

PERFORMANCE TESTING PROTOCOL
for the two (2)
COMBUSTION TURBINES-CT (#1 & #2)
prepared for
XYZ POWER, L.L.C.
XYZ Power Station
FDEQ Permit No. XXX-XXX-X (PSD)
January 29, 2001

Prepared by:

Quinn A. Bierman

Quinn A. Bierman, President

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I. INTRODUCTION

A. **Reason for Testing**

An emission test will be performed on the new natural gas fired Combustion Turbine Generators to demonstrate contractual guarantees between manufacturer and buyer.

B. **Equipment Description**

The natural gas fired combustion turbine generators will be General Electric (GE) LM6000 Sprint™ simple cycle turbines. The turbines are classified as peaking units and will produce electrical power as necessary for the operation. The combustion turbines are rated to operate at 47 megawatts (MW). The emission points will be from an exhaust stack with approximately a 10' diameter stack.

II. SUMMARY

- A. **Manufacturer:** S&S Energy Products
Contact person: John Doe
Mailing address: 16415 Jacintoport Blvd.
Houston, TX 77015
Telephone: (555) 555-5555
Fax: (555) 555-5555
e-mail: N/A
- Company:** XYZ Power, LLC
Contact person: Jane Doe
Mailing address: P.O. Box 429
Tampa, FL 77053
Telephone: (555) 555-5555
- B. **Site Name:** XYZ's Florida Power Station
Location: 555 NE 80th Street
Tampa, FL
- C. **Test Contractor:** Air Hygiene International, Inc.
Contact Person: Quinn A. Bierman, President
Mailing Address: 5819 South Owasso
Tulsa, OK 74105
Telephone: (918) 746-7680
Fax: (918) 746-7659
e-mail: quinn@airhygiene.com
website: www.airhygiene.com
- D. **Proposed Test Date:** Between Friday, March 3, 2001 and Wednesday March 8, 2001
- E. **Testing Schedule**

<u>Activity</u>	<u>Time</u>
Turbine #1 & #2 simultaneously	
➤ Mobilization upon request with 24 hour notice	6 hours to get to site
➤ Initial Setup & Calibrations	3 hours
➤ Initial Velocity Traverse on both turbines	2 hours
➤ Perform Peak Load NOx & CO Testing	1 hour

F. Report Format

A report detailing the results of the test will be prepared. The emission performance guarantee testing project will have one (1) report generated from the testing. The report will meet the requirements of the FDEQ and the EPA for compliance/certification testing and will include a discussion of the following:

- Introduction
- Plant and Sampling Location Description
- Summary and Discussion of Results
- Sampling and Analytical Procedures
- QA/QC Activities
- Results and Calculations
- Raw Field Data and Calibration Data Sheets
- Sampling Log and Chain-of-Custody Records
- Audit Data Sheets

G. Equipment & Procedures

1. Equipment Specifications:
Two (2) GE LM6000 Sprint™ combustion turbines rated at 47 Megawatts.
2. Reference method (RM) tests to be performed on the sources:

Turbine Performance Guarantee Emission Determination Test Methods

EPA Method 20 for Oxygen

EPA Method 20 for Nitrogen Oxides (NO_x)

EPA Method 10 for Carbon Monoxide (CO)

EPA Method 19 for exhaust flow using Dry Oxygen F-Factor, recent fuel gas analysis, and fuel flow

3. Proposed Variations:
 - a. none

4. Sampling Procedures:

Turbines – Simultaneous Emission Performance Guarantee Determination Test

Two sampling systems will be used to collect simultaneous emission data from the exhaust of the two turbines. An initial velocity traverse will be performed at the clients requested load to determine the lowest oxygen point for each turbine's exhaust stream. From this point all emissions will be collected during the one-hour performance test. Emission tests on the turbines will be tested using continuous reading analyzers for NO_x, CO, and Oxygen after conditioning the gas through a heated sample line, thermo-electric chiller, with moisture removal to eliminate any contact with water.

5. Quality Control/Quality Assurance Activities:

A number of quality assurance activities are undertaken before, during, and after each testing project. The following paragraphs detail the quality control techniques, which are rigorously followed during testing projects.

Each instrument's response is checked and adjusted in the field prior to the collection of data via multi point calibration. The instrument's linearity is checked by first adjusting it's zero and span responses to zero nitrogen and an upscale calibration gas in the range of the expected concentrations. The instrument response is then challenged with other calibration gases of known concentration and accepted as being

linear if the response of the other calibration gases agreed within ± 2 percent of range of the predicted values. A NO₂ conversion check is performed each day of testing. NO₂ to NO conversion is checked via direct connect with an EPA Protocol certified concentration of NO₂ in a balance of nitrogen. Conversion is verified to be above 90%.

