ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Air Permits Program

BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION
for
University of Alaska Fairbanks
Fairbanks Campus Power Plant

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G:\AQ\General\SIP_BACT_2017\BACT Determinations\Information Requests No. 2\UAF\UAF BACT Determination 05.10.19.docx

Table of Contents

Abbreviations/Acronyms

AAC ....Alaska Administrative Code
AAAQS ....Alaska Ambient Air Quality Standards
Department ....Alaska Department of Environmental Conservation
BACT ....Best Available Control Technology
CFB……………………Circulating Fluidized Bed
CFR. ....Code of Federal Regulations
Cyclones……………….Mechanical Separators
DFP……………………Diesel Particulate Filter
DLN..............................Dry Low NOx
DOC…………………...Diesel Oxidation Catalyst
EPA ....Environmental Protection Agency
ESP…………………….Electrostatic Precipitator
EU.................................Emission Unit
FITR…………………...Fuel Injection Timing Retard
GCPs…………………..Good Combustion Practices
HAP...............................Hazardous Air Pollutant
ITR…………………….Ignition Timing Retard
LEA……………………Low Excess Air
LNB……………………Low NOx Burners
MR&Rs ....Monitoring, Recording, and Reporting
NESHAPS ....National Emission Standards for Hazardous Air Pollutants
NSCR………………….Non-Selective Catalytic Reduction
NSPS ....New Source Performance Standards
ORL...............................Owner Requested Limit
PSD................................Prevention of Significant Deterioration
PTE................................Potential to Emit
RICE, ICE ....Reciprocating Internal Combustion Engine, Internal Combustion Engine
SCR ....Selective Catalytic Reduction
SIP ....Alaska State Implementation Plan
SNCR………………….Selective Non-Catalytic Reduction
ULSD ....Ultra Low Sulfur Diesel

Units and Measures

gal/hr..............................gallons per hour
g/kWh ....grams per kilowatt hour
g/hp-hr ....grams per horsepower hour
hr/day.............................hours per day
hr/yr ....hours per year
hp...................................horsepower
lb/hr ....pounds per hour
lb/MMBtu......................pounds per million British thermal units
lb/1000 gal.....................pounds per 1,000 gallons
kW ....kilowatts
MMBtu/hr......................million British thermal units per hour
MMscf/hr.......................million standard cubic feet per hour
ppmv..............................parts per million by volume
tpy..................................tons per year

Pollutants

CO ....Carbon Monoxide
HAP...............................Hazardous Air Pollutant
NOx ....Oxides of Nitrogen
SO_2 ....Sulfur Dioxide
PM-2.5...........................Particulate Matter with an aerodynamic diameter not exceeding 2.5 microns
PM-10............................Particulate Matter with an aerodynamic diameter not exceeding 10 microns

1. INTRODUCTION

The University of Alaska Fairbanks (UAF) Campus facility has two coal-fired boilers, installed in 1962, and two oil-fired boilers (converted to dual fuel-fired by Minor Permit No. AQ0316MSS02), installed in 1970 and 1987. The power plant also has a 13,266 hp backup diesel generator installed in 1998. The UAF Campus also includes 13 diesel-fired boilers installed between 1985 and 2005, three emergency diesel engines installed between 1998 and 2013, one classroom engine installed in 1987, and one permitted diesel engine not yet installed. Additional permitted EUs not yet installed at the UAF Campus include limestone, sand, and ash handling systems, a circulating fluidized bed dual fuel-fired boiler, and a coal handling system.

In a letter dated April 24, 2015, the Alaska Department of Environmental Conservation (Department) requested the stationary sources expected to be major stationary sources in the particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (PM-2.5) serious nonattainment area perform a voluntary Best Available Control Technology (BACT) review in support of the state agency's required SIP submittal once the nonattainment area is re-classified as a Serious PM-2.5 nonattainment area. The designation of the area as "Serious" with regard to nonattainment of the 2006 24-hour PM-2.5 ambient air quality standards was published in Federal Register Vol. 82, No. 89, May 10, 2017, pages 21703-21706, with an effective date of June 9, 2017.[1]

This report addresses the significant EUs listed in permit AQ0316TVP02, Revision 1 and permit AQ0316MSS06, Revision 1. This report provides the Department's review of the BACT analysis for PM-2.5 and BACT analyses provided for oxides of nitrogen (NOx) and sulfur dioxide (SO_2) emissions, which are precursor pollutants that can form PM-2.5 in the atmosphere post combustion.

The sections review UAF's BACT analysis for technical accuracy and adherence to accepted engineering cost estimation practices.

2. BACT EVALUATION

A BACT analysis is an evaluation of all available control options for equipment emitting the triggered pollutants and a process for selecting the best option based on feasibility, economics, energy, and other impacts. 40 CFR 52.21(b)(12) defines BACT as a site-specific determination on a case-by-case basis. The Department's goal is to identify BACT for the permanent emission units (EUs) at the UAF Campus Facility that emit NOx, PM-2.5, and SO_2, establish emission limits which represent BACT, and assess the level of monitoring, recordkeeping, and reporting (MR&Rs) necessary to ensure UAF applies BACT for the EUs. The Department based the BACT review on the five-step top-down approach set forth in Federal Register Volume 61, Number 142, July 23, 1996 (Environmental Protection Agency). Table A presents the EUs subject to BACT review.

[1] [1] Federal Register, Vol. 82, No. 89, Wednesday May 10, 2017 (https://dec.alaska.gov/air/anpms/comm/docs/2017-09391-CFR.pdf)

Table A: Emission Units Subject to BACT Review

EU ID[1]	Description of EU	Rating / Size		Fuel Type	Installation or Construction Date
3	Dual-Fired Boiler	180.9	MMBtu/hr	Dual Fuel	1970
4	Dual-Fired Boiler	180.9	MMBtu/hr	Dual Fuel	1987
8	Peaking/Backup Diesel Generator	13,266	hp	Diesel	1999
9A	Medical/Pathological Waste Incinerator	533	lb/hr	Medical / Infectious Waste	2006
19	Diesel Boiler	6.13	MMBtu/hr	Diesel	2004
20	Diesel Boiler	6.13	MMBtu/hr	Diesel	2004
21	Diesel Boiler	6.13	MMBtu/hr	Diesel	2004
23	Diesel Generator Engine	235	kW	Diesel	2003
24	Diesel Generator Engine	51	kW	Diesel	2001
26	Diesel Generator Engine	45	kW	Diesel	1987
27	Diesel Generator Engine	500	hp	Diesel	TBD
28	Diesel Generator Engine	120	hp	Diesel	1998
29	Diesel Generator Engine	314	hp	Diesel	2013
105	Limestone Handling System	1,200	acfm	N/A	TBD
107	Sand Handling System	1,600	acfm	N/A	TBD
109	Ash Handling System	1,000	acfm	N/A	TBD
110	Ash Handling System Vacuum	2,000	acfm	N/A	TBD
111	Ash Loadout to Truck	N/A		N/A	TBD
113	Dual Fuel-Fired Circulating Fluidized Bed (CFB) Boiler	295.6	MMBtu/hr	Coal/Woody Biomass	TBD
114	Dry Sorbent Handling Vent Filter Exhaust	5	acfm	N/A	TBD
128	Coal Silo No. 1 with Bin Vent	1,650	acfm	N/A	TBD
129	Coal Silo No. 2 with Bin Vent	1,650	acfm	N/A	TBD
130	Coal Silo No. 3 with Bin Vent	1,650	acfm	N/A	TBD

Table Notes:
[1]EUs 105, 107, 109-111, 113, 114, and 128-130 were authorized for construction with the issuance of Minor Permit AQ0316MSS06, Revision 2, but have not yet been installed.

UAF did not include BACT analyses for EUs 1 and 2 as it is required that these EUs be decommissioned with the startup of EU 113 under Minor Permit AQ0316MSS06, Revision 2. UAF did not include BACT analyses for EUs 10-16, 24-26, 28, and 29 because the emissions controls for these units are economically infeasible for the small potential emissions that could be controlled. Small diesel-fired boilers 17, 18, and 23, and small diesel-fired engine were also not included in the BACT analysis as these are units similar to those included in the BACT analysis. The Department did not require every EU to be included in the BACT analysis as long as a similar unit was included.

Five-Step BACT Determinations

The following sections explain the steps used to determine BACT for NOx, PM-2.5, and SO_2 for the applicable equipment.

Step 1 Identify All Potentially Available Control Technologies

The Department identifies all available control technologies for the EUs and the pollutant under consideration. This includes technologies used throughout the world or emission reductions through the application of available control techniques, changes in process design, and/or operational limitations. To assist in identifying available controls, the Department reviews available technologies listed on the Reasonably Available Control Technology (RACT), BACT, and Lowest Achievable Emission Rate (LAER) Clearinghouse (RBLC). The RBLC is an EPA database where permitting agencies nationwide post imposed BACT for PSD sources. In addition to the RBLC search, the Department used several search engines to look for emerging and tried technologies used to control NOx, PM-2.5, and SO_2 emissions from equipment similar to those listed in Table A.

Step 2 Eliminate Technically Infeasible Control Technologies:
The Department evaluates the technical feasibility of each control technology based on source specific factors in relation to each EU subject to BACT. Based on sound documentation and demonstration, the Department eliminates control technologies deemed technically infeasible due to physical, chemical, and engineering difficulties.

