QUALITY ASSURANCE PROGRAM MANUAL
FOR THE
CONTINUOUS EMISSIONS MONITORING SYSTEMS
AT THE
HOLYROOD THERMAL GENERATING STATION
VOLUME 1

(Revision 0)

Prepared for
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1 QUALITY ASSURANCE POLICY AND OBJECTIVE

1.1 INTRODUCTION

This document was written and will be followed to ensure that environmental emissions data are measured, recorded and stored in a valid and defensible manner. These goals will be achieved through proper planning, review, documentation, auditing, reporting, and corrective action.

1.2 POLICY

In accordance with their permit to operate, NL Hydro has developed and will follow this QAP manual to ensure the collection of valid, defensible data. The NL Hydro CEM Systems are required to meet the Environment Canada Guidelines "Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation: Report EPS 1/PG/7, September, 1993". This document is provided in the appendices.

1.3 QUALITY ASSURANCE OBJECTIVES

This QAP manual will ensure that air emissions data are valid and defensible. Specifically, this manual will outline procedures for:

- Proper procedure (calibrations, checks);
- Proper documentation (weekly logs, calibration data, troubleshooting maintenance);
- Proper maintenance activities (spare parts, etc);
- Proper reporting; and
- Proper corrective action.

Through the implementation of this QAP plan, the NL Hydro Holyrood Facility will fulfill the air emissions monitoring requirements of its Permit to Operate.

1.4 SPECIFIC NL HYDRO EMISSION AND OPERATIONAL LIMITS AND RECORDS

The guidelines in this QAP manual either meet or exceed those outlined in the NL Hydro Permit to Operate and Environment Canada Report 1/PG/7.

The NL Hydro Quality Assurance objectives are summarized in Table 3-1. The NL Hydro Holyrood Facility Permit to Operate is included in full in Appendix 1.

Table 1-1 - Stack Emission Criteria as required in NL Hydro Holyrood Facility Permit to Operate.

CONTAMINANT	LIMIT	METHOD
Particulate Matter		EPS 1/RM/8 as amended or US EPA 40 CFR Part 60, Method 29, as amended
Sulphur Dioxide		EPS 1-AP-74-3, as amended or as approved by the Department Operate in accordance with document EPS 1/PG/7 or as approved by the Department.
Oxides of Nitrogen		
Carbon Monoxide		
Carbon Dioxide		
Opacity		
Mercury		USEPA 40 CFR Part 60, Method 29, as amended

* The Least Restrictive of these requirements apply

** Based upon isomer specific analytical test data

RM^3 Reference cubic meter, i.e., the volume of gas at 25 ^{o}C and 101.3 kPa

ppmdv parts per million dry volume

In addition, the following records must be maintained (according to the Permit to Operate):

(to follow…)

1.5 UPDATES TO THE QUALITY ASSURANCE PLAN

The QAP Manual will be reviewed annually to ensure that all sections are kept up-to-date in regards to procedures, equipment, etc. At this point, any necessary revisions will be completed and distributed to all persons involved with the CEM system. ____________________ has primary responsibility for ensuring that these reviews and/or revisions take place annually.

2 DOCUMENT CONTROL SYSTEM

2.1 INTRODUCTION

The Document Control System (DCS) assigns each update a number and date so that changes to the document are recorded in a systematic fashion. As well, the documenting of revisions to this manual enables a person to see what procedures were followed (eg. How instruments were calibrated, how often preventative maintenance was performed) in the past. This allows for more a more complete history of events.

2.2 REVISION OF THE QAP MANUAL

____________________ has primary responsibility for the annual review and revisions of the QAP Manual.

2.3 APPROVAL MECHANISMS FOR THE MANUAL

____________________ has primary responsibility for the approval of new or newly revised sections of the QAP Manual.

2.4 DISTRIBUTION OF QAP MANUAL

____________________ has primary responsibility for the distribution of new or newly updated sections of the QAP Manual to all persons involved with the CEM system.

Three copies of the QAP documents will be stored in binders, one in each of the following locations:

- on-site in the control room,
- ____________________

and in the offices of NL Hydro.

