Refinery Sector Rule (RSR) Update, Part 2: Monitoring Flare NHV

A Defined Destination with Numerous Paths

Compliance guidelines for Refinery Sector Rule (RSR) monitoring are set forth in great detail in the Rule. In fact, there are enough details in various locations to create abundant opportunities for clarification and double checks, ensuring that all points are covered.

There are also plenty of different paths sites are taking to achieve compliance. This variety is based largely on factors such as:

- What systems are already in place for Ja or CD compliance
- Needs for integration with NHV control
- H2 speciation credits and costs
- Calibration standards requirements and engineering

It's also common for there to be new discoveries along the way—but it all starts with a base understanding of the Rule and some of its many facets. Leverage the information below to inform your journey to compliance.

Addressing NHV Monitoring

Key monitoring related sections of the Rule outline applicable Analyzer technology options for compliance—along with guidelines for ongoing operational management to assure performance is within specification. Also included in the performance guidelines are options for calibration, which have generated creation of a new Flare Class Btu standards.

The principle objective of the RSR is to improve destruction of Hazardous Air Pollutants (HAPs) in the flare combustion zone. This includes the primary requirement to maintain >270 BTU Net Heating Value in the flare combustion zone (NHV_{cz}) during consecutive 15-minute time blocks. The NHV_{cz} calculation requires monitoring of flare tip steam or air assist flow in order to subtract inert gas impacts from the measured flare gas stream. The associated requirement limiting the duration of flare smoking events further complicates decision making on Analyzer technologies and how to achieve the best balance of information speed and detail for various streams.

Analyzer Options

The recently published EPA ALT-124 notes that the Rule outlines the use of Calorimeters "or equipment that determines the concentration of individual components in the vent gas […] such as a gas chromatograph" for flare gas testing. This document notes that all monitoring equipment must meet minimum "accuracy, calibration and quality control requirements." It goes on to add mass spectrometry as an acceptable mode of flare gas testing based on meeting additional provisos outlined in the letter.

Calorimeters provide a direct calculation of Btu NHV as a lump sum value. The measurement

methods can vary depending on the specific analyzer, making some more applicable for use in flare applications than others. This calculation is available on a 'near real time' basis which can provide a valuable tool for steam or air assist and supplemental fuel gas control.

Gas chromatographs (GCs) and mass spectrometers measure flare stream components and then provide Btu NHV as a calculated value. GCs typically provide one to two readings per 15-minute block while mass spec readings are closer to 'real time.' NHV calculations for compliance are based on Table 12 of the Rule. This is further supplemented by language defining calculation of various isomers and unknown components "detected in the analysis that elute after n-pentane." The analysis of various components by GCs and mass specs can help isolate flare gas components to specific process streams and possibly prove useful for trouble shooting.

Table 12 and Hydrogen

Hydrogen is typically assigned an NHV of 274 Btu/scf. Table 12 provides an adjusted allowance of 1212 Btu/scf for hydrogen if it is specifically measured and quantified in a flare stream. This can have significant impacts for streams that are subject to high hydrogen concentrations. Options for capturing this benefit include:

- Addition of a hydrogen measuring device to a calorimeter to provide an adjusted calculation value where calorimeters are used as stand-alone devices;
- Use of the GC reported hydrogen value for calculation where a calorimeter is used with a GC for more real-time control value or as a standalone where a GC is used with other equipment for flare control;
- Use of mass spec for hydrogen and near real-time values in the same analyzer.

Not all streams contain enough hydrogen to warrant speciation.

Performance Specifications and Calibration Gases

Specifications for validating analyzer accuracy and performance along with associated calibration gases are distributed throughout the Rule in the written guidelines, tables 12 and 13, definitions and PS-9.

Calorimeter calibration is principally per "manufacturer's recommendations at a minimum" with a few additional requirements added.

GC and mass spec calibration standards generally call for establishment of a mid-point standard for daily use—accompanied by a low standard at 40-60% of mid and a high standard at 140-160% of mid for quarterly testing. Mid-point, high and low value testing results are all based on individual component responses and not Btu targets which were included in some previous consent decrees.

There are two options for development of calibration gas mixtures. Option A is tied to pre-survey based definition of components—some required and others optional. Option B outlines use of a surrogate gas consisting of C1 through C5 components plus hydrogen.

The Calibration Challenge

“Flare Class” Btu Calibration Standards vary significantly from traditional Btu custody transfer standards with their own set of reference conditions and treatment of isomers and analytes to determine NHV for various components. Attention to detail in formulation of blend compositions and COA reporting can provide positive significant impacts for ongoing operations and compliance management.