ATTACHMENT P
PROPOSED COMPLIANCE ASSURANCE MONITORING (CAM) PLAN
Submitted December 12, 2005

CAM Plan Development – James River Power Station

Documentation Revision CP05.1.*

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Section 1 - Introduction

About this Plan Guide...

This Plan Guide represents significant effort by City Utilities James River Power Station and other responsible personnel to meet or exceed the requirements for the development of an effective Compliance Assurance Monitoring (CAM) Plan pursuant to the provisions of 40 CFR Part 64.

How this Plan Guide is Organized...

This Plan Guide was designed to provide users with clear, easily accessible information for the development, understanding and implementation of the James River Power Station CAM Plan. All the information needed to properly identify and ascertain the decision-making process, background information, and robust testing that came together for the development of this CAM Plan is contained within the documentation. The *CAM* Plan guide is organized into the following sections:

- **Section 1 — Introduction.**
- **Section 2 — Applicability.**
- **Section 3 — Monitoring Approach Description.**
- **Section 4 — Monitoring Approach Justification.**
- **Section 5 — CAM Test Plan.**
- **Section 6 — Test Results Summary.**
- **Section 7 — CAM Test Report.**
- **Tables and Figures.**

Definitions and Acronyms

Terms and acronyms used throughout this document are defined in the table below:

Definitions

Term	*Definition*
Administrator	EPA is considered the Administrator and has delegated its authority to the Missouri Department of Natural Resources (MDNR). MDNR has a fully delegated Operating Permit Program and will be considered the approved delegate of the Administrator in regards to this Plan. The Administrator or its delegate has the rights to require additional information that it deems necessary for consideration of this Plan and the provisions of the Operating Permit.
Alarm Trigger Level	The level at which corrective measures will begin based on the CAM indicator range as indicated by the opacity/particulate matter correlation testing. The Alarm Trigger Level (ATL) will be based on hourly average data in excess of the indicator range. The purpose is to bring the operation of the applicable control device below the trigger (alarm) level.
Alternative Method	Any method of sampling and analyzing for an air pollutant which is not a reference or equivalent method but which has been demonstrated to the Administrator's satisfaction to, in specific cases, produce results adequate for his determination of compliance.
CAM Trigger Level	The level at which a "reasonable assurance" of compliance with the applicable standard is met. Typically, this level is established at a value within 10% of the particulate standard. The trigger level represents a percent opacity determined from the correlation testing or indicator range of the control equipment parameters being monitored and recorded (e.g., opacity %, ESP parametric data).

Term	Definition
Deviation	A departure from monitoring requirements established under this part, consistent with monitor downtime events, except for periods of quality assurance activities (visual inspections, calibrations, filter checks, linearity error checks).
Exceedance	A condition that is detected through monitoring or from stack test data that indicates emissions (or opacity) are greater than the applicable emission limitation or standard. The data should be expressed in terms of the applicable units and consistent with any designated averaging period or time interval. An exceedance will be any measured value in excess of the permitted limit as indicated by a stack test for particulate or monitored opacity measurement.
Excursion	A departure from the indicator range established for reasonable assurance of compliance under this part. An excursion should be defined consistent with any averaging period specified and based on the results from the most recent compliance testing. An excursion will be an event where the secondary indicator is in excess of its threshold value (e.g., 28.7% opacity for Unit 3) based on a three hour block average. Deviation of the indicator does not mean an exceedance of the permitted limit, but a reasonable indication of an exceedance or possible exceedance if condition persists.
Indicator Range	An appropriate range(s) or designated condition(s) for the specified parameter(s) such that operation within that range provides a "reasonable assurance" of compliance with the emission limitation or standard. One or more performance parameters (e.g., primary and secondary voltages, spark rate) for the control device can be monitor and recorded. Data may be collected from a continuous opacity monitoring system and correlated to results of the most recent compliance test.
Inherent Process Equipment	Equipment that is necessary for the proper or safe functioning of the process, or material recovery equipment that the owner or operator documents is installed and operated primarily for purposes other than compliance with air pollution regulations. Equipment that must be operated at an efficiency higher than that achieved during normal process operations in order to comply with the applicable emission limitation or standard is not inherent process equipment. For the purposes of this part, inherent process equipment is not considered a control device.
Malfunction	Any sudden, infrequent, and not reasonably preventable failure of air pollution control equipment, process equipment, or a process to operate in a normal or usual manner. Failures that are caused in part by poor maintenance or careless operation are not malfunctions.
Opacity	The degree to which emissions reduce the transmission of light and obscure the view of an object in the background.
Particulate Matter	Any finely divided solid or liquid material, other than uncombined water, as measured by the reference methods specified under each applicable subpart, or an equivalent or alternative method.
Potential to emit	The maximum capacity of a stationary source to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation is enforceable by the Administrator. This term does not alter or affect the use of this term for any other purposes under the Act, or the term "capacity factor" as used in title IV of the Act or the regulations promulgated there under.
Startup	The setting in operation of an affected facility for any purpose.
Shutdown	The cessation of operation of an affected facility for any purpose.
Valid Hourly Average Data	Valid hourly average data will be determined from at least four or more one-minute average data points in each of the four (4) quadrants of an hour, except for periods of quality assurance. For periods of startup or shutdown, a valid hourly average must consist of 31 or more one-minute average data points.
Valid 3-Hour Average Data	Valid three-hour average data will be determined from three consecutive valid hourly average data points. A three-hour block average will be calculated and maintained for monitoring purposes per the applicable sections of this CAM Plan.
Valid 6-Minute Average Data	Any one of the ten (10) equal parts of a one-hour period.

