



**Royal Oak  
Mines Inc.**

Head Office  
2nd Floor - 1425 W. Pender St.  
Vancouver, B.C.  
V6G 2S3

Tel: (604) 682-8320  
Fax: (604) 682-4286

**FAX TRANSMISSION**

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DESTINATION: Giant

ATTENTION: Dave Anthony

FROM: Larry Connell

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**COMMENTS:**

Information on Continuous Stack emission monitoring  
systems for sulphur dioxide. I will leave this with  
you to follow up with regard to pricing and  
overall feasibility for the Giant Roaster Stack.



Environmental Monitoring Systems  
Industrial Process Instrumentation  
Custom Equipment Fabrication  
Equipment Maintenance & Repair

October 6, 1993

Larry Connell  
Royal Oak Mines Inc.  
1425 West Pender St.  
Vancouver, British Columbia V6G 2S3

Dear Mr. Connell:

It was a pleasure speaking with you today about your companies possible acquisition of Asia Minerals Corporation.

We have done extensive work in the far east and have associated companies there as well. Currently, we are in the final stages of a proposal to supply the Chinese Government with a CEM system for regulatory enforcement purposes.

At AEM Systems Inc. we specialize in environmental and process monitoring systems.

We examine each application and design a system to meet its requirements. Thus, complete turn-key systems are provided; optimized for performance, cost, reliability and ease of maintenance.

Our equipment packages include:

- continuous emission monitoring systems (CEMS)
- water effluent monitoring
- process monitoring for optimization and/or control.

We back our products 100% and offer installation, service contracts, training programs and maintain a spare parts inventory to meet operational needs. We call this our Cradle-to-Grave service. Certification of environmental monitoring equipment and client personnel can be arranged if required.

Our environmental systems are guaranteed to meet all regulatory requirements including US EPA, Canadian and Peoples Republic of China compliance monitoring specifications. For applications involving water, air, or plant gases, individually and/or in any combination we can help.

I have enclosed our Generic Proposal on CEMS.

If you have any questions, please don't hesitate to call us or fill out the enclosed information request card. We shall be more than happy to be of service to you.

Yours truly,  
AEM SYSTEMS INC.

A handwritten signature in cursive script, appearing to read "Mel Bahrey".

Mel Bahrey  
Technical Sales

Specification No. AEM/0320/110

# CONTINUOUS EMISSIONS MONITORING SYSTEM

## GENERIC PROPOSAL FOR STATIONARY SOURCES

SEPTEMBER 1993

**AEM SYSTEMS INC.**

7125 PACIFIC CIRCLE, UNIT 17  
MISSISSAUGA, ONTARIO L5T 2A5  
TEL (905) 795-8318 FAX (905) 795-8317

# AEM SYSTEMS INC.

## CONTINUOUS EMISSIONS MONITORING SYSTEM

### GENERIC PROPOSAL FOR STATIONARY SOURCES

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## AEM SYSTEMS INC.

### CONTINUOUS EMISSIONS MONITORING SYSTEM GENERIC PROPOSAL FOR STATIONARY SOURCES

#### 1.0 INTRODUCTION

- 1.1 **GENERAL** - This proposal describes the typical specifications for an automatic Continuous Emissions Monitoring System (CEMS) for measuring stack gas emissions from stationary sources. It is a complete stand-alone system that meets, or exceeds, the regulatory requirements specified in the US Code of Federal Register 40 Part 60 and accepted protocols in Canada. The system design emphasizes measurement accuracy, ease of operation and maintenance. System performance meets all USA and Canadian data quality assurance and certification requirements.

The information provided in this proposal is generic in nature. A specific design will be proposed to meet the user's particular requirements and applications.

- 1.2 **FLEXIBILITY** - Different emission sources can vary considerably. Different sampling configuration and monitoring equipment in the system can be easily modified to suit the particular application. The incorporation of different sampling and analysis technologies may include in-stack dilution probe, specialised sample conditioner, etc.

- 1.3 **ENHANCEMENT** - For future system enhancement and development, the CEMS can be developed into a more comprehensive emission monitoring system. It can also be used for :

- (a) Combustion control (boiler operation)
- (b) Flue gas treatment monitoring and control (scrubbers, bag houses, etc.)

