Monitoring, Reporting and Quality Assurance in the Electricity Generation Sector

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Preamble

One of the key task areas for the CASA Electricity Project Team (EPT) was to recommend appropriate monitoring, reporting, information-sharing, and compliance mechanisms as part of a new air emissions management approach for the electricity sector. In discussing this key task area, the EPT determined that a review of the existing monitoring and reporting of air emissions and compliance with emission limits for the electricity sector would be desirable. This brief report attempts to provide such a review.

1 Introduction

Power plants that produce steam or thermal electrical power and have a rated production output of greater than 1 MW under peak load (but do not include a production facility for space heating) require an approval from Alberta Environment pursuant to the *Environmental Protection and Enhancement Act* (EPEA). The approvals issued by Alberta Environment (AENV) are for entire facilities and not individual units. Therefore, in some cases, a power plant such as a co-generation unit in a chemical manufacturing facility would most likely be approved as part of the overall chemical facility.

2 Monitoring

2.1 Types of Monitoring

Two types of monitoring are directly relevant to the electricity sector: source monitoring and ambient monitoring. ***Source monitoring*** measures the emissions from equipment, processes and chemical storage and handling facilities. In the case of electrical generation facilities, source monitoring focuses on the stack emissions from the combustion of fuel that provides the energy needed to generate electricity. ***Ambient monitoring*** involves measuring the air quality at or near ground level in specific locations. In some cases, the focus of ambient monitoring is on trying to determine the effect of certain emission sources on air quality and in other cases it is just to determine what the air quality is in a certain area. In the case of electrical generation facilities, ambient monitoring is conducted to determine the impact that these facilities are having on air quality in the vicinity of the facility.

2.2 Monitoring Documents

The current regulatory framework for industrial facilities reflects a facility-specific "command and control" approach. Facility approvals are used as the mechanism for specifying emission limits and related monitoring and reporting requirements. Approvals often reference AENV documents such as Codes and Directives that stipulate how monitoring and reporting requirements are to be fulfilled to comply with the approval. The following documents are referenced in many approvals and outline the details and specifics of monitoring requirements:

- the Alberta Stack Sampling Code,
- the Methods Manual for Chemical Analysis of Atmospheric Pollutants,
- the Air Monitoring Directive, and
- the Continuous Emission Monitoring System (CEMS) Code.

The *Alberta Stack Sampling Code* stipulates how manual stack surveys are to be conducted. It also outlines the specifications for sampling equipment built into the stack, the apparatus for collecting the emission sample from the stack, the preservation and analysis of the samples, and the documentation for quality assurance and quality control.

The *Methods Manual for Chemical Analysis of Atmospheric Pollutants* outlines the chemical analysis methods that analytical laboratories are expected to use to determine the concentration of a particular pollutant or parameter.

The *Air Monitoring Directive* addresses the siting of ambient air quality monitoring stations, specifications for ambient monitors, the collection of monitoring data, the recording and handling of data, the reporting formats for stack and ambient data, and other air emissions information required in facility approvals.

The *Continuous Emission Monitoring System Code* provides the performance specifications for the continuous monitoring of a number of pollutants, including nitrogen dioxide, sulphur dioxide, in-stack opacity, temperature, and effluent velocity and/or flowrate. The specifications cover calibration procedures, quality control checks, quality assurance procedures, cylinder gas audits, and relative accuracy test audits.

3 Current Regulatory Requirements

3.1 Monitoring

3.1.1 Source Monitoring

General Approval Requirements

EPEA facility approvals specify the emission limits for major emission sources, such as the generating unit stacks. These limits typically restrict the rates of emission of NOx, SO_2, particulate matter, and visible emissions. The units of emission rate are: tonnes per hour for mass emission, or parts per million or g/kg of effluent for concentration.

Approvals also specify what air emission parameters are to be monitored and what monitoring methods are to be used. The monitoring data is used to establish compliance with the limits in the approval. The approval holder is required to report the monitoring data to AENV at a frequency stated in the approval – usually monthly and/or annually.

Continuous Emission Monitors (CEMs)

Coal-fired power plants are required to monitor continuously for NOx, SO_2, in-stack opacity, temperature, and effluent flow rate. CEMs are mounted on stacks and provide a continuous stream of monitoring information that yields calculated emission rates of NOx and SO_2. In-stack opacity data can be used to estimate primary particulate matter emission rates using correlation equations developed on a site-specific basis.