Acronyms

Acronym	Meaning
APCP	Air Pollution Control Program
CAM	Compliance Assurance Monitoring
EMP	Environmental Management Program
EPA	Environmental Protection Agency
ESP	Electrostatic Precipitator
GEP	Good Engineering Practices
MDNR	Missouri Department of Natural Resources
PM	Particulate Matter
PS	Performance Specification

What Does a CAM Excursion Mean...

Excursion as defined in this plan will not necessarily or automatically indicate a failure to satisfy or comply with the applicable requirements of the regulation(s). In no way, should the MDNR or another regulatory agency or citizen group correlate excursions of the CAM indicator level with violation of the standard. Pursuant to 70.6(c)(5), CAM excursions are reported in the compliance certification statement as "possible exceptions to compliance," not as noncompliance and will not be reported as such. Reporting of excursions will be provided in conjunction with the usual semi-annual reports, submitted under 70.6(a)(3)(iii)(A).

How is a Deviation Interpreted...

A deviation will be interpreted as a failure to meet the monitoring requirements pursuant to the applicable regulation. Since percent opacity will be monitored and the COMS will be used as the monitoring device associated with the CAM trigger level, a deviation from the monitoring provisions pursuant to 10 CSR 10-4.040 for Units 1 through 5 will be reported quarterly as monitor downtime. Deviations from the required reporting and other administrative record keeping requirements will be recorded and reported semi-annually and as part of the annual compliance certification statement. Monitoring deviations for Units 1 and 2 will be reported pursuant to the Reporting Requirements listed in Table 9 to Subpart DDDDD and provisions stated in 63.7550.

What Constitutes an Exceedance...

An exceedance will be defined as emissions of particulate matter or percent opacity in excess of its applicable emission standard or limit. The CAM Plan provides a reasonable test that the applicable standard has not been exceeded. However, it is not an absolute measurement of the applicable standard. An exceedance of the particulate matter standard will be indicated when the average of three test runs, each of which are one hour or more (depending on the dust loading) in duration, exceeds 0.16 lbs/mmBtu for any affected unit. Other credible measurement methods may be used if requested and approved by the MDNR Enforcement Section. The CAM testing conducted for determining the appropriate CAM trigger levels was not necessarily a compliance test. However, the tests are credible evidence of compliance and a good indicator for developing the trigger levels and monitoring approach proposed in this plan.

Start-Up and Shutdown Exclusion from CAM Requirements

Missouri Regulations stipulate that MDNR *may* excuse excess emissions during startup and shutdown events, but require prompt reporting for periods when the emission limit is exceeded for greater than one hour. Typically, these particular exceedance events are reported next business day. Ten (10) day prior notification is required for startup or shutdown periods that are "expected" to have excess emissions for greater than one hour. The following details the startup and shutdown provisions within Missouri rules.

10 CSR 10-6.050 Start Up, Shutdown and Malfunction Conditions (1) Applicability. This regulation applies to all installations in the state of Missouri. (2) Definitions. Definitions of certain terms in this rule, other than those specified in this rule section, may be found in 10 CSR 10-6.020. (3) General Provisions. (B) The owner or operator shall notify the Missouri Department of Natural Resources' Air Pollution Control Program at least ten (10) days prior to any maintenance, startup or shutdown, which is expected to cause an excess release of emissions that exceeds one hour. If notice cannot be given ten (10) days prior to any maintenance, startup or shutdown, which is expected to cause an excess release of emissions, notice shall be given as soon as practicable prior to the maintenance, startup or shutdown or orally as soon as practical during normal working hours after the release and no later than close of business of the following working day with written notice to follow within ten (10) working days of the release. The owner or operator of such facility shall notify the Missouri Department of Natural Resources' Air Pollution Control Program in the following ways:

- A written report including (See Attachment C of the Operating Permit Application):
  1. Name and location of installation;
  2. Name and telephone number of person responsible for the installation;
  3. Name of the person who first discovered the malfunction and precise time and date that the malfunction was discovered;
  4. Identity of the equipment causing the excess emissions;
  5. Time and duration of the period of excess emissions;
  6. Type of activity and the reason for the maintenance, startup or shutdown;
  7. Type of air contaminant involved;
  8. Estimate of the magnitude of the excess emissions expressed in the units of the applicable emission control regulation and the operating data and calculations used in estimating the magnitude;
  9. Measures taken to mitigate the extent and duration of the excess emissions; and
  10. Measures taken to remedy the situation, which caused the excess emissions and the measures taken or planned to prevent the recurrence of these situations.

Plant startup and shutdown procedures are followed when energizing the ESPs. These procedures do not allow for immediate energizing of the ESP on natural gas or other fuel sources until a certain flue gas temperature is reached. For the affected units, the exit gas temperatures need to be at or above two hundred-seventy (270) degrees Fahrenheit (°F) to satisfy safety concerns and prevent ESP fouling. During any event, periods of extended unit startups or shutdowns must be minimized "to the extent practicable" to shorten the duration of excess PM emissions from the units. Typically, startup on pipeline natural gas minimizes the duration and magnitude of the exceedance(s). JRPS reserves the right to make any necessary changes to its CAM Plan and its Operation and Maintenance Plan or procedures as appropriate.

