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Bridging the RSR Compliance Gap, Part 2

This is the second of a two-part article delving into the reporting challenges of the US Environmental Protection Agency (EPA) 40 CFR Part 63 Subpart CC (MACT CC) requirement via Refinery Sector Rule (RSR). Part one focused on RSR background, challenges, and reporting, specifically highlighting quality control performance standard 9 (PS-9) and its calibration options. This article will focus on US EPA approved alternative 131 (ALT 131). ALT 131 allows for total calibration cylinder net heating value (NHV) as an alternative to the PS-9 requirement that specifies calibration and calibration check individual component agreement.

With with the introduction of RSR and the copious amounts of data now required for compliance, many refineries are turning to a data acquisition system (DAS) to meet regulatory requirements.

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Introduction

In general, RSR forces refineries to make flare minimization a priority while monitoring and reporting when regulated material flows to the flare. The rule also requires refineries to participate in active monitoring with immediate response to maintain minimum efficiencies.

Under RSR, refineries are quadrupling the amount of flare monitoring data collected. RSR also requires refineries to not only report but also retain and make data available for inspection within 24 hours upon request during a stated period. Refineries utilize different tools and processes to monitor, collect and analyze data to meet RSR compliance standards. Historically, refineries have used a distributed control system (DCS), historian and spreadsheet method. In recent years, many refineries have turned to a data acquisition system (DAS) to monitor, capture, and report data.

Data Monitoring Challenges of RSR

Developing a standard flare emissions protocol governance with state and federal transparency is the ultimate goal of RSR. As environmental initiatives driven by public and industry movements have increased, RSR provides a uniform guidance for flare emissions no matter unit type, age and combustion process. With a requirement to achieve flare combustion efficiency of 96.5% and destruction and removal efficiency of 98%, it has become necessary to reevaluate equipment as the need for real-time reporting is no longer a luxury, but a necessity to achieve compliance. The following highlights the top four RSR challenges as determined by process engineers and environmental specialists:

- 15-minute block averages and documentation – when regulated material is being routed to a flare for at least 15 minutes, NHVcz, NHVdil and Vtip must be calculated with documentation of algorithms included.
- Increases in monitoring = increases in quality control requirements – depending upon a refinery's data capture and monitoring method, flow meters, analyzers, temperature and pressure monitors, gas chromatograph and mass spectrometers are utilized. All of these require increased resources to maintain.
- Ready access to compliance parameters for operators – values monitored must be "readily accessible on site for operational control or inspection."[1]
- Requirement to report, retain and make data available – reported data must be stored for five years, and additional contextual data must be collected and stored.

These challenges combined with quality control PS 9, continuous monitoring of flare vent gas emissions, and its calibration methods lead the way to a calibration alternative.

Refinery Sector Rule Alternative 131

Although not explicitly mentioned by 40 CFR Part 63, Subpart CC, the net heating value of flare vent gas can be measured using a process mass spectrometer, provided it is operated

in accordance with Alternative 124[1]. ALT 124 was approved by the US EPA in February 2018 and allows for and confirms the use of a mass spectrometer. Essentially, the US EPA is treating mass spectrometers just like gas chromatographs. In most instances a mass spectrometer can analyze around 30 components in less than 20 seconds, meeting the 15-minute response time rule; the mass spectrometer can also be configured to handle multiple streams. When developing an RSR compliance strategy, it is important to consult all RSR alternatives, the timeline in which they were approved and their applicability.

Additionally, the US EPA passed ALT 131 which allows for alternative calibration procedures to those detailed in PS-9[2]. ALT 131 allows for total calibration cylinder NHV as an alternative to the PS-9 requirement that specifies calibration and calibration check individual component agreement. The single NHV is to be tested daily and allows for only a single point of failure. ALT 131 is a more lenient and error tolerant RSS quality assurance test, alleviating many of the challenges calibration option one and two require to meet compliance (Figure 1). This includes instrument calibration of all gases (hydrogen, methane, ethane, ethylene, propane, propylene, n-butane, iso-butane and butane) for option one or using surrogate calibration gases as required by option two.

