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MACT Analysis

MACT Analysis on Main Boiler
Submitted by IPL



Interstate Power and Light Co.
An Alliant Energy Company

May 14, 2008

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SUBJ: Sutherland Generating Station Unit 4, Project Number 07-602
RE: Air Permit Application, Case-by-Case MACT Analysis

Dear Mr. Roling:

Interstate Power and Light Company (IPL) is please to present you and the Department with the attached Case-by-Case MACT Analysis for the new Sutherland Generating Station (SGS) Unit 4.

On February 8, 2008, the District of Columbia Circuit Court of Appeals vacated the Clean Air Mercury Rule (CAMR). In light of this decision, IPL has conducted a Case-by-Case MACT Analysis for SGS Unit 4, and hereby submits the analysis for the Department's review.

IPL greatly appreciates the input that you and your staff have provided, and we look forward to continuing to work with the Department as this project proceeds forward. If at any time during the review of this submittal you have any questions or require additional information, please do not hesitate to contact me at (319) 786-4476 or via e-mail at alanarnold@alliantenergy.com.

Sincerely,

A handwritten signature in blue ink, appearing to read "Alan Arnold".

Alan Arnold
Senior Environmental Specialist
Interstate Power and Light Company

RECEIVED
MAY 16 2008

CC: Jeff Beer, Project Director, Interstate Power and Light Company
Andy Byers, Environmental Manager, Black & Veatch
Tim Hillman, Air Permitting Manager, Black & Veatch

Sutherland Generating Station Unit 4 Prevention of Significant Deterioration Air Permit Application

Case-by-Case MACT Analysis

Prepared for:
Interstate Power and Light Company
Cedar Rapids, Iowa



Prepared by:
Black & Veatch Corporation
Overland Park, Kansas

May 2008
Black & Veatch Project No. 145491
Black & Veatch File No. 32.2012

CASE-BY-CASE MACT ANALYSIS

Prepared for
Interstate Power and Light Company
Sutherland Generating Station
Unit 4

May 2008
PROJECT NO. 145491

Black & Veatch Corporation
Overland Park, Kansas

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Acronym List

AC	Activated Carbon
Acfm	Actual Cubic Foot per Minute
ACI	Activated Carbon Injection
AQC	Air Quality Control
BACT	Best Available Control Technology
BOP	Balance of Plant
B-PAC	Brominated Powdered Activated Carbon
Btu	British Thermal Unit
CAA	Clean Air Act
CAMR	Clean Air Mercury Rule
CEM	Continuous Emission Monitoring
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COHPAC	Compact Hybrid Particulate Collector
DOE	Department of Energy
ECO	Electro-Catalytic Oxidation
EGU	Electric Generating Unit
EPRI	Electric Power Research Institute
ESP	Electrostatic Precipitator
FF	Fabric Filter
FGD	Flue Gas Desulfurization
H ₂ SO ₄	Sulfuric Acid Mist
HAP	Hazardous Air Pollutant
HCl	Hydrochloric Acid
HF	Hydrofluoric Acid
Hg	Mercury
Hg ⁰	Elemental Mercury
Hg ⁺²	Oxidized Mercury
Hg _p	Particle Bound Mercury
Hg _T	Total Mercury
HNO ₃	Nitric Acid
ICR	Information Collection Request
IDNR	Iowa Department of Natural Resources
IPL	Interstate Power and Light Company



Lb/h	Pound per Hour
MACT	Maximum Achievable Control Technology
MBtu	Million British Thermal Unit
MerCAP	Mercury Control Adsorption Process
MSW	Municipal Solid Waste
MW	Megawatt
MWC	Medical Waste Combustors
NO	Nitrogen Monoxide
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
PAC	Powdered Activated Carbon
PC	Pulverized Coal
PEESP	Plasma Enhanced Electrostatic Precipitator
PIC	Product of Incomplete Combustion
PJFF	Pulse Jet Fabric Filter
PM/PM ₁₀	Particulate Matter/Particulate Matter Less than 10 Microns
PPM	Parts per Million
PRB	Powder River Basin
PRB-1	Powder River Basin - Rawhide
RACT	Reasonably Achievable Control Technology
RBLC	RACT/BACT/LAER Clearinghouse
SCA	Specific Collection Area
SCPC	Supercritical Pulverized Coal
SCR	Selective Catalytic Reduction
SDA	Spray Dryer Absorber
SGS	Sutherland Generating Station
SNCR	Selective Noncatalytic Reduction
SO ₂	Sulfur Dioxide
SO ₃	Sulfur Trioxide
tpy	Tons per Year
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WESP	Wet Electrostatic Precipitator
90/10 Blend	90 percent Powder River Basin Coal/10 percent Illinois Basin Coal Fuel Blend

1.0 Executive Summary

Interstate Power and Light Company (IPL) proposes to construct a new electric generating facility (hereinafter referred to as the “Project”) at its existing Sutherland Generating Station (SGS) in Marshalltown, Iowa. The Project, SGS Unit 4, will consist of one 649 MW (megawatt) (net) supercritical pulverized coal (SCPC) fired boiler.

The project is governed by Section 112 of the 1990 Clean Air Act Amendments (CAA) which requires the USEPA to develop standards to control major sources of Hazardous Air Pollutants (HAPs) to levels consistent with the lowest emitting facilities in similar source categories. These standards are called the Maximum Achievable Control Technology (MACT) standards.

Section 112(g)(2) of the CAA requires a “case-by-case” MACT determination for new major sources where USEPA has not established applicable emission limits. Based on a December 20, 2000 USEPA regulatory finding, coal fired electric generating units (EGU), which were constructed after December 14, 2000 became subject to the case-by-case MACT provisions. This finding was reversed by USEPA’s “Delisting Rule” in March 2005. This Delisting Rule was followed closely by the USEPA’s Clean Air Mercury Rule (CAMR) in May 2005. CAMR established a two-phased cap-and-trade program for regulating mercury emissions from coal fired utility units greater than 25 MW; however, CAMR and the Delisting Rule were vacated on February 8, 2008, by the District of Columbia Circuit Court of Appeals.

The decision of the D.C. Circuit may reinstate the USEPA’s December 2000 finding, adding coal fired EGUs to the source category list Under Section 112(c) of the Clean Air Act. However, in accordance with IDNR guidance, it is assumed for the purpose of this analysis that SGS Unit 4 is subject to a 112(g) case-by-case MACT emission limitation determination.

Hazardous air pollutants (HAPs) emitted from coal fired utility boilers and regulated under case-by-case MACT may generally be classified into four categories, including:

- Inorganic, solid phase HAPs.
- Inorganic, acid gas HAPs.
- Organic HAPs.
- Mercury.

Table 1-1 presents the case-by-case MACT determinations for SGS Unit 4, including the proposed control technology, surrogate pollutant basis (as applicable), and proposed emission limit for each of the four major HAP categories.

**Table 1-1
 Proposed Case-by-Case MACT Determination Summary**

HAP Category	Control Technology	Pollutant/Surrogate basis	Emission Limit
Inorganic Solid Phase HAPs	FF + WFGD	PM/PM ₁₀ - Proposed as a surrogate to represent MACT for Inorganic Solid HAPs	0.012 lb/MBtu* (filterable)
			0.018 lb/MBtu* (total)
Inorganic Acid Gas HAPs	WFGD	HCl	0.0012 lb/MBtu
		HF	0.0002 lb/MBtu*
Organic HAPs	Good Combustion Controls	CO and VOCs - Proposed as a surrogate to represent MACT for Organic HAPs	0.12 lb/MBtu* (CO)
			0.0034 lb/MBtu* (VOC)
Mercury HAP	Brominated PAC/ FF+WFGD	Hg	2.33 x 10 ⁻⁶ lb/MBtu

*BACT determination. PSD Air Permit Application - Addendum and Response to IDNR Requests for Additional Information (April 2008).

2.0 Introduction

Interstate Power and Light Company (IPL) proposes to construct a new electric generating facility (hereinafter referred to as the “Project”) at its existing Sutherland Generating Station (SGS) in Marshalltown, Iowa. The Project, SGS Unit 4, will consist of one 649 MW (megawatt) (net) supercritical pulverized coal (SCPC) fired boiler.

Section 112 of the 1990 Clean Air Act Amendments (CAA) requires the USEPA to develop national standards to control major sources of hazardous air pollutants (HAPs) to levels consistent with the lowest emitting facilities in similar source categories. These standards are referred to as the maximum achievable control technology (MACT) standards. A major source of HAPs is defined as any source with potential emissions of any single HAP listed in Section 112(b)(1) of the CAA in excess of 10 tons per year, or any combination of HAPs greater than 25 tons per year.

Section 112(g)(2) of the CAA requires a “case-by-case” MACT determination for new major sources where EPA has not established applicable emission limits. Those regulations require case-by-case MACT determinations by the Title V permitting authority for each major source of HAPs which is constructed after the effective date of that permitting authority’s Section 112(g) program.

Section 112(n) of the CAA required the USEPA to conduct a study of HAP emissions from electric generating units (EGU) and provide a report to Congress. This section states “The Administrator shall regulate electric utility steam generating units under this section, if the Administrator finds such regulation is appropriate and necessary after considering the results of the study required by this subparagraph”.

On December 20, 2000, the USEPA published in the Federal Register, 65 Fed. Reg. 79825, a notice stating that “regulation of HAP emissions from coal- and oil-fired electric utility steam generating units under Section 112 of the CAA is appropriate and necessary.” Based on this regulatory finding, coal fired EGU which were constructed or reconstructed after December 14, 2000, were added to the source category list in Section 112(c) of the CAA and became subject to the case-by-case MACT provisions until the EPA promulgates applicable MACT standards for this source category.

In March 2005, this finding was reversed by USEPA’s “Delisting Rule”- “Revision of December 2000 Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units and the Removal of Coal- and Oil-Fired Electric Utility Steam Generating Units From the Section 112(c) List,” 70 Fed. Reg. 15994. The Delisting Rule was followed closely by the USEPA’s Clean Air Mercury Rule (CAMR) in May 2005, “Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units,” 70 Fed. Reg. 28606.

On March 14, 2008, the rules for coal fired EGU changed again when the United States Court of Appeals for the District of Columbia Circuit in *New Jersey v. EPA*, Case No. 05-1097 (Feb. 8, 2008), vacated CAMR and the Delisting Rule. The Court's action in *New Jersey v. EPA* may be interpreted as reinstating the USEPA's December 2000 finding and adding coal fired EGU to the source category list required by Section 112(c) of the Clean Air Act. Under that interpretation, SGS Unit 4 may be subject to the requirement for case-by-case MACT emission limitations pursuant to Section 112(j) of the CAA.

However, the IDNR has advised IPL that in the aftermath of the D.C. Circuit court decision in *New Jersey v. EPA*, a case-by-case MACT determination will be required under Section 112(g) for permitting the proposed SGS Unit 4 project. Accordingly, this document is provided as IPL's case-by-case MACT analysis for the SGS Unit 4, assuming the requirements are applicable as a result of the *New Jersey v. EPA* decision.

2.1 MACT Definition

The standards for the control of hazardous air pollutants are established under Sections 112(d)(2) and (3) of the Clean Air Act:

(2) STANDARDS AND METHODS. —Emissions standards promulgated under this subsection and applicable to new or existing sources of hazardous air pollutants shall require the maximum degree of reduction in emissions of the hazardous air pollutants subject to this section (including a prohibition on such emissions, where achievable) that the Administrator, taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements, determines is achievable for new or existing sources in the category or subcategory to which such emission standard applies, through application of measures, processes, methods, systems or techniques including, but not limited to, measures which—

(A) Reduce the volume of, or eliminate emissions of, such pollutants through process changes, substitution of materials or other modifications,

(B) Enclose systems or processes to eliminate emissions,

(C) Collect, capture or treat such pollutants when released from a process, stack, storage or fugitive emissions point,

(D) Are design, equipment, work practice, or operational standards (including requirements for operator training or certification) as provided in subsection (h), or

(E) Are a combination of the above.

None of the measures described in subparagraphs (A) through (D) shall, consistent with the provisions of Section 114(c), in any way compromise any United States patent or United States trademark right, or any confidential business information, or any trade secret or any other intellectual property right.

(3) NEW AND EXISTING SOURCES.—*The maximum degree of reduction in emissions that is deemed achievable for new sources in a category or subcategory shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source, as determined by the Administrator.*

The principles of case-by-case MACT have been established in 40 CFR § 63.43(d):

(d) Principles of MACT determinations.

The following general principles shall govern preparation by the owner or operator of each permit application or other application requiring a case-by-case MACT determination concerning construction or reconstruction of a major source, and all subsequent review of and actions taken concerning such an application by the permitting authority:

(1) The MACT emission limitation or MACT requirements recommended by the applicant and approved by the permitting authority shall not be less stringent than the emission control which is achieved in practice by the best controlled similar source, as determined by the permitting authority.

(2) Based upon available information, as defined in this subpart, the MACT emission limitation and control technology (including any requirements under paragraph (d)(3) of this section) recommended by the applicant and approved by the permitting authority shall achieve the maximum degree of reduction in emissions of HAP which can be achieved by utilizing those control technologies that can be identified from the available information, taking into consideration the costs of achieving such emission reduction and any non-air quality health and environmental impacts and energy requirements associated with the emission reduction.