MACT Superior to CAM

Units 1 and 2 have emission limitations and continuous monitoring provisions contained within the MACT standard that will supercede the requirements of CAM. Further, EPA intended provisions of Part 63 to provide sufficient "enhanced monitoring" requirements pursuant to its authority under section 114(a)(3) of the Clean Air Act.[1] City Utilities will comply with the PM provisions as stated in the MACT standard, therefore; CAM does not apply. The current particulate matter emission rate limit is 0.16 lb/mmBTU. The MACT PM standard is 0.07 lb/mmBTU. Units 1 and 2 are required to be in compliance with the applicable MACT standard by September 13, 2007. The MACT requires City Utilities to conduct initial performance testing in order to certify compliance with the particulate matter emission rate limit cited in Table 1 for existing, large, solid fuel units. Initial MACT performance PM testing was completed on December 7, 2005. Preliminary test results indicated compliance with the 0.07 lb/mmBTU standard.

Plan Overview

City Utilities of Springfield, Missouri (City Utilities) proposes the following monitoring methodology to serve as CAM. Since the James River Power Station is submitting this plan with its operating permit renewal application, City Utilities reserves the right to revise the CAM Plan and provide subsequent submissions, as needed. City Utilities reserves the right to provide the most flexible approach possible within the regulatory obligations of this rule or other provisions of the Act. City Utilities will continue to investigate its options and will provide further notification to the MDNR regarding any changes in its approach.

The CAM Plan protocol provides guidance for monitoring control device performance and assessing, on a continuous basis, a "reasonable assurance" of compliance with the applicable emission limitation or standard. Each of the affected units at the James River Power Station is equipped with electrostatic precipitators (ESPs) control technology and has a certified Continuous Opacity Monitoring System (COMS) located on each unit stack. Units 1 and 2 have a COMS that measure the total opacity contribution from both units. High quality data collection will be maintain through periodic maintenance checks, and daily calibrations.

[1] 62 FR 54915 Preamble to Compliance Assurance Monitoring, final rule dated October 22, 1997.

Section 2 - Applicability

CAM Regulations

Why James River Units are Affected...

The James River Power Station is subject to the applicable requirements pursuant to 40 CFR Part 64, identified below (*Applicability*), and is required to submit a Compliance Assurance Monitoring (CAM) plan as part of its operating permit application. 40 CFR Part 64 requires the James River Power Station to maintain and operate its electrostatic precipitator control devices to "reasonably" assure compliance with the applicable particulate matter emission limitation for each affected unit.

§64.2 Applicability

(1) The unit is subject to an emission limitation or standard for the applicable regulated air pollutant (or a surrogate thereof), other than an emission limitation or standard that is exempt under paragraph (b)(1) of this section listed below;

(2) The unit uses a control device to achieve compliance with any such emission limitation or standard; and

(3) The unit has potential pre-control device emissions of the applicable regulated air pollutant that are equal to or greater than 100 percent of the amount, in tons per year, required for a source to be classified as a major source. For purposes of this paragraph, "potential pre-control device emissions" shall have the same meaning as "potential to emit," as defined in §64.1, except that emission reductions achieved by the applicable control device shall not be taken into account.

James River's affected coal-fired boilers satisfy the criteria requirements listed above. The exemptions listed in §64.2(b)(1) are provided below for future reference.

(b) Exemptions:

(1) Exempt emission limitations or standards. The requirements of this part shall not apply to any of the following emission limitations or standards:

(i) Emission limitations or standards proposed by the Administrator after November 15, 1990 pursuant to section 111 or 112 of the Act.

(ii) Stratospheric ozone protection requirements under title VI of the Act.

(iii) Acid Rain Program requirements pursuant to sections 404, 405, 406, 407(a), 407(b), or 410 of the Act.

(iv) Emission limitations or standards or other applicable requirements that apply solely under an emissions trading program approved or promulgated by the Administrator under the Act that allows for trading emissions within a source or between sources.

(v) An emissions cap that meets the requirements specified in §70.4(b)(12) or §71.6(a)(13)(iii) of this chapter.

(vi) Emission limitations or standards for which a part 70 or 71 permit specifies a continuous compliance determination method, as defined in §64.1. The exemption provided in this paragraph (b)(1)(vi) shall not apply if the applicable compliance method includes an assumed control device emission reduction factor that could be affected by the actual operation and maintenance of the control device.

The exemptions to the CAM provisions identified in (b)(1)(i) apply to JRPS Units 1 and 2. Both boilers are classified as Industrial Boilers under section 112 of the Act. MACT standards for particulate matter will apply. The MACT standard will supersede the applicable regulatory emission limitation for particulate matter found in Missouri Regulation 10 CSR 10-4.040(2)(B) and more specifically City Ordinance of Springfield Article III, Division 3, Section 6-235. Compliance with the MACT standard emission limitation will constitute compliance with the provisions of both Missouri regulation and Springfield City Ordinance. Continuous compliance monitoring requirements are specified in Table 8 of the MACT standard as stated in §63.7540(a)(1). James River will comply with the MACT standards for industrial boilers prior to the September 13, 2007 compliance date.

