

Quality assurance of automated emission monitoring systems

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Assuring high quality emission monitoring is not only about ensuring accurate analyzers. It is the whole process, from the reason for monitoring, to the implementation, to assuring the quality of the data.

Table 1 below lists three quality assurance steps, the consideration of which is a prerequisite for successful emission monitoring. This article will give some guidance on aspects to consider when evaluating the monitoring needs, and also look into the quality assurance of monitoring data. The relatively new EN 14181 standard is presented and a procedure for cost efficient quality assurance is proposed. The monitoring equipment itself is handled in the following article.

Purpose of monitoring

Monitoring of a process or an activity should not be performed for the pure pleasure of creating data. The General EHS Guidelines by IFC/WB recommend a systematic planning process to ensure that the data collected are adequate for their intended purpose (and to avoid collecting unnecessary data)¹. When choosing between different approaches to emission monitoring, there must be a balance between the availability of the method, its reliability, the level of confidence, the costs and the environmental benefits².

Reasons for monitoring emissions from a power plant or process include:

1) **Emergency response:** The emission monitoring is used to avoid and alarm

in situations where critically high emissions, which endanger the health and safety of people, can occur.

2) **Process feedback:** The emission data is used to control the process, for example to control the amount of combustion air in a boiler.

3) **Emission verification:** Emission monitoring is used to verify emission compliance or to quantify emissions as part of an emission trading scheme.

The nature of a process very much determines the need for emission monitoring. The different emission profiles shown in Figure 1, clearly call for different types of monitoring and monitoring frequency. For those emission sources that may exhibit excursions with very high →

1

Careful evaluation of the purpose of the monitoring to choose the correct monitoring approach.

2

Selection of equipment recognizing the specific features and requirements of the application.

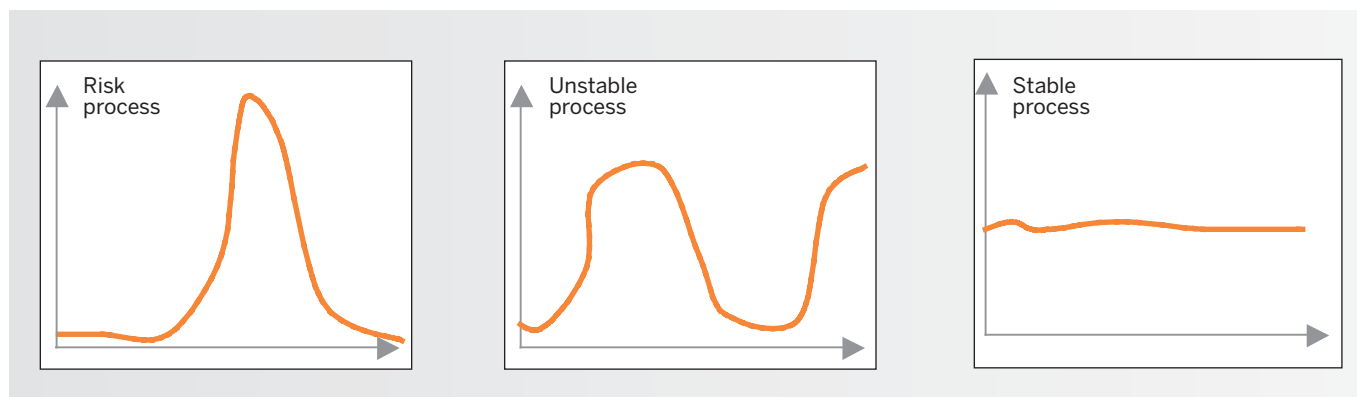
3

On-going assurance of the quality of the monitoring system and of the monitoring data.

■ Table 1 – Three steps in ensuring monitoring quality.

¹ IFC: Environmental, Health, and Safety (EHS) Guidelines. GENERAL EHS GUIDELINES, p. 10.

² European Commission: Integrated Pollution Prevention and Control (IPPC) – Reference document on the general principles of monitoring, p. 7.



■ Fig. 1 – Three processes with different emission profiles calling for different types of monitoring.

emissions and for unstable processes, it is typically justified to apply a high level of monitoring. The current diesel engine is a stable process with only small variations in emission levels, and excursions in operating conditions with very high emissions do not occur. Source testing supported by parametric monitoring is a powerful tool for validating that plants are being operated in accordance with requirements. For stable processes, time-sharing of analyzers is also a natural way of providing more cost-efficient monitoring.

