare Stack and Tip
Site:
For:
Combustion Engineer:
UAV Pilot:
Flight Date:



FIGURE 01 – Guy Wire Supported Steam-Assisted Flare System

EXECUTIVE SUMMARY

The flare tip and pilot assemblies should be replaced as soon as possible. Steam tube failure has occurred, which has resulted in loss of smokeless capacity and venting of flare gas to the atmosphere. Only (1) flare pilot is working, and the flare tip itself shows no sign of combustion. The flare system is operating at close to zero combustion efficiency. Steam has condensed in the piping, which resulted in a large release of water when steam rate was increased. This “water hammer” is detrimental to the life of the flare tip.

ACTIONS

1. Replace the flare tip and pilots as soon as possible.
2. Ensure flame front generator fuel gas is shut off unless actively igniting flare pilots.
3. Improve the quality of steam sent to the flare tip and consider heat tracing steam lines.
4. Ensure flare system is being operated at the minimum flare gas and steam purge rates per manufacturer requirements.

Please contact Zeeco with any further discussion of any item in this report. Zeeco is happy to facilitate a discussion and provide further recommendations for operation or maintenance.



FLARE TIP CONDITION SUMMARY

Heavy discoloration and significant heat deformation of the muffler assembly presents evidence of significant internal flame stabilization. The internal flame stabilization has damaged the flare tip muffler, steam tube penetrations, and steam tubes. Smokeless performance of the flare tip is degraded. The flare tip is compromised and should be replaced at the next maintenance opportunity. The flare tip is not fit for long term continued service. Continue to monitor the flare tip closely for further degradation.

There is also potential for release of unburned hydrocarbons from the lower portion of the flare tip. This release from the lower section of the flare tip could also ignite causing rapid catastrophic damage. If a large, prolonged flaring event takes place with a compromised flare tip barrel, the top of the flare stack and derrick structure could be damaged from flame impingement.

PILOTS CONDITION SUMMARY

The flare pilots present in fair and operable condition. Confirm pilots meeting the requirement of API 537 are installed with the replacement flare tip. Consider the installation of a retractable thermocouple system in the future to allow for the replacement and maintenance of the thermocouple elements from grade while the flare remains online and in operation.

IGNITION SYSTEM SUMMARY

The ignition system presents in fair and operable condition. The Flame Front Generator (FFG) piping does not present any signs of significant burn back or mis-operation. Gauges, regulators and instruments are in good condition. The pilot fuel gas setting is confirmed correct per the design parameter at 15 PSIG [1 barg]. Replace indication lamps as noted. Confirm the facility carries spare consumable and recommended components such as transformers, spark plugs, sight glasses, gauges, valve and regulator rebuild kits.

FLARE OPERATIONS SUMMARY

During the inspection, the flare was operated correctly. The steam flow ratios to flare gas were correct. This operation will offer the greatest longevity of the flare tip as well as the greatest hydrocarbon destruction efficiency. There is evidence from the damage to the flare a steam failure event has occurred or some "capping" of the flare tip due to the over application of steam injection has occurred. When steam flow rates were increased, significant quantities of condensed steam were expelled from the flare tip. This large mass of water will create a water hammer effect anytime the steam is quickly required to increase, such as an upset condition, and can cause damage to steam injection components and piping. In order, to realize the greatest longevity ensure the steam is properly trapped and lines are properly insulated, and heat traced.

FLARE STACK SUMMARY

The flare stack presents in good condition. Utility piping, conduit, brackets are all in good condition without anomaly. The stack coating and paint system presents in good condition. Guy wires, foundations, and lugs present in good visual condition. Guy wires should be regularly maintained and inspected.