The "Reasonable Assurance" of Compliance Criteria

The CAM Plan is designed to provide a "reasonable assurance" of compliance with each unit's applicable emission limitation. The CAM Plan is not intended as an enhanced monitoring approach that provides a *direct* measure of compliance. "Reasonable assurance" means that evidence of absolute measurement is not needed and that many monitoring approaches can be considered. Further, "reasonable assurance" does not mean that all possible scenarios or endless combination of possibilities need to be explored. It basically means that the weighing of sufficient evidence would lead to the possibility of determining compliance with the appropriate emission limit. EPA recognized this criterion in writing the preamble language to the CAM rule cited at 62 FR 54921.

Identification of Emissions Units

James River Units 1 and 2 are Combustion Engineering designed, balance draft tangential-fired, pulverized coal steam boilers that commenced commercial operation in 1957. Both boilers are rated at 250 mmBtu per hour heat input. Both turbine generators are a Westinghouse single case unit. Each turbine nameplate base load rating is 22 megawatts. The normal operating load range is 20-23 MW.

James River Unit 3 is a Riley balanced draft, dry bottom pulverized coal steam boiler that commenced commercial operation in 1960. The turbine generator is a Westinghouse tandem, compound non-reheat unit. Unit 3's turbine nameplate base load rating is 44 megawatts. The normal operating load range of the unit is 30-46 MW.

James River Unit 4 is a Riley pressurized horizontal front-fired, dry bottom pulverized coal steam boiler that commenced commercial operation in 1964. The turbine generator is an Allis-Chalmers tandem, compound unit. Unit 4's turbine nameplate base load rating is 60 megawatts. The normal operating load range of the unit is 40-65 MW.

James River Unit 5 is a Riley pressured draft horizontal front-fired, dry bottom pulverized coal steam boiler that commenced commercial operation in 1970. The turbine generator is a General Electric tandem, compound unit. Unit 5's turbine nameplate base load rating is 105 megawatts. The normal operating load range of the unit is 50-106 MW.

Emission Limitations

Table 2, below, lists the applicable emission limitations established for Units 1 to 5 through regulation. Since opacity will be used as a secondary indicator, the percent opacity limit for all the affected units has been identified. The CAM plan is designed around a trigger level calculated as a three-hour block average of percent opacity data. The alarm trigger level will be based on hourly average of opacity data. However, opacity limits for each unit are based on six-minute averages determined from Method 9 Visual Observations. The CAM Plan does not change James River's responsibility to comply with its opacity limitation. Unit 1 and 2 are identified in the CAM Plan to note CAM applicability for these units, should different methodologies be used to comply with the Federal MACT requirements.

Table 2: Unit Specific Emission Limits

James River Units	Applicable Regulatory Section		Opacity Limit	Particulate Matter
	State/City Rules	Federal Rules	(Percent)	(Pounds per Million Btu)[1]
Units 1 and 2	10 CSR 10-4.040, Article III, Division 3, Section 6-235 (Spfld)		40%	0.16 lb/mmBtu
Units 1 and 2		40 CFR Part 63, Subpart DDDDD	20%	0.07 lb/mmBtu
Unit 3	10 CSR 10-4.040, Article III, Division 3, Section 6-235 (Spfld)		40%	0.16 lb/mmBtu
Unit 4	10 CSR 10-4.040, Article III, Division 3, Section 6-235 (Spfld)		40%	0.16 lb/mmBtu
Unit 5	10 CSR 10-4.040, Article III, Division 3, Section 6-235 (Spfld)		40%	0.16 lb/mmBtu

[1]Linear regression equation of the emission limitations found under Section 6-235, yielded $y=1.0222x^{-0.2326}$