Step 3 Rank the Remaining Control Technologies by Control Effectiveness
The Department ranks the remaining control technologies in order of control effectiveness with the most effective at the top.

Step 4 Evaluate the Most Effective Controls and Document the Results as Necessary
The Department reviews the detailed information in the BACT analysis about the control efficiency, emission rate, emission reduction, cost, environmental, and energy impacts for each option to decide the final level of control. The analysis must present an objective evaluation of both the beneficial and adverse energy, environmental, and economic impacts. A proposal to use the most effective option does not need to provide the detailed information for the less effective options. If cost is not an issue, a cost analysis is not required. Cost effectiveness for a control option is defined as the total net annualized cost of control divided by the tons of pollutant removed per year. Annualized cost includes annualized equipment purchase, erection, electrical, piping, insulation, painting, site preparation, buildings, supervision, transportation, operation, maintenance, replacement parts, overhead, raw materials, utilities, engineering, start-up costs, financing costs, and other contingencies related to the control option. Sections 3, 4, and 5 present the Department's BACT Determinations for NOx, PM-2.5, and SO_2.

Step 5 Select BACT
The Department selects the most effective control option not eliminated in Step 4 as BACT for the pollutant and EU under review and lists the final BACT requirements determined for each EU in this step. A project may achieve emission reductions through the application of available technologies, changes in process design, and/or operational limitations. The Department reviewed UAF's BACT analysis and made BACT determinations for NOx, PM-2.5, and SO_2 for the UAF Campus Power Plant. These BACT determinations are based on the information submitted by UAF in their analysis, information from vendors, suppliers, sub-contractors, RBLC, and an exhaustive internet search.

3. BACT DETERMINATION FOR NOx

The NOx controls proposed in this section are not planned to be implemented. The optional precursor demonstration (as allowed under 40 C.F.R. 51.1006) for the precursor gas NOx for point sources illustrates that NOx controls are not needed. DEC is planning to submit with the Serious SIP a final precursor demonstration as justification not to require NOx controls. Please see the precursor demonstration for NOx posted at http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip-development. The PM2.5 NAAQS Final SIP Requirements Rule states if the state determines through a precursor demonstration that controls for a precursor gas are not needed for attaining the standard, then the controls identified as BACT/BACM or Most Stringent Measure for the precursor gas are not required to be implemented.[2] Final approval of the precursor demonstration is at the time of the Serious SIP approval.

The Department based its NOx assessment on BACT determinations found in the RBLC, internet research, and BACT analyses submitted to the Department by Golden Valley Electric Association (GVEA) for the North Pole Power Plant and Zehnder Facility, Aurora Energy, LLC (Aurora) for the Chena Power Plant, U.S. Army Corps of Engineers (US Army) for Fort Wainwright, and the University of Alaska Fairbanks (UAF) for the Combined Heat and Power Plant.

3.1 NOx BACT for the Large Dual Fuel-Fired Boiler (EU 113)

Possible NOx emission control technologies for the large dual fuel-fired boiler were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 11.110, Coal Combustion in Industrial Size Boilers and Furnaces. The search results for coal-fired boilers are summarized in Table 3-1.

Table 3-1. RBLC Summary of NOx Control for Industrial Coal-Fired Boilers

Control Technology	Number of Determinations	Emission Limits (lb/MMBtu)
Selective Catalytic Reduction	9	0.05 – 0.08
Selective Non-Catalytic Reduction	18	0.07 – 0.36
Low NOx Burners	18	0.07 – 0.3
Overfire Air	8	0.07 – 0.3
Good Combustion Practices	2	0.1 – 0.6

RBLC Review

A review of similar units in the RBLC indicates selective catalytic reduction, selective non-catalytic reduction, low NOx burners, and good combustion practices are the principle NOx control technologies installed on large dual fuel-fired boilers. The lowest NOx emission rate in the RBLC is 0.05 lb/MMBtu.

[2] https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

Step 1 - Identification of NOx Control Technology for the Large Dual Fuel-Fired Boiler
From research, the Department identified the following technologies as available for control of NOx emissions from the large dual fuel-fired boiler:

(a) Selective Catalytic Reduction (SCR)[3]
SCR is a post-combustion gas treatment technique for reducing nitric oxide (NO) and nitrogen dioxide (NO_2) in the turbine exhaust stream to molecular nitrogen (N_2), water, and oxygen (O_2). In the SCR process, aqueous or anhydrous ammonia (NH_3) is injected into the flue gas upstream of a catalyst bed. The catalyst lowers the activation energy of the NOx decomposition reaction. NOx and NH_3 combine at the catalyst surface forming an ammonium salt intermediate, which subsequently decomposes to produce elemental N_2 and water. Depending on the overall NH_3-to-NOx ratio, removal efficiencies are generally 70 to 90 percent. Challenges associated with using SCR on coal fired boilers include a narrow window of acceptable inlet and exhaust temperatures (500°F to 800°F), emission of NH_3 into the atmosphere (NH_3 slip) caused by non-stoichiometric reduction reaction, and disposal of depleted catalysts. The Department considers SCR a technically feasible control technology for the large dual fuel-fired boiler.

(b) Selective Non-Catalytic Reduction (SNCR)
SNCR involves the non-catalytic decomposition of NOx in the flue gas to N_2 and water using reducing agents such as urea or NH_3. The process utilizes a gas phase homogeneous reaction between NOx and the reducing agent within a specific temperature window. The reducing agent must be injected into the flue gas at a location in the unit that provides the optimum reaction temperature and residence time. The NH_3 process (trade name-Thermal DeNOx) requires a reaction temperature window of 1,600°F to 2,200°F. In the urea process (trade name–NO_xOUT), the optimum temperature ranges between 1,600°F and 2,100°F. Because the temperature of CFB boiler exhaust gas normally ranges from 1,550°F to 1,650°F, achieving the required reaction temperature is the main difficulty for application of SNCR to coal-fired boilers. Expected NOx removal efficiencies are typically between 40 to 62 percent, according to the RBLC, or between 30 and 50 percent reduction, according to the EPA fact sheet (EPA-452/F-03-031). Additionally, UAF received a statement from the manufacturer Babcock & Wilcox that SNCR would have a NOx removal efficiency of 10 to 20 percent with an ammonia lip of less than 20 ppm. The Department considers SNCR a technically feasible control technology for the large dual fuel-fired boiler.

(c) Non-Selective Catalytic Reduction (NSCR)
NSCR simultaneously reduces NOx and oxidizes CO and hydrocarbons in the exhaust gas to N_2, carbon dioxide (CO_2), and water. The catalyst, usually a noble metal, causes the reducing gases in the exhaust stream (hydrogen, methane, and CO) to reduce both NO and NO_2 to N_2 at a temperature between 800°F and 1,200°F, below the expected temperature of the CFB boiler flue gas. NSCR requires a low excess O_2 concentration in the exhaust gas stream to be effective because the O_2 must be depleted before the reduction chemistry can proceed. NSCR is only effective with rich-burn gas-fired units that operate at all times with an air/fuel ratio controller at or close to stoichiometric conditions. Coal-fired boilers

[3] https://www3.epa.gov/ttncatc1/dir1/fscr.pdf

operate under conditions far more fuel-lean than required to support NSCR. The Department's research did not identify NSCR as a control technology used to control NOx emissions from large coal fired boilers installed at any facility after 2005. The Department does not consider NSCR a technically feasible control technology for the large dual fuel-fired boiler.

(d) Low NOx Burners (LNBs)
Using LNBs can reduce formation of NOx through careful control of the fuel-air mixture during combustion. Control techniques used in LNBs includes staged air, and staged fuel, as well as other methods that effectively lower the flame temperature. Experience suggests that significant reduction in NOx emissions can be realized using LNBs. The U.S. EPA reports that LNBs have achieved reduction up to 80%, but actual reduction depends on the type of fuel and varies considerably from one installation to another. Typical reductions range from 40% - 60% but under certain conditions, higher reductions are possible. The Department considers the use of LNBs a technically feasible control technology for the large dual fuel-fired boiler.

(e) Circulating Fluidized Bed (CFB)
In a fluidized bed combustor, fuel is introduced to a bed of either sorbent (limestone) or inert material (usually sand) that is fluidized by an upward flow of air. This upward air flow allows for better mixing of the gas and solids to create a better heat transfer and chemical reactions. Combustion takes place in the bed at a lower temperature than other boiler types which lowers the formation of thermally generated NOx. The Department considers the use of a CFB as a technically feasible control technology for the large dual fuel-fired boiler.

(f) Low Excess Air (LEA)
Boiler operation with low excess air is considered an integral part of good combustion practices because this process can maximize the boiler efficiency while controlling the formation of NOx. Boilers operated with five to seven percent excess air typically have peak NOx formation from both peak combustion temperatures and chemical reactions. At both lower and higher excess air concentrations the formation of NOx is reduced. At higher levels of excess air, an increase in the formation of CO occurs. CO can increase reduced. As a result, the preference is to reduce excess air such that both NOx and CO generation is minimized and the boiler efficiency is optimized. Only one RLBC entry identified low excess air technology as a NOx control alternative for a mass-feed stoker designed boiler. Boilers are regularly designed to operate with low excess air as described in the previous LNB discussion. Low excess air technology can be achieved through LNB with a staged combustion and will therefore not be a technology carried forward.