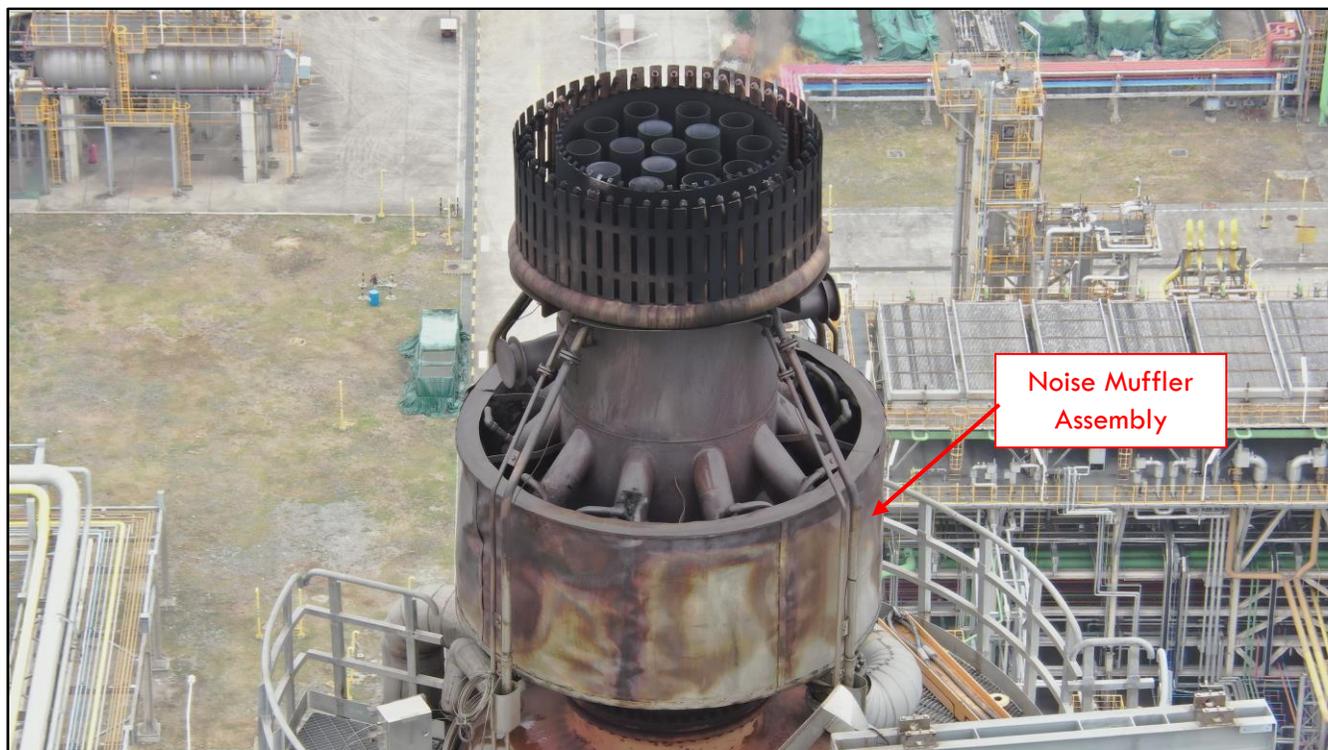


FIGURE 02 – Flare tip assembly should be replaced at the next opportunity. Significant internal burning has occurred in the flare tip noise muffler, smokeless capacity has been compromised, only (1) pilot is functioning, and no combust is occurring.



FIGURE 03 – Perimeter steam injection appears to be in fair condition. No deformation is detected on the upper flare tip barrel. Soot deposits are observed on the windshield assembly.

