

**AEM SYSTEMS INC.****FACSIMILE**

<b>To</b>	: Mr. Dave Anthony	<b>Facsimile</b>	: 403-669-9424
<b>COMPANY</b>	: Royal Oak Mines	<b>Your Ref.</b>	:
<b>From</b>	: Mel Bahrey	<b>Our Ref.</b>	:
<b>Date</b>	: Aug. 8, 1995	<b>Page 1 of</b>	: (1)
<b>Copy To</b>	:		

Dear Mr. Anthony,

Enclosed, please find the information on Continuous Emission Monitoring Systems (CEMS) for sulfur dioxide and arsenic.

I have enclosed a budgetary proposal for a CEMS for sulfur dioxide. The pricing has been designed for a "worst case" application and the final price almost always is lower.

For arsenic, at the a temperature of 100 degrees C, the arsenic in stack emissions will be in the form of particulate, not vapour. Currently there is no approved method for particulate CEMS. The only way to measure the arsenic is to sample the stack "iso-kinetically" (using EPA approved method) for particulate and do laboratory analysis on the sample.

If you have any questions, please don't hesitate to call.

Yours truly,  
AEM SYSTEMS INC.



Mel Bahrey  
Project Manager

Specification No. 95-10-164-058

**PROPOSAL FOR  
A CONTINUOUS EMISSION  
MONITORING SYSTEM FOR  
ROYAL OAK MINES  
ARSNIC ROASTER**

**SUBMITTED**

**AUGUST 1995**



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**AEM SYSTEMS INC.**  
**PROPOSAL FOR A CONTINUOUS EMISSION MONITORING SYSTEM FOR**  
**ROYAL OAK MINES**

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**PROPOSAL FOR A CONTINUOUS EMISSION MONITORING SYSTEM FOR  
ROYAL OAK MINES**

**1.0 INTRODUCTION**

AEM SYSTEMS INC. (AEM) is pleased to provide the following proposal for the supply of a Continuous Emissions Monitoring System (CEMS) to Royal Oak Mines. The proposed monitoring parameter Sulfur Dioxide (SO<sub>2</sub>). The system will be completely assembled with all necessary parts and fittings for fabrication are included. The following sections describe the specifications for the system proposed.

- 1.1 System Design** - The proposed CEMS is a complete stand-alone system. System design meets, or exceeds, the regulatory requirements specified in the US Code of Federal Register 40 Part 60.

The proposed design emphasizes on measurement accuracy, ease of operation and maintenance. It is used extensively for emission monitoring and is acceptable to regulatory authorities for such an application. System performance meets all Canadian and USA CEMS data quality assurance and certification requirements.

- 1.2 Sampling and Conditioning** - Extractive sampling and conditioning technologies will be used. This is a well-established and proven method. It allows for measurements in both dry and wet basis.

The proposed CEMS incorporates a comprehensive self-cleaning sample filtration and conditioning system. It is capable of handling samples with both high particulate and moisture contents.

- 1.3 Maintenance** - System components are modular in design. This allows efficient maintenance. The system can be easily maintained by the client's plant personnel. If required, AEM SYSTEMS will be pleased to provide a maintenance contract subsequent to the warranty period.

The equipment proposed are used extensively in Canada and, therefore, parts are readily available. Wherever possible, standard commercially available parts are

used. This further minimises maintenance and operating costs.

- 1.4 **Quality Assurance** All systems supplied are subjected to vigorous in-house quality assurance inspection prior to release for shipment. The inspection includes, but not limited to, functional test, calibration, reliability test, leak check and pressure test.

## 2.0 **SYSTEM CONFIGURATION**

The proposed CEMS is composed of the following main components. The following sections describe the functions and characteristics of each sub-system.

- 2.1 **Sampling Probe** The probe extracts gas samples from the stack. It is made of chemical and temperature resistant material, such as 316 stainless steel (SS). It is tilted down at slight angle to allow condensation to drain. To protect the system from particulate contamination, an out-of-stack dual-stage filter connects to the probe. The first stage is for condensate coalescing and coarse particles drop-out. The second stage holds a filter element, which removes fine particulate from the gas stream. The complete filter assembly is mounted in a weather-proof housing. It is heated to a temperature above typical acid boiling point (e.g.  $\text{H}_2\text{SO}_4$ ). This ensures sample integrity and prevents corrosion & contamination of the monitoring system components.

An automatic air blowback facility is incorporated for self-cleaning. Oilless filtered compressed air is used to blast the particulate and condensate off the sampling path. For the application, this feature ensures reliable continuous operation and minimizes system maintenance.

