QUALITY ASSURANCE PROGRAM MANUAL
FOR THE
CONTINUOUS EMISSIONS MONITORING SYSTEMS
AT THE
HOLYROOD THERMAL GENERATING STATION
VOLUME 2

(Revision 0)

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May, 2004

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1 START-UP AND OPERATION

1.1 PURPOSE AND APPLICABILITY

(to follow…)

1.2 GENERAL INFORMATION

A description of the CEM system, analyzer operating principles, and analyzer locations is found in Section 3 – CEM System Description of the Quality Assurance Plan (Vol. 1).

1.3 SAFETY PROCEDURES

The safety procedures are intended to:

- prevent injury to personnel;
- prevent damage to the environment, the installation environment, the measuring system described in this document, and other items of equipment;
- ensure the availability and correct operation of the measuring system;

In general, the following practices apply:

- If climbing a stack, be sure to take extra precaution in instances of adverse weather such as rain, sleet, or high winds. In these cases, appropriate precautions to ensure worker safety must be implemented;
- Compressed gas cylinders must be secured to a solid support to avoid accidental rupture;
- All maintenance crew must be qualified personnel familiar with instrumentation service and repair, especially when working with electrical power installations;

1.4 EQUIPMENT AND MATERIALS

See Section 5 – Facilities, Equipment and Spare Parts Inventory in the Quality Assurance Plan.

1.5 PROCEDURE

1.5.1 System Preparation

Check the Log Book to see when routine maintenance was last performed, and review the instrument's history of service. Verify that:

- The analyzer is receiving electrical power and instrument air; check to see if it is powered up;
- Check to see if the calibration gas cylinder is sufficiently pressurized (i.e. > 250 psi) for calibration;
- Check all gas connections to ensure that they are tight and leak-free.

1.5.2 Oxygen Monitor (Siemens Oxymat 61)

Before Start-up, perform the following:

- Check the electrical installation. Power input: 100, 115 VAC single phase, 50 to 60 Hz, 3 amp minimum (see label on analyzer);
- *(to follow…)*

The unit should be calibrated before operation. Perform calibration according to procedures outlined in Section 3.4.1 of this manual.

1.5.3 Sulphur Dioxide and Nitrogen Oxides (SO_2 & NO_X) Monitor (Ametek Model 922)

Before Start-up, perform the following:

- Check the electrical installation. Power input: 100, 115 VAC single phase, 50 to 60 Hz, 3 amp minimum (see label on analyzer);
- *(to follow…)*

The unit should be calibrated before operation. Perform calibration according to procedures outlined in Section 3 of this manual.

1.5.4 Carbon Monoxide and Carbon Dioxide (CO & CO_2) Monitor (Siemens Ultramat 23)

Before Start-up, perform the following:

- Check the electrical installation. Power input: 100, 115 VAC single phase, 50 to 60 Hz, 3 amp minimum (see label on analyzer);
- *(to follow…)*

The unit should be calibrated before operation. Perform calibration according to procedures outlined in Section 3 of this manual.

1.6 REFERENCES

- Instruction Manual for Siemens Oxymat 61;
- Instruction Manual for Ametek Model 922; and

- Instruction Manual for Siemens Ultramat 23.

2 WEEKLY CEM SYSTEM INSPECTION

2.1 PURPOSE AND APPLICABILITY

This section outlines the weekly inspection procedure of the Holyrood Generating Station CEM system. The frequency of the inspections may change depending on system performance and reliability.

Inspection checklists are filled out to ensure a systematic, error-free verification of system operations and performance. Inspection may prompt a revision of preventative maintenance techniques or it may cause the initiation of corrective maintenance.

2.2 SAFETY PROCEDURES

The safety procedures are intended to:

- prevent injury to personnel;
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- ensure the availability and correct operation of the measuring system.