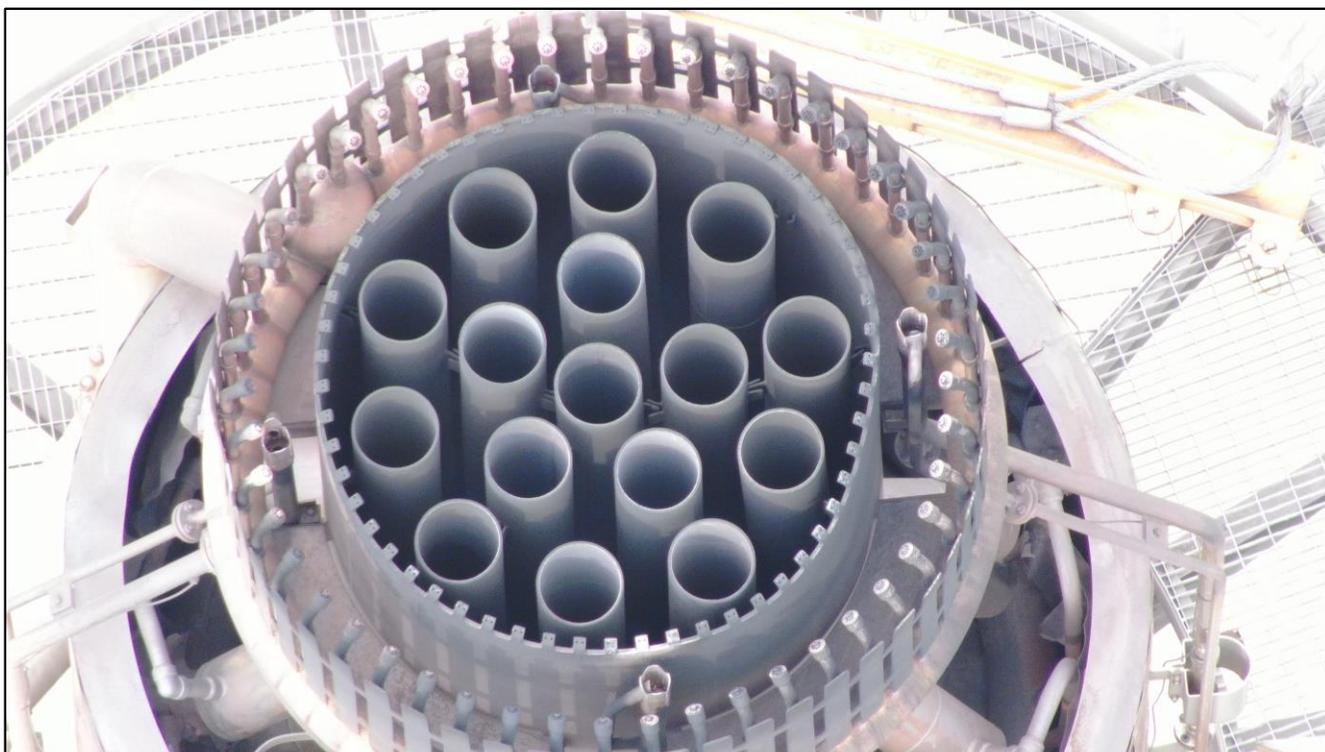


FIGURE 04 – Perimeter steam injectors, steam tubes, flame tabs and pilots all appear to be mechanically intact from an overhead view. The flare tip exit does not appear to have experienced significant heat or combustion, which is an indication that venting has been occurring.



FIGURE 05 – A hole was detected in the steam tubes. Smokeless capacity has been compromised.

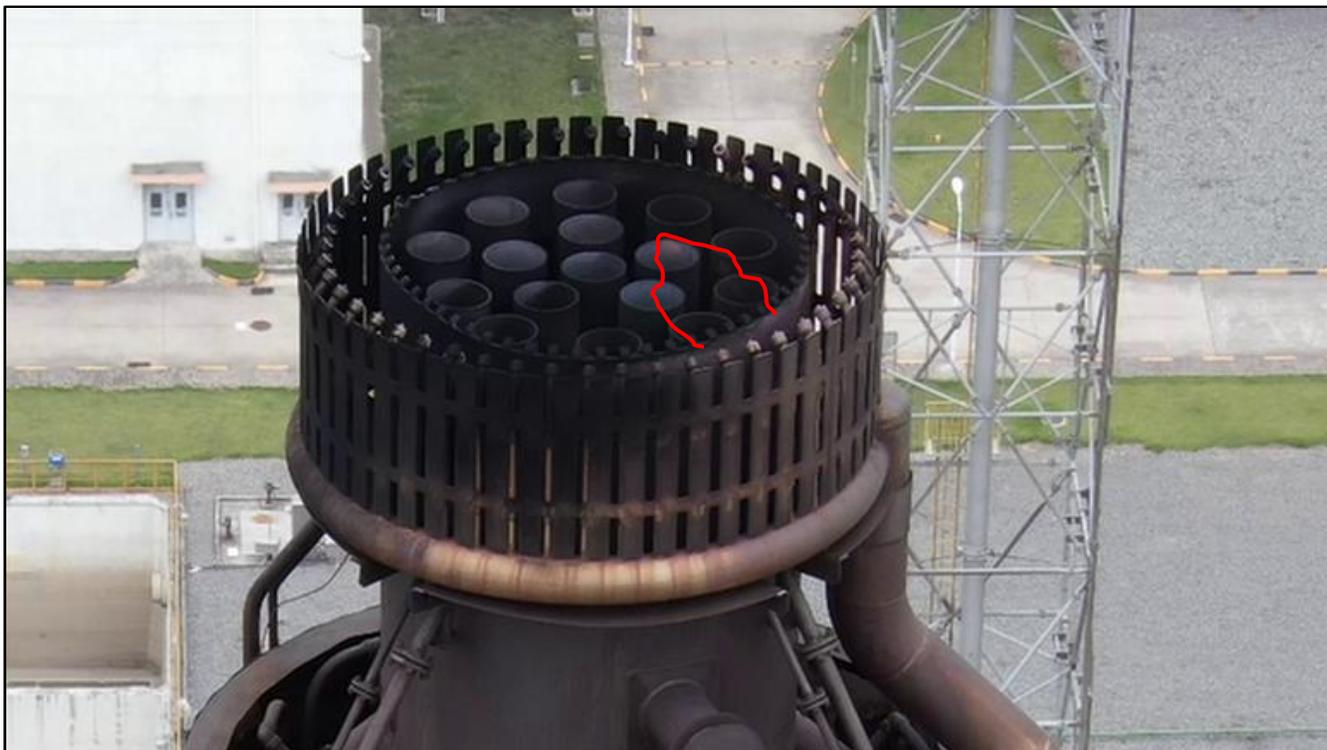


FIGURE 06 – Only (1) pilot appears to be working, and a long yellow flame is seen exiting from the pilot tip. Pilot flame should be blue in color and contained within the pilot hood. This operation indicates pilot instability. Ensure Flame Front Generator (FFG) fuel gas and air is shut off unless pilot ignition is occurring.