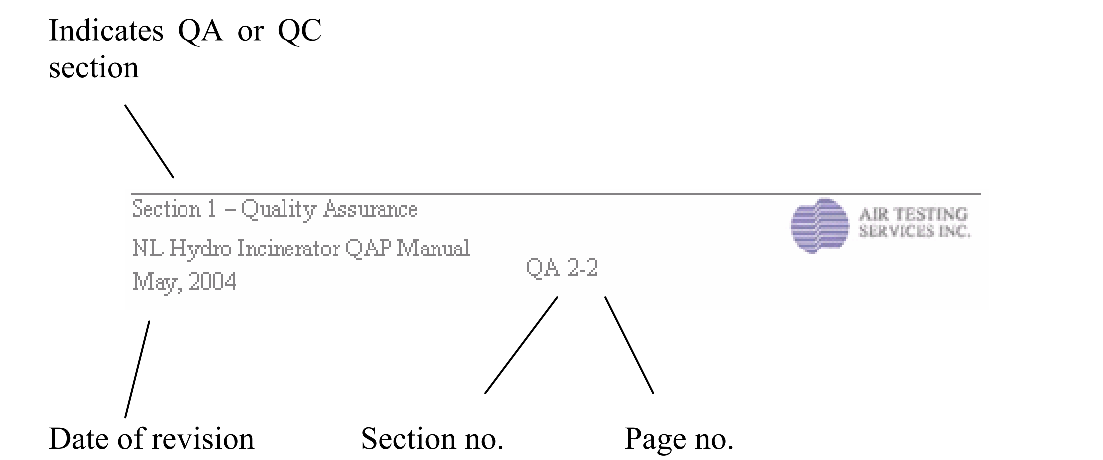
2.5 NUMBERING SYSTEM FOR THE QAP MANUAL

The QAP Manual is divided into two main sections:

1. Quality Assurance – Outlines the challenges and remedies for the successful operation of the CEM system; and
2. Quality Control – Outlines step-by-step procedures for taking action in regards to the successful operation of the CEM system.

In the footer of each page, in the left-hand corner, there is indication whether that page belongs to the QA or the QC section of the QAP Manual (See Figure 2-1, below). Under this is the abbreviated document title, "NL Hydro Holyrood TGS QAP Manual", and under this is the revision date.

Figure 2-1 - Number Scheme.



At the center of the footer is the page number in the form of [sub-section] – [page], where subsection refers to the ordering of the QA and QC Sections of the QAP Manual. These Sub-sections are summarized in Figure 2-2.

Figure 2-2 - Organization of QAP Manual.

Quality Assurance	Quality Control
1 Quality Assurance Policy and Objective	
2 Document Control System	
3 CEM System Description	
4 Organization and Responsibilities	
5 Facilities, Equipment and Spare Parts Inventory	
6 Methods and Procedures – Data Acquisition and Analysis	
7 Calibration and Quality Control Checks	
8 Preventative Maintenance Schedule	
9 Performance Evaluations	
10 Corrective Action Program	
11 Reports	
12 References	

2.6 Frequency of Revision

The QAP Manual will be reviewed annually to ensure that all sections are kept up-to-date in regards to procedures, equipment, etc. At this point, any necessary revisions will be completed and distributed to all persons involved with the CEM system. ____________________________ has primary responsibility for ensuring that these reviews and/or revisions take place annually.

2.7 Manual Revisions

This manual was written on an IBM PC Compatible in MS Word 2002 (10.267.265) (MS Word XP) and is backwards-compatible with MS Word 98 and 2000. Separate files are maintained for each of:

- Section 1 – Quality Assurance Plan;
- Section 2 – Quality Control Plan; and
- Appendices (i.e. each Appendix is its own file, where applicable).

Graphics are maintained in both electronic and hard-copy formats, where available.

3 CEM SYSTEM DESCRIPTION

3.1 INTRODUCTION

The model 0222492 Continuous Emission Monitoring system dry extractive type has been designed by Wilier Engineering Limited to measure several gases from three boilers at a Thermal Generating Station burning Bunker C oil. The system includes three heated stack probes and air accumulators, heated sample lines, thermoelectric gas cooler/dryer complete with sample pumps and water carry over sensors. The system is comprised of the following subsystems:

- Three independent extraction systems consisting of heated blowback filter assemblies and heated sample lines;
- Control subsystems;
- Gas handling subsystem;
- Gas component analyzers (SO_2/NO_X, O_2, CO/CO_2); and
- Data Acquisition System.

3.2 CEM SYSTEM DESCRIPTION

The system has three analyzers incorporated and are capable of measuring NOx, S02, 02, CO and C02. The principal type of measurement is Pulse Florescence UV for NOx and S02, Paramagnetic for oxygen and Infrared for CO/C02.

The system is designed with an Automation Direct PLC 205 to time sequence sample from three stacks to meet the various regulatory agencies such as 40 CFR 60 and EPS 1/PG/7 performance specifications.

Included into the system is the capability to perform daily calibration checks of the system manually and automatically and provide a means to report the data to meet the above standards. The system can also perform a calibration check at the stack probe when the analyzers exceed the zero and span cal drift tolerances.