(g) Good Combustion Practices (GCPs)
GCPs typically include the following elements:

1. Sufficient residence time to complete combustion;
2. Providing and maintaining proper air/fuel ratio;
3. High temperatures and low oxygen levels in the primary combustion zone;

4. High enough overall excess oxygen levels to complete combustion and maximize thermal efficiency.

Combustion efficiency is dependent on the gas residence time, the combustion temperature, and the amount of mixing in the combustion zone. GCPs are accomplished primarily through combustion chamber design as it relates to residence time, combustion temperature, air-to-fuel mixing, and excess oxygen levels. The Department considers GCPs a technically feasible control technology for the dual fuel-fired boiler.

(h) Fuel Switching

This evaluation considers retrofit of existing coal-fired boilers. It is assumed that use of another type of coal would not reduce NOx emissions. Therefore, the Department does not consider the use of an alternate fuel to be a technically feasible control technology for the dual fuel-fired boiler.

(i) Steam / Water Injection

Steam/water injection into the combustion zone reduces the firing temperature in the combustion chamber and has been traditionally associated with reducing NOx emissions from gas combustion turbines but not coal-fired boilers. In addition, steam/water has several disadvantages, including increases in carbon monoxide and un-burned hydrocarbon emissions and increased fuel consumption. Further, the Department found that steam or water injection is not listed in the EPA RBLC for use in any coal-fired boilers and it would be less efficient at controlling NOx emissions than SCR. Therefore, the Department does not consider steam or water injection to be a technically feasible control technology for the existing dual fuel-fired boiler.

(j) Reburn

Reburn is a combustion hardware modification in which the NOx produced in the main combustion zone is reduced in a second combustion zone downstream. This technique involves withholding up to 40 percent (at full load) of the heat input to the main combustion zone and introducing that heat input above the top row of burners to create a reburn zone. Reburn fuel (natural gas, oil, or pulverized coal) is injected with either air or flue gas to create a fuel-rich zone that reduces the NOx created in the main combustion zone to nitrogen and water vapor. The fuel-rich combustion gases from the reburn zone are completely combusted by injecting overfire air above the reburn zone. Reburn may be applicable to many boiler types firing coal as the primary fuel, including tangential, wall-fired, and cyclone boilers. However, the application and effectiveness are site-specific because each boiler is originally designed to achieve specific steam conditions and capacity which may be altered due to reburn. Commercial experience is limited; however, this limited experience does indicate NOx reduction of 50 to 60 percent from uncontrolled levels may be achieved. Reburn combustion control would require significant changes to the design of the existing boilers. Therefore, the Department does not consider reburn to be a technically feasible control technology to retrofit the existing dual fuel-fired boiler.

Step 2 - Eliminate Technically Infeasible NOx Control Technologies for the Dual Fuel-Fired Boiler
As explained in Step 1 of Section 3.1, the Department does not consider non-selective catalytic reduction, low NOx burners, fuel switching, steam/water injection, or reburn as technically feasible technologies to control NO_x emissions from the dual fuel-fired boiler.

Step 3 - Rank the Remaining NOx Control Technologies for the Large Dual Fuel-Fired Boiler
The following control technologies have been identified and ranked for control of NOx from the large dual fuel-fired boiler:

(a) Selective Catalytic Reduction (70% - 90% Control)
(b) Selective Non-Catalytic Reduction (30%-50% Control)
(g) Good Combustion Practices (Less than 40% Control)
(d) Low NOx Burners/Staged Combustion (0% Control)
(e) Circulating Fluidized Bed (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF provided an economic analysis for the installation of SCR or SNCR in conjunction with CFB and staged combustion. A summary of the analysis is shown below:

Table 3-2. UAF Economic Analysis for Technically Feasible NOx Controls

Control Alternative	Potential to Emit (tpy)	Emission Reduction (tpy)	Total Capital Investment ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
SCR	51.8	207.2	$26,740,640	$5,889,642	$22,232
SNCR	207.2	51.8	$2,960,000	$527,764	$10,192
Capital Recovery Factor = 0.1424 (7% interest rate for a 10 year equipment life)					

UAF contends that the economic analysis indicates the level of NOx reduction does not justify the use of SCR or SNCR for the dual fuel-fired boiler based on the excessive cost per ton of NOx removed per year.

UAF proposed the following as BACT for the large dual fuel-fired boiler:

(a) NOx emissions from the operation of the dual fired boiler will be controlled with the use of CFB and staged combustion; and

(b) NOx emissions from the large dual fuel-fired boiler shall not exceed 0.2 lb/MMBtu.

Department Evaluation of BACT for NOx Emissions from the Dual Fuel-Fired Boiler
The Department revised the cost analysis provided by UAF for the installation of SCR and SNCR using EPA's May 2016 Air Pollution Control Cost Estimation Spreadsheet for Selective Catalytic

Reduction,[4] and Selective Non-Catalytic Reduction,[5] using the unrestricted potential to emit of EU 113, a baseline emission rate of 0.2 lb NOx/MMBtu,[6] a retrofit factor of 1.0 for a retrofit of average difficulty, a NOx removal efficiency of 90% and 50% for SCR and SNCR respectively, an interest rate of 5.5% (current bank prime interest rate), and a 20 year equipment life. A summary of the analysis is shown below:

Table 3-3. Department Economic Analysis for Technically Feasible NOx Controls

Control Alternative	Potential to Emit (tpy)	Emission Reduction (tpy)	Total Capital Investment ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
SCR	259	233	$11,676,081	$1,444,246	$6,197
SNCR	259	129	$2,170,943	$291,628	$2,252
Capital Recovery Factor = 0.0837 (5.5% interest rate for a 20 year equipment life)					

The Department's economic analysis indicates the level of NOx reduction justifies the use of SCR or SNCR for the dual fuel-fired boiler located in the Serious PM-2.5 nonattainment area.

Step 5 - Selection of NOx BACT for the Large Dual Fuel-Fired Boiler

The Department's finding is that selective catalytic reduction and selective non-catalytic reduction are both economically and technically feasible control technologies for NOx. Since selective catalytic reduction has a higher control efficiency, it is selected as BACT to control NOx emissions from the dual fuel-fired boiler.

The Department's finding is that BACT for NOx emissions from the dual fuel-fired boiler is as follows:

(a) NOx emissions from EU 113 shall be controlled by operating and maintaining SCR in conjunction with the designed CFB and staged combustion at all times the unit is in operation;

(b) NOx emissions from EU 113 shall not exceed 0.02 lb/MMBtu averaged over a 3-hour period; and

(c) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation.

Table 3-4 lists the proposed BACT determination for this facility along with those for other coal-fired boilers in the Serious PM-2.5 nonattainment area.

[4] https://www3.epa.gov/ttn/ecas/docs/scr_cost_manual_spreadsheet_2016_vf.xlsm
[5] https://www3.epa.gov/ttn/ecas/docs/sncr_cost_manual_spreadsheet_2016_vf.xlsm
[6] Emission rate is NOx limit from 40 C.F.R. 60.44b(l)(1) [NSPS Subpart Db]

Table 3-4. Comparison of NOx BACT for Coal-Fired Boilers at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
UAF	Dual Fuel-Fired Boiler	295.6 MMBtu/hr	0.02 lb/MMBtu[7]	Selective Catalytic Reduction
Fort Wainwright	6 Coal-Fired Boilers	1,380 MMBtu/hr	0.06 lb/MMBtu[8]	Selective Catalytic Reduction
Chena	Four Coal-Fired Boilers	497 MMBtu/hr (combined)	0.05 lb/MMBtu[9]	Selective Catalytic Reduction

3.2 NOx BACT for the Mid-Sized Diesel-Fired Boilers (EUs 3 and 4)

Possible NOx emission control technologies for mid-sized diesel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 12.220, Industrial Size Distillate Fuel Oil Boilers (>100 MMBtu/hr and ≤ 250 MMBtu/hr). The search results for mid-sized diesel-fired boilers are summarized in Table 3-5.

Table 3-5. RBLC Summary of NOx Control for Mid-Sized Boilers Firing Diesel

Control Technology	Number of Determinations	Emission Limits (lb/1000 gal)
No Control Specified	2	4 – 13

Possible NOx emission control technologies for mid-sized diesel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 12.310, Industrial Size Gaseous Fuel Boilers (>100 MMBtu/hr and ≤ 250 MMBtu/hr). The search results for mid-sized diesel-fired boilers are summarized in Table 3-6.

Table 3-6. RBLC Summary of NOx Control for Mid-Sized Boilers Firing Natural Gas

Control Technology	Number of Determinations	Emission Limits (lb/MMBtu)
Selective Catalytic Reduction	7	0.01 – 0.014
Low NOx Burners	26	0.01 – 0.12
Limited Operation	1	0.098
Good Combustion Practices	6	0.0002 – 0.119
No Control Specified	7	0.04 – 0.14

RBLC Review

A review of similar units in the RBLC indicates selective catalytic reduction, low-NOx burners, limited operation, and good combustion practices are the principle NOx control technologies installed on mid-sized boilers. The lowest NOx emission rate listed in the RBLC is 0.0002 lb/MMBtu.