(3) The applicant may recommend a specific design, equipment, work practice, or operational standard, or a combination thereof, and the permitting authority may approve such a standard if the permitting authority specifically determines that it is not feasible to prescribe or enforce an emission limitation under the criteria set forth in Section 112(h)(2) of the Act.

The emission limitations described in the first part of the definition 40 CFR § 63.43(d)(1), pertaining to the emission limitation achieved in practice by the best-controlled similar source, are frequently referred to as the “MACT floor.” The evaluation of more stringent limitations is frequently referred to as “beyond the floor.”

2.2 MACT Basis

SGS Unit 4 will burn low sulfur PRB and Illinois Basin coals. SGS Unit 4 will have the capability of burning the PRB coal separately (or as a blend of 90 percent PRB and 10 percent Illinois Basin [90/10 Blend]) coals based on fuel heat input. Additionally, the Project will be capable of burning a blend of biomass (up to 5 percent based on fuel heat input) with either PRB coal or with the 90/10 Blend of the PRB/Illinois Basin coal. There was no literature found or any engineering calculations performed that would indicate that co-firing coal with a biomass blend of 5 percent would change the proposed MACT emission limits.

The specific fuels and coal specifications referenced in this case-by-case MACT analysis are contained in the Project’s PSD Air Permit Application Submittals. The following Table 2-1 summarizes the SGS Unit 4 design basis for this MACT analysis.

Table 2-1 SGS Unit 4 Design Basis⁽¹⁾	
Size	649 MW (net)
Maximum Heat Input	6,326 MBtu/h ⁽²⁾
Operating Hours	8,760 h/yr
Fuels	Powder River Basin (PRB), or 90 percent PRB and 10 percent Illinois Basin (90/10 Blend), or up to 5 percent biomass blend with PRB or 90/10 Blend
Startup Fuel	Natural Gas
⁽¹⁾ 100 percent load, average annual site conditions. ⁽²⁾ Based upon firing 100 percent PRB coal.	

3.0 Case-By-Case MACT Analysis for SGS Unit 4

HAPs emitted from coal fired utility boilers, and therefore regulated under case-by-case MACT, may generally be classified into four HAP categories as follows:

- Inorganic, solid phase HAPs.
- Inorganic, acid gas HAPs.
- Organic HAPs.
- Mercury HAP.

The following sections present a case-by-case MACT analysis based on these categories, including a description of the HAPs, estimated emission rates, determination of the MACT floor and beyond, as well as the proposed MACT emission limit(s) for the applicable HAPs.

3.1 Inorganic Solid Phase HAPs

Inorganic solid phase HAPs will occur as trace substances in the coal burned by SGS Unit 4. The inorganic solid phase HAPs addressed in this analysis include antimony, arsenic, beryllium, cadmium, chromium, chromium VI, cobalt, lead, manganese, nickel, and selenium. These HAPs are emitted in solid form as the coal fuel is combusted, and are controlled very effectively by high efficiency particulate matter (PM) collection devices such as fabric filters. Additionally, system-wide particulate collection efficiency (and thus inorganic solid phase HAPs collection) is further enhanced by flue gas desulfurization (FGD) systems, which reduce flue gas temperatures via the addition of moisture in the form of lime or limestone slurry, thereby increasing particulate control efficiency. Both a fabric filter and wet FGD (WFGD) are proposed as BACT for SGS Unit 4 to control emissions of PM/PM₁₀, and as this analysis will demonstrate, also represent MACT for inorganic solid phase HAPs.

3.1.1 Inorganic Solid Phase HAPs Emissions

Inorganic solid phase HAPs occur as trace substances in the coal fuel, consisting primarily of trace metals including antimony, arsenic, beryllium, cadmium, chromium, chromium VI, cobalt, lead, manganese, nickel, and selenium. While also a trace metal in the fuel, mercury, because of its complex nature, is addressed as a separate HAP category in this case-by-case MACT analysis. Table 3-1 summarizes the uncontrolled and controlled inorganic solid phase HAPs emissions from SGS Unit 4. The HAPs emission estimates are based on USEPA's AP-42, 5th Edition, Table 1.1-18, "Emission Factors for Trace Metals from Controlled Coal Combustion." The use of AP-42 emission factors is

appropriate for this category of HAPs, as the proposed limit for compliance demonstration of inorganic HAPS is the PM/PM₁₀ BACT emission limit. Because the emission factors are based on controlled emission rates, a 99 percent fabric filter particulate (total PM/PM₁₀) removal efficiency was used to estimate the uncontrolled levels. Attachment A includes an Excel spreadsheet documenting HAP emission calculations and assumptions.

As Table 3-1 demonstrates, the control technology proposed as MACT for inorganic solid phase HAPs will reduce the estimated uncontrolled HAPs from SGS Unit 4 by 99 percent.

Table 3-1 Inorganic Solid Phase HAPs Emission Estimates-SGS Unit 4		
HAP	Uncontrolled Emission (tpy)	Controlled Emission (tpy)
Antimony	3.00	0.03
Arsenic	68.44	0.68
Beryllium	3.51	0.04
Cadmium	8.51	0.09
Chromium	43.40	0.43
Chromium (VI)	13.19	0.13
Cobalt	16.69	0.17
Lead	19.95	0.50
Manganese	81.79	0.82
Nickel	46.74	0.47
Selenium	216.99	2.17
Total	522.20	5.52
Included in Attachment A, Table A-1 is an Excel spreadsheet detailing the calculations used as a basis for these emission estimates.		

3.1.2 Inorganic Solid Phase HAP MACT Floor Basis

Inorganic solid phase HAPs are particulates that are controlled in the same manner as PM/PM₁₀. Therefore, the PM/PM₁₀ BACT determination represents the maximum degree of reduction in inorganic solid phase HAPs emissions that is achievable

for new sources of the same category. In this instance, a fabric filter baghouse and WFGD, which is proposed as BACT for SGS Unit 4, combined with a PM/PM₁₀ emission limit as a surrogate for inorganic solid phase HAPs, represents the MACT floor for inorganic solid phase HAP emissions.

3.1.3 Beyond the Floor Inorganic Solid Phase HAPs MACT Analysis

The only pollution control methods available to control inorganic, solid phase HAPs resulting from coal combustion are the same particulate control systems specified as PM/PM₁₀ BACT for new coal fired boilers. Therefore, IPL finds that inorganic solid phase HAPs control beyond the MACT floor is not achievable.

3.1.4 Proposed Case-by-Case MACT Limit for Inorganic Solid Phase HAPs

IPL proposes that the fabric filter and WFGD pollution control technologies identified as BACT for SGS Unit 4 also represent MACT for inorganic solid phase HAPs. Additionally, IPL proposes to accept PM/PM₁₀ filterable and total emission limits of 0.012 lb/MBtu (based on USEPA Test Method 5B) and total (filterable + condensable) PM/PM₁₀ emissions limit of 0.018 lb/MBtu (based on USEPA Test Method 5B and 202, with artifact modification including SO₃ and VOC), as surrogate emission limits to demonstrate compliance with the inorganic solid phase MACT category of HAPs. These emissions limits represent the maximum degree of reduction guaranteed by the baghouse/fabric filter manufacturers for similar sources categories utilizing equivalent testing methods.

3.2 Inorganic Acid Gas HAPs

Inorganic acid gas HAPs will be formed from trace elements in the coal burned by SGS Unit 4. These acid gases include primarily hydrochloric acid (HCl) and hydrofluoric acid (HF) and are formed in the combustion process from elemental chlorine and fluorine found in the coal. HCl and HF are very strong, water soluble acids, which like SO₂, are very effectively controlled by FGD pollution control systems. A WFGD is proposed as BACT for SGS Unit 4 for the control of SO₂ (among other pollutants) and also represents MACT for the emission of inorganic acid gas HAPs.

3.2.1 Inorganic Acid Gas HAPs Emissions

Inorganic acid gas HAPs include HCl and HF formed from elemental chlorine and fluorine contained in the coal to be combusted by SGS Unit 4. Table 3-2 summarizes the uncontrolled and controlled emissions of inorganic acid gas HAPs from SGS Unit 4. The uncontrolled HCl and HF emissions estimates are based on the maximum chlorine and fluorine content for the range, composition, and blend of coal fuels proposed for the project. The controlled HCl and HF emission rates estimates are based on a 98 percent control efficiency of acid gases with a WFGD. Attachment A includes an Excel spreadsheet documenting HAP emission calculations and assumptions.

Table 3-2 Inorganic Acid Gas HAPs Emission Estimates- SGS Unit 4		
Inorganic Acid Gas HAP	Uncontrolled Emission (tpy)	Controlled Emission (tpy)
HF	251.53	5.54
HCl	1,567.53	33.25
Total	1,819.06	38.79
Included in Attachment A, Table A-1 is an Excel spreadsheet detailing the calculations used as a basis for these emission estimates.		

As Table 3-2 shows, the control technology proposed as MACT for inorganic acid gas HAPs will reduce the uncontrolled HAPs from SGS Unit 4 by approximately 98 percent or more than 1,780 tpy.

3.2.2 Inorganic Acid Gas HAP MACT Floor Basis

A rigorous 5-step BACT determination process for SO₂ control was conducted for SGS Unit 4 as part of the PSD Air Permit Application. Considering several potential SO₂ control alternatives, the top control, a WFGD, was determined to represent BACT. Because inorganic acid gases are strong water soluble acids, they are controlled in a similar method as SO₂. Therefore, a BACT determination for emissions of SO₂ represents the maximum degree of reduction in inorganic acid gas HAPs emissions that is achievable for new sources of the same category, as required in the regulatory definition of MACT. In combination with specific HCl and HF HAPs emission limits proposed below, a WFGD, which is proposed as BACT for SGS Unit 4, represents the MACT floor for inorganic acid gas HAP emissions.

3.2.2.1 HCl MACT Floor Basis. Based on available information on recently permitted coal fired power plants (refer to Attachment B), the most stringent HCl emission limit identified for an operating pulverized coal fired boiler that burns subbituminous coal is the limit of 0.00118 lb/MBtu for Centennial Hardin, Comanche Park plant in Montana. For comparison, a limit of 0.0029 lb/MBtu was established and demonstrated for Unit 4 at Walter Scott, Jr. Energy Center (formerly known as Council Bluffs Energy Center) firing subbituminous coal in a PC boiler.

For purposes of this case-by-case MACT analysis, it is conservatively concluded that the HCl emission limit of 0.00118 lb/MBtu is demonstrated in practice and represents the MACT floor for HCl for boilers burning subbituminous coal.

3.2.2.2 HF MACT Floor Basis. In order to establish the HF MACT floor basis, a search of the available data on recently permitted coal fired power plants was conducted, and the results are included in Attachment C. The most stringent HF emission limit identified for facilities that burn subbituminous coal is the MACT limit established for the Weston Generating Station Unit 4 (a subbituminous coal fired unit) of 0.000217 lb/MBtu. The analysis also indicates that Springerville Unit 3, now in commercial operation at the Springerville Generating Station in Arizona, has demonstrated compliance with a 0.00044 lb/MBtu. For comparison, a MACT limit of 0.0009 lb/MBtu was established and demonstrated for Unit 4 at Walter Scott, Jr. Energy Center (formerly known as Council Bluffs Energy Center) firing subbituminous coal in a PC boiler.

For the purposes of this case-by-case MACT analysis, it is conservatively concluded that an HF emission limit of 0.000217 lb/MBtu is demonstrated in practice and represents the MACT floor for HF for boilers burning primarily subbituminous coal.

3.2.3 Beyond the Floor Inorganic Acid Gas HAPs MACT Analysis

The most effective pollution control method for inorganic acid gas HAPs emissions, including HCl and HF, from coal fired boilers is FGD systems. As previously demonstrated in the Project's sulfuric acid mist BACT analysis, the use of a WESP on SGS Unit 4 has been shown not to be cost effective as an emissions control device. However, on a case-by-case basis, IPL concludes that further control beyond the identified MACT floors for HCl and HF may be achievable as a function of the removal efficiency of the proposed FGD system and the composition of the proposed coal fuels. Therefore, based on (i) the WFGD, proposed as BACT for SGS Unit 4, (ii) a 98 percent removal efficiency and (iii) the specific composition of the proposed coal fuels identified for the Project, IPL proposes an equivalent to the MACT floor limit for HCl (rounded to the 4th significant digit) and a slightly below the MACT floor emission limit for HF.

3.2.4 Proposed Case-by-Case MACT Limit for Inorganic Acid Gas HAPs

IPL proposes that the WFGD pollution control technology, identified as BACT for SGS Unit 4, also represents MACT for inorganic acid gas HAPs. Additionally, IPL proposes to accept an HCl and HF emission limits of 0.0012 lb/MBtu and 0.0002 lb/MBtu, respectively, to demonstrate compliance with the inorganic acid gas MACT category of HAPs. The HCl and HF emission limits are calculated based on the maximum chlorine and fluorine content of the fuels proposed for SGS Unit 4 and the minimum heating value, taking into consideration a 90/10 fuel blend (subbituminous/bituminous) on a boiler heat input basis. A spreadsheet (Table A-2) is included in Attachment A, which documents the HCl and HF calculations and assumptions. These emissions limits were selected because they represent the maximum degree of reduction guaranteed by the WFGD manufacturers for similar sources categories.