Control Equipment Description

Control Technology Description Located at James River Power Station

Unit 1 and 2 ESPs

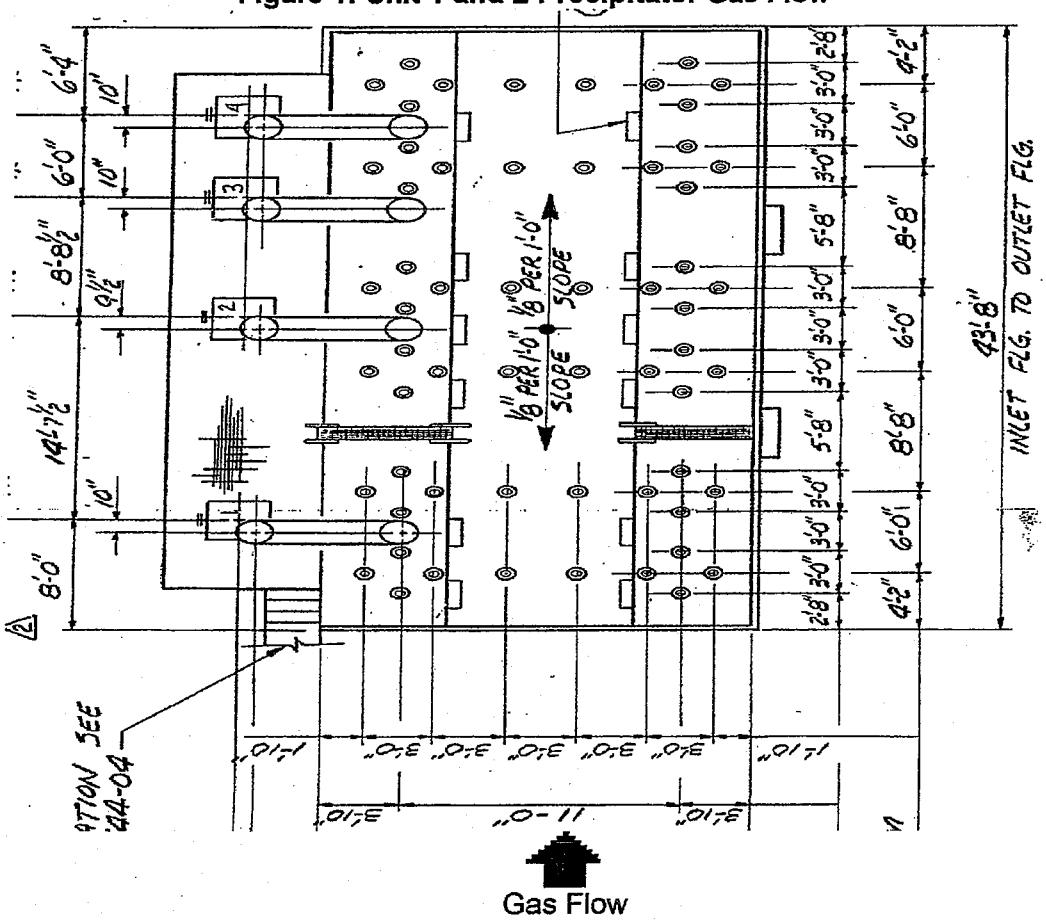
Units 1 and 2 contain a Buell Environmental high efficiency electrostatic precipitator (ESP) in the flue gas ductwork downstream of its coal-fired steam generator. Both precipitators consist of a four (4)-chamber unit, designed to remove fly ash from the cold-side flue gas originating from the coal-fired steam generator. As the gas passes the high voltage rigid discharge electrode (RDEs), the ash receives a negative charge and is attracted to the positively charged collecting plates. At timed intervals, magnetic impact rappers attached to the collecting plates and RDEs are energized and "rapped" to dislodge the accumulated material, which falls by gravity to the hoppers below. Following the fly ash removal, the cleaned flue gas is emitted to the atmosphere through a common stack. The original purchasing contract specified an overall design collection efficiency rating of greater than 99.5 percent. Table 3, details more specifically Unit 1 and 2's ESP design parameters.

Table 3: Unit 1 and 2 ESP Design Parameters:

Parameter	Design
Total gas flow, ACFM x 10^3	210
Gas Temperature, °F	325
Design Pressure, inches, w.g.	±15
Collection Efficiency, %	99.5

The control devices are similar in design and configuration. Both electrostatic precipitators are classified as a rigid frame, horizontal flow dry-type precipitator and housed in a reinforced steel casing. Figure 1, depicts the gas flow through the ESP for illustrative purposes, and reflects the design of both unit's ESPs.

Figure 1: Unit 1 and 2 Precipitator Gas Flow



Unit 3 ESP

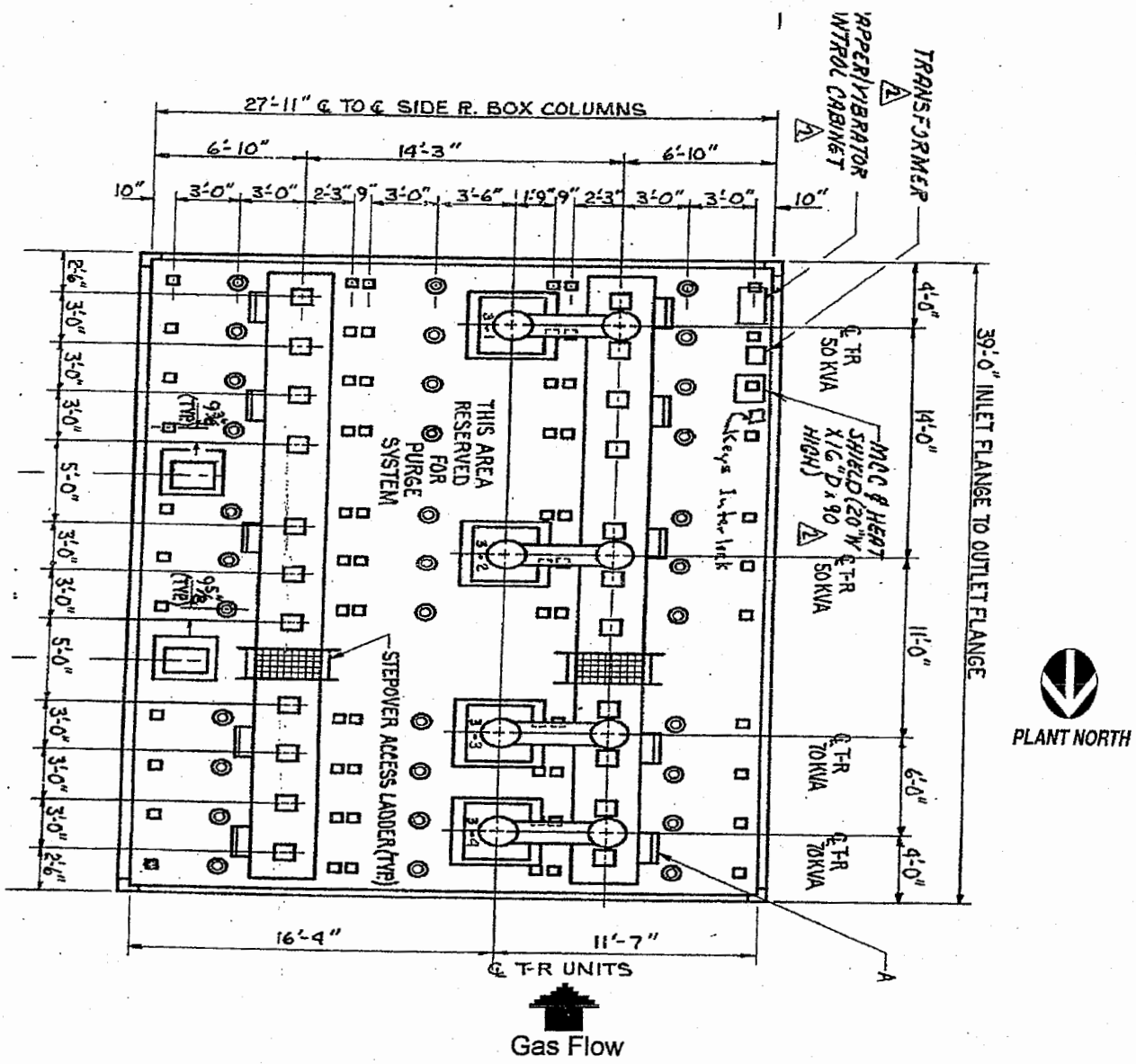
Unit 3 is equipped with a high efficiency electrostatic precipitator (ESP) used for controlling emissions of particulate matter. The original manufacturer of the precipitator was Buell Environmental. The original purchasing contract specified an overall design collection efficiency rating of 99.5 percent. Table 4, below, details more specifically Unit 3's ESP design parameters.