Step 1 - Identification of NOx Control Technology for the Mid-Sized Diesel-Fired Boilers

[7] Calculated using a 90% NOx control efficiency for SCR with uncontrolled emission rate from 40 C.F.R. 60.44b(l)(1) [NSPS Subpart Db].

[8] Calculated using a 90% NOx control efficiency for SCR with uncontrolled emission factor from AP-42 Table 1.1-3 for spreader stoker sub-bituminous coal (8.8 lb NOx/ton) and converted to lb/MMBtu using heat value for Usibelli Coal of 7,560 Btu/lb, http://www.usibelli.com/coal/data-sheet.

[9] Calculated using a 90% NOx control efficiency for SCR with uncontrolled emission rate from most recent NOx source test, which occurred on Oct 27, 2018.

From research, the Department identified the following technologies as available for NOx control of mid-sized diesel-fired boilers:

(a) Selective Catalytic Reduction
The theory of SCR was discussed in detail in the NOx BACT for the dual fuel-fired boiler and will not be repeated here. The Department considers SCR a technically feasible control technology for the mid-sized diesel-fired boilers.

(b) Selective Non-Catalytic Reduction
The theory of SNCR was discussed in detail in the NOx BACT for the CFB dual fuel-fired boiler and will not be repeated here. The expected NOx control efficiency for the SNCR without LNB is 30 to 50 percent, and with LNB is 65 to 75 percent. The Department considers SNCR a technically feasible control technology for the mid-sized diesel-fired boilers.

(c) Low NOx Burners
The theory of LNBs was discussed in detail in the NOx BACT for the CFB dual fuel-fired boiler and will not be repeated here. EUs 3 and 4 currently have LNB controls in the place. If the LNB systems were to be replaced an estimated NOx control efficiency of 35 to 55 percent is expected. The use of LNBs is a technically feasible control technology for the mid-sized diesel-fired boilers.

(d) Natural Gas
Natural gas combustion has a lower NOx emission rate than diesel combustion. For this reason, combustion of natural gas rather than diesel is preferred. EU 4 is equipped to burn natural gas, but due to the lack of guarantee of natural gas always being available to them, UAF has retained the ability due to burn diesel in EU 4. EU 3 is not currently configured to burn natural gas. UAF has had pressure issues with operating EU 4 on natural gas and feels that operating both mid-sized diesel-fired boilers on natural gas would create an issue. The Department agrees that operating on natural gas is not a technically feasible control technology for the mid-sized diesel-fired boilers.

(e) Limited Operation
EU 4 currently has an owner requested limit through the Title I permitting program to limit NOx emissions to no more than 40 tons per 12 month rolling period. With the limit on operation in place the NOx emissions are reduced from EU 4. The Department considers limited operation a technically feasible control technology for the mid-sized diesel-fired boilers.

(f) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the CFB dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of NOx emissions. The Department considers GCPs a technically feasible control technology for the mid-sized diesel-fired boilers.

Step 2 - Eliminate Technically Infeasible NOx Controls for the Mid-Sized Boilers
As explained in Step 1 of Section 3.2, the Department does not consider switching fuel to natural gas as technically feasible technologies to control NOx emissions from the mid-sized diesel-fired boilers.

For EU 4, SCR is not a technically feasible technology due to the lack of space surrounding the EU required for an SCR system.

EU 3 is used as a backup to the existing large boilers if one of them fails, and will be used as the backup to EU 113 if it fails. As the backup EU, it is not technically feasible to use an operational limit to control NOx emissions.

SNCR is not identified in the RBLC as a control technology used for diesel-fired boilers between 100 and 250 MMBtu/hr and is therefore not considered a feasible technology.

Step 3 - Rank the Remaining NOx Control Technologies for the Mid-Sized Diesel-Fired Boilers
The following control technologies have been identified and ranked by efficiency for the control of NOx emissions from EU 3.

(a) Selective Catalytic Reduction (80% - 90% Control)
(c) Low NOx Burners (35% - 55% Control)
(f) Good Combustion Practices (Less than 40% Control)

The following control technologies have been identified and ranked by efficiency for the control of NOx emissions from EU 4.

(c) Low NOx Burners (35% - 55% Control)
(f) Good Combustion Practices (Less than 40% Control)
(e) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF provided an economic analysis for the installation of LNB and SCR. A summary of the analysis is shown below:

Table 3-7. Economic Analysis for Technically Feasible NOx Controls

Control Alternative	Potential to Emit (tpy)	Emission Reduction (tpy)	Total Capital Investment ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
SCR (EU 3)	20.8	118.0	$3,434,525	$992,901	$7,261
LNB (EU 3)	79.2	59.6	$1,255,695	$216,454	$3,634
LNB (EU 4)	12.7	1.2	$1,342,628	$231,439	$189,312
Capital Recovery Factor = 0.1424 (7% interest rate for a 10 year equipment life)					

UAF contends that the economic analysis indicates the level of NOx reductions does not justify the use of SCR or LNB for the mid-sized diesel fired boilers based on the excessive cost per ton of NOx removed.

UAF proposed the following as BACT for NOx emissions from EU 3:

(a) NOx emissions from the operation of EU 3 shall be controlled by good combustion practices; and

(b) NOx emissions from EU 3 shall not exceed 0.2 lb/MMBtu.

UAF proposes the following as BACT for NOx emissions from EU 4:

(a) NOx emissions from the operation of EU 4 shall be controlled by limited operation;

(b) Combined NOx emissions from EUs 4 and 8 shall not exceed 40 tons per 12 month rolling period;

(c) NOx emissions from the operation of EU 4 shall be controlled by good combustion practices; and

(c) NOx emissions from EU ID 4 shall not exceed 0.2 lb/MMBtu while firing diesel fuel and 140 lb/MMscf while firing natural gas.

Department Evaluation of BACT for NOx Emissions from the Mid-Sized Diesel-Fired Boilers

The Department revised the cost analyses provided by UAF for the installation of SCR and LNB on EU 3 using a NOx control efficiency of 90% and 55% respectively, an interest rate of 5.5% (current bank prime interest rate), and a 20 year equipment life. A summary of the analysis is shown below:

Table 3-8. Department Economic Analysis for Technically Feasible NOx Controls

Control Alternative	Potential to Emit (tpy)	Emission Reduction (tpy)	Total Capital Investment ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
SCR	138.8	125	$3,434,525	$792,939	$6,348
LNB	138.8	76	$1,255,695	$142,747	$1,870
Capital Recovery Factor = 0.0837 (5.5% interest rate for a 20 year equipment life)					

The Department's economic analysis indicates the level of NOx reduction justifies the use of SCR or LNB as BACT for EU 3 located in the Serious PM-2.5 nonattainment area.

The Department reviewed UAF's proposal for EU 4 and finds that because the EU is already limited to 40 tpy of NOx emissions combined with EU 8, requiring the installation and operation of any add-on control technology will not further reduce annual NOx emissions.

Step 5 - Selection of NOx BACT for the Mid-Sized Diesel-Fired Boilers

The Department's finding is that selective catalytic reduction and low NOx burners are both economically and technically feasible control technologies for NOx. Since selective catalytic reduction has a higher control efficiency, it is selected as BACT to control NOx emissions from EU 3.

The Department's finding is that BACT for NOx emissions from EU 3 is as follows:

(a) NOx emissions from EU 3 shall be controlled by operating and maintaining selective catalytic reduction at all times the unit is in operation;

(b) NOx emissions from EU 3 shall not exceed 0.02 lb/MMBtu averaged over a 3-hour averaging period; and

(c) Maintain good combustion practices at all times of operation by following the manufacturer's operation and maintenance procedures.

The Department's finding is that BACT for NOx emissions from EU 4 is as follows:

(a) NOx emissions from EU 4 shall be controlled by limiting the combined NOx emissions of EU 4 and 8 to no more than 40 tons per 12 month rolling period;

(b) Maintain good combustion practices at all times of operation by following the manufacturer's operation and maintenance procedures and

(c) NOx emissions from EU 4 shall not exceed 0.2 lb/MMBtu while firing diesel fuel and 140 lb/MMscf while firing natural gas, both over a 3-hour averaging period.

Table 3-9 lists the proposed NOx BACT determination for the facility along with those for other mid-sized diesel-fired boilers in the Serious PM-2.5 nonattainment area.

Table 3-9. Comparison of NOx BACT for the Mid-Sized Diesel-Fired Boilers

<table>
<tr><th>Facility</th><th>EU ID</th><th>Process Description</th><th>Capacity</th><th>Fuel</th><th>Limitation</th><th>Control Method</th></tr>
<tr><td rowspan="3">UAF</td><td>3</td><td rowspan="3">Dual Fuel-Fired Boilers</td><td rowspan="3">100 – 250 MMBtu/hr</td><td>Diesel</td><td>0.02 lb/MMBtu</td><td>Selective Catalytic Reduction
Good Combustion Practices</td></tr>
<tr><td rowspan="2">4</td><td>Diesel</td><td>0.2 lb/MMBtu</td><td rowspan="2">Limited Operation
Good Combustion Practices</td></tr>
<tr><td>Natural Gas</td><td>140 lb/MMscf</td></tr>
</table>

3.3 NOx BACT for the Small Diesel-Fired Boilers (EUs 19-21)

Possible NOx emission control technologies for small diesel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 13.220, Commercial/Institutional Size Boilers (<100 MMBtu/hr). The search results for the small diesel-fired boilers are summarized in Table 3-10.