After each test run, the analyzers are checked for zero and span drift. This allows each test run to be bracketed by calibrations and documents the precision of the data just collected. The criterion for acceptable data is that the instrument drift is no more than 3 percent of the full-scale response. Quality assurance worksheets are repaired to document the multipoint calibration checks and zero to span checks performed during the tests.

The sampling systems is leak checked by demonstrating that a vacuum greater than 10 in. Hg. could be held for at least 1 minute with a decline of less than 1 in. Hg. A leak test is conducted after the sample system is set up and before the system is dismantled. This test was conducted to ensure that ambient air had not diluted the sample.

Any leakage detected prior to the tests would be repaired and another leak check conducted before testing commenced.

The absence of leaks in the sampling system is also verified by a sampling system bias check. The sampling system's integrity is tested by comparing the responses of the analyzers to the calibration gases introduced via two paths. The first path was directly into the analyzer and the second path via the sample system at the sample probe. Any difference in the instrument responses by these two methods is attributed to sampling system bias or leakage. The criterion for acceptance is agreement within 5% of the span of the analyzer.

APPENDIX A

QA/QC PROGRAM

QA/QC PROGRAM

AIR HYGIENE ensures the quality and validity of its emission measurement and reporting procedures through a rigorous quality assurance (QA) program. The program is developed and administered by an internal QA team and encompasses five major areas described as follows:

QA Reviews

AIR HYGIENE's review procedure includes a review of each source test report, along with laboratory and fieldwork by the QA Team.

The most important review is the one that takes place before a test program begins. The QA Team works closely with technical division personnel to prepare and review test protocols. Test protocol review includes selection of appropriate test procedures, evaluation of interferences or other restrictions that might preclude use of standard test procedures, and evaluation and/or development of alternate procedures.

Equipment Calibration and Maintenance

The equipment used to conduct the emission measurements is maintained according to the manufacturer's instructions to ensure proper operation. In addition to the maintenance program, calibrations are carried out on each measurement device according to the schedule outlined by the Environmental Protection Agency. Quality control checks are also conducted in the field for each test program.

Chain-of-Custody

AIR HYGIENE maintains full chain-of-custody documentation on all samples and data sheets. In addition to normal documentation of changes between field sample custodians, laboratory personnel, and field test personnel, **AIR HYGIENE** documents every individual who handles any test component in the field (e.g., probe wash, impinger loading and recovery, filter loading and recovery, etc.). Samples are stored in a locked area to which only **AIR HYGIENE** personnel have access. Field data sheets are secured at **AIR HYGIENE**'s offices upon return from the field.

Training

Personnel training is essential to ensure quality testing. **AIR HYGIENE** has formal and informal training programs, which include:

1. Attendance at EPA-sponsored training courses;
2. Enrollment in EPA correspondence courses;
3. A requirement for all technicians to read and understand Air Hygiene Incorporated's QA manual;
4. In-house training and QA meetings on a regular basis; and
5. Maintenance of training records.

Knowledge of Current Test Methods

With the constant updating of standard test methods and the wide variety of emerging test procedures, it is essential that any qualified source tester keep abreast of new developments. **AIR HYGIENE** subscribes to services, which provide updates on EPA reference methods, rules, and regulations. Additionally, source test personnel regularly attend and present papers at testing and emission-related seminars and conferences.

COMBUSTION TESTING QUALITY ASSURANCE ACTIVITIES

A number of quality assurance activities are undertaken before, during, and after each testing project. The following paragraphs detail the quality control techniques, which are rigorously followed during testing projects.

Each instrument's response is checked and adjusted in the field prior to the collection of data via multi-point calibration. The instrument's linearity is checked by first adjusting its zero and span responses to zero nitrogen and an upscale calibration gas in the range of the expected concentrations. The instrument response is then challenged with other calibration gases of known concentration and accepted as being linear if the response of the other calibration gases agreed within ± 2 percent of range of the predicted values.

After each test run, the analyzers are checked for zero and span drift. This allowed each test run to be bracketed by calibrations and documents the precision of the data just collected. The criteria for acceptable data are that the instrument drift is no more than 3 percent of the full-scale response. Quality assurance worksheets are prepared to document the multipoint calibration checks and zero to span checks performed during the tests.

The sampling systems are leak checked by demonstrating that a vacuum greater than 10 in Hg could be held for at least 1 minute with a decline of less than 1 in. Hg. A leak test is conducted after the sample system is set up and before the system is dismantled. This test was conducted to ensure that ambient air had not diluted the sample. Any leakage detected prior to the tests would be repaired and another leak check conducted before testing commenced.