Table 4: Unit 3 ESP Design Parameters:

Parameter	Design
Total gas flow, ACFM x 10^3	225
Gas Temperature, °F	375
Design Pressure, inches, w.g.	±15
Collection Efficiency, %	99.5

In 2003, MERRICK Environmental Technologies, Inc. rebuilt the existing precipitator. The rebuild consisted of new anti-sneak baffles, and Hamon/Research Cottrell collecting surfaces. The baffles act as stiffeners. They provide rigidity and straightness for the collecting plate assemblies and also enhance the transmission of rapping energy over the entire collecting surface. MERRICK utilizes a rigid electrode design, Model RS-115.[2] Figure 2, below, depicts the gas flow through Unit 3's ESP.

Figure 2: Unit 3 Precipitator Gas Flow



2 MERRICK Environmental Technology, Inc. Proposal No. P030516.

The electrostatic precipitator is classified as a rigid frame, horizontal flow dry type precipitator. The electrostatic precipitator's chamber contains three mechanical and ten electrical fields in the direction of the gas flow. Table 5 lists Unit 3's ESP physical characteristics data for reference.

Table 5: Unit 3 Precipitator Physical Characteristics

Parameter	Value
Design Gas Volume	225,000 ACFM
Design Gas Temperature, °F	375 °F
Number of Precipitators	1
Number of Mechanical Fields	3
Number of Electrical Fields	10
Number of Chambers in Parallel/ESP	1
Number of Gas Passages/Field	27 Total
Spacing of Gas Passages	12"
Collecting Surface Material	G-Opzel
Specific Collecting surface SCA = A / V	350 ft^2/kACFM
Electrode Spacing (in direction of gas flow)	12"