Table 3-10. RBLC Summary of NOx Control for Small Diesel-Fired Boilers

Control Technology	Number of Determinations	Emission Limits (lb/MMBtu)
Low NOx Burners	3	0.02 – 0.14
Good Combustion Practices	1	0.01

RBLC Review

A review of similar units in the RBLC low NOx burners, and good combustion practices are the principle NOx control technologies installed on small-diesel fired boilers. The lowest emission rate listed in the RBLC is 0.01 lb/MMBtu.

Step 1 - Identification of NOx Control Technology for the Small Diesel-Fired Boilers

From research, the Department identified the following technologies as available for control of NOx emissions from small diesel-fired boilers:

(a) Low NOx Burners
The theory of LNBs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers LNB a technically feasible control technology for small diesel-fired boilers.

(b) Limited Operation
The three small diesel-fired boilers share an operating limit of 19,650 hours per 12 rolling month period. Limiting the operation of emission units reduces the potential to emit for those units. The Department considers limited operation a technically feasible control technology for the small diesel-fired boilers.

(c) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers GCPs a technically feasible control technology for the small diesel-fired boilers.

(d) Flue Gas Recirculation (FGR)
Flue gas recirculation involves extracting a portion of the flue gas from the economizer section or air heater outlet and readmitting it to the furnace through the furnace hopper, the burner windbox, or both. This method reduces the concentration of oxygen in the combustion zone and may reduce NOx by as much as 40 to 50 percent in some boilers. Chapter 1.3-7 from AP-42 indicates that FGR can require extensive modifications to the burner and windbox and can result in possible flame instability at high FGR rates. The Department does not consider FGR a technically feasible control technology for the small diesel-fired boilers.

Step 2 - Eliminate Technically Infeasible NOx Control Technologies for the Small Diesel-Fired Boilers
As explained in Step 1 of Section 3.2, the Department does not consider flue gas recirculation as technically feasible technology for the small diesel-fired boilers.

Step 3 - Rank the Remaining NOx Control Technologies for the Small Diesel-Fired Boilers
The following control technologies have been identified and ranked by efficiency for the control of NOx emissions from the small diesel-fired boilers:

(a)	Low NOx Burners	(35% - 55% Control)
(c)	Good Combustion Practices	(Less than 40% Control)
(b)	Limited Operation	(0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for NOx emissions from the small diesel-fired boilers:

(a) NOx emissions from the operation of the small diesel-fired boilers shall be controlled with limited operation;

(b) Limit the combined operation of EUs 19-21 to no more than 19,650 hours in any 12 month rolling period; and

(c) NOx emissions from the small diesel-fired boilers shall not exceed 1.24 g/MMBtu.

Department Evaluation of BACT for NOx Emissions from Small Diesel-Fired Boilers

The Department reviewed UAF's proposal and finds that the 3 small diesel-fired boilers have a combined potential to emit (PTE) of 8.8 tons per year (tpy) for NOx based on combined operation of 19,650 hours per year. At 8.8 tpy, the cost effectiveness in terms of dollars per ton for add-on pollution control for these units is economically infeasible. The Department finds that in addition to limiting the operation of the small diesel-fired boilers, good combustion practices is BACT for NOx.

Step 5 - Selection of NOx BACT for the Small Diesel-Fired Boilers

The Department's finding is that BACT for NOx emissions from the diesel-fired boilers is as follows:

(a) NOx emissions from EUs 19-21 shall not exceed 0.15 lb/MMBtu[10];

(b) Combined operating limit of no more than 19,650 hours per 12 month rolling period;

(c) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation; and

(d) Compliance with the hour limit will be monitored with an hour meter.

Table 3-11 lists the proposed BACT determination for this facility along with those for other diesel-fired boilers rated at less than 100 MMBtu/hr in the Serious PM-2.5 nonattainment area.

Table 3-11. Comparison of NOx BACT for the Small Diesel-Fired Boilers at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
UAF	3 Diesel-Fired Boilers	< 100 MMBtu/hr	0.15 lb/MMBtu	Limited Operation Good Combustion Practices
Fort Wainwright	27 Diesel-Fired Boilers	< 100 MMBtu/hr	0.15 lb/MMBtu	Limited Operation Good Combustion Practices
GVEA Zehnder	2 Diesel-Fired Boilers	< 100 MMBtu/hr	0.15 lb/MMBtu	Low NOx Burners

3.4 NOx BACT for the Large Diesel-Fired Engine (EU 8)

Possible NOx emission control technologies for large engines were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process codes 17.100 to

[10] Emission rate from AP-42 Table 1.3-1 for boilers smaller than 100 MMBtu/hr (20 lb/1,000 gallons of diesel) and converted to lb/MMBtu assuming 0.137 MMBtu/gal diesel (AP-42).

17.190, Large Internal Combustion Engines (>500 hp). The search results for large diesel-fired engines are summarized in Table 3-12.

Table 3-12. RBLC Summary for NOx Controls for Large Diesel-Fired Engines

Control Technology	Number of Determinations	Emission Limits (g/hp-hr)
Selective Catalytic Reduction	3	0.5 - 0.7
Other Add-On Control	1	1.0
Federal Emission Standards	13	3.0 - 6.9
Good Combustion Practices	31	3.0 - 13.5
No Control Specified	60	2.8 - 14.1

RBLC Review
A review of similar units in the RBLC indicates selective catalytic reduction, good combustion practices, and compliance with the federal emission standards are the principle NOx control technologies installed on large diesel-fired engines. The lowest NOx emission rate listed in the RBLC is 0.5 g/hp-hr.

Step 1 - Identification of NOx Control Technology for the Large Diesel-Fired Engine
From research, the Department identified the following technologies as available for the control of NOx emissions from diesel-fired engines rated at 500 hp or greater:

(a) Selective Catalytic Reduction
The theory of SCR was discussed in detail in the NOx BACT for the dual fuel-fired boiler and will not be repeated here. EU 8 currently has an SCR system installed at this time, therefore, the Department considers SCR a technically feasible control technology for the large diesel-fired engine.

(b) Turbocharger and Aftercooler
Turbocharger technology involves the process of compressing intake air in a turbocharger upstream of the air/fuel injection. This process boosts the power output of the engine. The air compression increases the temperature of the intake air so an aftercooler is used to reduce the intake air temperature. Reducing the intake air temperature helps lower the peak flame temperature which reduces NOx formation in the combustion chamber. EU ID 8 is currently operating with a turbocharger and aftercooler. The Department considers turbocharger and aftercooler a technically feasible control technology for the large diesel-fired engine.

(c) Fuel Injection Timing Retard (FITR)
FITR reduces NOx emissions by the delay of the fuel injection in the engine from the time the compression chamber is at minimum volume to a time the compression chamber is expanding. Timing adjustments are relatively straightforward. The larger volume in the compression chamber produces a lower peak flame temperature. With the use of FITR the engine becomes less fuel efficient, particular matter emissions increase, and there is a limit with respect to the degree the timing may be retarded because an excessive timing delay can cause the engine to misfire. The timing retard is generally limited to no more than three degrees. Diesel engines may also produce more black smoke due to a decrease in exhaust temperature and incomplete combustion. FITR can achieve up to 50 percent NOx

reduction. Due to the increase in particulate matter emissions resulting from FITR, this technology will not be carried forward.

(d) Ignition Timing Retard (ITR)
ITR lowers NOx emissions by moving the ignition event to later in the power stroke, after the piston has begun to move downward. Because the combustion chamber volume is not at a minimum, the peak flame temperature is not as high, which lowers combustion temperature and produces less thermal NOx. Use of ITR can cause an increase in fuel usage, an increase PM emissions, and engine misfiring. ITR can achieve between 20 to 30 percent NOx reduction. Due to the increase in the particulate matter emissions resulting from ITR, this technology will not be carried forward.

(e) Federal Standard
RBLC NOx determinations for federal emission standards require the engines meet the requirements of 40 C.F.R. 60 NSPS Subpart IIII, 40 C.F.R 63 Subpart ZZZZ, non-road engines (NREs), or EPA tier certifications. NSPS Subpart IIII applies to stationary compression ignition internal combustion engines that are manufactured or reconstructed after July 11, 2005. EU 8 was manufactured prior to July 11, 2005 and has not been reconstructed since. Therefore, EU 8 is not subject to NSPS Subpart IIII. EU 8 is considered an institutional emergency engine and is therefore exempt from NESHAP Subpart ZZZZ. For these reasons federal emission standards will not be carried forward as a control technology.

(f) Limited Operation
EU 8 currently operates under a combined annual NOx emission limit with EU 4. Limiting the operation of emissions units reduces the potential to emit of those units. The Department considers limited operation a technically feasible control technology for the large diesel-fired engine.

(g) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers GCPs a technically feasible control technology for the large diesel-fired engine.

Step 2 - Eliminate Technically Infeasible NOx Control Technologies for the Large Engine
As explained in Step 1 of Section 3.4, the Department does not consider fuel injection timing retard, ignition timing retard, and federal emissions standards as technically feasible technologies to control NOx emissions from the large diesel-fired engine.

Step 3 - Rank the Remaining NOx Control Technologies for the Large Diesel-Fired Engine
The following control technologies have been identified and ranked by efficiency for the control of NOx emissions from the large diesel-fired engine.