3.3 Organic HAPs

Organic HAPs are formed from volatile, semivolatile or condensable organic compounds that are either present in the coal fuel or formed as a product of incomplete combustion (PIC). Organic HAPs are primarily categorized as a subset of the criteria pollutant referred to as volatile organic compounds (VOC), and generally include unburned vapor and condensed phase hydrocarbon compounds including substituted benzenes (e.g., benzene, toluene, xylene, and ethyl benzene), polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDF), polycyclic organic matter (POM), and polynuclear aromatic hydrocarbons (PAH). As with VOC and CO emissions from coal fired boilers, which are also PIC, organic HAPs are effectively controlled with efficient boiler operation and good combustion controls. Good combustion controls are proposed as BACT for SGS Unit 4 for the control of VOCs and CO, and as this analysis will demonstrate, also represents MACT for organic HAPs.

3.3.1 Organic HAP Emissions

Organic HAPs include a wide range of organic compounds that are formed as a result of incomplete combustion. Table 3-3 summarizes the total uncontrolled and controlled organic HAPs from SGS Unit 4. The organic HAP emission estimates are based on USEPA’s AP-42, 5th Edition, Tables 1.1-12, 1.1-13, and 1.1-14 for PCDD/PCDF, POM/PAH, and organic compounds, respectively. Emission factors are based on controlled emission rates, which are the result of good combustion control. Back-end AQC equipment will provide little or no control of organic HAP emissions. Thus, the uncontrolled and controlled emission estimates are the same for organic HAPS. Attachment A includes an Excel spreadsheet documenting HAP emission calculations and assumptions.

Table 3-3 Organic HAPs Emission Estimates-SGS Unit 4		
Organic HAPS	Uncontrolled Emission (tpy)	Controlled Emission (tpy)
PCDD/PCDF	0.0004	0.0004
POM/PAH	0.035	0.035
Other Organic Compounds	15.33	15.33
Total	15.37	15.37
Included in Attachment A, Table A-1 is an Excel spreadsheet detailing the calculations used as a basis for these emission estimates.		

As Table 3-3 demonstrates, the control technology proposed as MACT for organic HAPs will result in approximately 15 tpy of total organic HAPs from SGS Unit 4.

3.3.2 HAP MACT Floor Basis

As noted earlier, organic HAPs are PIC and are effectively controlled in the same manner as VOCs and CO. Consequently, a BACT determination for the emissions of VOCs and CO represents the maximum degree of reduction of organic HAP emissions achievable for new sources of the same category. Good combustion controls, as proposed as BACT for SGS Unit 4, combined with emission limits for VOC and CO as surrogates for emissions of organic HAPs, represents the MACT floor for organic HAPs emissions.

3.3.3 Beyond the Floor Organic HAPs MACT Analysis

The only pollution control method available to control PIC, including organic HAPs, VOCs and CO emissions from coal fired boilers, is good combustion practices. Therefore, IPL finds that organic HAPs control beyond the MACT floor is not achievable.

3.3.4 Proposed Case-by-Case MACT Limit for Organic HAPs

IPL proposes that efficient operation and good combustion controls identified as BACT for SGS Unit 4 also represent MACT for organic HAPs. Additionally, IPL proposes to accept VOC and CO emission limits of 0.0034 lb/MBtu and 0.12 lb/MBtu, respectively, as surrogate emission limits to demonstrate compliance with the organic MACT category of HAPs. These emissions limits represent the maximum degree of reduction guaranteed by boiler manufacturers for similar sources categories and fuels proposed for SGS Unit 4.

The use of CO or VOC emissions as a surrogate for the control of organic HAP emissions is consistent with the USEPA's practice when establishing MACT standards for combustion source categories emitting organic HAPs. In the preamble for the "National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters," 69 Fed. Reg. 55218 (Sep. 13, 2004), the USEPA stated "Because CO is a good indicator of incomplete combustion; there is a direct correlation between CO emissions and the formation of organic HAPs emissions." Monitoring equipment for CO is readily available and proposed for SGS Unit 4. It is significantly easier and less expensive to measure and monitor CO emissions than to measure and monitor emissions of each individual organic HAPs. Therefore, using CO as a surrogate for organic HAPs is a reasonable approach because minimizing CO emissions will result in minimizing organic HAPs emissions."

3.4 Mercury HAP

Mercury (Hg) is a hazardous air pollutant released from coal fired utility boilers as trace elements of mercury in the coal become entrained in the flue gas during coal combustion. Mercury content varies naturally in the coal, from seam to seam and from mine to mine. Coal supplied from a single mine will experience variations of mercury content because of differences between specific coal seams quality and mining procedures. Even wider variation in mercury content occurs if coals from different mines are fired, even for coals generally categorized as subbituminous PRB. As discussed and

proposed in the air permit application, SGS Unit 4 will burn a variety of subbituminous and bituminous fuels and blends, resulting in a wide variance of mercury levels in the fuel. This is a key factor considered in this case-by-case analysis of the mercury MACT for SGS Unit 4.

3.4.1 Mercury HAP Emissions

As discussed in Section 2.2, the coals proposed for firing at SGS Unit 4 are primarily subbituminous PRB coals, with the proposed flexibility to burn a blend of 90 percent PRB and 10 percent bituminous coals. This SGS Unit 4 mercury MACT determination is conservatively based on firing 100 percent PRB coals, which represents the greatest potential for mercury emissions. Further, there is no data as to what affect the blending of up to 10 percent bituminous coal will have on reducing mercury emissions. Although coal blending may enhance mercury reductions, it cannot be relied upon for the MACT determination. Additionally, a range of PRB coals must be taken into consideration in the determining the case-by-case mercury MACT emission limit for SGS Unit 4.

Elemental mercury (Hg^0) is formed when the high combustion temperatures of an industrial boiler cause the mercury to vaporize into the flue gas. Elemental mercury can then react with other constituents in the flue gas to produce an oxidized form of mercury (Hg^{+2}), which is also referred to as ionic mercury. There is also a quantity of mercury that is adsorbed onto particulate matter in the flue gas, which is known as particle bound mercury (Hg_p). The total mercury content in the flue gas from a coal fired boiler (Hg_T) is the sum of Hg_p , Hg^{+2} , and Hg^0 .

Mercury speciation in flue gas varies with relatively small differences in other coal constituents (halogens, in particular) and with boiler conditions such as firing rate, excess air, boiler tube cleanliness, etc. The increase in halogen content in the coal leads to the production of more oxidized form of mercury (Hg^{+2}) than elemental mercury (Hg^0) in the flue gas. Oxidized forms of mercury such as mercury halides are formed to a greater extent when coal with higher halogen content is fired in the boiler. Subbituminous or PRB coal (which contains less halogens as compared to bituminous coal) when fired in the boiler produces higher amounts of elemental mercury than oxidized mercury in the flue gas. Boiler conditions, such as increase in excess air, aids in the formation of mercury oxide (an oxidized form of mercury).

Table 3-4 sets forth a summary of the mercury HAP emissions for SGS Unit 4. The uncontrolled mercury emissions for Jacobs Ranch coal, which is considered a worst case coal, are based on the maximum mercury content and lowest heating value reported in the Jacobs Ranch mine data. Figure 3-2 details the calculations that were used as a basis for the mercury emission estimates reported in Table 3-4. The controlled mercury emissions are based on an ACI system vendor’s guarantee of 12 lb/TWh of mercury emissions, which is equivalent to 1.33×10^{-6} lb/MBtu for SGS Unit 4, or 90 percent mercury removal, whichever occurs first. For example, using typical Rawhide coal will allow SGS Unit 4 to achieve 12 lb/TWh, but the worst case Jacobs Ranch coal will not. Therefore, a 90 percent mercury removal rate was applied to the worst case Jacobs Ranch coal to determine the controlled mercury emission rate.

Table 3-4 Mercury HAP Emission Estimates-SGS Unit 4		
Fuel Scenario	Uncontrolled Emission (lb/y)	Controlled Emission (lb/y)
Jacobs Ranch (worst case)	1,291	129
Figure 3-2 details the calculations used a basis for these emission estimates.		

3.4.2 Mercury HAP MACT Floor Basis

The first step of the case-by-case mercury MACT analysis for SGS Unit 4 is to determine the most stringent mercury emission limit for a similar unit and source category. A search for mercury emissions from recently permitted coal fired power plants was conducted and is included in Attachment D. Unit 4 at the Walter Scott, Jr. Energy Center in Iowa is identified as having the most stringent mercury emission limit for a facility which burns primarily subbituminous coal and has completed an initial compliance demonstration. Walter Scott, Jr. Energy Center Unit 4 has an emission limit of 1.7×10^{-6} lb/MBtu.¹ Wisconsin Public Service Corp. Oak Creek power plant in Wisconsin is identified as having the most stringent permitted mercury emission limit for a facility that intends to burn primarily subbituminous coal but has not completed a compliance demonstration. Oak Creek Power Plant has a permitted mercury emission limit of 1.12×10^{-6} lb/MBtu, but is still under construction with a commercial online date of September 29, 2010. As the Walter Scott, Jr. Energy Center completed an initial

¹Iowa Department of Natural Resources. Permit 03-A-425-P. Issued June 17, 2003. The Walter Scott, Jr. Energy Center was formerly known as Council Bluffs Energy Center.

compliance test, the emission limit of 1.7×10^{-6} lb/MBtu is considered the MACT floor for SGS Unit 4.

No steam generating unit firing a subbituminous and bituminous coal blend was found to have the documented ability to achieve a lower mercury emission limit than that of Walter Scott, Jr. Energy Center Unit 4.

3.4.3 Beyond the Floor Mercury HAPs MACT Analysis

Case-by-case MACT determination requires an evaluation of whether or not a greater degree of emission reduction than the MACT floor can be achieved. Cost and other environmental impacts are taken into consideration for this evaluation. Similar to the top-down process that was used to evaluate and determine the SGS Unit 4 BACT emissions limits, IPL proposes a similar methodology to review and address the mercury control technologies potentially capable of reducing mercury emissions beyond the MACT floor.

The first step in this beyond the floor mercury MACT analysis is to identify all the available control options. Available control options are those air pollution control technologies or techniques with a practical potential for application to the emission unit and the mercury emissions limit that is being evaluated. Mercury control technologies that were identified as available for SGS Unit 4 are listed in this section and followed by brief descriptions of each technology.

3.4.3.1 Co-Benefit Mercury Control Technologies.

Mercury capture by existing flue gas emission reducing devices depends on the speciation of mercury in the gas. Elemental mercury is not water soluble and therefore cannot be captured in WFGD systems. Ionic mercury is more water soluble and can be captured in a WFGD. Both ionic mercury and elemental mercury can be adsorbed onto fly ash for subsequent collection in a particulate control device, although ionic mercury more readily adsorbs than elemental mercury. Three ways that mercury can be captured by existing emission control devices: 1) the capture of particulate bound mercury in the particulate control device; 2) the adsorption of elemental and ionic mercury onto fly ash for subsequent capture in the particulate control device; and 3) the solvation of ionic mercury in the WFGD. Speciation and capture of mercury are governed by properties of the coal, combustion conditions, emission control technology installed, and the flue gas temperatures.²

²Technical Memorandum. Control of Mercury Emissions from Coal Fired Electric Utility Boilers. James D. Kilgroe, Ravi K. Srivastava, Charles B. Sedman, and Susan A. Thorneloe. U.S. Environmental Protection Agency. October 25, 2000.

Based on the technical memorandum issued by the USEPA on October 25, 2000, which included the 1999 EPA Information Collection Request (ICR) data on mercury removal, the mercury removal efficiencies of each type of emission control technology for a PC boiler firing subbituminous coal is included in Table 3-5.

Table 3-5 Co-Benefit Mercury Removal Efficiency for Subbituminous Coal Fired Boilers	
Technology	Removal %
Cold-Side ESP	16
Hot-Side ESP	13
Fabric Filter	72
SDA-ESP	38
SDA-Fabric Filter	25
Cold-Side ESP + Wet FGD	35
Cold-Side Fabric Filter + Wet FGD	72*
Hot-Side ESP + Wet FGD	33
Based on the 1999 EPA Information Collection request (ICR).	
*Not tested for the ICR, but assumed to be equivalent to FF.	

3.4.3.2 Mercury Specific Control Technologies. There are currently several mercury specific control technologies with varying degrees of commercial testing and success. The mercury specific control technologies are listed below:

- Reagent-Based Control Technologies:
 - PAC Injection.
 - Chemically Treated (Halogenated) Carbon Injection:
 1. Bromine Impregnated PAC Injection.
 2. Iodine Impregnated PAC Injection.
 3. Chlorine Impregnated PAC Injection.
 - Non-Carbon-Based Sorbent Injection in Duct:
 1. Amended Silicates.
 2. BASF Material (Engelhard FA100).
 3. Sodium Tetrasulfide.