The means to monitor this is through a DAS (Data Acquisition System) which can provide various types of data analysis, digital input/output status and alarm diagnostics. The analyzers are microprocessor based and can perform calibration either manually or automatically with or without correction of zero and span. Each analyzer has built in diagnostics and can display a system warning or faults.

The data acquisition system can provide graphical display of data, printing or storing reports in electronic format, archive data, and can provide access to the system via modem. The system can facilitate system control through operator selectable menus and offer several levels of password capability. The system can log power failures and off line status. Trend analysis in real time and historical data are built in features and can be edited by the user. All alarms of the system are monitored and can be retrieved from the history table as far back as one year.

The system is provided with a DELL Pentium 4, 1.8 GHz. CPU computer with 256MB ram, 40 Gbyte hard drive, 3.5 inch Floppy Drive, read and writable CD drive, 56 kilobaud modem, a 17" color monitor, and color printer. The system included Windows 2000 (Microsoft 2000 small business edition (Excel and Word) and PC Anywhere remote control software with three com ports.

A summary of the analyzers is given in Table 3-1, below.

Table 3-1 - Summary of CEM Analyzers installed at the NL Hydro Holyrood TGS facility.

Equipment	Supplier Manufacturer/Model	Operating Range / Output Range	Operating Requirements
Oxygen (O_2) Monitor	Siemens Oxymat 61	0-25 % / 4-20 mA	
Sulphur Dioxide (SO_2)	Ametek Model 922	0-1500 ppm / 4-20 mA	
Oxides of Nitrogen (NO_X)	Ametek Model 922	0-1000 ppm / 4-20 mA	
Carbon Monoxide	Siemens Ultramat 23	0-500 ppm / 4-20 mA	
Carbon Dioxide	Siemens Ultramat 23	0-20 % / 4-20 mA	

3.2.1 Sample Blow-back / Heated Stack Probe

This system has a 270SS-F-F4-BB-FG heated stack probe complete with a four inch Flange for mounting onto the stack and is equipped with an air accumulator to store 90 psi of instrument air. The blow-back occurs every 2 hours which is programmed in the PLC and is controlled by timer T4. An output from the PLC Y13 is sent to all three blowback solenoid valves simultaneously at the stack. The solenoids will be activated for 5 seconds to allow for a high pressure burst of air at the probe tip to clear any particulate build-up. Refer to 0222492E Electrical Drawing and 0222492F Flow Diagram. There is an oven incorporated in the stack enclosure which is heated to 400 Deg F and is equipped with a ceramic filter to remove any excess particulate. This is to prevent the sample from cooling below its dew point, avoiding water condensation. The stack probe assembly has a sensor to monitor the oven temperature and will provide a contact when the temperature falls below 250 Deg F. This signal is sent back to the panel and is terminated at TS- 16, 17, 18. Refer to 0222492E Electrical Drawing.

This will also be flagged at the DAS by Station Manager these inputs are at the PLC and are labelled D4, D5, D6.

3.2.2 Heated Sample Line

The Sample lines provided are specifically for CEMs and have a low CO Permeability and low temperature capability. The outer jacket is capable of handling temperatures below —2O Deg F. The unit is equipped with three tubes each 3/8” Diameter. These are connected up at the stack probe and are terminated in the panel. The tubes are for Blowback, Sample and a Calibration line.

Due to the lengths of the sample lines 240 VAC has been provided in the panel to provide ample voltage to the heaters. The sample lines have an RTD installed @ Mid Point for monitoring the temperature of the sample line. The temperature is controlled by the Eurotherm 221 6e temperature controller. This is set 200 Deg F. to maintain the temperature above the dewpoint.

There is a relay contact provided on TS-0 from each controller in the event the temperature falls below the set point. Refer to the 0222492E Electrical Drawing.

3.2.3 Sample Pump / Vacuum Switch / Water Carry Over

This system is equipped with an ADI model RlOl-FT-AA1 sample pumps with an 181 eccentric. Wetted components of these pumps are stainless steel for the single head with a Teflon coated EPDM diaphragm.

The pumps are operated and controlled by three relays which are wired from the water carry over sensor. The sample pump will run when the WCO has detected no moisture. If moisture is detected the WCO sensor will provide a contact to shut the sample pump off. This will be flagged by the DAS as an alarm input Water Slip #1, #2 or #3 and is designated by PLC inputs B2, B6 and C2.

Each Pump is equipped with a High Vacuum switch which will provide a contact closure if the sample inlet has been plugged. This will be flagged by the DAS and the PLC inputs designations are D7 for High Vacuum #1 B4 for #2 and CO for #3. Refer to Digital Input form 22492-1.