A calibration gas inlet is also provided upstream of the filter. The inlet allows calibration gas standards to be introduced into the system near the sampling point. During calibration, standard gas floods the sampling probe and prevents stack gas from entering the system. With such a configuration, the calibration gas is exposed to the same flow path and conditioning as the sample gas prior to analysis. Any leak or contamination in the sampling path will easily be identified.

2.2 **Sampling Location** - gas samples are extracted from the stack via a client supplied port with mounting flange.

2.3 **Sampling Line** - A dual-core sampling line will be used. The line is heated to prevent condensation in the sample gas. It serves the following two functions.

- (a) Transports the sample gas to the sample conditioner; and
- (b) Delivers the calibration gas and purge air to the sampling probe.

The sample gas carrying line has an inner Teflon liner which can be removed for cleaning or replacement. This allows for much easier maintenance and, without replacement of the entire heated line, significant cost savings are achieved.

2.4 **Sample Conditioner** - The proposed conditioner is a refrigeration type condenser. It is used to cool the gas sample and remove condensate continuously. Since the conditioner removes moisture very rapidly, contact between sample and condensate is minimal. This ensures sample integrity.

2.5 **Sample Flow Control Module** - This module is used to transport the sample gas and control the gas flow rate through the system. A heated head pump drives the sample gas flow to each analyzer. Gas flow is monitored by a rotameter and adjusted by a flow control valve. A manifold distributes the sample to the analyzer 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 Analyzer** - State-of-the-art automatic continuous monitoring equipment will be used. The gas analyzer meet US EPA accuracy and performance specifications.

2.7 **Gas Calibration** - Compressed gas standards will be used to calibrate the monitoring system. An optional automatic calibration controller can be incorporated in the Sample Flow Control Module (See options section for pricing). For maintenance and audit purposes, independent manual front panel calibration controls for the gas analyzer is provided. During calibration (manual or automatic), the controller supplies a digital signal to the data acquisition system for identifying calibration data.

2.8 **Data Acquisition** - A monitoring equipment signal output connection block is provided at the equipment cabinet. Client can connect external data acquisition

equipment, such as recorders and Distributed Control Systems (DCS) to this connection block. If required, we shall be glad to propose an optional data acquisition and reporting system for data collection and reporting.

- 2.9 **Equipment Enclosure** - The equipment will be mounted in an insulated free-standing equipment rack. For hot and dusty conditions, a purge air system will be provided. It provides cool air to keep the analyzers operating within the design ambient temperature limits. It will also keep out the ambient dust because of a slight positive air pressure inside the rack. Also, a heater will be used to maintain the temperature in the winter. If required, an optional separate enclosure complete with air conditioning and heating can be supplied to house the equipment rack.

### 3.0 **SCOPE OF SUPPLY**

AEM SYSTEMS INC. will supply the **complete CEMS**. The scope of supplies for AEM and that for Client's are listed below. Optional system certification assistance, system installation, operator training, on-site support, and equipment service contracts can also be provided.

#### 3.1 **Scope of Supply for AEM**

- 3.1.1 System design and fabrication. Monitoring equipment installation in the equipment cabinets. System testing and calibration. All necessary pneumatic, electrical and signal cables connections internal to the equipment rack.
- 3.1.2 Sampling system as described in Sections 3.1 to 3.5. This includes sampling probe, sampling line, sample conditioner, sample flow & calibration control module, and system operation controller.
- 3.1.3 Gas analyzer to monitor SO<sub>2</sub>
- 3.1.4 Equipment rack as described in Section 3.7. This includes all internal hardware and wiring.
- 3.1.5 Documentations. A complete set of technical documentation on the monitoring system will be provided as part of the system. This includes equipment operation manual, system schematic, wiring and pneumatic diagrams.
- 4.1.6 Miscellaneous items - All necessary parts and fittings for system

fabrication. This includes pneumatic tubing & fittings, electrical & signal cables & connectors, etc.

### 3.2 Client's Supply

The following items are to be supplied by client:

- 3.2.1 Flanged port for mounting equipment to stack.
- 3.2.2 Floor mounting for equipment cabinet.
- 3.2.3 External 110 VAC 40 A electrical power supply and signal cables for equipment rack.
- 3.2.4 Oil-free compressed instrument quality air
- 3.2.5 Equipment exhaust vent and condensate drain connections
- 3.2.6 Cement pad to mount equipment enclosure, if required

### 4.0 SYSTEM COST

Basic system includes : gas analyzer (SO<sub>2</sub>), manual calibration control, parts and labour for system integration. **Basic system cost : \$ 52,000.00**