(g)	Good Combustion Practices	(Less than 40% Control)
(a)	Selective Catalytic Reduction	(0% Control)
(b)	Turbocharger and Aftercooler	(0% Control)

(f) Limited operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for NOx emissions from the large diesel-fired engine:

(a) NOx emissions from the operation of the large diesel-fired engine shall be controlled with limited use of the unit;

(b) NOx emissions from the operation of the large diesel-fired engine shall be controlled by operating a turbocharger and aftercooler;

(c) NOx emissions from the large diesel-fired engine shall not exceed 0.0195 g/hp-hr; and

(d) Combined NOx emissions from EUs 4 and 8 shall not exceed 40 tons per 12 month rolling period; and

(e) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation.

Department Evaluation of BACT for NOx Emissions from the Large Diesel-Fired Engine

The Department reviewed UAF's proposal and found that in addition to a turbocharger and aftercooler, and limited operation (all currently in practice), SCR (currently installed but not operating) and good combustion practices are also BACT for the control of NOx emissions from the large diesel-fired engine.

Step 5 - Selection of NOx BACT for the Large Diesel-Fired Engine

The Department's finding is that the BACT for NOx emissions from the large diesel-fired engine is as follows:

(a) NOx emissions from EU 8 shall be controlled by operating SCR, and a turbocharger and aftercooler at all times of operation;

(b) Limit non-emergency operation of EU 8 to no more than 100 hours per year for maintenance checks and readiness testing;

(c) NOx emissions from the large diesel-fired engine shall not exceed 1.3 g/hp-hr[11] averaged over a 3-hour period;

(d) Combined NOx emissions from EUs 4 and 8 shall not exceed 40 tons per 12 month rolling period; and

(e) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation.

Table 3-13 lists the proposed BACT determination for this facility along with those for other diesel-fired engines rated at more than 500 hp located in the Serious PM-2.5 nonattainment area.

[11] Worst-case NOx emissions rate from February 1, 2002 source test report while EU 8 was operating with SCR.

Table 3-13. Comparison of NOx BACT for Large Diesel-Fired Engines at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
Fort Wainwright	8 Large Diesel-Fired Engines	> 500 hp	3.0 – 10.9 g/hp-hr	Limited Operation Good Combustion Practices Federal Emission Standards
UAF	Large Diesel-Fired Engine	13,266 hp	1.3 g/hp-hr	Selective Catalytic Reduction Turbocharger and Aftercooler Good Combustion Practices Limited Operation
GVEA North Pole	Large Diesel-Fired Engine	600 hp	10.9 g/hp-hr	Turbocharger and Aftercooler Good Combustion Practices Limited Operation
GVEA Zehnder	2 Large Diesel-Fired Engines	11,000 hp (each)	10.9 g/hp-hr	Turbocharger and Aftercooler Good Combustion Practices Limited Operation

3.5 NOx BACT for the Small Diesel-Fired Engines (EUs 23, 24, and 26 – 29)

Possible NOx emission control technologies for small engines were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 17.210, Small Internal Combustion Engines (<500 hp). The search results for small diesel-fired engines are summarized in Table 3-14.

Table 3-14. RBLC Summary for NOx Control for Small Diesel-Fired Engines

Control Technology	Number of Determinations	Emission Limits (g/hp-hr)
Federal Emission Standards	5	2.2 – 4.8
Good Combustion Practices	25	2.0 – 9.5
Limited Operation	4	3.0
No Control Specified	25	2.6 – 5.6

RBLC Review

A review of similar units in the RBLC indicates limited operation, good combustion practices, and compliance with the federal emission standards are the principle NOx control technologies for small diesel-fired engines. The lowest NOx emission rate listed in the RBLC is 2.0 g/hp-hr

Step 1 - Identification of NOx Control Technology for the Small Diesel-Fired Engine

From research, the Department identified the following technologies as available for NOx control of the small diesel-fired engines:

(a) Selective Catalytic Reduction
The theory of SCR was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers SCR a technically feasible control technology for the small diesel-fired engines.

(b) Turbocharger and Aftercooler
The theory of a turbocharger and aftercooler was discussed in detail in the NOx BACT for the large diesel-fired engine and will not be repeated here. EU 27 currently operates with a turbocharger and aftercooler. The Department considers a turbocharger and aftercooler a technically feasible control technology for the small diesel-fired engines.

(c) Ignition Timing Retard (ITR)
The theory of ITR was discussed in detail in the NOx BACT for the large diesel-fired engine and will not be repeated here. Due to the increase in particulate matter emissions resulting from ITR, this technology will not be carried forward.

(d) Federal Emission Standards
RBLC NOx determinations for federal emission standards require the engines meet the requirements of 40 C.F.R. 60 Subpart IIII, 40 C.F.R 63 Subpart ZZZZ, non-road engines (NREs), or EPA tier certifications. Subpart IIII applies to stationary compression ignition internal combustion engines that are manufactured or reconstructed after July 11, 2005. The Department considers meeting the technology based NSPS of Subpart IIII as a technically feasible control technology for the small diesel-fired engines.

(e) Limited Operation
EU 27 currently operates under an owner requested limit of 4,380 hours of operation per 12 month rolling period, and EUs 24, 28, and 29 are considered emergency engines with 100 hour limits per calendar year for non-emergency operations. Limiting the operation of emission units reduces the potential to emit for those units. The Department considers limited operation as a technically feasible control technology for the small diesel-fired engines.

(f) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fired boiler and will not be repeated here. The Department considers GCPs a technically feasible control technology for the small diesel-fired engines.

Step 2 - Eliminate Technically Infeasible NOx Control Technologies for the Small Engines
As explained in Step 1 of Section 3.5, the Department does not consider ignition timing retard as a technically feasible technology to control NOx emissions from the small diesel-fired engines.

Step 3 - Rank the Remaining NOx Control Technologies for the Small Diesel-Fired Engines
The following control technologies have been identified and ranked by efficiency for the control of NOx emissions from the small diesel-fired engines.

(a)	Selective Catalytic Reduction	(90% Control)
(f)	Good Combustion Practices	(Less than 40% Control)
(d)	Federal Emission Standards	(Baseline)
(b)	Turbocharger and Aftercooler	(0% Control)
(e)	Limited Operation	(0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF provided an economic analysis of the installation of SCR on EU 27. A summary of the analysis is shown below:

Table 3-15. Economic Analysis for Technically Feasible NOx Controls

Control Alternative	Captured Emissions (tpy)	Emission Reduction (tpy)	Capital Cost ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
SCR	0.8	6.9	$151,592	$84,544	$12,200
Capital Recovery Factor = 0.1424 (7% interest rate for a 10 year equipment life)					

UAF contends that the economic analysis indicates the level of NOx reduction does not justify the use of SCR based on the excessive cost per ton of NOx removed per year.

UAF proposes the following as BACT for NOx emissions from the small diesel-fired engine EU 27:

(a) NOx emissions from the operation of the small diesel-fired engine shall be controlled with limited use of the unit;

(b) NOx emissions from the operation of the small diesel-fired engine shall be controlled by complying with the federal standards under 40 C.F.R. 63 Subpart ZZZZ;

(c) NOx emissions from the operation of the small diesel-fired engine shall be controlled by operating a turbocharger and aftercooler;

(d) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation;

(e) NOx emissions from the small diesel-fired engine shall not exceed 3.20 g/hp-hr; and

(f) Operating hours for the small diesel-fired engine shall not exceed 4,380 hours per year.

Department Evaluation of BACT for NOx Emissions from the Small Diesel-Fired Engine

The Department revised the cost analysis provided by UAF for the installation of SCR on EU 27 to a 20 year equipment life. A summary of the analysis is shown below:

Table 3-16. Department Economic Analysis for Technically Feasible NOx Controls

Control Alternative	Captured Emissions (tpy)	Emission Reduction (tpy)	Capital Cost ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
SCR	0.8	6.9	$151,592	$84,544	$11,141

Capital Recovery Factor = 0.094 (7% for a 20 year life cycle)

The Department's economic analysis indicates the level of NOx reduction does not justify installing SCR as BACT for the small diesel-fired engine EU 27 in the Serious PM-2.5 nonattainment area.

Step 5 - Selection of NOx BACT for the Small Diesel-Fired Engines
The Department's finding is that BACT for NOx emissions from the small diesel-fired engines is as follows:

(a) NOx emissions from EU 27 shall be controlled by operating a turbocharger and aftercooler at all times of operation;
(b) Limit the operation of EU 27 to no more than 4,380 hours per year;
(c) Limit non-emergency operation of EUs 24, 28, and 29 to no more than 100 hours per year each for maintenance checks and readiness testing;
(d) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation; and
(e) Comply with the numerical BACT emission limits listed in Table 3-17.