3.2.4 Sample By-pass Section

To increase speed of response of this system, a by-pass or fast loop section has been included. Furthermore all sample flow is diverted through this section when the system is off-line for calibration and is vented to atmosphere. System design ensures that the pump will not be subjected to a deadhead condition therefore it will only be necessary to shut down the pump when specific maintenance of that device is required. By-pass sample flow is monitored and controlled with a Brooks flowmeter with inlet needle valve. Sample By-Pass is set 5 SCFH and may require adjustment due to sample length.

3.2.5 Sample Cooler

The Sample Cooler reduces the temperature of the sample gas to approximately 4 °C using a refrigeration system. This removes excess moisture from the sample before delivering it to the analyzers.

The Universal Analyzers Model 1050 Thermoelectric two stage Sample Cooler employs a peltier element to effect this refrigeration. Reduction of sample dewpoint ensures that water will not collect or condense in this system. Formation of water in the analyzer would require substantial down time to enable repair. There are two Kynar impingers for sample to protect against concentrations of SO_2 and NO_X forming with water.

There is a cooler failure alarm which will activate if the Dew point rises above 9 Deg C. This will be flagged by the DAS and is designated by PLC inputs B3, B7 and C3.

The cooler will cause water to condense in a heat exchanger. This water is forced to drain using pressure derived from the sample pump.

3.2.6 Sample Filters

The sample filters are course filters to remove any further particulate or contamination which has passed through the Chillers. These are aluminum body filters model 360A- 50C and have a filter element # 25-64-SOC which will need to be periodically replaced.

3.2.7 Sample Pressure Regulator

Pressure control is key to accurate measurement when analyzing gases. A stainless steel pressure regulator is used with this system to control analyzer sample pressure. A pressure gauge ranged 0 — 15 psig is used in conjunction with the regulator to provide a visible verification of sample pressure.

3.2.8 Analyzer Cabinet

The system analyzer cabinet measures approximately 72”H X 60”W X 30”D. The system is fitted with two operating front doors which will allow access to analysis system components. Designed to meet NEMA 12 specifications for General Purpose Electrical Approval. The system is a rack mount system and incorporates all system components except for the DAS PC. All sample connections are clearly identified and are external to the enclosure. Refer to Drawing 0222492D Dimensional Drawing.

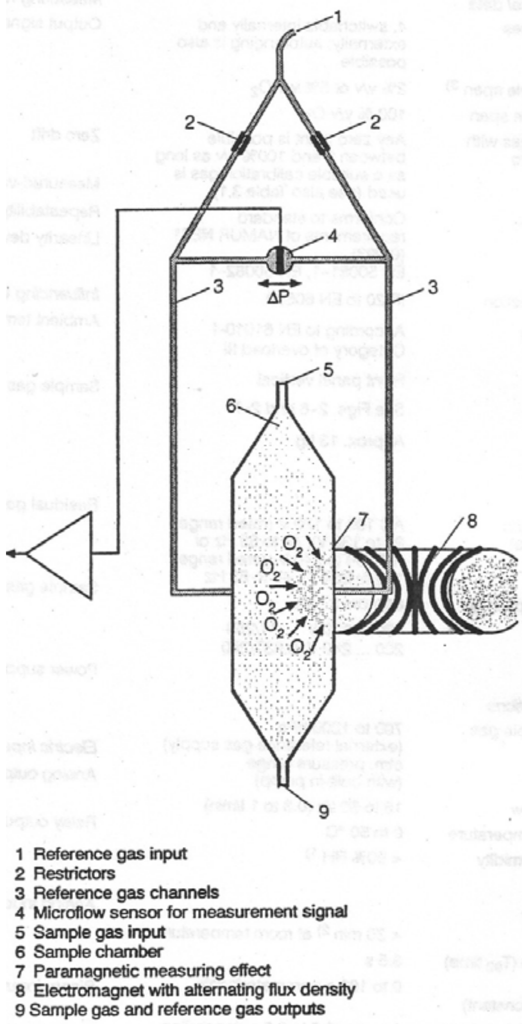
The cabinet is equipped with two exhaust fans and is controlled with a temperature Thermostat set 90 Deg F.

3.2.9 Oxygen Monitor (Siemens Oxymat 61)

A Siemens Oxymat 61 Oxygen Analyzer is used to determine in-stack Oxygen (O_2) concentrations.

The Oxygen molecule (O_2) has a unique physical property of paramagnetism, and this is ustilized as the measuring principle of the Oxymat 61 analyzer. Oxygen molecules ain an inhomogeneous magnetic field are drawn in the direction of increased field strength due to their magnetic dipole.

Figure 3-1 - Oxymat 61 principle of operation.



The analyzer compares the reaction of a reference gas (in channel 3 in the above diagram) with that of a sample gas when they encounter a magnetic field. The difference in response induces gas flow in the reference gas stream which is proportional to the in-stack gas concentration.