#### 4.1 Optional Costs

(a)	Bottle calibration gas and regulators (Set of 2 bottles, leased cylinders)	\$ 1,800
(b)	Data acquisition system with CEMS operating software	\$ 18,000
(c)	Computer with printer	\$ 8,500
(d)	Certification, if required by the MOEE	\$ 10,000
(e)	Site installation, expenses extra	\$ 45/hr.
(f)	Complete equipment shelter	\$ 8,000
(g)	Training, factory OR site, as below	
	Factory training for up to 4 persons, 3 days	\$ 1,500
	Site training, 3 days	\$ 3,500

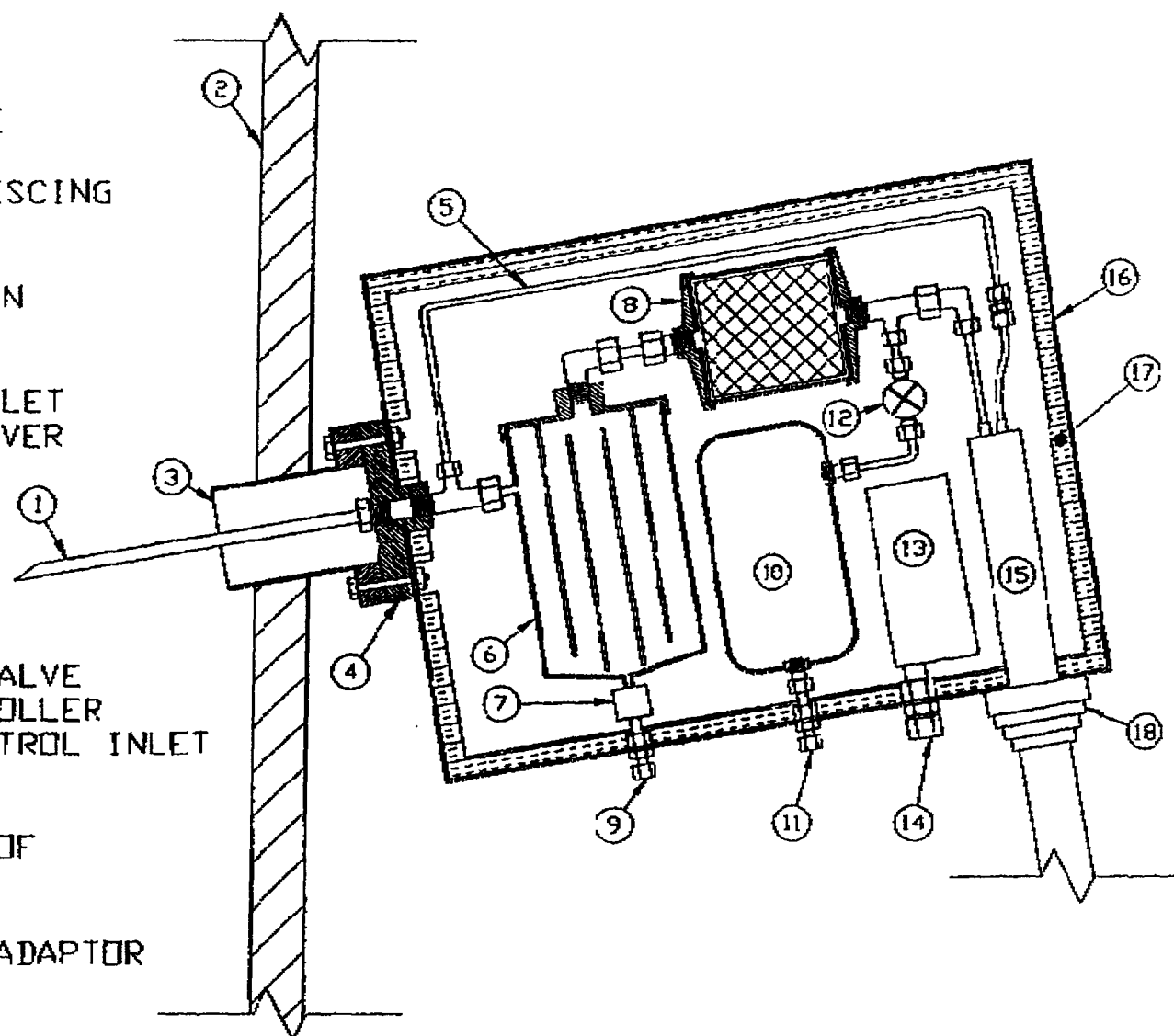
#### 4.2 Conditions

- 4.2.1 System price does not include applicable taxes and shipping fees.
- 4.2.1 The complete system will be warranted against defects in workmanship for a period of one year.