- MinPlus.
- Boiler Chemical Additives:
 1. Calcium Bromide.
 2. Calcium Chloride.
 3. Hydrogen Chloride.
 4. Ferrous Chloride.
 5. Magnesium Chloride.
 6. Sodium Chloride.
- Combination Technologies:
 1. ACI with Boiler Chemical Additive.
 2. Coal Cleaning (K-Fuel) with B-PAC Injection.
- Fuel Blending.
- Multi-Pollutant Technologies:
 - TOXECON.
- Emerging Technologies:
 - Low Temperature Oxidation Catalyst (for flue gas desulfurization [FGD] mercury capture).
 - Mercury Control Adsorption Process (MerCAP).
 - Carbon Bed/Filter in Gas Stream.
 - Plasma Enhanced ESP (PEESP).
 - EnviroScrub Pahlman Process.

3.4.3.2.1 PAC injection. With a reported mercury removal rate of more than 90 percent for bituminous coal applications, PAC injection is an effective and mature technology for the control of mercury in municipal solid waste (MSW) and medical waste combustors (MWC). Its potential effectiveness on a wide range of coal fired power plant applications is gaining acceptance, according to recent pilot and slipstream testing activities sponsored by the Department of Energy (DOE), EPA, Electric Power Research Institute (EPRI), and various research organizations and power generators. However, recent pilot-scale test results indicate that the level of mercury control achieved with a PAC injection system is affected by variables such as the type of fuel, mercury speciation in the fuel, operating temperature, fly ash properties, flue gas chloride content, and the particulate collection device used in the removal of the mercury sorbent.

PAC injection typically involves the use of a lignite-based activated carbon that is injected into the flue gas upstream of a particulate control device. Elemental and oxidized forms of mercury are adsorbed into the carbon and are collected with the fly ash in the particulate control device.

PAC injection is added upstream of particulate control devices such as fabric filters or ESPs. PAC injection system performance is highly dependant on temperature. For optimal performance of a PAC injection system, the air heater outlet temperature should be below 300° F. For ESPs, the mercury species in the flue gas are removed as they pass through a dust cake of unreacted carbon products on the surface of the collecting plates. Additionally, a significantly higher carbon injection rate is required for PAC injection upstream of an ESP than is required for PAC injection upstream of a high air-to-cloth ratio fabric filter (FF). Literature indicates that PAC injection upstream of a cold ESP can reduce mercury emissions up to 60 percent for units that burn a subbituminous or lignite coal, and up to 80 percent for units that burn a bituminous coal. PAC injection systems can get above 80 percent removal for units burning subbituminous coal, when the PAC is injected upstream of a FF. PAC injection was further evaluated for SGS Unit 4.

3.4.3.2.2 Chemically treated (Halogenated) carbon injection. Numerous testing efforts and studies have shown that most of the mercury resulting from the combustion of subbituminous coal leaves the boiler in the form of elemental mercury, and that the level of chlorine in the coal has a major affect on the efficiency of mercury removal with PAC injection and the particulate removal system. As discussed above, low chlorine coals, such as subbituminous and lignite coals, typically demonstrate relatively low mercury removal efficiency with conventional PAC. Subbituminous and lignite coals produce very low levels (approximately 100 parts per million [ppm]) of hydrogen chloride during combustion; therefore, normal PAC injection would be expected to achieve very low elemental mercury removal.

However, the removal efficiency of mercury can be significantly increased by the use of PAC that has been pretreated with halogens, such as chlorine, iodine, or bromine.

Chemically treated PAC is more expensive than standard PAC. Iodine impregnated PAC is 5 to 10 times more expensive than brominated PAC. Tests have shown that it would take 10 times more chlorine impregnated PAC than bromated for the same removal efficiency. Brominated PAC is the standard sorbent used for ACI on units that burn subbituminous coal. ACI system suppliers issue performance guarantees that are contingent upon the injection of brominated PAC. For these reasons, only brominated PAC is evaluated further for SGS Unit 4.

It should be noted that long-term testing of halogenated additives has not been conducted to identify their long-term potential for corrosion and other negative BOP impacts. Also, a concrete-friendly, brominated activated carbon is currently in development and testing and may offer the additional benefit of not affecting the pozzolonic qualities of the fly ash.

3.4.3.2.3 Non-carbon-based sorbent injection in duct. A new market has developed for sorbents that are non-carbon-based, such as sodium tetrasulfide (Na_2S_4), amended silicates, and BASF material (Engelhard FA100). The main driving force for this development is to maintain revenues generated by fly ash sales.

Sodium tetrasulfide is a liquid that is injected into the flue gas upstream of the particulate control device by air-atomized dual-fluid nozzles. Elemental and oxidized forms of gaseous mercury react with the sodium tetrasulfide to form solid mercuric sulfide (HgS). The resulting particulate bound mercury is removed by the particulate control device, along with the fly ash. Some of the pilot test results indicated that higher mercury removal rates could be achieved at lower gas temperatures.

Amended silicates are a solid non-carbon-based sorbent that can be handled and injected into the flue gas in the same manner as PAC. Rather than carbon, this sorbent uses silicate materials as the base component. Chemicals with a strong affinity for mercury are impregnated into the base component. This type of transport phenomena is called chemisorption. One of the primary physical qualities of silicates is that each particle has an extended surface area, which maximizes the exposure of the impregnated chemicals to the mercury components in the flue gas.

Engelhard Mercury Sorbent FA100 (developed by BASF) is a family of mineral-based mercury sorbents derived from coal combustion fly ash. The fly ash is used as an inert substrate onto whose surface metal sulfides have been added by a controlled deposition process. The metal sulfides function as active sites for mercury control. This technology does not adversely affect coal combustion products, such as fly ash, which are sold for cement applications. Engelhard Mercury Sorbent FA100 has demonstrated control of vapor-phase mercury emissions, both total and elemental.

Sodium tetrasulfide and amended silicates can remove mercury emissions at a comparable cost to halogenated PAC. The advantage of the advanced sorbents over PAC injection is that the facilities that currently generate revenues from ash sales can continue doing so after the implementation of these mercury control technologies. In the case of sodium tetrasulfide, care would need to be taken in the handling of the sorbent, because it is highly toxic and potentially corrosive.

The non-carbon-based sorbents are not technically or commercially advanced. Amended silicates technology is still under development, and no commercial terms and performance guarantees have been established. Engelhard Mercury Sorbent FA100 has demonstrated its capability for mercury removal in slipstream testing, but no full-scale demonstrations of mineral-based sorbents have been performed. The sodium tetrasulfide technology has not yet demonstrated satisfactory results for PRB coals. In addition, there are significant unresolved issues regarding reagent availability, since it has to be shipped

from Europe. Therefore, none of these technologies were considered further for SGS Unit 4.

3.4.3.2.4 MinPlus. MinPlus is a meta-kaolin-containing mineral sorbent that can be injected directly into the furnace of a boiler. The MinPlus sorbent is used to capture metal ions at high in-furnace temperatures, and the sorbent is then collected in the particulate control device. Previous studies have demonstrated the capability of the MinPlus sorbent to capture both elemental and oxidized forms of mercury at high temperatures. In addition, the mercury-loaded (spent) sorbent does not release mercury unless it is heated to temperatures above 1,650° F.

The major concern associated with MinPlus technology is the issue regarding reagent availability. MinPlus currently does not have any manufacturing facilities for the production of MinPlus reagent in the United States. The reagent has to be shipped from the Netherlands in Europe. The manufacturing facilities in Europe produce around 50,000 tons/year of MinPlus reagent.

The amount of reagent required to achieve mercury control is uncertain. For this project, Mobotec estimated a consumption rate of 2 lb/MWh (gross). However, this amount was not guaranteed. Testing at a plant in North Carolina and at the Whitewater Station showed feed rates ranging from 0.8 lb/MWh (gross) to 21 lb/MWh (gross). Mercury reduction of 90 percent (from fuel) was achieved at the Whitewater Station with an injection rate of 21 lb/MWh (gross). However, the injection ports were not optimized. MinPlus typically achieves mercury reduction rates from 70 percent to 80 percent. Testing at the North Carolina plant used much lower injection rates but did not achieve 90 percent reductions. Therefore, determining annual costs is difficult because of the potential for significant variation in the reagent feed rate. MinPlus is considered further for SGS Unit 4, because it has demonstrated the capability to remove mercury in a full-scale demonstration.

3.4.3.2.5 Boiler chemical additives. Chemical additives offer a potential, low cost method for enhancing mercury emissions control when fly ash sales are not an important consideration. Boiler chemical additives are chemicals composed of metal halides that are injected into the boiler to promote the oxidization of Hg^0 to Hg^{+2} during combustion. Their principal benefit would be in boilers firing low chlorine content coals, such as western subbituminous coal (i.e., PRB coal) and lignite, which generally produce a low Hg^{+2}/Hg^0 ratio in the flue gas. These chemical additives do not themselves remove mercury from the flue gas. Instead, the desired result is a higher Hg^{+2}/Hg^0 ratio in the flue gas, similar to that produced by the combustion of higher chlorine content bituminous coal. As noted previously, water soluble Hg^{+2} is much easier to remove from the flue gas than Hg^0 by all of the alternative emissions control technologies. Thus,

boiler chemical additives may increase the effectiveness and/or reduce the capital or annual operating costs of the downstream mercury emissions control equipment when firing low chlorine content fuels.

Metal halides such as calcium chloride (CaCl_2), magnesium chloride (MgCl_2), sodium chloride (NaCl), ferrous chloride (FeCl_2), hydrogen chloride (HCl), calcium bromide (CaBr_2), and $\text{KNX}^{\text{®}}$ have been studied recently. The introduction of chloride compounds into the high temperature furnace region results in the production of atomic chlorine and/or molecular chlorine, which are generally thought to be the dominant Hg^0 oxidants in coal combustion flue gases. The formation of atomic chlorine is a key pathway involved in the chemical reaction mechanisms that result in the oxidation of elemental mercury. The pathway for mercury oxidation is by gas-phase elemental mercury oxidation by atomic chlorine (chlorine radical). Similar reactions occur with bromide compounds, and data indicates that bromine may be more efficient than chlorine at promoting mercury oxidation.

The effectiveness of using boiler chemical additives for mercury oxidation has a strong theoretical basis and has been demonstrated to increase the $\text{Hg}^{+2}/\text{Hg}^0$ ratio in several full-scale pilot tests. However, this is still an emerging technology that has not yet been demonstrated by long-term tests. This approach also has some known or suspected long-term detrimental effects on the boiler.

Increased quantities of alkalis in coal, such as metal chlorides and their eutectics, tend to reduce the fusion temperature of the fuel and increase the potential to develop slag deposits on boiler heating surfaces. Slag, thus formed, attacks the surface's protective iron oxide layer and, over the course of time, erodes the base tube material. This slag is difficult to remove and results in increased furnace exit gas temperatures. The temperature increase can lead to increased desuperheater spray flows and can affect net plant heat rates or limit steam production from the steam generator. The other disadvantage of metal chloride compounds is that these compounds condense on tube surfaces in nonequilibrium states. Under oxidizing conditions, the compounds will react to form alkali sulfates that will release chlorine as HCl in relatively short time periods (minutes to hours). Under reducing conditions, the alkali chlorides can reach equilibrium as alkali silicates, releasing HCl only after long time periods (days). The HCl that is released corrodes the boiler tubes, particularly those operating above 800°F , resulting in tube thinning and failure. Alkali chloride deposits, like sodium chloride, increase corrosion rates by a factor of four.

In addition, several nonferrous salts are formed with the chlorine, which also have very low fusion temperatures. These compounds can build up deposits on low temperature surfaces, such as evaporator tubes, and corrode them. By reducing the gas

temperature to the convection sections below the fusion temperatures of these salts, the slagging concerns can be minimized. However, reducing gas temperature may not always be economically viable, since a very large radiant furnace would be needed in some cases.

Operating in a mode that has the potential to create a corrosive environment is not recommended. If a corrosive environment is created in the boiler, the increased rate of corrosion will result in frequent outages, increased maintenance repair costs, and reduced unit availability. Because it is such an undesirable mode of operation, very few utilities have chosen to employ chloride furnace injection systems, and no long-term industry data is available. The short-term data that is available does not provide sufficient information to quantify the frequency or magnitude of the resultant problems or the maintenance costs associated with the repair work caused by the increased corrosion.

Because of the high level of uncertainty surrounding the long-term effects of chemical injection on the boiler and the fact that the technology does not itself reduce mercury emissions, it was not considered as a stand alone viable technology for SGS Unit 4.

3.4.3.2.6 Combination technologies. Reagent-based control technologies can be combined to reduce mercury emissions. Chemical additive technology in the boiler can be combined with the addition of PAC or halogenated PAC in the flue gas stream to remove mercury.

Long-term testing needs to be conducted to determine the optimum injection locations, to ensure any boiler tube corrosion is manageable, and to demonstrate that mercury capture efficiency benefits are sustainable. Also, the overall effects on operation and cost-effective characteristics of the chemical additives need to be assessed.