The analyzer is providing an analog output to CR 3 of the PLC and Pins 5&6 of TS-0. The output is represented by a 4-20 mA output for a range of 0-25%.

The recommended calibration gas for these components is *(to follow…)*.

There are three alarms associated with the Oxymat 61 O_2 Maintenance: Request, O_2 Fault, and O_2 N2 Low flow. Refer to Form 22492-1 digital inputs and 22492-2 digital outputs for pin designations.

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

Sulphur Dioxide (SO_2) and Nitrogen Oxides concentrations are measured using an Ametek Model 922 analyzer.

The Western Research Analyzer is a Pulse Florescence UV measuring NO_X and SO_2. The analyzer measures the absorbance of ultraviolet radiation (UV) light by a gas sample. Since different gas components absorb different wavelengths of UV light in different proportions, the concentrations of gas components can be determined from these absorbencies. The concentrations of the components absorbing the light (absorbers) are then determined from relationships developed through application of the ideal gas law in concert with the laws of Bouguer, Beer, and Lambert:

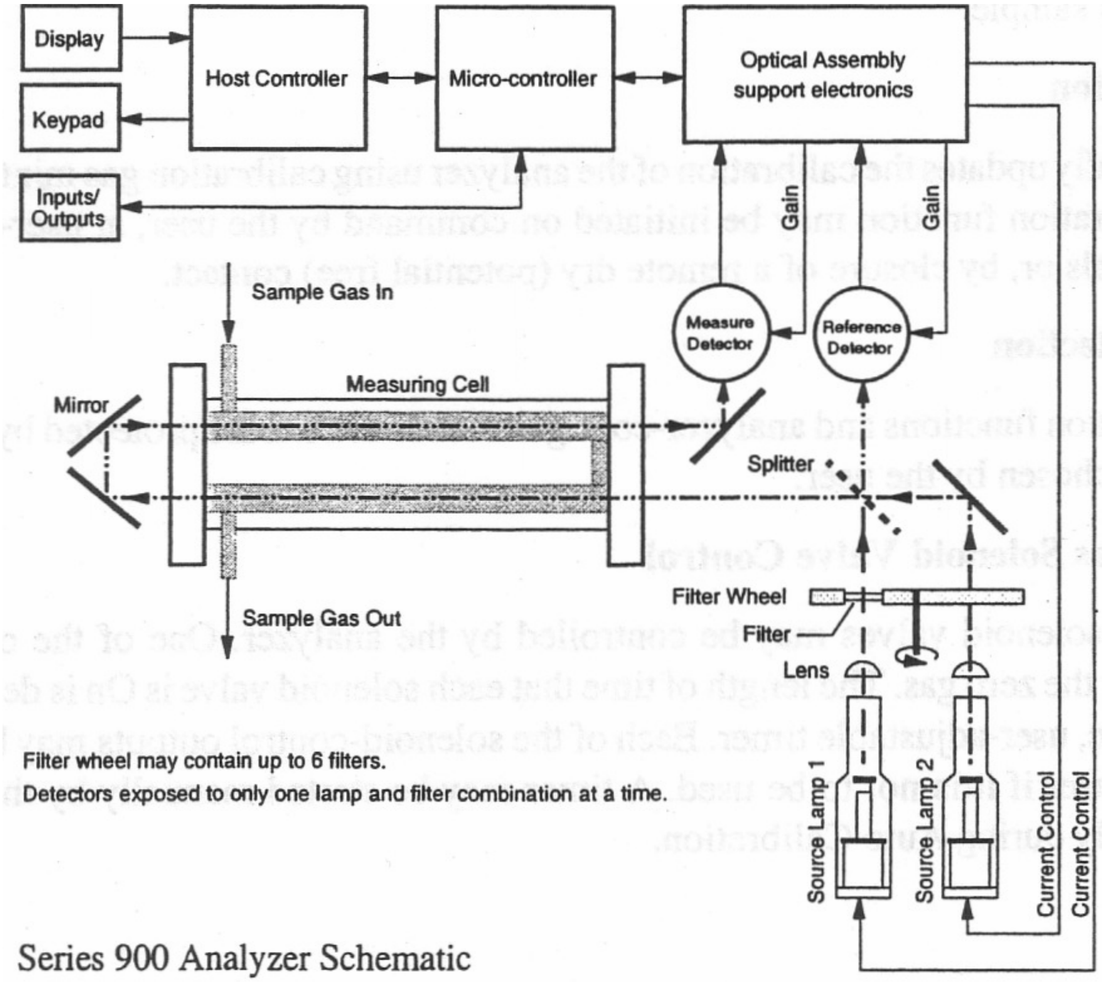
$$A = \frac{[x] \cdot k_\lambda \cdot l \cdot P}{R \cdot T}$$

Equation 3-1 - Determining Absorbance (A) from the ideal gas law and the laws of Bouguer, Beer and Lambert.

where A is the absorbance of the gas component, l is the path length of the light in the gas sample, $[x]$ is the concentration in mole percent of absorber x, k_λ is the molar absorptivity of absorber x at the measuring wavelength, λ, T and P are the temperature and pressure of the gas sample, respectively and R is the universal gas constant.