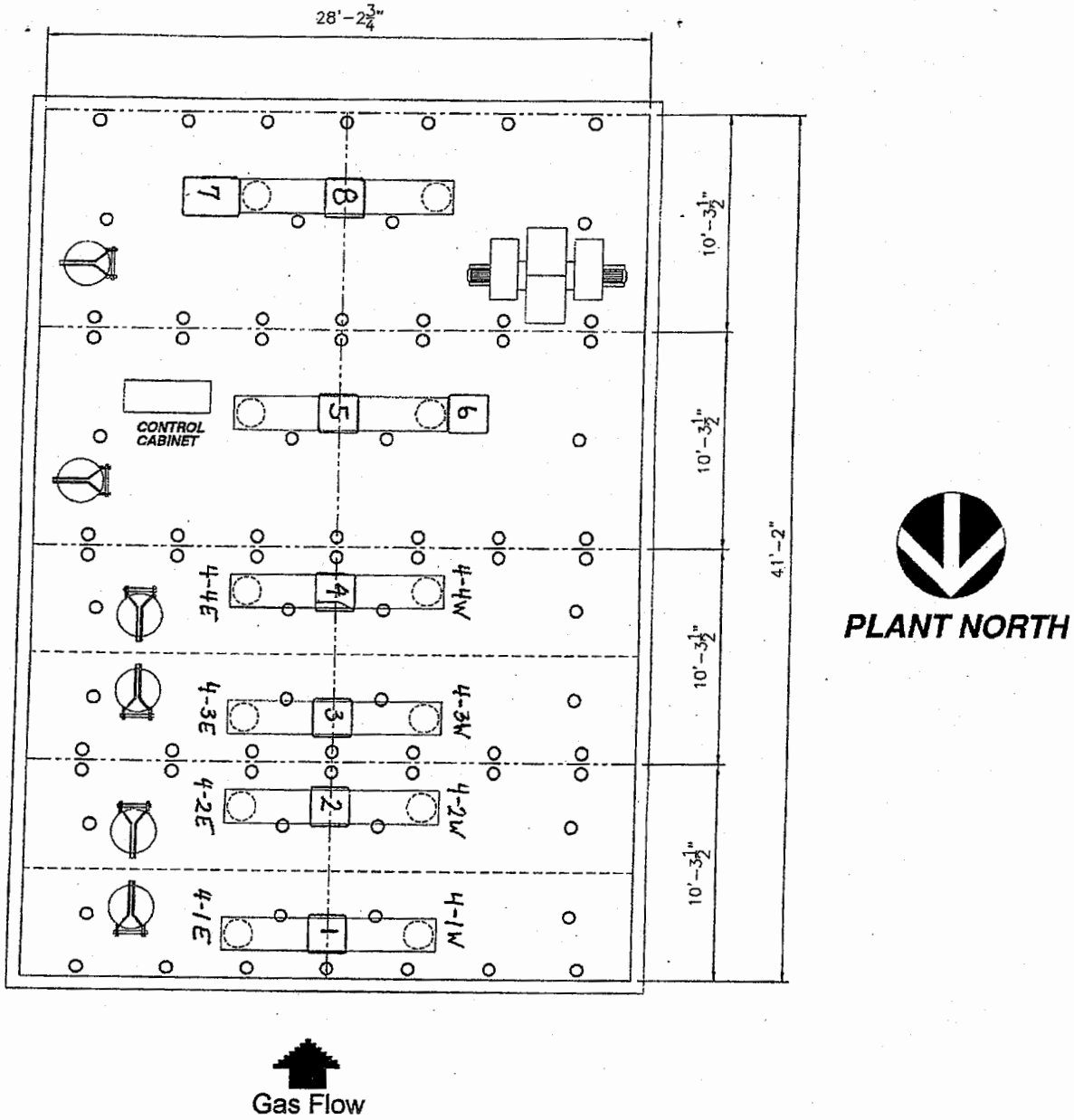
Unit 4 ESP

Unit 4 is equipped with a high efficiency electrostatic precipitator (ESP) used for controlling emissions of particulate matter. The original manufacturer of the precipitator was Universal Oil Products (UOP). The original purchasing contract specified an overall design collection efficiency rating of greater than 99 percent. In 2000, PECO rebuilt the original precipitator to its existing configuration and to maintain control efficiency of the particulate collection device. The precipitator consists of a single chamber unit, with 27 gas passages, designed to remove fly ash from the cold-side flue gas originating from the coal-fired steam generator. Table 6, below, details more specifically Unit 4's ESP design parameters. Figure 3, below, depicts the gas flow through Unit 4's ESP.

Table 6: Unit 4 ESP Design Parameters:

Parameter	Design
Total gas flow, ACFM x 10^3	250
Gas Temperature, °F	330
Draft Loss, inches wc	N/A
Collection Efficiency, %	> 99

Figure 3: Unit 4 Precipitator Gas Flow



The electrostatic precipitator is classified as a rigid frame, horizontal flow dry type precipitator. The electrostatic precipitator's chamber contains four mechanical and electrical fields. Table 7 lists Unit 4's ESP physical characteristics data for reference.

Table 7: Unit 4 Precipitator Physical Characteristics

Parameter	Value
Design Gas Volume	250,000 ACFM
Design Gas Temperature, °F	330 °F
Number of Precipitators	1
Number of Mechanical Fields in Series/ESP	4 @ 9'
Number of Electrical Fields in Series/ESP	4 @ 4.5', 2@9'
Number of Cells in Parallel/ESP	2 in one chamber
Bus Sections/ESP	12
Number of Gas Passages/ESP	27
Spacing of Gas Passages	12"
Collecting Surface Material	A36, 18 Gauge Opzel-Type Plate
Total Effective Plate Area per Precipitator	58,320 ft^2
Specific Collecting surface SCA = A / V	58,320 ft^2 / 250,000 ACFM = 233 ft^2 / 1000 ACFM
Total Number of Discharge Electrodes/ESP	648
Electrode Spacing (in direction of gas flow)	17 3/16"
Electrode Material for Field 1	A513, 16 ga. Tube w/ 1 ½" Pins
Electrode Diameter for Field 1	1 ½ "
Number/Type of Plate Rappers/ESP	56/Magnetic Impact
Number/Type of Electrode Rappers/ESP	24/Magnetic Impact
Collecting Surface/Rapper, ft^2 for Field 1	1080
Discharge Electrode/Rapper, ft for Field 1	624/672 (4.5" Fields)
	1248/1344 (9" Fields)
Insulator Compartment Purge System	Positive Pressure Air