In general, the following practices apply:

- If climbing a stack, be sure to take extra precaution in instances of adverse weather such as rain, sleet, or high winds. In these cases, appropriate precautions to ensure worker safety must be implemented;
- Compressed gas cylinders must be secured to a solid support to avoid accidental rupture;
- All maintenance crew must be qualified personnel familiar with instrumentation service and repair, especially when working with electrical power installations;

2.3 EQUIPMENT AND MATERIALS

The following materials are required for the inspection process:

- CEM System Inspection Form;
- CEM System QAP Manual; and
- Analyzer Instruction Manuals (see section 2.5**,** below).

2.4 PROCEDURE

Weekly inspections are done by the technicians. The inspections are a critical function of the QC of the CEM systems. The inspection will be done by a qualified and trained

technician or technicians. The inspection will take an average of 1 hour per CEM system depending on problems found. Any problems will be corrected immediately.

The weekly check follows the weekly checklist, found in this section with copies in Appendix 2.

2.5 REFERENCES

- Instruction Manual for Siemens Oxymat 61;
- Instruction Manual for Ametek Model 922; and
- Instruction Manual for Siemens Ultramat 23.Analyzer Manuals.

3 CALIBRATION PROCEDURES

3.1 PURPOSE AND APPICABILITY

System calibration checks are used to determine the validity of the data collected by the analyzers. These procedures outline checking, documenting, and reviewing the zero and span responses from the NL Hydro Holyrood TGS CEM system

Environment Canada 1/PG/7 requires that analysers be calibrated once per day.

3.2 SAFETY PRECAUTIONS

The safety procedures are intended to:

- prevent injury to personnel;
- prevent damage to the environment, the installation environment, the measuring system described in this document, and other items of equipment;
- ensure the availability and correct operation of the measuring system;

In general, the following practices apply:

- If climbing a stack, be sure to take extra precaution in instances of adverse weather such as rain, sleet, or high winds. In these cases, appropriate precautions to ensure worker safety must be implemented;
- Compressed gas cylinders must be secured to a solid support to avoid accidental rupture; and
- All maintenance crew must be qualified personnel familiar with instrumentation service and repair, especially when working with electrical power installations.

3.3 EQUIPMENT AND MATERIALS

Calibration Gases and System Log Book.

3.4 PROCEDURES

(to follow…)

3.4.1 Oxygen Analyser

The oxygen analyser will require daily calibration with calibration gas. The operator will challenge the analyser with zero gas followed by 21% oxygen certified standard gas every day at the same time. A log will be recorded of the calibration values.

3.4.2 Sulphur Dioxide and Nitrogen Oxides Analyser

The sulphur dioxide and nitrogen oxides analyser will require daily calibration with calibration gas. The operator will challenge the analyser with zero gas followed by 1500ppm Sulphur Dioxide/1000ppm Nitrogen Oxide certified standard gas every day at the same time. A log will be recorded of the calibration values.

3.4.3 Carbon Monoxide and Carbon Dioxide Analyser

The carbon monoxide and carbon dioxide analyser will require daily calibration with calibration gas. The operator will challenge the analyser with zero gas followed by 500ppm Carbon Monoxide/20% Carbon Dioxide certified standard gas every day at the same time. A log will be recorded of the calibration values.

3.5 CALIBRATION ADJUSTMENT

If calibration drift is above 4% on the low calibration or 5% on the high calibration then the analysers will be out of control and all data is invalid until corrective maintenance and another calibration is completed.

Technicians will attempt another calibration to correct the instrument. If this does not correct the problem then the corrective maintenance must be performed. (Refer to Section 5 for corrective maintenance procedures)

3.6 REPLACING CYLINDER GAS BOTTLES

Reserve gas cylinders must be stocked and cylinders currently in use must have their pressures monitored. For each mixture of gas used, two (2) replacement gas bottles must be kept on-site, and weekly checks of bottle pressure will be performed.

New cylinder gas bottles must be checked with the previous bottles for acceptance. If the difference in the bottles is more than 5% then the new bottle should be rejected and another bottle ordered.