As implemented, a gas sample is extracted, conditioned and delivered to the analyzer. Ultra Violet (UV) light is passed through the sample and is reflected back to the transceiver unit. Since SO_2 absorbs UV light at a specific wavelength (apx 207 nm), the transceiver unit detects the difference between the amount of light sent though the measuring probe and the amount returned to the diode row, and this difference is correlated with in-stack SO_2 concentrations. A similar process is used to determine in-stack NO_X concentrations. The physical configuration of the analyzer is shown in Figure 3-2, below.

Figure 3-2 - Functional diagram of Sulphur Dioxide Monitor *(Ametek Model 922 Operating Manual)*



The ranges for these gas concentrations are represented by a 4-20 mA output for a range of 0-l500ppm for SO_2 and 0-l000ppm for NO_X.

The recommended calibration gas for these components is *(to follow…)*.

The analyzer is providing an analog output to Channel one and two of the PLC and Pins 1-4 of TS-0 electrical terminal strip. Refer to Form 22492-1 digital inputs and 22492-2 digital outputs for pin designations.

3.2.11 Carbon Monoxide and Carbon Dioxide (Siemens Ultramat 23)

The Siemens Ultramat 23 Analyzer uses infrared (IR) technology for measuring CO and CO_2. The analyzer uses a light absorption principle similar to that implemented by the Ametek Model 922 SO_2 & NO_X analyzer; sample gas is passed through a measuring chamber where IR light is passed through it. The amount of light absorbed at certain wavelengths is proportional to the concentrations of gas components within the gas sample.

The ranges for these gas concentrations are represented by a 4-2O mA output for ranges of 0-500ppm CO and 0-20% CO_2.

The recommended calibration gas for these components is *(to follow…)*.

The analyzer is providing an analog output to Channel four & five of the PC and Pins 7-10 of TS-0 terminal strip. Refer to Form 22492-1 digital inputs and 22492-2 digital outputs for pin designations.

3.3 SYSTEM CONTROL

The analyzers and associated components are located in a central instrumentation room within the boiler house. Four (4) to twenty (20) milliamp (mA) signals from the analyzers connected to the DAS.

(to follow…)

The accuracy of all of these signals must be assured through documentation, which must be available for review. To assure this accuracy it is necessary to verify the 4 – 20 mA signal developed by the instrument accurately reflects the parameter being measured and it is required to verify the 4 – 20 mA signal is accurately translated in the computer system.

The operating permit for the Holyrood Facility requires that information be stored for a period of two (2) years. Collected data must be safely transferred to appropriate data storage devices and secured.

4 ORGANIZATION AND RESPONSIBILITIES

4.1 General Information

A system of authority has been developed to ensure that:

- The instrument measurement (signal) accurately reflects the parameter which it is monitoring
- The signal is accurately transferred to the computer system and is properly translated, and
- The data is safely transferred to a secure location.

4.2 Responsibilities

(Person A) – (Person A) has overall responsibility to ensure the resources required to ensure the safe, efficient and accurate operation of the instruments are available and to ensure the data is safely stored for viewing as required.

(Person B) – (Person B) will apply the resources to ensure the safe and accurate operation of the instruments. (Person B) will ensure the maintenance procedures are carried out as outlined in this document, the calibration checks required to be carried out are completed and will ensure any repairs required are done in as timely a manner as possible. (Person B) will ensure a CEM Quality Assurance Log Book is maintained as all required entries are made.

Maintenance Technicians – The Maintenance Technicians will monitor the operation of the instruments on a continuing basis. Maintenance Technicians will ensure the weekly visual examinations of the instruments are carried out, the preventative maintenance carried out on shift is documented and any abnormalities in the operation of the CEMs are reported to (Person B). Maintenance Technicians will carry out the scheduled preventative maintenance activities, and the repair activities as requested by the Supervisor of Incineration. The Maintenance Technicians will acquire all calibration gasses and will install the gas canisters. The Maintenance Technicians will place copies of the documentation verifying the test gasses in the CEM Quality Assurance Log Book. The Maintenance Technicians will record all activities associated with the CEMs and the results of all testing associated with the CEM in the CEM Quality Assurance Log Book. The maintenance contractor will perform an annual verification of the electronic data acquisition system using traceable signal generators to verify the data acquisition system zero and full scale as well as accuracy over the full range of operation. The Maintenance Technicians will perform weekly maintenance consisting of a visual examination of the system components, and examination of associated filters and replacement when necessary.