Gas-fired power plants above 25 MW are required to have CEMs that monitor for NOx, temperature and effluent flow rate. SO_2 measurements are not required because the fuel gas used is sweet natural gas containing only trace quantities of sulphur.

Biomass-fired power plants have CO, NOx, in-stack opacity, temperature, and effluent flow rate CEMS requirements.

Manual Stack Surveys
Manual stack surveys are required in addition to any continuous monitoring that a facility must conduct. This requirement involves manually sampling stack effluent emissions once or twice a year, depending on facility size. A third party consultant typically does this monitoring. The samples collected are analysed in accredited laboratories. The results from manual stack surveys are used to establish compliance with the emission limits stated in the facility approval and can also be used to check the accuracy of the CEMs.

In some cases, additional parameters are required to be tested as part of the manual stack test. These may include trace heavy metals, mercury or other substances of concern. Where the Alberta Stack Sampling Code does not have a specified monitoring methodology for a contaminant of interest (e.g., mercury), authorization for use of an alternate methodology from another jurisdiction is given.

3.1.2 Ambient Monitoring

To assess the impact of emissions on ambient air quality, approvals require most large emitters to maintain and operate one or more ambient air quality stations. These stations are located where facility emissions are expected to have the greatest impact on air quality; that is, in the normal downwind region around the facility and in the general location where the plume(s) from the emitting stack(s) is (are) expected to reach the ground. Typically, stations would continuously monitor the concentrations of contaminants such as nitrogen dioxide, sulphur dioxide, and total suspended particulate matter (TSP) in the vicinity of the plant. Concurrent and continuous measurement of wind speed and direction provides data that can be used to relate stack emissions to ambient air quality monitoring results.

In some cases, static monitoring of ambient air quality is required. For example, one coal-fired power plant has 15 static exposure stations located in the vicinity of facilities to gauge total dustfall and the cumulative impact of the emissions on sulphation (SO_2 impact). Sulphation stations consist of a chemically treated surface exposed to the ambient air but protected from rain and snow in a shelter. The surface reacts with the sulphur dioxide, hydrogen sulphide and other sulphur compounds in the ambient air over a period of 30 days, and is then analysed in the laboratory to determine the cumulative exposure the surface had to sulphur-containing compounds. Dustfall stations are containers that collect whatever suspended particulate matter, such as fly ash, falls from the air.

3.2 Reporting

The approval specifies the monitoring information that must be reported, and to whom and when it is to be reported. Depending on the fuel type, power plant approval holders are typically required to report or provide the following:

1. summary CEMS data once a month;
2. manual stack survey results, within 30 days after the manual stack survey was conducted;
3. summary ambient air quality monitoring results, monthly;
4. power production data, monthly;

5. total mass emissions, annually;
6. CO_2 emissions, annually (proposed);
7. coal analysis, monthly;
8. mercury deposition and other study results, as stated in the approval; and
9. an annual summary of all monitoring.

Power production data submitted by approval holders is considered confidential by AENV and is not made public. Presently, AENV is implementing a procedure for electronic submission of CEMS data that will enable facilities to batch transfer CEMS data to AENV on a monthly basis.

3.3 Quality Assurance

Reliable and representative data is a cornerstone of an effective emissions management and environmental protection program. AENV has a number of monitoring and reporting requirements that are intended to ensure reliable and representative information that can be used for compliance purposes. For example, where chemical analysis of samples is required, the use of standardized methods of analysis and appropriate quality assurance and quality control procedures ensure that the results are accurate, reproducible and comparable. Automated monitoring instruments and systems are subjected to frequent performance and calibration checks to maintain integrity of the data. These data controls help ensure that all environmental monitoring data submitted to AENV can be verified.

3.3.1 Laboratory Accreditation

All analytical laboratory data submitted to AENV must be from laboratories accredited by the Standards Council of Canada (SCC) or the Canadian Association for Environmental Analytical Laboratories (CAEAL) for analysis of the parameters being reported. This is a recent requirement, which was implemented to ensure that environmental monitoring data, such as air emission data, submitted by approval holders is from credible laboratories using proper quality assurance/quality control procedures.

What are the SCC and CAEAL?

The Standards Council of Canada (SCC) is the focal point for standardization and conformity assessment in Canada. The Council accredits the organizations that develop standards and/or verify the conformity of products or services to standards. SCC also approves National Standards of Canada, represents Canada in international standards forums, and serves as a source for standards information in Canada.