FIGURE 07 – Infrared imagery does not detect any combustion coming from the flare tip. Only (1) pilot shows combustion. Remaining pilots are not lit, and any gas running to the flare system is venting.



FIGURE 08 – Internal burning has occurred in the noise muffler due to flashback in the steam tubes. This indicates breakage in steam tubing, and a lack of continuous steam flow. Continuous flow is required through steam injection components to provide cooling and prevent flashback. Ensure continuous cooling steam is run to the flare tip per manufacturer recommendations.

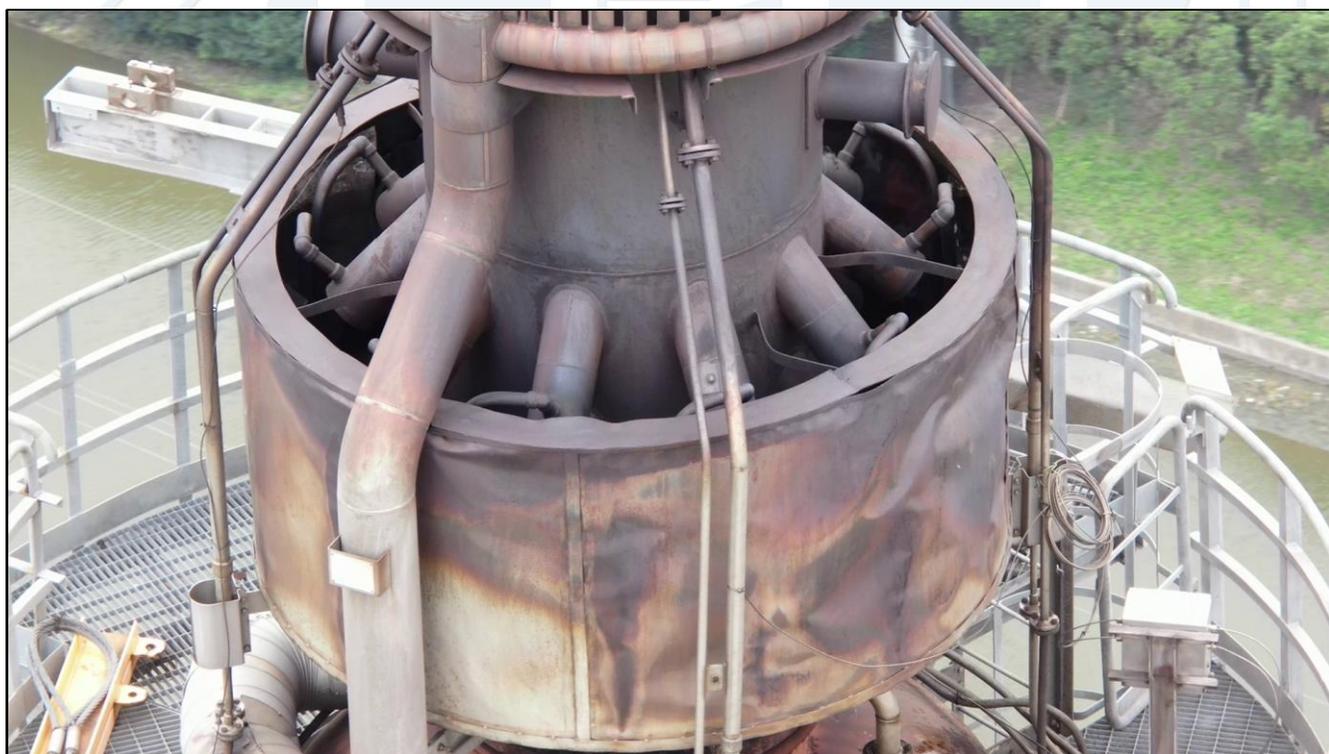


FIGURE 09 – Thermocouples are directly exposed in the heat affected zone. Zeeco recommends running thermocouples in tubing or conduit to prevent failure.



FIGURE 10 – When steam rate was increased, a significant amount of water exited the steam injectors. Zeeco recommends improving steam quality to improve smokeless performance and extend the lifetime of steam injection components. Another option to consider is heat tracing steam risers.



FIGURE 11 – Steam condensation exiting the noise muffler; this indicates breakage in steam tubes. Smokeless capacity has been compromised, and there is the potential for tubes to break apart and fall into the molecular seal assembly.