Coal cleaning can be combined with halogenated PAC (B-PAC) technology to reduce mercury emissions, while minimizing the B-PAC injection rate. K-Fuel, a product developed by KFx Inc., uses a pre-combustion process of refining low-rank coal feedstocks, such as subbituminous and lignite coals. The K-Fuel process employs heat and pressure to transform the coal into a cleaner, more efficient fuel by removing water and polluting impurities, thus increasing combustion efficiency. K-Fuel can be directly fired into the boiler or can be blended with other coals. On average, when compared to raw, low-rank (subbituminous and lignite) coal from Wyoming's Powder River Basin, K-Fuel has approximately 30 percent more Btus per pound, up to 70 percent less mercury, and, upon combustion, emits less SO₂, NO_x, and CO₂ per kilowatt-hour generated. Although firing K-Fuel can control a significant portion of mercury emissions, a minimized amount of B-PAC injection would still be required to approach the proposed MACT floor at SGS Unit 4. There is no indication that ACI system vendor guarantees

will go beyond the floor limit of 12 lb/TWh when K-Fuel technology is implemented. Therefore, using a combination of K-Fuel and B-PAC injection will carry the same mercury emission guarantees as using B-PAC alone.

K-Fuel is a promising but immature technology. There has been a limited number of small scale tests conducted that indicate K-Fuel can significantly reduce the mercury in coal, but there are not enough data points to consider it a proven technology. Due to a lack of test data, K-Fuel combination technology is not further considered for SGS Unit 4 MACT determination.

3.4.3.2.7 Fuel blending. Blending a bituminous coal with a subbituminous or lignite coal is a way of decreasing mercury emissions. This decrease occurs because bituminous coals have a higher concentration of chlorides, and the addition of halogens creates more oxidized mercury which, in turn, allows mercury to be more easily captured with existing or new AQC equipment. Literature indicates that bituminous coal with typical chlorine contents greater than a 1,000 ppm converts approximately 20 percent of its total mercury to elemental mercury. By contrast, subbituminous coal with a chlorine content in the range of 100 ppm can convert up to 70 percent of its total mercury to elemental mercury. Recent demonstration testing indicates that a 30 percent blend of eastern bituminous and a 70 percent blend of subbituminous coal exhibits high levels of the oxidized mercury form, which can be more easily removed in downstream emissions control equipment. Fuel blends with as low as 10 percent bituminous coal can possibly result in higher levels of chlorides and oxidized mercury, but such blends are generally considered to have similar flue gas characteristics as firing 100 percent subbituminous coal. Therefore, blending coals can increase mercury removal. However, for a 90/10 blend utilized within SGS Unit 4, it is expected to have the same mercury removal efficiency in downstream equipment as 100 percent PRB due to the limited addition of chlorides in the blended fuel mix in comparison to the 100 percent PRB.

A blend of 90 percent subbituminous and 10 percent bituminous coal was considered for SGS Unit 4, but was not analyzed because there is no indication that firing a 90/10 blend will reduce mercury emissions.

3.4.3.2.8 TOXECON. Another control technology that is effective in removing mercury is a high air-to-cloth ratio FF (secondary particulate control device) installed after an ESP or other primary particulate control device. Commonly referred to as a compact hybrid particulate collector (COHPAC), this technology was developed and trademarked by EPRI. Recent test results with COHPAC following an ESP indicate that it can reduce mercury emissions by 60 to 70 percent for units that burn a subbituminous or lignite coal, and up to 85 percent for units that burn a bituminous coal. This configuration is referred to as TOXECON and is also trademarked by EPRI. The

TOXECON technology injects reagents and/or sorbents, including PAC for mercury control, and others for NO_x and SO_x control, into the inlet duct of a secondary particulate control device that is downstream of the existing primary particulate control device. This configuration thus segregates the ash collected in the primary particulate control device from the ash/reagent/sorbent mixture collected in the secondary (downstream) particulate control device, preserving the salability of the fly ash from the primary particulate control device. TOXECON can reduce mercury emissions by 90 percent for a unit that burns subbituminous coal.

The COHPAC filter typically operates at air-to-cloth ratios ranging from 6 to 8 ft/min, compared to a conventional FF that operates at air-to-cloth ratios of approximately 3 to 4 ft/min. For a COHPAC or TOXECON system, the majority of the particulate is collected in the upstream ESP. Therefore, the performance requirements of a high air-to-cloth ratio fabric filter are reduced and allow installation of this technology in a smaller footprint area with less steel and filtration media all of which can substantially lower both capital and operating costs compared to conventional fabric filter. Outage time for installing the TOXECON technology is significantly less than major ESP rebuilds or upgrades required to handle the increased loading and greater collection difficulty of the injected carbon. Also the ash/reagent/sorbent mixture from the secondary particulate control device contains only a small fraction of the ash (typically in the range of 1 percent of the total ash), which reduces the impact of reagent/sorbent on ash reuse and waste disposal. The COHPAC requires significantly less sorbent than ESPs to achieve similar mercury removal efficiencies. TOXECON process with halogenated PAC injection is further evaluated for SGS Unit 4.

3.4.3.2.9 Low temperature oxidation catalyst (for FGD mercury capture).

Research and testing are ongoing to promote a specifically formulated low temperature catalyst to oxidize Hg⁰. This approach is based on a honeycombed catalyst that is located at the particulate control device outlet. This is the preferred location to maximize residence time while minimizing pressure drop. Additionally, this technology would fall under a “low dust” category, thus minimizing catalyst volume. Preliminary pilot-scale data indicate that as much as 90 percent total mercury reductions could be achieved by wet FGD systems located downstream of this technology for units burning bituminous coal. The catalysts that are being tested are formulated with activated carbon, palladium, or gold bases. Some are manufactured as extruded monoliths in an alumina substrate. As the oxidation activity decreases, the mercury oxidation catalyst can be thermally regenerated at approximate temperatures of 600° F. This oxidation technology looks promising for configurations with a wet FGD downstream of the mercury oxidation catalyst, which allows the water soluble oxidized mercury to be removed by the

downstream wet FGD. Since this technology is still at the pilot (slipstream) stage of development, it is considered not available until more is known and performance guarantees become available.

3.4.3.2.10 EPRI Mercury Control Adsorption Process (MerCAP). Another mercury control technology that has garnered the attention of the power generation industry is MerCAP, under development by EPRI. This technology has been successfully proven in the MSW industry. This process uses fixed plate or honeycomb structures coated with gold to adsorb mercury from the flue gas. MerCAP is ideally installed in the clean side of an ESP or PJFF. This location allows for easy installation, maintenance, and isolation of PJFF compartments without causing facility shutdowns. The gold sorbent requires regeneration once it becomes saturated with mercury. Regeneration can be accomplished in place, or components can be removed for offsite regeneration. The mercury can be removed with carbon canister or cryogenics, and the gold surface can be thermally regenerated.

The current configuration of the technology consists of collection plates 10 to 15 feet long and 1 inch thick, with 1/2 inch spacing between the plates. The pressure drop is anticipated to be approximately 1 inch of water. The major factors that affect the economics of this technology are the mercury removal efficiency and the number of regenerations that are required per year. Literature indicates that, when commercially available, MerCAP is predicted to reduce mercury emissions by 60 to 80 percent. Since this technology is still at the pilot (slipstream) stage of development, it is considered not available until more is known and performance guarantees become available.

3.4.3.2.11 Carbon bed/filter in gas stream. Carbon filter beds are capable of removing high mercury concentrations from waste incinerators. In addition, several power plants in Germany and Japan use this technology for acid gas removal and have achieved more than 90 percent mercury control as a co-benefit. However, carbon filter beds have not been tested for power plant flue gas mercury removal in the United States. One pilot project measured at least 99 percent mercury removal on a municipal waste incinerator. Since this technology is still at the pilot (slipstream) stage of development, it is considered not available until more is known and performance guarantees become available.

3.4.3.2.12 Plasma enhanced ESP (PEESP). MSE Technology Applications, Inc. (MSE) and Croll-Reynolds Clean Air Technologies, Inc. (CRCAT) have developed a process that applies plasma physics to a WESP, creating a PEESP to remove mercury. The PEESP concept relies on the central electrode of a WESP to inject a reagent gas directly into the flue gas stream. At an operating voltage between 10 and 20 kV (negative polarity with respect to the collection plate), a visible corona discharge is

generated around the electrode. As the reagent gas (oxygen mixed with the steam that is generated by boiling deionized water) passes through this corona discharge, reactive species are formed, which subsequently oxidize the elemental mercury vapor. In its oxidized state, mercury takes the form of fine particulate that acquires a negative charge in the electrical field of the precipitator. The charged mercury particles are attracted to the electrically positive electrode, where they are collected into the washdown liquor and are removed from the process. At this time, the technology is tested through bench-scale qualitative tests only. Since this technology is still at the pilot (slipstream) stage of development, it is considered not available until more is known and performance guarantees become available.

3.4.3.2.13 EnviroScrub Pahlman process. Pahlman™ is a single-stage, dry system multi-pollutant control technology that can replace three separate emission reduction technology systems; wet FGD for SO_x scrubbing, selective catalytic reduction (SCR) for NO_x scrubbing and ACI for mercury reduction. The Pahlman process uses a sorbent composed of oxides of manganese. The technology would be placed downstream of a particulate control device in order to prevent the mixing of captured fly ash and facilitates fly ash disposal as well as ash utilization as a byproduct. The Pahlman process reported high level SO₂, NO_x, and mercury removal and importantly, Pahlman achieved more than 90 percent mercury removal. Since this technology is still at the pilot (slipstream) stage of development, it is considered not available until more is known and performance guarantees become available.

3.4.3.3 Technically Feasible Mercury Control Technologies. The next step in this beyond the floor mercury MACT analysis is to determine if the aforementioned control technologies are technically feasible for consideration as mercury MACT. The technologies described in Subsection 3.4.3.1 and Subsection 3.4.3.2 consist of currently available and/or soon to market mercury emissions control technologies. These available technologies were then screened to determine if the technologies would be applicable for SGS Unit 4. A technology was considered to be applicable if it had been demonstrated on the same or similar source type. The issues that determined the applicability of a technology are as follows:

- Size of the unit.
- Location of the proposed site.
- Operating problems after installation of the technology.
- Space and other site constraints.
- Reliability.
- Adverse effects on the rest of the facility.

Using the guidelines above, each technology identified as available in Subsection 3.4.3.1 and Subsection 3.4.3.2 was evaluated to determine its technical feasibility at the SGS Unit 4 plant site. The co-benefit emission control devices are all considered technically feasible options since their primary function is to remove particulate or SO₂. As for the mercury specific controls, only PAC injection, B-PAC injection, MinPlus injection, and the TOXECON process are considered technically feasible. Table 3-6 summarizes the results of the evaluation process for the mercury control technologies, including the reasons for eliminating control technologies considered to be technically infeasible.

3.4.3.4 Ranking Technically Feasible Mercury Control Technologies. The final step in this beyond the floor mercury MACT analysis is to determine the ranking of all the technically feasible mercury control technologies and compare their removal and mercury control potential results with the previously established mercury MACT floor. To accomplish this analysis, the typical fuel (Rawhide) and the worst case fuel (Jacobs Ranch) were used as a basis to determine the controlled mercury emissions from SGS Unit 4 for each of the technically feasible mercury control technologies. A summary of the mercury control ranking results in ascending order is shown in Table 3-7. The mercury MACT floor and vacated NSPS Subpart Da limits are included in Table 3-7 for reference.

Vendors of B-PAC injection systems guarantee either 90 percent mercury removal or down to 12 lb/TWh of mercury, whichever occurs first. The TOXECON process uses B-PAC injection as a means to remove mercury, and carries the same guarantee as B-PAC injection. A MinPlus injection system is also assumed to meet the same reduction rate. The worst case for a fuel is the highest mercury content that was found in coal from a specific mine, along with the lowest heating value.

Since the effectiveness of the technically feasible control options depends, in part, on coal characteristics, the MACT limit needs to account for this variability. In this instance, the appropriate range of coals to consider in determining MACT is Rawhide (the typical design coal) and Jacobs Ranch (the “worst case” design coal). Typical Rawhide coal contains 0.09 ppm of mercury with a heating value of 8,300 Btu/lb. Jacobs Ranch coal contains 0.20 ppm of mercury and has a heating value of 8,576 Btu/lb. The co-benefit and mercury control emission calculations are evaluated for both design fuels and are shown in Figure 3-1 and Figure 3-2, respectively.