Validation Option	Calibration Bottle Value (C_a)	Actual Measured Value (C_m)	$CE = \frac{C_m - C_a}{C_a} \times 100$
Option 1 or 2 NBUTANE	0.9	0.7	22.2 = FAIL
ALT-131 NHV	1086.6	1042.3	4.1 = PASS

Figure 1. Example calculation of RSR option one and two vs ALT 131 and using ALT 131 NHT to illustrate compliance pass/fail.

With 100+ refineries operating in the US and a majority of these facing ageing infrastructure challenges, meeting RSR compliance standards has required equipment and monitoring updates. Many refineries have chosen to implement a DAS for data collection, computation and storage. With a compliance-centric focus and the ability to configure based upon a refinery's exact equipment setup, DAS controllers and software expand compliance reporting capabilities and allow operators and their process engineers to pursue all RSR PS 9 methods without impacting their ability to meet and/or pass current compliance regulations. It is important to note ALT 131 is not always a viable option, based on local regulatory drivers. In many cases local regulations dictate validating option one or option two for pass/fail criteria.

Technology Overview

The ESC Spectrum 8864 Data Controller provides a powerful hardware bridge between StackVision™ software and an emissions monitoring rack. The DAS controller acts as the engine that powers emissions data collection and reporting, ensuring raw data from analyzers become reportable values (Figure 2).

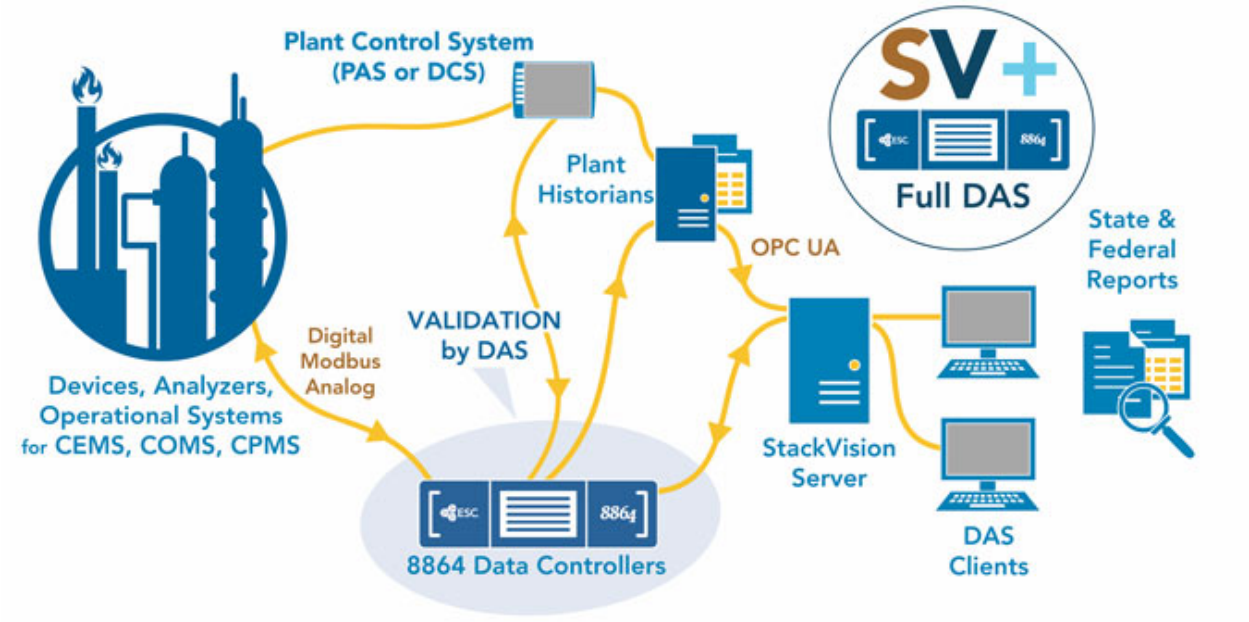

Figure 2. Data acquisition system (DAS) integration used for RSR strategy development including data monitoring, collection and reporting.

The 8864 controller acquires emissions data from analyzers and provides operational data from control systems via digital inputs, analog inputs and Modbus (via Ethernet). It has the ability to output data, flags and commands through these channels, and the controller stores both raw and calculated data. The controller's dual Ethernet interface allows a system to communicate independently and simultaneously with an instrumentation or a CEMS network, as well as software server on the network. Each network port supports multiple sessions of data polling and remote user interaction while the controller continues to collect, compute and store new data.