Table 3-17. Proposed NOx BACT Limits for the Small Diesel-Fired Engines

EU	Year	Description	Size	Status	BACT Limit	Proposed BACT
23	2003	Detroit Diesel	235 kW	AP-42 Table 3.3-1	14.1 g/hp-hr	Good Combustion Practices
26	1987	Mitsubishi-Bosh	45 kW	AP-42 Table 3.3-1	14.1 g/hp-hr	
27	TBD	Caterpillar C-15	500 hp	Certified Engine	3.2 g/hp-hr	Limit Operation to 4,380 hours per year, Turbo Charger and Aftercooler, & Good Combustion Practices
24	2001	Cummins	51 kW	AP-42 Table 3.3-1	14.1 g/hp-hr	Limit Operation for non-emergency use (100 hours each per year) and Good Combustion Practices
28	1998	Detroit Diesel	120 hp	AP-42 Table 3.3-1	14.1 g/hp-hr	
29	2013	Cummins	314 hp	Certified Engine	0.3 g/hp-hr	

Table 3-18 lists the proposed BACT determination for this facility along with those for other diesel-fired engines rated at less than 500 hp located in the Serious PM-2.5 nonattainment area.

Table 3-18. Comparison of NOx BACT for the Small Diesel-Fired Engines at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
UAF	Six Small Diesel-Fired Engines	< 500 hp	0.3 – 14.1 lb/hp-hr	Turbocharger and Aftercooler Good Combustion Practices Limited Operation
Fort Wainwright	41 Small Diesel-Fired Engines	< 500 hp	3.0 – 14.1 lb/hp-hr	40 CFR 60 Subpart IIII & Limited Operation

3.6 NOx BACT for the Pathogenic Waste Incinerator (EU 9A)

Possible NOx emission control technologies for pathogenic waste incinerators were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 21.300, Hospital, Medical, and Infectious Waste Incinerator. The search results for the pathogenic waste incinerators are summarized in Table 3-19.

Table 3-19. RBLC Summary of NOx Control for Pathogenic Waste Incinerators

Control Technology	Number of Determinations	Emission Limits (lb/hr)
Multiple Chamber Design	1	0.0900

RBLC Review
The RBLC has one entry for medical waste incinerators. The lowest emission rate listed in the RBLC is 0.0900 lb/hr.

Step 1 - Identification of NOx Control Technology for the Pathogenic Waste Incinerator
From research, the Department identified the following technologies as available for control of NOx emissions from pathogenic waste incinerators:

(a) Selective Catalytic Reduction
The theory of SCR was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers SCR a technically feasible control technology for the pathogenic waste incinerator.

(b) Selective Non-Catalytic Reduction
The theory of SNCR was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers SNCR a technically feasible control technology for the pathogenic waste incinerator.

(c) Limited Operation
EU 9A is currently operating under an owner requested limit to combust no more than 109 tons of waste per 12 month rolling period. With this limit NOx emissions for EU 9A are 0.2 tpy. The Department considers limited operation a technically feasible control technology for the pathogenic waste incinerator.

(d) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers GCPs a technically feasible control technology for the pathogenic waste incinerator.

Step 2 - Eliminate Technically Infeasible NOx Control Technologies for the Pathogenic Waste Incinerator
All control technologies are technically feasible. However, the Department finds that due to the limited NOx emissions from the pathogenic waste incinerator (0.2 tpy); SCR and SNCR will not be effective in reducing NOx emissions.

Step 3 - Rank the Remaining NOx Control Technologies for the Pathogenic Waste Incinerator

The following control technologies have been identified and ranked by efficiency for the control of NOx emissions from the pathogenic waste incinerator:

(d) Good Combustion Practices (Less than 40% Control)
(c) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for NOx emissions from the pathogenic waste incinerator:

(a) Limit the operation of pathogenic waste incinerator to no more than 109 tons of waste per 12 month rolling period;

(b) NOx emissions from the pathogenic waste incinerator shall not exceed 3.56 lb/ton;

(c) Compliance with the proposed operational limit will be demonstrated by recording pounds of waste combusted for the pathogenic waste incinerator; and

(d) Maintain good combustion practices.

Step 5 - Selection of NOx BACT for the Pathogenic Waste Incinerator

The Department's finding is that BACT for NOx emissions from the pathogenic waste incinerator is as follows:

(a) NOx emissions from EU 9A shall not exceed 3.56 lb/ton;

(b) Limit the operation of EU 9A to 109 tons of waste combusted per 12 month rolling period;

(c) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation; and

(d) Compliance with the proposed operational limit will be demonstrated by recording pounds of waste combusted for the pathogenic waste incinerator.

Table 3-20 lists the proposed BACT determination for this facility along with those for other waste incinerators located in the Serious PM-2.5 nonattainment area.

Table 3-20. Comparison of NOx BACT for Pathogenic Waste Incinerators at Nearby Power Plants

Facility	Process Description	Capacity	Limitation		Control Method
UAF	One Pathogenic Waste Incinerator	83 lb/hr	3.56	lb/ton	Limited Operation Good Combustion Practices

4. BACT DETERMINATION FOR PM-2.5

The Department based its PM-2.5 assessment on BACT determinations found in the RBLC, internet research, and BACT analyses submitted to the Department by GVEA for the North Pole Power Plant and Zehnder Facility, Aurora for the Chena Power Plant, US Army for Fort Wainwright, and UAF for the Combined Heat and Power Plant.

4.1 PM-2.5 BACT for the Large Dual Fuel-Fired Boiler (EU 113)

Possible PM-2.5 emission control technologies for large dual fuel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 11.110, Coal Combustion in Industrial Size Boilers and Furnaces. The search results are listed in Table 4-1.

Table 4-1. RBLC Summary of PM-2.5 Control for Industrial Coal-Fired Boilers

Control Technology	Number of Determinations	Emission Limits (lb/MMBtu)
Pulse Jet Fabric Filters	4	0.012 – 0.024
Electrostatic Precipitators	2	0.02 – 0.03

RBLC Review
A review of similar units in the RBLC indicates that fabric filters and electrostatic precipitators are the principle particulate matter control technologies installed on large dual fuel-fired boilers. The lowest PM-2.5 emission rate listed in RBLC is 0.012 lb/MMBtu.

Step 1 - Identification of PM-2.5 Control Technologies for the Large Dual Fuel-Fired Boiler
From research, the Department identified the following technologies as available for control of PM-2.5 emissions from the large dual fuel-fired boiler:

(a) Fabric Filters
Fabric filters or baghouses are comprised of an array of filter bags contained in housing. Air passes through the filter media from the "dirty" to the "clean" side of the bag. These devices undergo periodic bag cleaning based on the build-up of filtered material on the bag as measured by pressure drop across the device. The cleaning cycle is set to allow operation within a range of design pressure drop. Fabric filters are characterized by the type of cleaning cycle: mechanical-shaker,[12] pulse-jet,[13] and reverse-air.[14] Fabric filter systems have control efficiencies of 95% to 99.9%, and are generally specified to meet a discharge concentration of filterable particulate (e.g., 0.01 grains per dry standard cubic feet). The Department considers fabric filters a technically feasible control technology for the large dual fuel-fired boiler.

(b) Wet and Dry Electrostatic Precipitators (ESP)
ESPs remove particles from a gas stream by electrically charging particles with a discharge electrode in the gas path and then collecting the charged particles on grounded plates. The inlet air is quenched with water on a wet ESP to saturate the gas stream and ensure a wetted surface on the collection plate. This wetted surface along with a period deluge of water is what cleans the collection plate surface. Wet ESPs typically control streams with inlet grain loading values of 0.5 – 5 gr/ft^3 and have control efficiencies between 90% and 99.9%.[15] Wet ESPs have the advantage of controlling some amount of condensable particulate

12 https://www3.epa.gov/ttn/catc/dir1/ff-shaker.pdf
13 https://www3.epa.gov/ttn/catc/dir1/ff-pulse.pdf
14 https://www3.epa.gov/ttn/catc/dir1/ff-revar.pdf
15 https://www3.epa.gov/ttn/catc/dir1/fwespwpi.pdf
https://www3.epa.gov/ttn/catc/dir1/fwespwpl.pdf

matter. The collection plates in a dry ESP are periodically cleaned by a rapper or hammer that sends a shock wave that knocks the collected particulate off the plate. Dry ESPs typically control streams with inlet grain loading values of 0.5 – 5 gr/ft^3 and have control efficiencies between 99% and 99.9%.[16] The Department considers ESP a technically feasible control technology for the large dual fuel-fired boiler.

(c) Wet Scrubbers
Wet scrubbers use a scrubbing solution to remove PM/PM_{10}/$PM_{2.5}$ from exhaust gas streams. The mechanism for particulate collection is impaction and interception by water droplets. Wet scrubbers are configured as counter-flow, cross-flow, or concurrent flow, but typically employ counter-flow where the scrubbing fluid is in the opposite direction as the gas flow. Wet scrubbers have control efficiencies of 50% - 99%.[17] One advantage of wet scrubbers is that they can be effective on condensable particulate matter. A disadvantage of wet scrubbers is that they consume water and produce water and sludge. For fine particulate control, a venturi scrubber can be used, but typical loadings for such a scrubber are 0.1-50 grains/scf. The Department considers the use of wet scrubbers to be a technically feasible control technology for the large dual fuel-fired boiler.