Assuring quality of data

Recognizing the fact that the monitoring of emissions involves a lot of potential error sources, it is crucial that the quality of the measured data is assured and that sources of errors can be identified and corrected. In the United States, standards of performance for continuous emission monitoring systems are given by US EPA 40 CFR 60 and 75³. The EN 14181⁴ standard and EN 13284-2⁵ standards unify the quality assurance of automatic monitoring systems within the European Union. The quality assurance requirements of the EN 14181 standard will be discussed more in detail here. A simplified quality assurance process is also proposed. This approach will enable cost-efficient quality assurance, especially in projects where there is not an adequate infrastructure to support the relatively demanding EN or US requirements.

Quality assurance according to EN 14181

As of today, implementing the EN14181 and EN13284-2 directives is mandatory only for plants which are covered by the Waste Incineration Directive (WID)⁶ and the Large Combustion Plant Directive (LCP)⁷. Note that engine driven plants are specifically excluded in the LCP directive, even when the plant size is above the trigger of 100 MW_{th}.

The EN 14181 standard specifies how the selection of equipment, installation verification and calibration, as well as on-going and yearly quality checks shall be performed. The procedures are outlined in Figure 2. The main features of the different parts of the quality process are described below.

QAL-1

The monitoring has to be performed by equipment suited to the purpose. The suitability of a measurement procedure is evaluated by comparison with the required measurement uncertainty. This procedure is described in the EN ISO 14956.

QAL-2

This is the onsite validation of the measurement equipment after installation. The main steps in the process are:

- Validation of the installation.
- Calibrating the monitoring system using standard reference methods.

A calibration curve for the instruments

is obtained by an extensive set of at least 15 data pairs of standard reference method results and monitoring system data, spread out over at least three days.

- The statistical variability of the data is calculated and is used to verify that the monitoring system fulfils the requirements set on the monitoring system.

This procedure is to be repeated every 5 years, or when triggered by the AST or by a significant process change or modification to the monitoring system.

QAL-3

QAL-3 is a procedure to maintain and demonstrate the required quality of the measurement results during the normal operation of a monitoring system. It works by checking that the zero and span characteristics are consistent with those determined during QAL-1.

AST

The purpose of the annual surveillance tests (AST) is to evaluate that the monitoring system functions correctly and that its performance remains valid. It also verifies that the calibration function and variability remain as previously determined during QAL-2.

A simplified and cost-efficient quality assurance process

The requirements set forward by standards such as the EN 14181, are

³ EPA TITLE 40 – Protection of Environment: Part 60 Standards of Performance for New Sources and Part 75 Continuous Emission Monitoring.

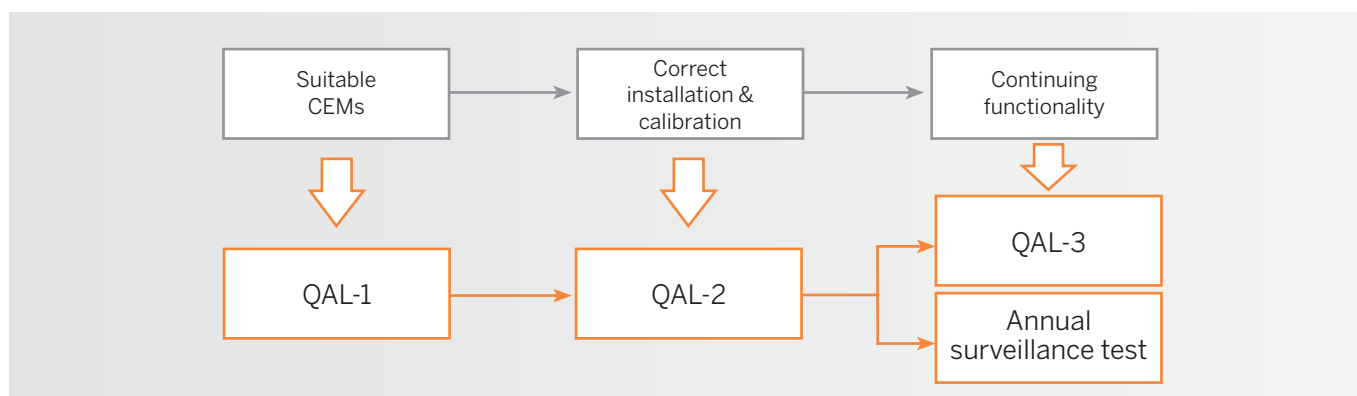
⁴ EN 14181: Stationary source emissions. Quality assurance of automated measuring systems.