Unit 5 ESPs

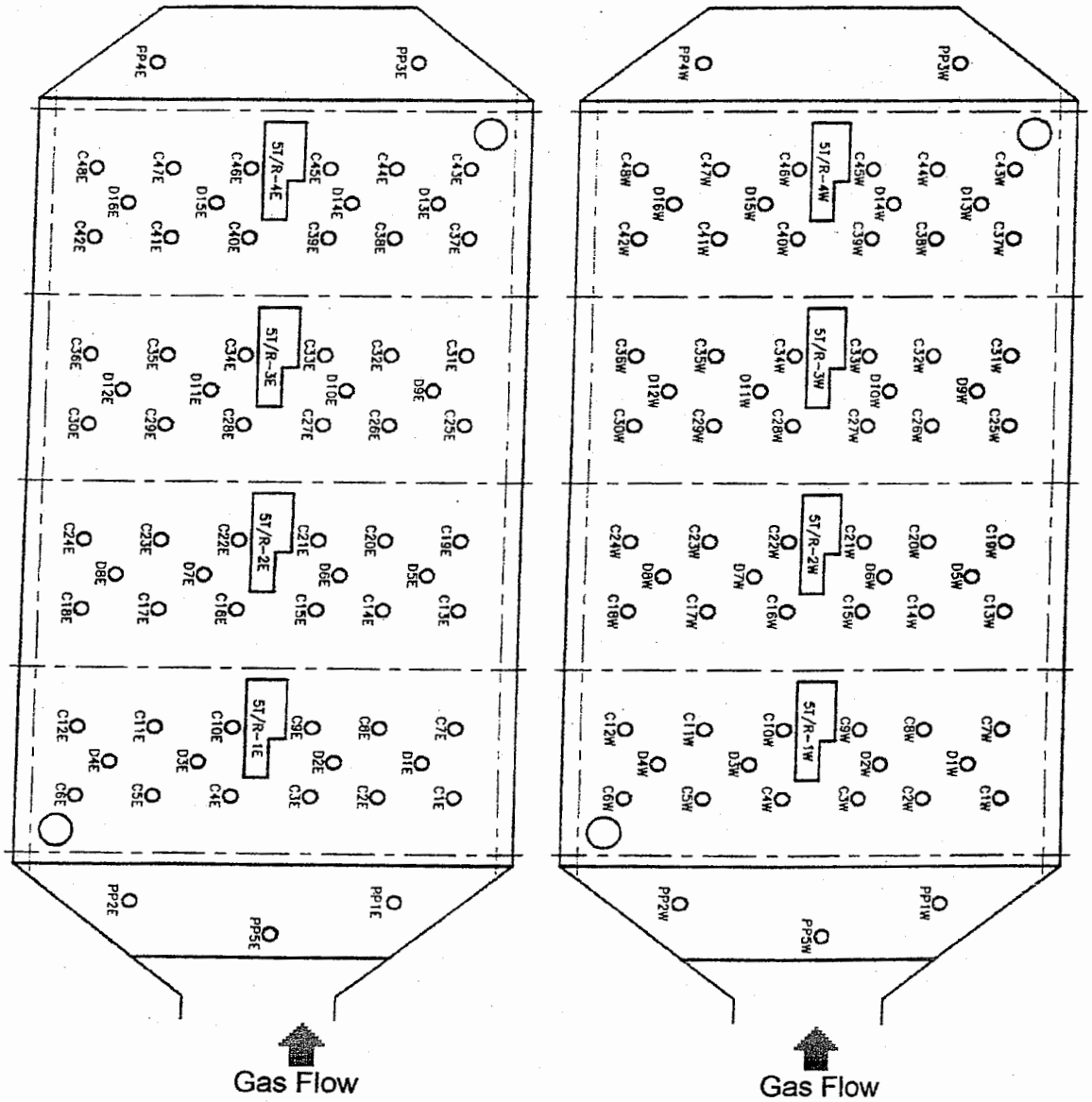
Unit 5 is equipped with high efficiency electrostatic precipitators (ESPs) used for controlling emissions of particulate matter. The original precipitator box was manufactured by Research Cottrell and remains upstream of the new ESPs. The new ESPs were manufactured by Belco Technologies, Corp. and designed with an overall collection efficiency rating of 99.88 percent. Table 8, below, details more specifically Unit 5's ESPs design parameters.

Table 8: Unit 5 ESP Design Parameters:

Parameter	Design	Range
Total gas flow, ACFM x 10^3	484	N/A
Gas Temperature, °F	400	370-430
Draft Loss, inches w.c.	±20	N/A
Collection Efficiency	99.88	N/A

Three electrostatic precipitators are in the flue gas ductwork downstream of the Unit 5 coal-fired steam generator. The three precipitator units were designed and built under two separate projects. However, only two of the three precipitators remain electrically charged for particulate capture and removal. The original Research Cottrell ESP removes large, heavier particles gravimetrically. Figure 4, below, depicts the gas flow through Unit 5's Belco ESP. The precipitators built by Belco consists of two separate chambers, designed to further treat the flue gases coming from the existing ESP. Elements of the CAM Plan specifically reference the continued operation and maintenance of the two Belco ESPs.

Figure 4: Unit 5 Precipitator Gas Flow



The Belco electrostatic precipitators are classified as rigid frame, horizontal flow dry type precipitators. Each electrostatic precipitator's chamber contains four independently energized fields in series. Table 9 lists Unit 5's ESP physical characteristics data for reference.

Table 9: Unit 5 Precipitator Physical Characteristics

Parameter	Value
Design Gas Volume	484,000
Design Gas Temperature, °F	400
Number of Precipitators	2
Number of Mechanical Fields in Series/ESP	4
Number of Electrical Fields in Series/ESP	4
Number of Chambers in Parallel/ESP	2
Number of Bus Sections in Parallel/Chamber	4
Bus Sections/ESP	8
Spacing of Gas Passages	16"
Total Effective Plate Area per Precipitator	127,680 ft^2
Specific Collecting surface SCA = A / V	127,680 ft^2 / 484,000 ACFM = 264 ft^2/1000 ACFM
Electrode Spacing (in direction of gas flow)	6"