System Auditor – An independent auditor will be contracted annually to verify that this QAP program is being followed and will provide a written report. The audit will include the following:

- A visual examination if the instruments;
- An examination if the CEM Quality Assurance Log Book;
- An examination for the records of calibration checks;
- A written report.

4.3 PERSONNEL TRAINING

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

- Why the CEM systems are important to the facility operations;
- General issues including keeping the weather covers closed, how to notice alarms, etc.; and
- Who to call for any maintenance and/or issues outside the abilities of the Maintenance Technicians.

5 FACILITIES, EQUIPMENT AND SPARE PARTS INVENTORY

5.1 INTRODUCTION

The CEM System consists of the following:

- Sample Conditioning and delivery;
- Oxygen Monitor (Siemens Oxymat 61);
- SO_2 and NO_X Monitor (Ametek Model 922);
- CO and CO_2 Monitor (Siemens Ultramat 23);
- Data acquisition and logging; and
- Calibration Gases.

Sample is drawn from a probe located on the lower of two exposed platforms which are situated on each of three stacks. The platforms are approximately 150 feet from the ground level and require a harnessed climber for access to the probes and the associated sample extraction equipment.

Sample is drawn from each of the three stacks, is filtered to remove particulate matter, then delivered hot and wet to the instrumentation room. Each of the three individual samples (one coming from each stack) is cycled through a Universal Analyzers Model 1050 Single Channel Sample Cooler to chill the sample and remove moisture. The three different samples are then cycled through the individual analyzers to determine the concentration of given components. This data is logged in data files unique to the particular stack associated with the sample being measured.

5.2 SPARE PARTS AND CONSUMABLES LISTINGS

Spare parts are normally maintained at the supplier of the equipment (Willer Engineering Ltd). Some critical or long delivery items will be stored onsite to avoid unnecessary down time. The actual spare parts list is not yet determined. The spare parts lists provided include all spare parts recommended by the manufacturer.

5.2.1 Spare Parts for the Blowback Stack Filters

(to follow…)

Table 5-1 - Company Contact Information for

Company Information	Universal Analyzers Inc. 1701 South Sutro Terrace Carson City, NV 89706, USA

Local Dealer Information	Willer Engineering Ltd.

5.2.2 Spare Parts for Oxygen Monitor (Siemens Oxymat 61)

(to follow…)

Table 5-2 - Company Contact Information for

Company Information	Siemens SPA CSC 1, chemin de la Sandlach F-67506 Haguenau, France
Local Dealer Information	Willer Engineering Ltd.

5.2.3 Spare Parts for Sulphur Dioxide & Nitrogen Oxides Monitor

(to follow…)

Table 5-3 - Company Contact Information for

Company Information	Ametek Process 2876 Sunridge Way N.E. Calgary, Alberta T1Y 7H9
Local Dealer Information	Willer Engineering Ltd.

5.2.4 Spare Parts for Carbon Monoxide and Carbon Dioxide Monitor (Siemens Ultramat 23)

(to follow…)

Table 5-4 - Company Contact Information for

Company Information	Siemens SPA CSC 1, chemin de la Sandlach F-67506 Haguenau, France
Local Dealer Information	Willer Engineering Ltd.

5.2.5 Spare Parts for the Sample Cooler

(to follow…)

Table 5-5 - Company Contact Information for

Company Information	Universal Analyzers Inc. 1701 South Sutro Terrace Carson City, NV 89706, USA
Local Dealer Information	Willer Engineering Ltd.

6 METHODS AND PROCEDURES – DATA ACQUISITION AND ANALYSIS

(to follow…)

7 CALIBRATION AND QUALITY CONTROL CHECKS

7.1 INTRODUCTION

Calibration of the CEM system is one of the most important aspects of the QAP program. The NL Hydro CEM System is checked daily by plant operators. To check a calibration, a known quantity of gas is automatically introduced to the system. The gas monitor measures this gas, and the measured value can then be compared to the known concentration.

If it is found that the measured value significantly differs from the known value, then a calibration adjustment must be made to bring the system in line.

Calibration adjustment consists of two steps:

1. An analyzer calibration – an adjustment of the zero and span settings on the analyzer; and
2. Software calibration to adjust for daily drifts in the CEM system.