⁵ EN 13284-2: Stationary source emissions. Determination of low range mass concentration of dust. Part 2: Automated measuring systems.

⁶ DIRECTIVE 2000/76/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 December 2000 on the incineration of waste.

⁷ DIRECTIVE 2001/80/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants.

⁸ UK Environment Agency: Technical Guidance Note (Monitoring) M20. Quality assurance of continuous emission monitoring systems - application of BS EN 14181 and BS EN 13284-2.



■ Fig. 2 – The sequence of quality assurance levels in EN 14181 .

typically very demanding. Even though the need for quality assurance of data is obvious, requiring the implementation of the standards in all projects involving continuous emission monitoring is not always the correct medicine. The quality assurance requirements need to take into consideration the properties of the plant, as well as the infrastructure and the conditions where the monitoring system is installed. Overambitious quality procedures may even draw the attention away from assuring that the basic requirements are in place.

Engine driven plants typically involve multiple relatively small units, and are often installed in locations where the infrastructure for continuous quality assurance and maintenance is only developing. It is obvious that there is a clear need to develop a simplified procedure for assuring the quality of the monitoring systems. This kind of validation has been performed on a voluntary basis by conscientious plant and process owners/operators. The number one priority should be to ensure that the system is working, and to maintain it in working order. If the long term maintenance of the system is neglected, putting a lot of resources into an exhaustive calibration and validation process is not justified. Below, the main features of a simplified and cost efficient QA/QC process are outlined:

I – Verification of the installation

The correct installation of the system is evaluated. This includes checking the physical installation as well as verifying measurement ranges, etc.

II – Functional checks

A functional test of the system is performed to verify the monitoring performance of the system. The demanding QAL-2 procedure described in EN 14181 is replaced by:

1. Verification of zero and span calibrations.
2. The function of the monitoring system can be verified by a simplified comparison to reference method data. Measurements recorded during compliance plant performance testing can be used for this purpose.

III – Continuous quality assurance

The successful operation of a monitoring system relies very much on everyday routines. To facilitate this, a follow-up system shall be put in place to ensure that:

1. There are assigned and trained resources at the plant to manage the monitoring equipment.
2. The service and maintenance of the system is performed regularly by trained personnel.
3. There is a procedure in place for performing regular calibration checks. The interval for this may depend on the type of monitoring system and plant.
4. There is a system in place for documenting the quality assurance of the monitoring system. This includes documenting maintenance actions, performed calibrations, malfunctions and reasons for these. Specifically note that checks when everything was OK should also be documented.

Parts I & II can be performed by the monitoring system supplier or by an external consultant, e.g. the same party

who is performing the verification of the plant emission compliance. It is recommended that the evaluating party provides a written statement that an adequate quality system has been put in place. If required, the inspection can be witnessed by the relevant authority.

Quality assurance for time-shared analyzers

Time-sharing of one or several analyzers can be used as a means of reducing the monitoring burden of plants with multiple units. If all are operating under equal conditions resulting in equal flue gas properties, it shall be considered adequate to perform a more in-depth calibration for one complete path per analyzer, including sampling, sample conditioning and analyzer. For the other same type of sources being monitored by the same analyzer, a functional check of the sampling system, including a leak check, is to be performed.

CONCLUSION

Successful monitoring needs to be supported by quality assurance procedures which take the specific features of the plant or process into consideration. Engine driven power plants often include multiple, relatively small, units and are delivered to locations lacking the infrastructure for, and a tradition of, quality assurance. An approach for cost-efficient quality assurance in this type of project has been presented in the text. It is recommended that a similar quality assurance is applied in projects where quality assurance is not directly specified by some other standard. ●