- 1: SAMPLING PROBE
- 2: STACK WALL
- 3: SAMPLING PORT
- 4: MOUNTING FLANGE
- 5: CALIBRATION GAS LINE
- 6: DRUP OUT CHAMBER  
FOR CONDENSATE COALESCING  
AND COARSE PARTICLE  
REMOVAL
- 7: AUTO CONDENSATE DRAIN
- 8: FILTER FOR FINE  
PARTICLE REMOVAL
- 9: CONDENSATE DRAIN OUTLET
- 10: COMPRESSED AIR RECEIVER

- 11: COMPRESSED AIR INLET
- 12: BLOW-BACK SOLENOID VALVE
- 13: HEATER W/TEMP. CONTROLLER
- 14: POWER SUPPLY AND CONTROL INLET
- 15: DUAL-CORE HEATED  
SAMPLING LINE
- 16: INSULATED WEATHERPROOF  
HOUSING
- 17: INSULATION
- 18: SAMPLING LINE ENTRY ADAPTOR



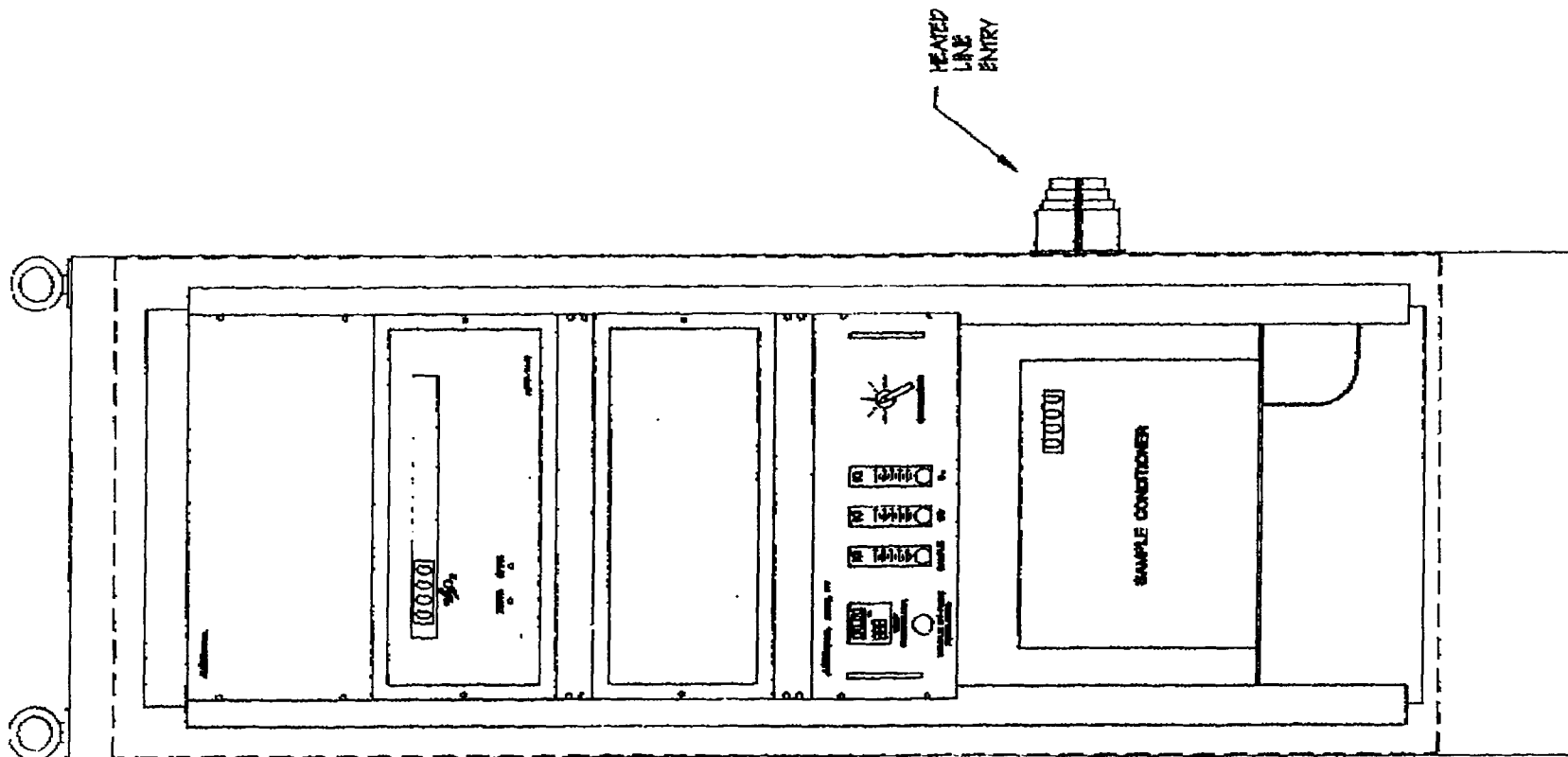
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MODEL 610  
STACK GAS SAMPLING PROBE  
FOR CEMS APPLICATIONS