7.2 CALIBRATION FREQUENCY FOR ANALYZERS

The drift of each monitor must be checked once daily, at 24-hour intervals. Two concentration levels are used:

1. low-range (0 to 20% Full Scale) and
2. high range (80-100% Full Scale).

7.3 CALIBRATION TOLERANCE AND OUT-OF-CONTROL LIMITS

See Environment Canada EPS 1/PG/7.

7.4 CALIBRATION GAS STANDARDS

Either Protocol 1 or gases certified to an accuracy of 2% may be used for the daily calibration.

7.5 TABULATION OF DATA

Calibration checks are recorded in the log book. Magnitude of drifts (in ppm for pollutant analyzers and % for diluent gas analyzers) is recorded and summarized on a quality control chart.

8 PREVENTATIVE MAINTENANCE SCHEDULE

8.1 INTRODUCTION

Preventative maintenance will be conducted by an outside contractor according to the specifications of this manual.

8.2 PREVENTATIVE MAINTENANCE FOR THE CEM SYSTEM

Preventative maintenance will be performed as weekly, monthly and annual checks. Each analyzer/sensor will be checked at least weekly. One weekly check per month will be replaced by a monthly check. One monthly check per year will be replaced by an annual check.

It is recommended that the monthly check be performed the first week of each month and that the annual check be performed during the same month each year.

8.3 OVERVIEW OF PROCEDURES

Preventative maintenance will follow the checklists that are found in the QC section.

9 PERFORMANCE EVALUATIONS

9.1 INTRODUCTION

Calibration and system maintenance alone do not necessarily ensure that CEM systems will report accurate data. An independent assessment using an appropriate auditing technique can help to provide data validity.

9.2 TEST FREQUENCY

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.

During each quarter, perform a cylinder gas audit (CGA) or a CEM check on the CEM system and calculate the system availability for the quarter. Where calibration gas cannot be introduced to the analyzer due to the analyzer design, checks are performed by comparison with a portabTests may be no closer than thirty (30) days for two (2) adjacent quarters, using the procedure outlined in section 9.4.

9.3 THE RELATIVE ACCURACY TEST AUDIT (RATA)

The relative accuracy is the percent difference in the CEM system's measurement of the pollutant versus the values as determined using a USEPA 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.

To receive certification, a CEM system must perform within certain specifications. EPS 1/PG/7 declares in Section 5.1.6 that the relative accuracy for individual pollutant analyzers must not exceed 10% (≤ 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 9-1, below.

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

Equation 9-1

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.

9.4 THE CYLINDER GAS AUDIT (CGA)

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 9-2, below.

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

Equation 9-2

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.

9.5 OUT-OF-CONTROL PERIODS AND MISSING DATA

The out-of-control period begins with the hour that the system or analyzer failed to meet the conditions outline in sections 9.3 or 9.4, and ends with the hour that the problem has been rectified and a test has been carried out demonstrating that the relative accuracy and/or bias results fall within the specification.

9.6 DATA AVAILABILITY

The availability of both the system and each individual monitor must be at least 90% for each calendar quarter during the first full year of operation, and 95% thereafter. Availability is determined using Equation 9-3, below.

$$\%\ Availability = \frac{T_a}{T} \cdot 100\%$$

Equation 9-3

Where:

T_a is the time during which the system or analyzer was generating quality-assured data during the quarter.

T is the total time the source operated during the quarter. The source operation hours are those during which fuel is burned.

9.7 ANNUAL SYSTEM AUDIT

An independent auditor will be contracted annually to verify that this QAP program is being followed and will provide a written report. The audit will include the following:

- A visual examination if the instruments;
- An examination if the CEM Quality Assurance Log Book;
- An examination for the records of calibration checks;
- A written report.

10 CORRECTIVE ACTION PROGRAM

10.1 INTRODUCTION

Corrective actions will be conducted by an outside contractor according to the specifications of this manual. Corrective actions will be identified using checklists that are found in the QC section and by operator checks of continuous data.

10.2 CORRECTIVE ACTION PROCEDURE

Corrective action will be performed as required by daily, weekly, monthly and annual checks. Each analyzer/sensor will be checked at least weekly. One weekly check per month will be replaced by a monthly check. One monthly check per year will be replaced by an annual check.

It is recommended that the monthly check be performed the first week of each month and that the annual check be performed during the same month each year.

11 REPORTS

11.1 RECORDS

Records will be kept for the required two (2) years.

11.2 REPORTS

(to follow…)

11.2.1 External Reports

(to follow…)

11.2.2 Report Generation

(to follow…)

11.3 RETENTION OF RECORDS

(to follow…)

12 REFERENCES

Environment Canada,
"Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation" (EPS 1/PG/7) (September 1993)

Monitor Manuals

(to follow…)