**Table 3-6
Technical Feasibility of Mercury Control for MACT Determination-SGS Unit 4**

Technology	Technically Feasible and Applicable?	Comments
PAC Injection Upstream of ESP/Fabric Filter	Yes	--
B-PAC Injection Upstream of ESP/Fabric Filter	Yes	--
Amended Silicates	No	No full-scale demonstration.
MinPlus	Yes	Limited reagent availability. Reagent has to be shipped from Europe. Significant uncertainty about reagent feed rate. Ongoing talks with two major clients for future production (50,000 ton capacity) of MinPlus in the United States.
BASF Material	No	Only slipstream testing has been done. No full-scale demonstration.
Sodium Tetrasulfide	No	Contradictory results for PRB coals. Significant unresolved issues regarding reagent availability.
Boiler Chemical Additives	No	High fouling and corrosion potential for boiler internals. High risk of slagging. Uncertainty related to long-term boiler operation. Needs back-end AQC equipment to be effective.
Coal Additive (K-Fuel) with B-PAC Injection	No	K-Fuel is still an emerging technology. There is not enough test data to consider it a proven mercury removal option. K-Fuel does not qualify as MACT alone and requires additional equipment to achieve total Hg removal.
Fuel Blending	Yes	While SGS Unit 4 will be capable of burning a 90/10 percent blend of coal, there is no data to indicate exactly to what extent a very limited blend of bituminous fuel will have on reducing mercury emissions.
TOXECON	Yes	--
Emerging Technologies (Low Temperature Oxidation Catalyst, MerCAP, Carbon Bed/Filter, PEESP)	No	No full-scale demonstration. Only bench-scale and pilot-scale testing complete.

Table 3-7
Ranking Technically Feasible Mercury Control Technologies

Fuel Scenario	Control Option	Emissions (lb/MBtu)	Emissions (lb/TWh)	Basis
Subbituminous	MACT Floor	1.7×10^{-6}	15.00 ¹	Subsection 3.4.2
Rawhide (Typical)	Co-Benefit + B-PAC Injection or MinPlus or TOXECON	1.33×10^{-6}	12.00	Subsection 3.4.3.2
Rawhide (Typical)	Co-Benefit + PAC Injection	2.17×10^{-6}	19.60	Subsection 3.4.3.2
Jacobs Ranch (Worst Case)	Co-Benefit + B-PAC Injection or MinPlus or TOXECON	2.33×10^{-6}	21.12 ²	Subsection 3.4.3.2
Rawhide (Typical)	Co-Benefit	3.04×10^{-6}	27.44	Subsection 3.4.3.1
Jacobs Ranch (Worst Case)	Co-Benefit + PAC Injection	4.66×10^{-6}	42.15	Subsection 3.4.3.2
Jacobs Ranch (Worst Case)	Co-Benefit	6.53×10^{-6}	59.01	Subsection 3.4.3.1
Subbituminous	40 CFR § 60.45Da(a)(2) (now vacated)	-	66.00	NSPS Subpart Da

¹ Based on a maximum heat input of 7,675 MBtu/h and a gross rating of 870 MW. Walter Scott Jr. Energy Center, IDNR Permit 03-A-425-P.
² Proposed MACT limit for SGS Unit 4
 Co-Benefit for SGS Unit 4 is WFGD + FF
 Figures 3-1 and 3-2 presented the mercury control calculations and assumptions.

3.4.4 Proposed Case-by-Case MACT Limit for Mercury

Based on the emission calculations, the use of a fabric filter and WFGD in conjunction with brominated PAC injection will achieve the maximum mercury reduction. The use of a WFGD should further reduce mercury emissions, but there is no test data in the EPA ICR to substantiate such a reduction. MinPlus can achieve the same reduction in mercury as brominated PAC, but it is not guaranteed. Also, MinPlus must be shipped from the Netherlands in Europe and the amount of reagent required to achieve mercury control is uncertain. The TOXECON process can also achieve the same mercury removal as brominated PAC injection, assuming the use of a higher FF air-to-cloth ratio configuration as a secondary particulate control device, as previously discussed. However, because the front-end DESP proposed for SGS Unit 4 is intended to collect saleable fly ash and not designed as a primary particulate control device, and because a low air-to-cloth ratio FF is proposed as BACT as the primary particulate control device for SGS Unit 4, TOXECON while feasible, is not the preferred mercury control option for the proposed SGS Unit 4 air quality control design.

As shown in Table 3-7, when burning typical Rawhide coal, SGS Unit 4 will likely achieve mercury reduction beyond the established MACT floor. However, the proposed operation of the facility will allow SGS Unit 4 to burn a variety of coal fuels and blends, with the Jacobs Ranch fuel exhibiting the greatest potential for mercury emissions. Therefore, taking into consideration the range of fuels as part of this case-by-case analysis, as well as the proposed co-benefit and mercury specific control technology identified and selected above (i.e., brominated PAC injection), IPL proposes a case-by-case mercury MACT limit of 2.33×10^{-6} lb/MBtu based on a 12-month rolling average and a mercury continuous emission monitor (CEM) for SGS Unit 4.

Basis: Jacobs Ranch Worst Case Fuel

Fuel Heating Value (min)	8,576 Btu/lb
Fuel Burn Rate	6,326 MBtu/h
Hours of Operation	8,760 h/yr
Unit MW (gross)	700 MW
Total Hg in Coal (max)	0.20 ppm

Co-Benefit Technology	Mercury Reduction	Uncontrolled			Controlled				
		Total Hg Emissions (lb/MBtu)	Emissions (lb/h)	Emissions (tpy)	Total Hg Emissions (lb/MBtu)	Emissions (lb/TBtu)	Emissions (lb/h)	Emissions (tpy)	Emissions (lb/TWh)
Cold-Side ESP	16%	0.0000233	0.15	0.65	1.96E-05	19.6	0.12	0.5428	177.03
Hot-Side ESP	13%	0.0000233	0.15	0.65	2.03E-05	20.3	0.13	0.5622	183.36
Fabric Filter	72%	0.0000233	0.15	0.65	6.53E-06	6.5	0.04	0.1809	59.01
SDA-ESP	38%	0.0000233	0.15	0.65	1.45E-05	14.5	0.09	0.4006	130.67
SDA-Fabric Filter	25%	0.0000233	0.15	0.65	1.75E-05	17.5	0.11	0.4846	158.07
Cold-Side ESP + WFGD	35%	0.0000233	0.15	0.65	1.52E-05	15.2	0.10	0.4200	136.99
Hot-Side ESP + WFGD	33%	0.0000233	0.15	0.65	1.56E-05	15.6	0.10	0.4329	141.21
Fabric Filter + WFGD	72%	0.0000233	0.15	0.65	6.53E-06	6.5	0.04	0.1809	59.01

Basis: Typical Rawhide Fuel

Fuel Heating Value (typical)	8,300 Btu/lb
Fuel Burn Rate	6,326 MBtu/h
Hours of Operation	8,760 h/yr
Unit MW (gross)	700 MW
Total Hg in Coal (typical)	0.09 ppm

Co-Benefit Technology	Mercury Reduction	Uncontrolled			Controlled				
		Total Hg Emissions (lb/MBtu)	Emissions (lb/h)	Emissions (tpy)	Total Hg Emissions (lb/MBtu)	Emissions (lb/TBtu)	Emissions (lb/h)	Emissions (tpy)	Emissions (lb/TWh)
Cold-Side ESP	16%	0.0000108	0.07	0.30	9.11E-06	9.1	0.06	0.2524	82.31
Hot-Side ESP	13%	0.0000108	0.07	0.30	9.43E-06	9.4	0.06	0.2614	85.25
Fabric Filter	72%	0.0000108	0.07	0.30	3.04E-06	3.0	0.02	0.0841	27.44
SDA-ESP	38%	0.0000108	0.07	0.30	6.72E-06	6.7	0.04	0.1863	60.76
SDA-Fabric Filter	25%	0.0000108	0.07	0.30	8.13E-06	8.1	0.05	0.2253	73.49
Cold-Side ESP + WFGD	35%	0.0000108	0.07	0.30	7.05E-06	7.0	0.04	0.1953	63.70
Hot-Side ESP + WFGD	33%	0.0000108	0.07	0.30	7.27E-06	7.3	0.05	0.2013	65.66
Fabric Filter + WFGD	72%	0.0000108	0.07	0.30	3.04E-06	3.0	0.02	0.0841	27.44

Figure 3-1
Co-Benefit Mercury Control Technology Emissions Calculations

Basis: Jacobs Ranch Worst Case Fuel

Fuel Heating Value (min)	8,576 Btu/lb
Fuel Burn Rate	6,326 MBtu/h
Hours of Operation	8,760 h/yr
Unit MW (gross)	700 MW
Total Hg in Coal (max)	0.20 ppm

Mercury Specific Technology	Mercury Reduction	Uncontrolled			Controlled				
		Total Hg Emissions (lb/MBtu)	Emissions (lb/h)	Emissions (tpy)	Total Hg Emissions (lb/MBtu)	Emissions (lb/TBtu)	Emissions (lb/h)	Emissions (tpy)	Emissions (lb/TWh)
PAC Injection	80%	2.33E-05	0.15	0.65	4.66E-06	4.7	0.03	0.1292	42.15
Brominated PAC Injection*	90%	2.33E-05	0.15	0.65	2.33E-06	2.3	0.01	0.0646	21.08
MinPlus**	90%	2.33E-05	0.15	0.65	2.33E-06	2.3	0.01	0.0646	21.08
TOXECON	90%	2.33E-05	0.15	0.65	2.33E-06	2.3	0.01	0.0646	21.08

Basis: Typical Rawhide Fuel

Fuel Heating Value (typical)	8,300 Btu/lb
Fuel Burn Rate	6,326 MBtu/h
Hours of Operation	8,760 h/yr
Unit MW (gross)	700 MW
Total Hg in Coal (typical)	0.09 ppm

Mercury Specific Technology	Mercury Reduction	Uncontrolled			Controlled				
		Total Hg Emissions (lb/MBtu)	Emissions (lb/h)	Emissions (tpy)	Total Hg Emissions (lb/MBtu)	Emissions (lb/TBtu)	Emissions (lb/h)	Emissions (tpy)	Emissions (lb/TWh)
PAC Injection	80%	1.08E-05	0.07	0.30	2.17E-06	2.2	0.01	0.0601	19.60
Brominated PAC Injection*	88%	1.08E-05	0.07	0.30	1.33E-06	1.3	0.01	0.0368	12.00
MinPlus**	88%	1.08E-05	0.07	0.30	1.33E-06	1.3	0.01	0.0368	12.00
TOXECON	88%	1.08E-05	0.07	0.30	1.33E-06	1.3	0.01	0.0368	12.00

* Brominated PAC injection limit is based on guarantee of either 12 lb/TWh of mercury or 90% removal, whichever occurs first.

** MinPlus is assumed to have the same limitations as B-PAC injection

Figure 3-2
Co-Benefit and Mercury Specific Control Technology Emissions Calculations

Attachment A
Hazardous Air Pollutant Emission Calculations

Table A-1

IPL
Sutherland Unit 4
HAPs Emission Calculations

Emission Calculation

Basis:

Fuel Burn Rate	6,326 MBtu/h	
Unit MW (net)	649 MW	
Unit MW (gross)	700 MW	
Hours of Operation	8,760 h/y	
Fuel Heating Value	8,300 Btu/lb	Rawhide PRB design fuel typical heating value

Emission Factor	Uncontrolled			Controlled			
	(lb/ton)	(lb/MBtu)	(lb/h)	(tpy)	(lb/MBtu)	(lb/h)	(tpy)
Inorganic Solid HAPs							
Antimony	1.80E-05	1.08E-04	6.86E-01	3.00	1.08E-06	6.86E-03	0.03
Arsenic	4.10E-04	2.47E-03	1.56E+01	68.44	2.47E-05	1.56E-01	0.68
Beryllium	2.10E-05	1.27E-04	8.00E-01	3.51	1.27E-06	8.00E-03	0.04
Cadmium	5.10E-05	3.07E-04	1.94E+00	8.51	3.07E-06	1.94E-02	0.09
Chromium	2.60E-04	1.57E-03	9.91E+00	43.40	1.57E-05	9.91E-02	0.43
Chromium (VI)	7.90E-05	4.76E-04	3.01E+00	13.19	4.76E-06	3.01E-02	0.13
Cobalt	1.00E-04	6.02E-04	3.81E+00	16.69	6.02E-06	3.81E-02	0.17
Lead (See Note 3)		7.20E-04	4.55E+00	19.95	1.80E-05	1.14E-01	0.50
Manganese	4.90E-04	2.95E-03	1.87E+01	81.79	2.95E-05	1.87E-01	0.82
Nickel	2.80E-04	1.69E-03	1.07E+01	46.74	1.69E-05	1.07E-01	0.47
Selenium	1.30E-03	7.83E-03	4.95E+01	216.99	7.83E-05	4.95E-01	2.17
Inorganic Solid HAPs Sub-Total			119.22	522.20		1.26	5.52

Emission Factor	Uncontrolled			Controlled			
	(lb/ton)	(lb/MBtu)	(lb/h)	(tpy)	(lb/MBtu)	(lb/h)	(tpy)
Inorganic Acid Gas HAPs							
HF (See Note 4)		9.08E-03	5.74E+01	251.53	2.00E-04	1.27E+00	5.54
HCl (See Note 4)		5.66E-02	3.58E+02	1,567.53	1.20E-03	7.59E+00	33.25
Inorganic Acid Gases Sub-Total			415.31	1,819.06		8.86	38.79