In some scenarios and for best monitoring results, a refinery will implement a strategy of combining technologies that include all available monitoring options plus ALT 131. In a two-flare refinery scenario, a calorimeter and a GC analyzer can be used together. The system utilizes a single sampling system with two sample streams, one from each flare. The calorimeter provides analysis of the flare gas streams for reporting compliance, while the common gas chromatograph provides compositional analysis for process trouble shooting.

For a refinery with three flares, one solution is to install a single mass spectrometer, utilizing ALT 131. It would have common sampling system with three sample streams, one from each flare. The mass spectrometer provides the ability to switch process streams quickly enough to meet monitoring and reporting requirements[3].

Implementation of either strategy along with the amount of data collected and required to be stored becomes an achievable task when implementing a DAS controller. The controller provides the robustness needed to collect, store and compute while the overall system provides a unified strategy for real-time monitoring. Plus, the ability to meet compliance standards and the need to merge data from multiple operational segments allows for controls, processing and environmental to produce accurate data and reporting.

Case Study and Regulatory Timeline

In January 2018, an ESC refinery customer reached out for guidance regarding how to incorporate the PS-9 requirements outlined in RSR MACT CC. This customer can process a variety of crude oil types with a capacity of up to 135 000 bpd. They had been reviewing compliance possibilities and evaluating which calibration options would be best for operational setup. They were considering either calibration option 1 (11 hydrocarbons plus hydrogen) or calibration option 2 (C1-C5 normal hydrocarbons plus hydrogen). ESC began to evaluate DAS software/hardware options for compliance with both the original RSR PS-9 requirements and the modified (using alternatives) RSR PS-9 requirements. ESC also initiated a DAS implementation project to install an Extrel mass spectrometer on the customer's West flare. ALT 124 approving mass spectrometer use in lieu of a calorimeter or GC for BTU compliance, was expected to receive approval and the customer wanted to implement all compliance passing parameters.

In February 2018, ALT 124 received approval by the US EPA and the customer moved forward with installation of a mass spectrometer in the field. After evaluating their options, the customer elected to demonstrate compliance with RSR validation requirements using calibration option 2 and ordered bottles containing the C1-C5 hydrocarbons plus hydrogen. They also started the process of installing an additional mass spectrometer on its East flare, which did not have an existing GC as it was not required for 40 CFR Part 60 Subpart Ja compliance[4].

It is important to note based upon the strategy used for subpart Ja compliance many refineries were forced to develop an entirely new strategy to meet RSR including additions of necessary monitoring and system equipment to meet pilot flame presence, smokeless flare flames and NHV and flare tip velocity monitoring.

In November 2018, ESC worked to incorporate process data into the ESC 8864 Data Controller for data comparison purposes on both flares (Figure 3). ESC also set up recently developed PS-9 validation sequences and began testing them daily, adhering to the requirements of PS-9 calibration option 2. The mass spectrometer and the customer's existing GC ran in parallel for six months to ensure the readings from the mass spectrometer were satisfactory.

Figure 3. Environmental Systems Corp. (ESC) 8864 Data Controller used to collect emissions from analyzers and operational data from control systems.

In December 2018, ALT 131 received approval from the US EPA. This allowed using the calculated NHV in daily/quarterly validations in lieu of the existing options (1 or 2) for PS-9 compliance for gas chromatographs and mass spectrometers. The customer had been having trouble meeting the stringent pass/fail criteria introduced by calibration option 2, and in some instances required calibration of the mass spectrometers daily to maintain compliance. ESC implemented ALT 131 in parallel to their existing calibration option 2 validations and allowed to operate for three to six months, providing ample data for comparison.

In January 2019, it was determined ALT 131 was a better compliance strategy with repeatable results. The drift/OOC limits on the C1-C5 plus hydrogen were removed but left in the results for diagnostic information. The customer's system was deemed compliant by the operator ahead of the federal 2020 compliance date.

Conclusion

ALT 131 has provided refineries an alternative to meeting RSR compliance through a single NHV tested daily. By implementing this alternative, refineries now have a much cleaner method for reporting and only a single point of failure to evaluate for compliance. A combination of ALT 131 along with the use of a DAS including a controller with ability to store and process multiple streams of data is a necessary path forward to total compliance and overall operational ability to handle the copious amount of data necessary for compliance.

References

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