3.7 LEAK CHECK PROCEDURES

The O_2 system is to be snooped for leaks once each year, as per the annual checklist (Appendix 2)

3.8 REPLACEMENT OR INTERCHANGING OF PROBES

(to follow…)

3.9 REFERENCES

- Instruction Manual for Siemens Oxymat 61;
- Instruction Manual for Ametek Model 922;

- Instruction Manual for Siemens Ultramat 23.Analyzer; and
- Environment Canada Reference Method EPS 1/PG/7.

4 PREVENTATIVE MAINTENANCE PROCEDURES

4.1 PURPOSE AND APPLICABILITY

Electronic measuring systems need regular care and maintenance to ensure reliable performance.

4.2 SAFETY PRECAUTIONS

The safety procedures are intended to:

- prevent injury to personnel;
- prevent damage to the environment, the installation environment, the measuring system described in this document, and other items of equipment;
- ensure the availability and correct operation of the measuring system;

In general, the following practices apply:

- Where there is risk of electric shock, all power should be disconnected from a device before maintenance is performed;
- If climbing a stack, be sure to take extra precaution in instances of adverse weather such as rain, sleet, or high winds. In these cases, appropriate precautions to ensure worker safety must be implemented;
- Compressed gas cylinders must be secured to a solid support to avoid accidental rupture;
- All maintenance crew must be qualified personnel familiar with instrumentation service and repair, especially when working with electrical power installations.

4.3 EQUIPMENT AND MATERIALS

See Section 5 of the Quality Assurance Manual for a list of spare parts for each unit. As well, the following tools may be required:

- Assorted Tools – wrenches, screwdrivers, etc.;
- Multimeter;
- Assorted electrical components (lamps, etc.); and
- Assorted Disposables – filters, desiccants.

4.4 PROCEDURES

The key Preventative Maintenance (PM) procedures are contained in the weekly, monthly and annual check sheets as shown in Appendix 2. These check sheets will be periodically

revised as experience is gained in operating the systems.

The following lists several of the PM procedures contained in the check sheets.

4.4.1 Oxygen Monitor (Siemens Oxymat 61)

(to follow…)

4.4.2 Sulphur Dioxide and Nitrogen Oxides Monitor (Ametek Model 922)

(to follow)…

4.4.3 Carbon Monoxide and Carbon Dioxide (Siemens Ultramat 23)

(to follow)…

4.5 REFERENCES

- Instruction Manual for Siemens Oxymat 61;
- Instruction Manual for Ametek Model 922; and
- Instruction Manual for Siemens Ultramat 23.Analyzer.

5 CORRECTIVE MAINTENANCE PROCEDURES

5.1 PURPOSE AND APPLICABILITY

Corrective maintenance procedures are performed in response to observations made during the regular CEM checks, or in response to another indication of malfunction, e.g. alarms or system failure. Corrective maintenance procedures, therefore, are not scheduled.

5.2 SAFETY PRECAUTIONS

The safety procedures are intended to:

- prevent injury to personnel;
- prevent damage to the environment, the installation environment, the measuring system described in this document, and other items of equipment;
- ensure the availability and correct operation of the measuring system;

In general, the following practices apply:

- Where there is risk of electric shock, all power should be disconnected from a device before maintenance is performed;
- If climbing a stack, be sure to take extra precaution in instances of adverse weather such as rain, sleet, or high winds. In these cases, appropriate precautions to ensure worker safety must be implemented;
- Compressed gas cylinders must be secured to a solid support to avoid accidental rupture;
- All maintenance crew must be qualified personnel familiar with instrumentation service and repair, especially when working with electrical power installations.

5.3 EQUIPMENT AND MATERIALS

- Assorted Tools – wrenches, screwdrivers, etc.;
- Multimeter;
- Assorted electrical components (lamps, etc.); and
- Assorted Disposables – filters, desiccants.

5.4 PROCEDURES

5.4.1 Oxygen Monitor (Siemens Oxymat 61)

(to follow…)

5.4.2 Sulphur Dioxide and Nitrogen Oxides Monitor (Ametek Model 922)

(to follow…)

5.4.3 Carbon Monoxide and Carbon Dioxide (Siemens Ultramat 23)

(to follow…)

5.4.4 Reports

Documentation will be kept in the log book.