Emission Factor	Uncontrolled			Controlled			
	(lb/ton)	(lb/MBtu)	(lb/h)	(tpy)	(lb/MBtu)	(lb/h)	(tpy)
Organic HAPs							
Total PCDD/PCDF	2.44E-07	1.47E-08	9.30E-05	0.0004	1.47E-08	9.30E-05	0.0004
Biphenyl	1.70E-06	1.02E-07	6.48E-04	0.0028	1.02E-07	6.48E-04	0.0028
Acenaphthene	5.10E-07	3.07E-08	1.94E-04	0.0009	3.07E-08	1.94E-04	0.0009
Acenaphthylene	2.50E-07	1.51E-08	9.53E-05	0.0004	1.51E-08	9.53E-05	0.0004
Anthracene	2.10E-07	1.27E-08	8.00E-05	0.0004	1.27E-08	8.00E-05	0.0004
Benzo(a)anthracene	8.00E-08	4.82E-09	3.05E-05	0.0001	4.82E-09	3.05E-05	0.0001
Benzo(a)pyrene	3.80E-08	2.29E-09	1.45E-05	0.0001	2.29E-09	1.45E-05	0.0001
Benzo(b,j,k)fluoranthene	1.10E-07	6.63E-09	4.19E-05	0.0002	6.63E-09	4.19E-05	0.0002
Benzo(g,h,i)perylene	2.70E-08	1.63E-09	1.03E-05	0.0000	1.63E-09	1.03E-05	0.0000
Chrysene	1.00E-07	6.02E-09	3.81E-05	0.0002	6.02E-09	3.81E-05	0.0002
Fluoranthene	7.10E-07	4.28E-08	2.71E-04	0.0012	4.28E-08	2.71E-04	0.0012
Fluorene	9.10E-07	5.48E-08	3.47E-04	0.0015	5.48E-08	3.47E-04	0.0015
Indeno(1,2,3-cd)pyrene	6.10E-08	3.67E-09	2.32E-05	0.0001	3.67E-09	2.32E-05	0.0001
Naphthalene	1.30E-05	7.83E-07	4.95E-03	0.0217	7.83E-07	4.95E-03	0.0217
Phenanthrene	2.70E-06	1.63E-07	1.03E-03	0.0045	1.63E-07	1.03E-03	0.0045
Pyrene	3.30E-07	1.99E-08	1.26E-04	0.0006	1.99E-08	1.26E-04	0.0006
5-Methyl chrysene	2.20E-08	1.33E-09	8.38E-06	0.0000	1.33E-09	8.38E-06	0.0000
Acetaldehyde	5.70E-04	3.43E-05	2.17E-01	0.9514	3.43E-05	2.17E-01	0.9514
Acetophenone	1.50E-05	9.04E-07	5.72E-03	0.0250	9.04E-07	5.72E-03	0.0250
Acrolein	2.90E-04	1.75E-05	1.11E-01	0.4841	1.75E-05	1.11E-01	0.4841
Benzene	1.30E-03	7.83E-05	4.95E-01	2.1699	7.83E-05	4.95E-01	2.1699
Benzyl chloride	7.00E-04	4.22E-05	2.67E-01	1.1684	4.22E-05	2.67E-01	1.1684
Bis(2-ethylhexyl)phthalate	7.30E-05	4.40E-06	2.78E-02	0.1218	4.40E-06	2.78E-02	0.1218
Bromoform	3.90E-05	2.35E-06	1.49E-02	0.0651	2.35E-06	1.49E-02	0.0651
Carbon disulfide	1.30E-04	7.83E-06	4.95E-02	0.2170	7.83E-06	4.95E-02	0.2170
2-Chloroacetophenone	7.00E-06	4.22E-07	2.67E-03	0.0117	4.22E-07	2.67E-03	0.0117
Chlorobenzene	2.20E-05	1.33E-06	8.38E-03	0.0367	1.33E-06	8.38E-03	0.0367
Chloroform	5.90E-05	3.55E-06	2.25E-02	0.0985	3.55E-06	2.25E-02	0.0985
Cumene	5.30E-06	3.19E-07	2.02E-03	0.0088	3.19E-07	2.02E-03	0.0088
Cyanide	2.50E-03	1.51E-04	9.53E-01	4.1729	1.51E-04	9.53E-01	4.1729
2,4-Dinitrotoluene	2.80E-07	1.69E-08	1.07E-04	0.0005	1.69E-08	1.07E-04	0.0005
Dimethyl sulfate	4.80E-05	2.89E-06	1.83E-02	0.0801	2.89E-06	1.83E-02	0.0801
Ethyl benzene	9.40E-05	5.66E-06	3.58E-02	0.1569	5.66E-06	3.58E-02	0.1569
Ethyl chloride	4.20E-05	2.53E-06	1.60E-02	0.0701	2.53E-06	1.60E-02	0.0701
Ethylene dichloride	4.00E-05	2.41E-06	1.52E-02	0.0668	2.41E-06	1.52E-02	0.0668
Ethylene dibromide	1.20E-06	7.23E-08	4.57E-04	0.0020	7.23E-08	4.57E-04	0.0020
Formaldehyde	2.40E-04	1.45E-05	9.15E-02	0.4006	1.45E-05	9.15E-02	0.4006
Hexane	6.70E-05	4.04E-06	2.55E-02	0.1118	4.04E-06	2.55E-02	0.1118
Isophorone	5.80E-04	3.49E-05	2.21E-01	0.9681	3.49E-05	2.21E-01	0.9681
Methyl bromide	1.60E-04	9.64E-06	6.10E-02	0.2671	9.64E-06	6.10E-02	0.2671
Methyl chloride	5.30E-04	3.19E-05	2.02E-01	0.8846	3.19E-05	2.02E-01	0.8846
Methyl ethyl ketone	3.90E-04	2.35E-05	1.49E-01	0.6510	2.35E-05	1.49E-01	0.6510
Methyl hydrazine	1.70E-04	1.02E-05	6.48E-02	0.2838	1.02E-05	6.48E-02	0.2838
Methyl methacrylate	2.00E-05	1.20E-06	7.62E-03	0.0334	1.20E-06	7.62E-03	0.0334
Methyl tert butyl ether	3.50E-05	2.11E-06	1.33E-02	0.0584	2.11E-06	1.33E-02	0.0584
Methylene chloride	2.90E-04	1.75E-05	1.11E-01	0.4841	1.75E-05	1.11E-01	0.4841
Phenol	1.60E-05	9.64E-07	6.10E-03	0.0267	9.64E-07	6.10E-03	0.0267
Propionaldehyde	3.80E-04	2.29E-05	1.45E-01	0.6343	2.29E-05	1.45E-01	0.6343
Tetrachloroethylene	4.30E-05	2.59E-06	1.64E-02	0.0718	2.59E-06	1.64E-02	0.0718
Toluene	2.40E-04	1.45E-05	9.15E-02	0.4006	1.45E-05	9.15E-02	0.4006
1,1,1-Trichloroethane	2.00E-05	1.20E-06	7.62E-03	0.0334	1.20E-06	7.62E-03	0.0334
Styrene	2.50E-05	1.51E-06	9.53E-03	0.0417	1.51E-06	9.53E-03	0.0417
Xylenes	3.70E-05	2.23E-06	1.41E-02	0.0618	2.23E-06	1.41E-02	0.0618
Vinyl acetate	7.60E-06	4.58E-07	2.90E-03	0.0127	4.58E-07	2.90E-03	0.0127
Organic HAPs Sub-Total			3.51	15.37		3.51	15.37

Notes:

- 1) Inorganic Solid HAPs emission factors based on USEPA AP-42, Table 1.1-18 "Emission Factors for Trace Metals from Controlled Coal Combustion."
- 2) Uncontrolled Inorganic Solid HAPs emission estimates based on 99 percent control efficiency through the fabric filter.
- 3) Lead (Pb) is a PSD pollutant, previously calculated from the maximum Pb concentration (6 ppm in Greater Belleville coal). (See Application Addendum)
- 4) HF and HCl emissions are based on maximum coal composition data for Fluorine (F) and Chlorine (Cl), respectively. (See Table A-2 for calculations)
- 5) Controlled Inorganic Acid Gas HAPs emission estimates based on 98 percent control efficiency through the WFGD.
- 6) Organic HAPs emission factors based on USEPA AP-42, Table 1.1-12, 1.1-13, and 1.1-14 for PCDD/PCDF, PAHs, and Organic Compounds, respectively.
PCDD/PCDF = Polychlorinated Dibenzo-P-Dioxans/Polychlorinated Dibenzofurans.
PAH = Polynuclear Aromatic Hydrocarbons.

Table A-2

IPL
Sutherland Unit 4
HCl and HF HAPs Emission Calculations

Emission Calculation

Basis:

Fuel Burn Rate	6,326 MBtu/h
Unit MW (net)	649 MW
Unit MW (gross)	700 MW
Hours of Operation	8,760 h/y

Trace Element Analysis (ppm, dry basis)

Coal Mine	Chlorine (Cl)			Fluorine (F)			Heating Value (Btu/lb)		
	Min	Typical	Max	Min	Typical	Max	Min	Typical	Max
Subbituminous Fuels									
Peabody Caballo		0.01			56		8,300	8,500	8,600
Rawhide	120	240	400	17	27.6	34.9	8,100	8,300	8,500
Jacobs Ranch (Upper Wyodak)	47	147	247	15.5	26.1	36.7	8,576	8,800	9,024
Antelope Mine		106.42			45.98		8,500	8,800	9,100
Black Thunder		140			42		8,610	8,840	9,070
Jacobs Ranch		159			26.4		8,557	8,781	9,005
Cordero Rojo		100			68.79		8,258	8,454	8,649
Belle Ayr		100			51.93		8,409	8,550	8,691
Coal Creek							8,140	8,350	8,600
Eagle Butte		100			53.49		8,286	8,400	8,514
Buckskin		10			49.43		8,100	8,400	8,500

Maximum Trace Element Value **400**
Minimum Heating Value **8,100**

Bituminous Fuels

Sufco Utah		105			22.6			11,400	
Colowyo Colorado		100			92			10,490	
West Elk Colorado		221			44			12,059	
Twenty Mile Colorado								11,400	
Peabody Gateway		1100			102			11,004	
Greater Belleville		759			99		10,400	10,800	11,100
Galatia		759			99			11,830	
Pond Creek #1								11,729	

Maximum Trace Element Value **1100**
Minimum Heating Value **10,400**

	HCl	HF
Uncontrolled Subbituminous Emissions (lb/MBtu)	0.0508	0.0089
Uncontrolled Bituminous Emissions (lb/MBtu)	0.1088	0.0103
Uncontrolled 90/10 Blend Emissions (lb/MBtu)	0.0566	0.0091
Control Efficiency (percent)	98%	98%
Controlled Emissions (lb/MBtu)	0.0012	0.0002
Controlled Emission (lb/h)	7.59	1.27
Controlled Emissions (tpy)	33.25	5.54

Notes:

- 1) The coal data, including the Chlorine (Cl) and Fluorine (F) concentration levels and fuel heating values are based on the coal fuel analysis provided in the Addendum and Response to IDNR Requests for Additional Information, April 2008.
- 2) Emission calculations are based on the maximum concentration data for each coal fuel/mine and the minimum heating value (i.e., highest feed rate).
- 3) Uncontrolled emission rates are calculated as the (concentration ppm/1,000,000) X (1/heating value) X (MW of Compound/MW of Element)
- 4) Uncontrolled 90/10 blend emission rates assume a 90/10 blend of subbituminous and bituminous coals, respectively, based on boiler heat input.
- 5) Controlled Emissions (lb/MBtu) were calculated as Uncontrolled 90/10 Emissions (lb/MBtu) X (1-CE), and rounded up to the fourth digit.
- 6) Controlled Emissions (lb/h) were calculated as Controlled Emissions (lb/MBtu) X 6,326 MBtu/h
- 7) Controlled Emissions (tpy) were calculated as Controlled Emissions (lb/h) X (8,760 h/yr) X (ton/2000 lbs)