The Canadian Association for Environmental Analytical Laboratories (CAEAL) is a non-profit organization dedicated to raising the level of competency, consistency, capability, and communication within environmental testing laboratories in Canada. While SCC provides formal accreditation, that is recognition of the competence of the testing laboratories to perform specified tests, CAEAL, in a signed agreement with SCC, provides proficiency testing services and site assessments of laboratories according to ISO/IEC 17025.

Accreditation, by verifying that laboratories have the appropriate people, equipment and skills, helps to ensure the reliability of laboratory results.

3.4 Reporting Protocols

Reporting protocols for facilities are outlined in the Air Monitoring Directive. AENV is in the process of reviewing and revising and expanding this Directive into a more comprehensive document titled "Monitoring and Reporting Directive." This new document is intended to address monitoring and reporting of not only air emissions, but also wastewater discharges, waste management, and soil conservation and reclamation.

3.5 Mercury Emissions

Mercury emissions from power plants are not currently regulated by Alberta. Mercury emissions from coal-fired power plants have been the subject of extensive review over the past four years by the Canadian Council of Ministers of the Environment (CCME) on the basis that this sector is a major mercury emitter. Mercury is classified as a toxic under the *Canadian Environmental Protection Act* and designated by the federal government as a Track II toxic substance requiring management. Mercury emissions from coal-fired power plants have become a priority issue within the last five years. There is limited historical information on mercury emissions from Alberta power plants in terms of quantity, speciation and fate, and behaviour. There is also limited information on the effectiveness of possible mercury control technologies for the mercury emissions associated with the burning of the type of sub-bituminous coal found in Alberta.

The recent *Environmental Protection and Enhancement Act* approval for the expansion of EPCOR's Genesee coal-fired power plant requires that the company submit a "Mercury Assessment Program" to quantify mercury emissions for the plant and that it assess the ecological impacts of these emissions. This requirement also applies to the TransAlta facilities in the Lake Wabamun area.

Alberta coal-fired power plants have, through a memorandum of understanding with AENV, initiated a comprehensive mercury sampling and monitoring program at all plants to better understand the quantities, speciation and behaviour of mercury during coal combustion. It is expected that mercury emission standards and related monitoring requirements will become a part of coal-fired power plant approvals in the future.

4 Summary

The following table summarizes the current monitoring and reporting systems and also provides some information on how these systems might be applied to in an emissions trading system or in sectoral agreements for greenhouse gases.

Table 1: Monitoring and Reporting Systems for the Air Emission Management System within the Electricity Sector

Program Element	Type of Monitoring	Command and Control (current system)	Emissions Trading (for NOx and SO_2)	Sectoral Agreement (for greenhouse gases)
Monitoring	Source Emissions	Alberta Stack Sampling Code covers NOx, SO_2, PM Authorized method covers Hg	Alberta Stack Sampling Code covers NOx, SO_2 as well as RATA for CEMS	Stack sampling could cover RATAs for CEMS
		CEMS covers NOx, SO_2, in-stack opacity (indirectly PM),	CEMS covers NOx, SO_2	CEMS could also include CO_2
	Ambient Air Quality	Air quality monitoring stations cover TSP, NO_2, SO_2 continuously and exposure stations cover sulphation and dustfall (may also be covered by air quality monitoring zones)	Same as for current C&C system	Not applicable
Reporting	Source emissions	Covered by AMD/MRD and CEMS Code, primarily paper system	Covered by current C&C system, to be totally e-based	Covered by current C&C system, to be totally e-based
			New electronic system required to report trades	New e-system required to report offsets
	Ambient air quality	Covered by AMD/MRD/AAQS Code, or air quality monitoring zones; primarily paper except for zones which are electronic	Covered by current C&C system	Not applicable
Compliance	EPEA, regulations, approvals	Approval conditions	New regulations and processes required for allocation and trading	New regulations required for credit trading, offsets, and target compliance
Information Sharing	Integration of EMS, CASA, AENV websites	On request from AENV	Possible new web-based system	Possible new web-based system

RATA – Relative Accuracy Technical Assessment
CEMS – Continuous Emission Monitoring System
AMD/MRD – Air Monitoring Directive/Monitoring and Reporting Directive
C&C – Command and Control
AAQS – Ambient Air Quality System
EMS – Environmental Management System