5.4.5 Trouble Shooting Guide/Corrective Maintenance Procedures

Appropriate cheklists are to be followed. These are found in Appendix 2.

5.5 REFERENCES

- Instruction Manual for Siemens Oxymat 61;
- Instruction Manual for Ametek Model 922; and
- Instruction Manual for Siemens Ultramat 23.Analyzer.

6 EVALUATION PROCEDURES – CYLINDER GAS AUDITS

6.1 PURPOSE AND APPLICABILITY

Cylinder Gas Audits are to show that the system is operating acceptably by using high quality calibration gases to challenge the analysers.

6.2 SAFETY PRECAUTIONS

The safety procedures are intended to:

- prevent injury to personnel;
- prevent damage to the environment, the installation environment, the measuring system described in this document, and other items of equipment;
- ensure the availability and correct operation of the measuring system;

In general, the following practices apply:

- Where there is risk of electric shock, all power should be disconnected from a device before maintenance is performed;
- If climbing a stack, be sure to take extra precaution in instances of adverse weather such as rain, sleet, or high winds. In these cases, appropriate precautions to ensure worker safety must be implemented;
- Compressed gas cylinders must be secured to a solid support to avoid accidental rupture;
- All maintenance crew must be qualified personnel familiar with instrumentation service and repair, especially when working with electrical power installations.

6.3 EQUIPMENT AND MATERIALS

- Assorted Tools – wrenches, screwdrivers, etc.;
- Low (0 to 20% of analyzer span), mid (40 to 60% of analyzer span) and high (80 to 100% of analyzer span) Protocol 1 calibration gases.

6.4 PROCEDURE

The CGA is to be conducted using the following Protocol 1 gases:

- Low-range (0 to 20% FS);

- Mid-range (40 to 60% FS);
- High-range (80 to 100% FS);

where FS refers to the Full Scale setting of each pollutant and diluent gas analyzer. Separate gas cylinders are to be used for each concentration required.

With the system operating normally, each gas (low-, mid-, and high-level) is introduced to the system three (3) times in succession, allowing the system to respond to and stabilize with each gas introduced. The accuracy of such a test is determined by Equation 6-1, below.

$$A = \frac{C_M - C_A}{C_A} \cdot 100\%$$

Equation 6-1

Where:

A CGA Accuracy of the CEM analyzer (%);

C_M Average analyzer response during the audit;

C_A Certified value of the audit gas

The CEM System is "out-of-control" if A exceeds ± 7.5%. The "out-of-control" period begins at the completion of the audit. The CEM system can be shown to be operating properly – after performing corrective measures – by successfully completing a second CGA or RATA.

6.5 SCHEDULING

CGA tests are to be done once during every 3 month period.

6.6 REFERENCES

- Instruction Manual for Siemens Oxymat 61;
- Instruction Manual for Ametek Model 922;
- Instruction Manual for Siemens Ultramat 23.Analyzer; and
- Environment Canada Reference Method EPS 1/PG/7.

7 EVALUATION PROCEDURES – RELATIVE ACCURACY TESTS

7.1 PURPOSE AND APPLICABILITY

Relative Accuracy Test Audits (RATAs) are performed to show that the system is operating acceptably by using comparing the readings to a completely separate set of analysers operated by specified reference methods.

7.2 RESPONSABILITIES

The plant manager has the responsibility to schedule the RATA test once per year.

7.3 SAFETY PRECAUTIONS

The safety procedures are intended to:

- prevent injury to personnel;
- prevent damage to the environment, the installation environment, the measuring system described in this document, and other items of equipment;
- ensure the availability and correct operation of the measuring system;

In general, the following practices apply:

- Where there is risk of electric shock, all power should be disconnected from a device before maintenance is performed;
- If climbing a stack, be sure to take extra precaution in instances of adverse weather such as rain, sleet, or high winds. In these cases, appropriate precautions to ensure worker safety must be implemented;
- Compressed gas cylinders must be secured to a solid support to avoid accidental rupture;
- All maintenance crew must be qualified personnel familiar with instrumentation service and repair, especially when working with electrical power installations.