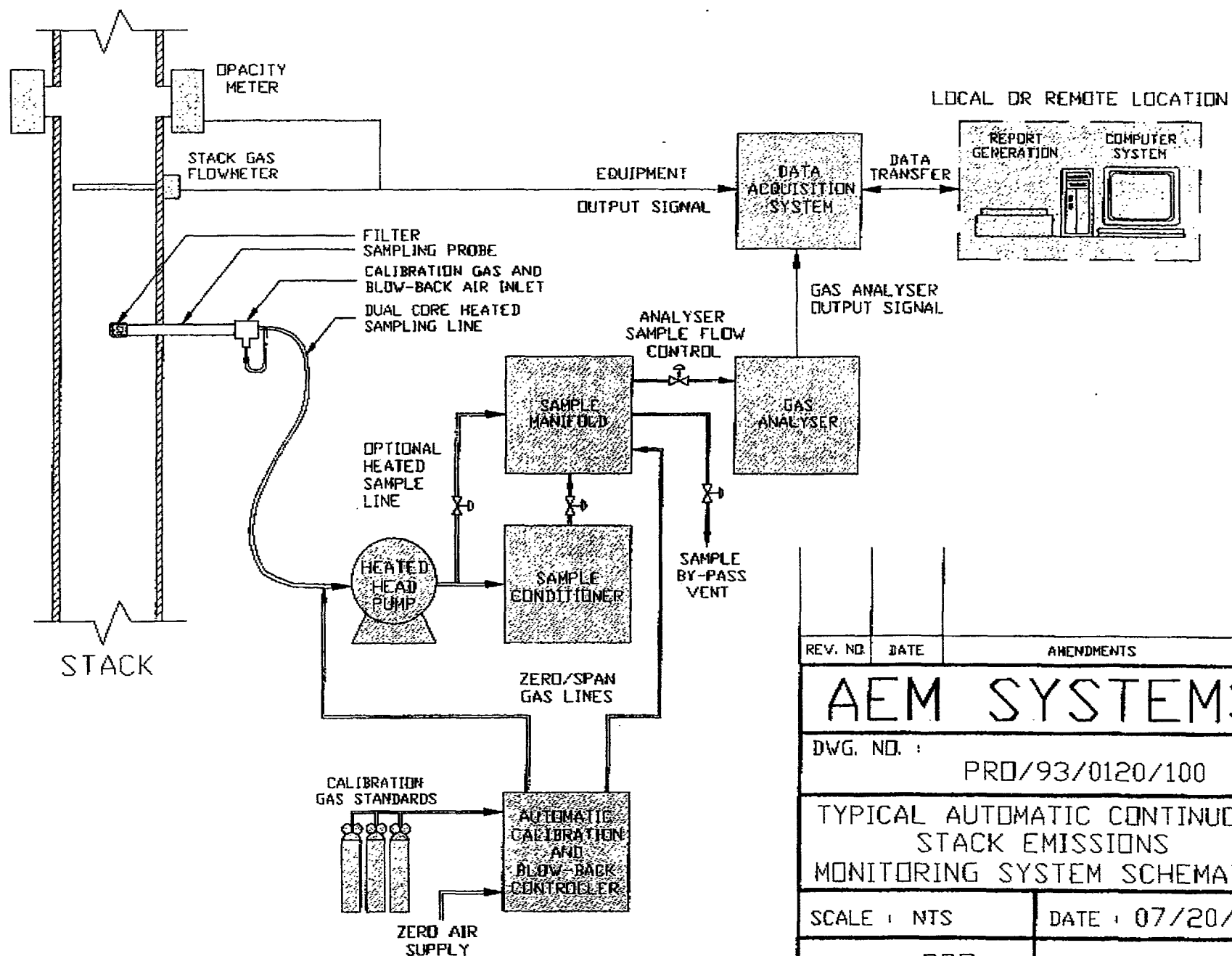
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**GENERIC PROPOSAL****CEM SYSTEM FOR STATIONARY SOURCES**

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**2.0 TYPICAL SYSTEM CONFIGURATION**

- 2.1 The proposed CEM system main components are described below. The system schematic is shown in FIG. 1.
- 2.2 **SAMPLING PROBE** - The probe extracts the gas sample from the stack. It is made of chemical and temperature resistant material, commonly Inconel or Hastelloy. It has an in-stack particulate pre-filter, a calibration gas inlet, and other supporting accessories. Coarse particulate in the gas sample are removed by the pre-filter. The calibration gas inlet allows gas standards to be introduced into the system near the sampling point. With such a configuration, the calibration gas is exposed to the same flow path and conditioning as the sample gas prior to analysis. Other accessories include optional out-of-stack filter mounted in a heated enclosure and a purge air supply for cleaning the in-stack filter.
- 2.3 **SAMPLING LINE** - The sampling line transports the sample gas to the sample conditioner. It also delivers the calibration gas and purge air to the sampling probe. The line is heated to prevent condensation in the sample stream and it may branch into two separate paths. One stream goes to the sample conditioner and the other to those analyzers that measure gas concentrations prior to conditioning (e.g. total hydrocarbon analyzer).
- 2.4 **SAMPLE CONDITIONER** - The proposed conditioner is a refrigeration type condenser. It is used to cool the sample and remove condensate continuously. There is only minimal contact between the condensate and the sample. This ensures the integrity of the gas sample.