The absence of leaks in the sampling system is also verified by a sampling system bias check. The sampling system's integrity is tested by comparing the responses of the analyzers to the calibration gases introduced via two paths. The first path was directly into the analyzer and the second path via the sample system at the sample probe. Any difference in the instrument responses by these two methods is attributed to sampling system bias or leakage. The criteria for acceptance are agreement within 5% of the span of the analyzer.

The control gases used to calibrate the instruments are analyzed and certified by the compressed gas vendors to $\pm 1\%$ accuracy for all gases. EPA Protocol No. 1 was used where applicable to assign the concentration values traceable to the National Institute of Standards and Technology (NIST), Standard Reference Materials.

AIR HYGIENE maintains a large variety of calibration gases to allow the flexibility to accurately test emissions over a wide range of concentrations.

APPENDIX B

TEST EQUIPMENT CONFIGURATION & DESCRIPTION

INSTRUMENT CONFIGURATION AND OPERATIONS FOR GAS ANALYSIS

The sampling and analysis procedures used during tests conform in principle with the methods outlined in the Code of Federal Regulations, Title 40, Part 60, Appendix A, Methods 10, 19, and 20.

The sample system to be used for the NO_x, CO, and O₂ tests is configured per the following description. A stainless steel probe will be inserted into the sample port of the stack. The gas sample will be continuously pulled through the probe and transported via 3/8 inch heat-traced Teflon® tubing to a stainless steel minimum-contact condenser designed to dry the sample and through Teflon® tubing via a stainless steel/Teflon® diaphragm pump and into the sample manifold within the mobile laboratory. From the manifold, the sample is partitioned to the NO_x, CO, and O₂ analyzers through glass and stainless steel rotameters that controlled the flow rate of the sample.

The schematic shows that the sample system was also equipped with a separate path through which a calibration gas could be delivered to the probe and back through the entire sampling system. This allows for convenient performance of system bias checks as required by the testing methods.

All instruments are housed in an air-conditioned trailer-mounted mobile laboratory. Gaseous calibration standards are provided in aluminum cylinders with the concentrations certified by the vendor. EPA Protocol No. 1 was used to determine the cylinder concentrations where applicable (i.e. NO_x, O₂, N₂, etc. calibration gases).

The schematic provides a description of the analyzers used for the instrument portion of the tests. All data from the continuous monitoring instruments are recorded on a Logic Beach Hyperlogger. The Hyperlogger retrieves calibrated emissions data from each instrument every second. An average value is recorded every 30 seconds.

The stack gas analysis for O₂ concentrations will be performed in accordance with procedures set forth in EPA Method 20. The O₂ analyzer uses a paramagnetic cell detector.

NO_x emission concentrations will be determined by EPA Method 20. A chemiluminescence analyzer will be used to provide the analysis. The NO_x mass emission rates will be calculated as if all the NO_x were in the NO₂. This approach corresponds to EPA's convention. However, it tends to overestimate the actual stack NO_x mass emission rates, since the majority of the NO_x is in the form of NO which is less dense (i.e. lbs of emissions per ppmv concentration) than the NO₂ form of NO_x. This gives a worst case scenario of NO_x emissions.

CO emission concentrations will be quantified in accordance with procedures set forth in EPA Method 10 using 6c restrictions. A continuous nondispersive infrared (NDIR) analyzer was used for this purpose.

ANALYTICAL INSTRUMENTATION SPECIFICATIONS

Parameter	Model & Manufacturer	Max. Range	Sensitivity	Response Time (sec.)	Detection Principle
NOx	TECO 42H or API 200	User may select any range up to 5000 ppm	0.1 ppm	30	Thermal reduction of NO ₂ to NO Chemiluminescence of reaction of NO with O ₃ . Detection by PMT. Inherently linear for listed ranges.
CO	TECO 48H or API 300	User may select any range up to 1000 ppm	0.1 ppm	30	Infrared absorption, gas filter correlation detector, microprocessor based linearization.
O ₂	Servomex 1400 or CAI 300	User may select any range up to 25%	0.1%	15	Paramagnetic cell, inherently linear.

ANALYTICAL INSTRUMENTATION TESTING CONFIGURATION

Parameter	Sample Methodology	Selected Range	Sensitivity	Response Time (sec.)	Calibration Gases
NOx	Performance Guarantee Test	0-300 ppm	0.1 ppm	30	Zero = 0 ppm nitrogen Extra Low = 20 - 30 ppm Low = 60 - 90 ppm Mid = 135 - 165 ppm High = 240 - 270 ppm
CO	Performance Guarantee Test	0-100 ppm	0.1 ppm	30	Zero = 0 ppm nitrogen Low = 20 - 30 ppm Mid = 40 - 60 ppm High = 80 - 100 ppm
O ₂	Performance Guarantee Test	1-25%	0.1%	15	Zero = 0 ppm nitrogen Mid = 12% High = 21%