7.4 EQUIPMENT AND MATERIALS

The RATA test must be done by a qualified contractor familiar with the EPA and EC reference methods.

7.5 PROCEDURE

The relative accuracy is the percent difference in the CEM system's measurement of the pollutant versus the values as determined using a US EPA Reference Method (RM) running in parallel with the CEM. The term "relative accuracy" versus "accuracy" is used because the accuracy is determined relative to a second, independent measurement and not to a known standard value.

Reference methods to be used are as follows:

- O_2 and CO_2 EPA Method 3A;
- SO_2 and NO_X EPA Method 6C; and
- CO EPA Method 10.

Nine individual 30 minute tests are required for a RATA.

To receive certification, a CEM system must perform within certain specifications. EC EPS 1/PG/7 declares in Section 5.1.6 that the relative accuracy for individual pollutant analyzers must not exceed 10% ($\leq$ 10%) calculated in units of the standard. For diluent gas analyzers, the relative accuracy shall not exceed 10%, or 1% O_2/CO_2, whichever is greater.

The Relative Accuracy is calculated using Equation 7-1, below.

$$RA = \frac{|d| + |cc|}{RM} \cdot 100\%$$

Equation 7-1

Where:

RA	is the relative accuracy
d	is the mean absolute difference between the CEM and Reference Method results;
cc	is the confidence coefficient
RM	is the average of the Reference Method

When the pollutant gas concentrations are less than 250 ppm, substitute the full-scale setting of the analyzer for the value of Reference Method when calculating the RA using Equation 3. For the diluent gas analyzer, substitute the full-scale setting of the analyzer.

The CEM System is "out-of-control" if the RA of a pollutant or diluent analyzer exceeds 10%. The CEM system can be shown to be operating properly – after performing corrective measures – by successfully completing a second RATA.

RATA results also must base the bias criteria of 4% as defined in 1/PG/7.

7.6 SCHEDULING

Relative accuracy testing is required semi-annually. The semi-annual test may be waived and conducted annually after the first year of operation is all of the following criteria have been met:

- The system and analyzer availabilities are greater that 95%;
- The previous relative accuracy for pollutant concentration analyzers and the system relative accuracy are both equal to or less than 7.5%;
- The system and analyzer bias test results fall within specification.

RATA tests must be done to certify a system on start up and when major components are replaced.

7.7 REFERENCES

- Instruction Manual for Siemens Oxymat 61;
- Instruction Manual for Ametek Model 922;
- Instruction Manual for Siemens Ultramat 23.Analyzer;
- Environment Canada Reference Method EPS 1/PG/7;
- Appropriate EPA Reference Methods.

8 DATA BACKUP PROCEDURES

(to follow…)

9 TRAINING PROCEDURES

(to follow…)

Training items to be included in a comprehensive program:

1. Cross training of technicians to allow for holidays, sick time;
2. Job shadowing for a minimum preset time for technician training;
3. External training by equipment suppliers when new gear is installed;
4. Internal review of all supplier manuals;
5. Software training on all equipment maintenance software;
6. Minimum basic education for technicians (ie electrician or electrical technologist); and
7. Training documentation to be completed and available upon request.

Site staff workshops will be held as necessary to ensure that personnel understand:

1. Why the CEM systems are important to plant operations;
2. General issues including keeping the weather covers closed, how to notice alarms, etc.;
3. Who to call for any maintenance issues beyond the abilities of technicians.

10 CEM SYSTEM SECURITY

The CEM systems are contained within a fenced, controlled-access area in Holyrood, Newfoundland and Labrador. Only authorized personnel will be allowed to work on the equipment.

11 DATA REPORTING PROCEDURES

11.1 REPORTS

(to follow…)

11.1.1 External Reports

(to follow…)

11.1.2 Report Generation

(to follow…)

11.2 RETENTION OF RECORDS

(to follow…)