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- 2.5 **SAMPLE FLOW CONTROL MODULE** - This module is used to transport the sample gas and controls the flow rate through the system. A pump drives the sample gas flow to the analyzers. Flow rate is monitored by a rotameter and can be adjusted by a flow control valve. A gas manifold distributes the sample to the various analyzers and discharges the remaining sample to a by-pass vent. All wetted parts of the module are made of chemically inert material to ensure sample integrity.
- 2.6 **GAS ANALYZERS** - Automatic continuous gas analyzers, such as SO<sub>2</sub>, NO<sub>x</sub>, CO/CO<sub>2</sub>, HCl, HC and O<sub>2</sub> analyzers, are used to determine the sample gas composition. All analyzers meet or exceed US EPA accuracy and performance specifications. Appendix A describes some of the analyzers operating principles.
- 2.7 **GAS CALIBRATION** - Traceable gas standards, in compressed gas bottles with regulators are used to calibrate the monitoring system. Automatic and manual calibration methods are available. Automatic calibration time, duration, and repetition rate are fully programmable. Multilevel calibration events may be defined and recorded. With the recommended data acquisition system, calibration results are recorded, but are excluded from the monitoring data. The system also allows for a variable data purge period after calibration or analyzer out of service periods.
- 2.8 **IN-SITU ANALYZERS** - This type of analyzer is typically mounted directly on the stack or duct work. The analyzing sensor is in direct contact with the gas stream. Some of the common parameters monitored by in-situ equipment are opacity, velocity and oxygen. Appendix B lists the operating principles of these analyzers.



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2.9 DATA ACQUISITION AND REPORTING SYSTEM (DAS) - A data logging and computer system is recommended for data acquisition and reporting. The system includes : a data logging unit, a computer system with printer, and an operating software package. A typical DAS system has the following characteristics :

- (a) Real-time acquisition and storage of data obtained from the various monitoring equipment.
- (b) User programmable operational control modes of the gas analyzers, such as : back purge of the sample probe filter ; monitoring of the zero and span calibration.
- (c) Mass data storage.
- (d) Data editor capable of retrieving, modifying and deleting any data record from files on disk.
- (e) Monitoring data files can be transferred to other program formats, such as Lotus 1-2-3 and dBase III.
- (f) Graphical display of real-time or stored monitoring data for all or any selected parameters.
- (g) Communication Capabilities of the DAS includes telemetry (remote) and local console operations. Communication protocol conforms to RS 232. The transmission speed is 1200 to 9600 baud. A variety of communication devices (i.e. terminals, modems, computers, etc.) can be used to communicate with the DAS either to set up the system or to retrieve data. Data collection and control functions are not interrupted during data communication.

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The computer system will be used to retrieve and store monitoring data from the DAS via the serial (RS 232) port. After obtaining the data, the system can be used to process the data and generate CEMS reports. The format of the reports meet the requirements prescribed by the Ministry of the Environment, US Federal and State authorities. The hardware includes a computer, a video display unit, a printer, interfacing cards and controllers, and all necessary signal and connecting cables.

The following list shows some of the reports that can be generated by the system. Other report or display formats can be prepared upon request.

- (a) Data listings (single or multiple parameters).
- (b) Hourly, daily, and monthly report for any parameter monitored
- (c) Statistical reports which include totals, subtotals, counts, averages, maximum, minimum, percentiles, etc.
- (d) Calibration and data reports which include parameters, date, time (start and end), calibration performed, calibration reference and results, percentage calibration change and status.
- (e) Graphical outputs which include time series plots (trends), scatter plot (linear regression), etc.

2.10 CHART RECORDERS - If a data acquisition system is not required, a chart recorder can be used to provide a hard copy or a back-up of the monitoring data.

2.11 EQUIPMENT HOUSING - All equipment is mounted on standard 19" racks or enclosed in NEMA rated cabinets. The type of rack or enclosure used is based on the protection, heating and cooling needs of the equipment.