Attachment B
Summary of Hydrochloric Acid Permit Limits for Recent Projects



Attachment B

Summary of Hydrochloric Acid Permit Limits for Recent Projects

Company – Unit (Source Design)	State	Fuel (Type of Coal)	Size (MW)	HCl Limit (lbs/MBtu)	HCl Control Technology	Status of Project Permit Status Commercial Online
Longview Power, LLC – Fort Martin, Robinson Run (SCPC Boiler)	WV	Bituminous	600	0.0001	Dry Sorbent Injection, FF	Permitted Issued: 3/2/2004 C.O.: 3/1/2011
City Utilities of Springfield, Southwest Power Station (PC Boiler)	MO	PRB	275	0.00073	Spray Dryer Absorber, FF	Under Construction Issued: 12/15/2004 C.O.:10/1/2010
Omaha Public Power District, Nebraska City Unit 2 (PC Boiler)	NE	PRB	660	0.0008	Dry FGD, FF	Under Construction Issued: 3/9/2005 C.O.:5/1/2009
Centennial Hardin, Comanche Park, Rocky Mountain Power, Inc. (PC Boiler)	MT	PRB	116	0.00118	Dry FGD, FF	Operating Issued: 6/11/2002 C.O.: 1/19/2006
Longleaf Energy Assoc., LLC – LS Power Development, LLC (PC Boiler)	GA	PRB Sub- bituminous	1,200	0.0013 ¹ 0.0083 ²	Dry FGD, FF	Permitted C.O. 1/1/2010
Wisconsin Public Service Corp. Weston (SCPC Boiler)	WI	PRB	500	0.0021 (10.94 lb/h)	FF	Testing Issued: 10/19/2004 C.O.: 6/1/2008
Santee Cooper Cross Generating Station, Santee Cooper (2 x 660MW PC Boilers)	SC	Bituminous	1,320	0.0024	Wet FGD	Permitted Issued: 2/5/2004 Unit 3 Operating: 1/1/2007 Unit 4 C.O.: 1/1/2009
Walter Scott, Jr. Energy Center Unit 4, MidAmerican Energy Company (SCPC Boiler)	IA	PRB	790	0.0029	Dry FGD	Operating Issued: 6/17/2003 C.O.: 6/1/2007
Peabody - Prairie State Generating Station (PC Boiler)	IL	Illinois #6	1500	0.0032	Wet FGD	Site Prep Issued: January '05 C.O.: 6/1/2011
Intermountain Power Service Corp. (PC Boiler)	UT	Bituminous or blend of Bit. + Sub-bi. P.R.R. ¹	950	0.0042 (38.13 lb/h)	FF	Permitted Issued: 10/15/2004 C.O.:6/1/2012

Company – Unit (Source Design)	State	Fuel (Type of Coal)	Size (MW)	HCl Limit (lbs/MBtu)	HCl Control Technology	Status of Project Permit Status Commercial Online
LS Power, Sandy Creek Energy Station (PC Boiler)	TX	PRB	800	0.0088 (72 lb/h)	Dry FGD, FF	Permitted Issued: Dec. '04 C.O.: 1/1/2009
LS Power, Plum Pt. Energy, Plum Pt. Power Sta. (PC Boiler)	AR	PRB	800	0.013	Dry FGD, FF	Under Construction Issued: 8/20/2003 C.O.: 6/1/2010
<p>Notes: ¹-Annual average while firing PRB coal. ²-Annual average while firing Central Appalachian bituminous coal.</p>						

Attachment C
Summary of Hydrofluoric Acid permit Limits for Recent Projects

Attachment C

Summary of Fluorides Permit Limits for Recent Projects

Company – Unit (Source Design)	State	Fuel (Type of Coal)	Size (MW)	Fluorides Limit (lbs/MBtu)	Fluorides Control Technology	Status of Project Permit Status Commercial Online
Longview Power, LLC – Fort Martin, Robinson Run (SCPC Boiler)	WV	Bituminous	600	0.0001	Wet FGD, FF	Permitted Issued: 3/2/2004 C.O.: 3/1/2011
Thoroughbred Generating Company, LLC -- Peabody Energy (PC Boiler)	KY	Bituminous	1,500	0.000159 (30-day average)	Wet FGD	Permitted Issued: 4/14/2006 C.O.: 1/1/2011
Wisconsin Public Service Corp. Weston (SCPC Boiler)	WI	PRB	500	0.000217	FF	Testing Issued: 10/19/2004 C.O.: 6/1/2008
Florida Power and Light Company, Glades Power Park (2 x 980 MW SCPC Boilers)	FL	Bituminous and up to 20% Petcoke	1,960	0.00023 (Method 8A)	FF, WESP	Cancelled App.: 12/19/2006 Unit 1 C.O.: 6/1/2013 Unit 2 C.O.: 6/1/2014
Peabody – Prairie State Generating Station (PC Boiler)	IL	Illinois #6	1,500	0.00026 (3-hr average)	Wet FGD	Site Prep Issued: January 2005 C.O.: 6/1/2011
Santee Cooper Cross Generating Station, Santee Cooper (2 x 660MW PC Boilers)	SC	Bituminous	1,320	0.0003 (30-day average)	Wet FGD	Permitted Issued: 2/5/2004 Unit 3 Operating: 1/1/2007 Unit 4 C.O.: 1/1/2009
City Utilities of Springfield, Southwest Power Station (PC Boiler)	MO	PRB	275	0.00037	Spray Dryer Absorber, FF	Under Construction Issued: 12/15/2004 C.O.: 10/1/2010
Omaha Public Power District, Nebraska City Unit 2 (PC Boiler)	NE	PRB	660	0.0004	Dry FGD, FF	Under Construction Issued: 3/9/2005 C.O.: 5/1/2009
Municipal Energy Agency of Nebraska, Whelan Energy Center (PC Boiler)	NE	PRB	220	0.0004	FF	Site Prep Issued: 3/30/2004 C.O.: 1/1/2011

Company – Unit (Source Design)	State	Fuel (Type of Coal)	Size (MW)	Fluorides Limit (lbs/MBtu)	Fluorides Control Technology	Status of Project Permit Status Commercial Online
LS Power, Plum Pt. Energy, Plum Pt. Power Sta. (PC Boiler)	AR	PRB	800	0.00044	Dry FGD, FF	Under Construction Issued: 8/20/2003 C.O.: 6/1/2010
Unisource Energy, Tuscon Electric's Springerville Station (2 x 400 MW PC Boilers)	AZ	Sub-bituminous	800	0.00044	Dry FGD, FF	Permitted Unit 3 Oper: 7/28/2006 Unit 4 C.O.: 12/31/2009
Comanche Station, Public Service Company of Colorado/Xcel Energy (SCPC Boiler)	CO	PRB	750	0.0005 (3 test runs)	FF	Under Construction Issued: 7/5/2005 C.O.: 10/1/2009
Intermountain Power Service Corp. (PC Boiler)	UT	Bituminous or blend of Bit. + Sub-bi. P.R.R. ¹	950	0.0005 (3 test runs)	FF	Permitted Issued: 10/15/2004 C.O.:6/1/2012
TS Power Plant	NV	PRB	200	0.0005 (1.17 lb/h)	Dry Spray Scrubber, FF	Permitted Issued: 5/5/2005
Centennial Hardin, Comanche Park, Rocky Mountain Power, Inc. (PC Boiler)	MT	PRB	116	0.00051	Dry FGD, FF	Operating Issued: 6/11/2002 C.O.: 1/19/2006
Dry Fork Station	WY	PRB	385	0.00069 (2.62 lb/h)	Circulating Dry Scrubber, FF	Permitted Issued: 10/15/2007
Wisconsin Energy – Oak Creek Power Plant (SCPC Boiler)	WI	Sub-bituminous	1,230	0.00088	FF	Under Construction Issued: 1/14/2004 C.O.: 9/29/2010
Walter Scott, Jr. Energy Center Unit 4, MidAmerican Energy Company (SCPC Boiler)	IA	PRB	790	0.0009	FF	Operating Issued: 6/17/2003 C.O.: 6/1/2007
Longleaf Energy Assoc., LLC -- LS Power Development, LLC (PC Boiler)	GA	PRB/Bituminous	1,200	0.00095 ¹ , 0.0014 ²	FF	App. Pending P.R.R. ³ : 1/14/2005 C.O.: 1/1/2010
<p>Notes: ¹ – Annual average while firing Powder River Basin (PRB) sub-bituminous coal ² – Annual average while firing Central Appalachian (CAPP) bituminous coal ³ – P.R.R. (Proposal Received in Regional EPA Office)</p>						

Attachment D
Summary of Mercury Permit Limits for Recent Projects

Attachment D

Summary of Mercury Permit Limits for Recent Projects

Company – Unit (Source Design)	State	Fuel (Type of Coal)	Size (MW)	Mercury Limit (lbs/TBtu)	Mercury Control Technology	Status of Project Permit Status Commercial Online
Wisconsin Energy – Oak Creek Power Plant (SCPC Boiler)	WI	Sub-bituminous	1,230	1.12	FF	Under Construction Issued: 1/14/2004 C.O.: 9/29/2010
Wisconsin Public Service Corp. Weston (SCPC Boiler)	WI	PRB	500	1.7	FF	Under Construction Issued: 10/19/2004 C.O.: 6/1/2008
Walter Scott, Jr. Energy Center Unit 4, MidAmerican Energy Company (SCPC Boiler)	IA	PRB	790	1.7	Activated Carbon, FF	Operating Issued: 6/17/2003 C.O.: 6/1/2007
Omaha Public Power District, Nebraska City Unit 2 (PC Boiler)	NE	PRB	660	1.98	FF	Under Construction Issued: 3/9/2005 C.O.:5/1/2009
Peabody – Prairie State Generating Station (PC Boiler)	IL	Illinois #6	1,500	2.1 (0.016 lb/h)	FF	Site Prep Issued: January 2005 C.O.: 6/1/2011
Thoroughbred Generating Company, LLC -- Peabody Energy (PC Boiler)	KY	Bituminous	1,500	3.21 (quarterly)	FF	Permitted Issued: 10/11/2002 C.O.: 1/1/2011
Santee Cooper Cross Generating Station, Santee Cooper (2 x 660MW PC Boilers)	SC	Bituminous	1,320	3.6	Dry ESP	Permitted Issued: 5/31/2006 Unit 3 Operating:1/1/2007 Unit 4 C.O.: 1/1/2009
Centennial Hardin, Comanche Park, Rocky Mountain Power, Inc. (PC Boiler)	MT	PRB	116	5.8 (1-hr avg)	FF	Operating Issued: 6/11/2002 C.O.: April 2006
City Utilities of Springfield, Southwest Power Station (PC Boiler)	MO	PRB	275	7.5	FF	Under Construction Issued: 3/9/2005 C.O.:10/1/2010
Western Farmers Electric Coop, Hugo Station (PC Boiler)	OK	PRB	750	8	FF	Permitted Issued: February 2007 C.O.: 1/1/2012

Company – Unit (Source Design)	State	Fuel (Type of Coal)	Size (MW)	Mercury Limit (lbs/TBtu)	Mercury Control Technology	Status of Project Permit Status Commercial Online
CPS Energy, J K Spruce (PC Boiler)	TX	PRB	750	9.83	FF	Under Construction Issued: 12/02/2003 C.O.:6/1/2010
LS Power, Plum Pt. Energy, Plum Pt. Power Sta. (PC Boiler)	AR	PRB	800	12.8	FF	Under Construction Issued: 8/20/2003 C.O.: 6/1/2010
LS Power, Sandy Creek Energy Station (PC Boiler)	TX	PRB	800	20	Dry FGD, FF	Permitted Issued: Dec. '04 C.O.: 1/1/2009
TXU Power, Oak Grove Steam Electric Station (2 x 800 MW PC Boilers)	TX	Lignite	1,600	145	FF	App. Pending P.R.R. ¹ : 7/28/2005 Unit 1 and 2 C.O.: 1/1/2011
Intermountain Power Service Corp. (PC Boiler)	UT	Bituminous or blend of Bit. + Sub-bi	950	6×10^{-6} lb/MW-hr ² , 20×10^{-6} lb/MW-hr ³	FF	Permitted Issued: 10/15/2004 C.O.:6/1/2012
Longleaf Energy Assoc., LLC -- LS Power Development, LLC (PC Boiler)	GA	PRB Sub-Bituminous	1,200	15×10^{-6} lb/MW-hr ⁴ , 6×10^{-6} lb/MW-hr ⁵	FF	App. Pending P.R.R. ¹ : 1/14/2005 C.O.: 1/1/2010
Sand Sage, Sunflower Holcomb East Power Station (3 x 700 MW PC Boilers)	KS	PRB	2,100	20×10^{-6} lb/MW-hr (bit. and blends), 97×10^{-6} lb/MW-hr (sub-bit.)	FF	Proposed P.R.R. ¹ : 9/22/2006 Units 1 & 2 C.O.:1/1/2011 Unit 3: Cancelled
Association Electric Cooperative, Inc. (SCPC Boiler)	MO	PRB	689	66×10^{-6} lb/MW-hr	FF	Permitted Issued: 2/22/2008 Cancelled
Notes:						
¹ – P.R.R. (Proposal Received in Regional EPA Office)						
² – Twelve (12) month rolling total while firing bituminous coal						
³ – Twelve (12) month rolling total while firing sub-bituminous coal						
⁴ – Annual average while firing Powder River Basin (PRB) sub-bituminous coal						
⁵ – Annual average while firing Central Appalachian (CAPP) bituminous coal						

Roling, Chris [DNR]

From: Arnold, Alan [AlanArnold@alliantenergy.com]
Sent: Thursday, May 15, 2008 3:31 PM
To: Roling, Chris [DNR]
Cc: Hillman, Timothy M.; Byers, Andrew C. (Andy); Beer, Jeffery
Subject: Case-by-Case MACT Analysis- Sutherland Unit 4
Attachments: IPL MACT 051408 Final.pdf; 4392_001.pdf; IPL MACT HAPS Calc 051408 Final.xls

Chris- please find an electronic copy of IPL's Case-by-Case MACT analysis and supporting information for Sutherland Station Unit 4. Two hard copies with CDs have been placed in the mail to your attention today.

Regards- Alan

Alan J. Arnold

Environmental Lead- IPL Baseload Project

Alliant Energy Corporate Services

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