Refining a Monitoring System
Managing CEMS at a Texas-sized Refinery

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By Lisa Cruz

When state regulators decided to crack down on certain toxic emissions, one Gulf Coast refinery used the rulemaking changes as an opportunity to streamline its operations. With recent rulemaking governing compliance determinations in regards to the emissions of NOx and highly reactive volatile organic compounds (HRVOCs), the Texas Commission on Environmental Quality (TCEQ) required more frequent monitoring, which resulted in the installation of more monitoring systems at the facility.

The refinery chose to meet that challenge by streamlining all monitoring systems required for environmental regulatory compliance. Restructuring the entire process to manage the multiple continuous emissions monitoring systems (CEMS) was necessary for an effective system. opsEnvironmental Suite, an environmental management information system (EMIS) developed by ESP, Mountain View, Calif. was selected to assist in the process.

The data normally collected from monitors are typically stored in non-relational process data historians. These data are key to proper CEMS management, calculating emissions and demonstrating regulatory compliance. Typically, EMIS solutions do not directly interface with process data historians due to their various configurations and the sheer volume of data they contain. Additionally, process data historians cannot properly determine the validity of data according to the strict regulatory guidelines.

Therefore, a more robust tool was required to both migrate reduced data (in 15-minute and 1-hour increments) while simultaneously performing the validation procedure prior to storing data in the EMIS. In order to process and validate data from the process historian into the EMIS, this facility chose to implement a Data Integration and Averaging (DIA) application from T3, Inc., Dallas.

After configuring the interface between process data and the EMIS, the next step was to develop the interaction between personnel and the EMIS. To promptly address analyzer problems, field technicians needed a more effective notification system when analyzer faults occurred. Environmental personnel also needed notification in order to proactively schedule required monitoring in the instance that analyzers could exceed downtime allowances. In addition, environmental personnel needed to produce quarterly and semi-annual reports from the system to demonstrate compliance with the regulatory CEMS requirements. Both notification and reporting requirements were met with a properly configured EMIS.

DIA overview

Due to applicable federal and state regulatory requirements, the refinery had to install, configure and maintain numerous CEMS. The DIA ensures data integrity as it validates data according to the complex regulatory guidelines. Simply described, the DIA application moves data from one location to another in order to make it available for use in another application. Specifically, the application uses a set of fault tags to validate or invalidate raw and minute data to create valid 15-minute averages; and from these valid 15-minute block averages, to create valid hourly block averages. The DIA also has the ability to pull averages and snapshots of data from data historians without validation. The application then generates the analyzer fault, excessive drift and calibration logs for each CEMS. The DIA stores the processed data in a database called the “Environmental Data Mart,” or EDM.

A total of 48 analyzers were installed at the refinery. Each analyzer has approximately 16 fault tags used in the data validation process. To calculate a valid 15-minute block average, each analyzer and its respective fault values are pulled from the process data historian and processed by the DIA on a one-minute basis. Each validated 15-minute block average is then used to produce a valid one-hour block average. The number of analyzers and associated fault tags result in an analysis of over 45,000 data points per hour.
EMIS configuration

Prior to the EMIS implementation, field technicians were alerted to CEMS issues when reviewing the analyzer panel. This approach would have proven insufficient with the installation of additional analyzers. In order to document compliance and submit quarterly and semi-annual CEMS reports, environmental personnel spent hours manually reviewing spreadsheets as they tried to determine when emission limits were exceeded. Additional effort was required to report CEMS downtime (another regulatory requirement), which was determined by investigating unexpected values and confidence levels stored in the process data historian. Finally, at the end of each reporting cycle, the total downtime and emission exceedances for each system analyzer were manually calculated and entered into the report form.

To expedite this process, the system was configured to send all CEMS downtime to one central location (the EDM) and that information is then disseminated to the appropriate parties. The fault log, generated by the DIA and stored in the EDM, is linked to each analyzer object developed in the EMIS. Then, using EMIS functionality (data ticklers), field technicians are notified via e-mail and/or the paging system of these faults in a more visible/documented fashion than alerts on the analyzer panel alone.

The EMIS is configured so that every hour the data tickler reviews the fault log and sends notifications for each analyzer that has a fault flag assigned. This notification continues each hour until the fault has been fixed. Environmental personnel also are notified of CEMS outages. These notifications allow proactive scheduling of manual monitoring when approaching the 24-hour outage requirements of the HRVOC regulations.

The system is also configured to streamline the data verification and reporting process for environmental personnel. Each analyzer corresponds to an object developed in the EMIS. The validated downtime and excess emissions are pulled into each object through the EDM. The data is then exported for verification by environmental personnel, who categorize the data based on field documentation and import the results back into the EMIS. A final report for each analyzer is then printed and ready for signature.

Project results

As expected with the newly configured CEMS, the refinery was overwhelmed with the resulting volume of data. Adding to the burden of meeting these new reporting requirements, many of the newly installed analyzers exceeded 5-percent downtime, resulting in additional reporting requirements. In anticipation of these results, the project team continued beyond the initial EMIS configuration to work through each issue, starting with reducing analyzer downtime and increasing reporting efficiency. The integration and streamlining efforts at the refinery were met with many successes and a few lessons learned.

Successes

The goal of ensuring data integrity while decreasing the amount of time spent on reporting was a major milestone for this project. Now this refinery can accurately report analyzer downtime in an efficient manner. This success was heavily dependant on the process being streamlined from data collection through reporting, and may have been impossible without implementing an efficient system to handle the tremendous volume of data it processed hourly.

In addition to data integrity and reduced reporting preparation, the field technicians are now more aware of the analyzer warnings and faults that occur on an ongoing basis. The technicians have been able to address issues in a timely fashion after being notified via e-mail. By the third reporting cycle, all analyzers were under the percent downtime required for detailed reporting. This, in turn, decreased the amount of time required to produce the regulatory reports.

As a result of the new regulatory requirements, 28 analyzers were added, resulting in a total of 48 analyzers, 37 of which required semi-annual reporting. Prior to the EMIS implementation, each analyzer required approximately four man-hours for a total of nearly 150 man-hours for each semi-annual reporting period. This was initially reduced to 90 man-hours and now takes 50 man-hours. Initially there were 18 analyzers with downtime exceedances greater than 5 percent and ranging anywhere from 6 to 17 percent. In the last reporting cycle, no analyzers exceeded the 5 percent downtime requirement.
Lessons learned

On the heels of the integration project's completion, it was quickly evident that the analyzers were experiencing more downtime than previously anticipated. The HRVOC analyzers seemed to produce the most faults and required more investigation. Upon further review, field technicians were able to determine that some faults were simply warnings that did not have a direct effect on the data.

Increased communication between the field technicians and the environmental staff was established. The teams increased the field documentation meetings from quarterly to monthly. This allowed the environmental staff to document gaps in field documentation for actions taken during each analyzer downtime, when information was still fresh with the field technicians. The other communication issue involved pager notification. The pager system was not able to handle the e-mail format generated by the EMIS. This issue will be resolved by upgrading the field technicians' pagers.

Overall, the integration project and subsequent efforts were a huge success. The improved communication developed as a result of this project helped this facility overcome the daily challenges of managing all the required CEMS systems. PE

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