GENERIC PROPOSALCEM SYSTEM FOR STATIONARY SOURCES**3.0 SCOPE OF SUPPLY**

- 3.1 AEM SYSTEMS INC. can supply the complete system or any system components required. If a completely assembled system is required, the scope of supply can include system design, installation, testing, and supply of all necessary parts (such as electrical signal & power cables & connectors, pneumatic tubing and fittings), etc.
- 3.2 System certification can be arranged.
- 3.3 Operator training, on-site support and equipment service contracts can also be provided. The CEMS system described in this generic proposal employs sophisticated hardware and software systems. While it is easily operated and maintained, training is recommended for a thorough understanding of the system and its capabilities to maximize its usefulness. If required, AEM SYSTEMS INC. can provide factory or on-site training for client personnel.

The training program is based on accepted emission monitoring protocols prescribed by the US Code of Federal Register Title 40 Part 60 or equivalent Canadian protocols.

- 3.4 A complete set of operation and maintenance manuals for the monitoring system will be provided.

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## APPENDIX A

## EXTRACTIVE GASEOUS POLLUTANTS MONITORING EQUIPMENT

PARAMETER	PRINCIPLE OF ANALYSIS
Sulphur Dioxide (SO <sub>2</sub> )	Pulsed fluorescence. Automatic, continuous. The SO <sub>2</sub> molecules in the air sample are excited by the pulsed UV light. As these molecules return to the ground state, they emit a characteristic fluorescence with intensity linearly proportional to the SO <sub>2</sub> concentration.
Oxides of Nitrogen (NO <sub>x</sub> )	Chemiluminescent reaction of nitric oxide with ozone. Automatic, continuous. The sample is divided into two parts. One part is led through a NO <sub>x</sub> -to-NO converter and the other is fed directly to the reaction chamber. The NO concentration is determined by chemiluminescent reaction. The difference between the measurements of the two reaction chambers is the NO <sub>x</sub> concentration.
Carbon Monoxide (CO)	Gas filter correlation. Automatic, continuous. Infrared radiation passes through a gas filter which alternates between CO and N <sub>2</sub> due to rotation of the filter wheel. The CO gas filter acts to produce a reference beam which cannot be further affected by CO in the sample chamber. The N <sub>2</sub> side of the filter wheel is transparent to IR radiation and therefore produces a measure beam which can be absorbed by CO. Using the signals obtained by the alternation between the two gas filters, the CO concentration can be determined.

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Oxygen  
(O<sub>2</sub>)      Paramagnetic. Automatic, continuous.  
Oxygen is a paramagnetic gas. The analyzer produces a dynamic magnetic field which affects the oxygen molecules. A transducer-detector system measures this effect and outputs a current which is proportional to the oxygen concentration.

Hydro-  
carbons  
(HC)      Flame Ionization Detection. Automatic, continuous.  
Hydrocarbons passing through a hydrogen-rich flame are converted to ions. When subjected to an electrostatic field, an electric current is produced. The current is proportional to the concentration of ions and therefore hydrocarbons. By using hydrocarbon specific "cutters" the concentrations of methane, non-methane hydrocarbon and total hydrocarbon can be determined.

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## APPENDIX B

## IN-SITU MONITORING EQUIPMENT

## PARAMETER PRINCIPLE OF ANALYSIS

Opacity Optical attenuation. Automatic, continuous.  
The opacity monitor is also known as a transmissometer. It directs a narrow beam of light across the stack and through the process stream. The optical attenuation is measured and "percent opacity" values are determined. Dust concentration (in mg/M<sup>3</sup>) can be related to opacity. Calibration is accomplished by using a manual iso-kinetic dust sampling system.

The equipment does not come in direct contact with the process gas. This is accomplished by passing a stream of clean filtered air continuously between the equipment and the process gas.

Velocity Differential temperature measurement. Automatic, continuous.  
Heat lost due to process gases passing over the sensors relates to the velocity of the gas. The faster the gas stream, the greater the heat loss from the sensors. Density and pressure variations are compensated for by the use of dual sensors giving a differential temperature reading.

Other types of velocity monitors, based on other measuring principles (ie. ultrasonic, pitot tubes, etc.) are available. The type of velocity monitor selected depends on the operational conditions of each particular application (ie. temperature, abrasive and corrosive nature of the gas, dust loading, etc.)

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Oxygen Zirconium Oxide ( $ZrO_2$ ) detector. Automatic, continuous.  
The sensor is in direct contact with the process stream and acts as an electrode. It reacts with the oxygen in the stream to produce an electrical signal. The signal is then converted to an oxygen concentration reading.