**AEM SYSTEMS**

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Mississauga, Ontario, L5T 2A5

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**SO2 MONITORING  
EQUIPMENT RACK LAYOUT**

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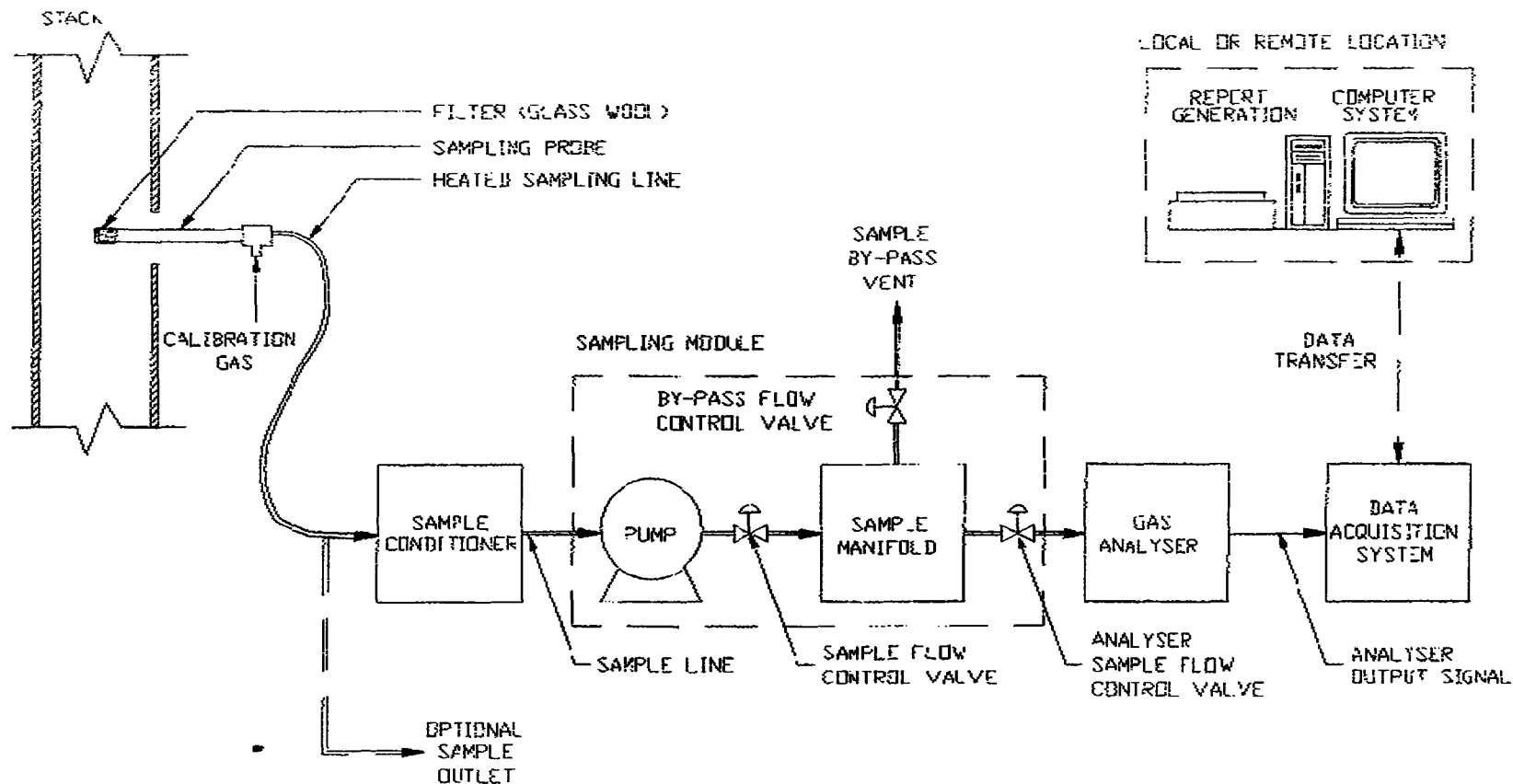
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TYPICAL CONTINUOUS  
STACK EMISSIONS TESTING  
SYSTEM SCHEMATIC

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