(d) Cyclone
Cyclones are used in industrial applications to remove particulate matter form exhaust flows and other industrial stream flows. Dirty air enters a cyclone tangentially and the centrifugal force moves the particulate matter against the cone wall. The air flows in a helical pattern from the top down to the narrow bottom before exiting the cyclone straight up the center and out the top. Large and dense particles in the stream flow are forced by inertia into the walls of the cyclone where the material then falls to the bottom of the cyclone and into a collection unit. Cleaned air then exits the cyclone either for further treatment or release to the atmosphere. The narrowness of the cyclone wall and the speed of the air flow determine the size of particulate matter that is removed from the stream flow. Cyclones are most efficient at removing large particulate matter (PM-10 or greater). Conventional cyclones are expected to achieve 0 to 40 percent PM-2.5 removal. High efficiency single cyclones are expected to achieve 20 to 70 percent PM-2.5 removal. The Department considers cyclones a technically feasible control technology for the large dual fuel-fired boiler.

[16] https://www3.epa.gov/ttn/catc/dir1/fdespwpi.pdf
https://www3.epa.gov/ttn/catc/dir1/fdespwpl.pdf
[17] https://www3.epa.gov/ttn/catc/dir1/fcondnse.pdf
https://www3.epa.gov/ttn/catc/dir1/fiberbed.pdf
https://www3.epa.gov/ttn/catc/dir1/fventuri.pdf

(e) Settling Chamber

Settling chambers appear only in the biomass fired boiler RBLC inventory for particulate control, not in the coal fired boiler RBLC inventory. This type of technology is a part of the group of air pollution control collectively referred to as "pre-cleaners" because the units are often used to reduce the inlet loading of particulate matter to downstream collection devices by removing the larger, abrasive particles. The collection efficiency of settling chambers is typically less than 10 percent for PM-10. The EPA fact sheet does not include a settling chamber collection efficiency for PM-2.5. The Department does not consider settling chambers a technically feasible control technology for the large dual fuel-fired boiler.

(f) Good Combustion Practices

The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of PM-2.5 emissions. The Department considers GCPs a technically feasible control technology for the large dual fuel-fired boiler.

Step 2 - Elimination of Technically Infeasible PM-2.5 Control Technologies for the Large Dual Fuel-Fired Boiler

As explained in Step 1 of Section 4.1, the Department does not consider a settling chamber a technically feasible control technology to control PM-2.5 emissions from the large dual fuel-fired boiler.

Step 3 - Rank the Remaining PM-2.5 Control Technologies for the Large Dual Fired Boiler

The following control technologies have been identified and ranked by efficiency for the control of PM-2.5 from the dual fuel-fired boiler:

(a) Fabric Filters	(99.9% Control)
(b) Electrostatic Precipitator	(99.6% Control)
(c) Scrubber	(50% - 99% Control)
(d) Cyclone	(20% - 70%)
(f) Good Combustion Practices	(Less than 40%)

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for PM-2.5 emissions from the large dual fuel-fired boiler:

(a) PM-2.5 emissions shall be controlled by installing, operating, and maintaining a fabric filter; and

(b) PM-2.5 emissions shall not exceed 0.012 lb/MMBtu.

Step 5 - Selection of PM-2.5 BACT for the Large Dual Fuel-Fired Boiler

The Department's finding is that BACT for PM-2.5 emissions from the large dual fuel-fired boilers is as follows:

(a) PM-2.5 emissions from EU 113 shall be controlled by operating and maintaining fabric filters at all times of operation;

(b) PM-2.5 emissions from EU 113 shall not exceed 0.006 lb/MMBtu[18];

(c) Maintain good combustion practices at all times of operation by following the manufacturer's operating and maintenance procedures; and

(d) Initial compliance with the proposed PM-2.5 emission limit will be demonstrated by conducting a performance test to obtain an emission rate.

Table 4-2 lists the proposed PM-2.5 BACT determination for this facility along with those for other industrial coal-fired boilers in the Serious PM-2.5 nonattainment area.

Table 4-2. Comparison of PM-2.5 BACT for Coal-Fired Boilers at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
UAF	One Dual Fuel-Fired Boiler	295.6 MMBtu/hr	0.006 lb/MMBtu[18]	Fabric Filters
Fort Wainwright	Six Coal-Fired Boilers	1,380 MMBtu/hr	0.006 lb/MMBtu[18]	Full Steam Baghouse

4.2 PM-2.5 BACT for the Mid-Sized Diesel-Fired Boilers (EUs 3 and 4)

Possible PM-2.5 emission control technologies for mid-sized diesel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 12.220, Industrial Size Distillate Fuel Oil Boilers (>100 MMBtu/hr and ≤ 250 MMBtu/hr). The search results for mid-sized diesel-fired boilers are summarized in 4-3.

Table 4-3. RBLC Summary of PM-2.5 Control for Mid-Sized Boilers Firing Diesel

Control Technology	Number of Determinations	Emission Limits (lb/MMBtu)
No Control Specified	7	0.0066 – 0.02
Good Combustion Practices	3	0.007 – 0.015

Possible PM-2.5 emission control technologies for mid-sized diesel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 12.310, Industrial Size Gaseous Fuel Boilers (>100 MMBtu/hr and ≤ 250 MMBtu/hr). The search results for mid-sized diesel-fired boilers are summarized in Table 4-4.

Table 4-4. RBLC Summary of PM-2.5 Control for Mid-Sized Boilers Firing Natural Gas

Control Technology	Number of Determinations	Emission Limits (lb/MMBtu)
Limited Operation	2	0.0074 - 0.3
Good Combustion Practices	42	0.0019 – 0.008
No Control Specified	19	0.0074 – 0.01

RBLC Review

A review of similar units in the RBLC indicates limited operation and good combustion practices are the principle PM-2.5 control technologies installed on mid-sized boilers. The lowest PM-2.5 emission rate listed in the RBLC is 0.0019 lb/MMBtu.

[18] Average soot blown emission rate (rounded up) from worst coal-fired boiler tested at Fort Wainwright (Boiler No. 3) during most recent source test on April 19-22, 24, and 25, 2017.

Step 1 - Identification of PM-2.5 Control Technology for the Mid-Sized Diesel-Fired Boilers
From research, the Department identified the following technologies as available for PM-2.5 control of mid-sized diesel-fired boilers:

(a) Fabric Filters
The theory behind fabric filters was discussed in detail in the PM-2.5 BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers fabric filters a technically feasible control technology for the mid-sized diesel-fired boilers.

(b) Electrostatic Precipitators
The theory behind ESPs was discussed in detail in the PM-2.5 BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers ESPs a technically feasible control technology for the mid-sized diesel-fired boilers.

(c) Scrubber
The theory behind scrubbers was discussed in detail in the PM-2.5 BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers scrubbers a technically feasible control technology for the mid-sized diesel-fired boilers.

(d) Cyclone
The theory behind cyclones was discussed in detail in the PM-2.5 BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers cyclones a technically feasible control technology for the mid-sized diesel-fired boilers.

(e) Natural Gas
The theory behind the use of natural gas for the mid-sized diesel-fired boilers was discussed in detail in the NOx BACT for the mid-sized diesel-fired boilers. The Department does not consider switching to natural gas a technically feasible control technology for the mid-sized diesel-fired boilers.

(f) Limited Operation
The theory behind limited operation for EUs 3 and 4 was discussed in detail in the NOx BACT for the mid-sized diesel-fired boilers and will not be repeated here. The Department considers limited operation a technically feasible control technology for the mid-sized diesel-fired boilers.

(g) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of PM-2.5 emissions. The Department considers GCPs a technically feasible control technology for the mid-sized diesel-fired boilers.

Step 2 - Eliminate Technically Infeasible PM-2.5 Control Technologies for the Mid-Sized Diesel-Fired Boilers

As explained in Step 1 of Section 4.2, the Department does not consider natural gas as a technically feasible technology to control particulate matter emissions from the mid-sized diesel-fired boilers.

Additionally, due to the residue from the diesel combustion in the exhaust gas, fabric filters, scrubbers, ESPs, and cyclones are not technically feasible control technologies.

EU 3 is used as a backup to the existing large boilers if one of them fails, and will be used as the backup to EU 113 if it fails. As the backup EU, it is not technically feasible to use an operational limit to control PM-2.5 emissions.

Step 3 - Rank the Remaining PM-2.5 Control Technologies for the Mid-Sized Diesel-Fired Boilers
UAF has selected the only remaining control technologies, therefore, ranking is not required.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for the mid-sized diesel-fired boilers:

(a) PM-2.5 emissions from EU 3 and 4 shall not exceed 0.016 lb/MMBtu while firing diesel fuel;

(b) PM-2.5 emissions from EU 4 shall not exceed 7.6 lb/MMscf while firing natural gas; and

(c) PM-2.5 emissions from EU 4 will be limited by complying with the combined annual NOx emission limit of 40 tons per 12 month rolling period for EUs 4 and 8.

Step 5 - Selection of PM-2.5 BACT for the Mid-Sized Diesel-Fired Boilers
The Department's finding is that BACT for PM-2.5 emissions from EUs 3 and 4 is as follows:

(a) PM-2.5 emissions from EUs 3 and 4 shall not exceed 0.012 lb/MMBtu[19] averaged over a 3-hour period while firing diesel fuel;

(b) PM-2.5 emissions from EU 4 shall not exceed 0.0075 lb/MMBtu[20] averaged over a 3-hour period while firing natural gas;

(c) PM-2.5 emissions from EU 4 shall be controlled by limiting combined NOx emissions of EU 4 and 8 to no more than 40 tons per 12 month rolling period;

(d) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation.

Table 4-5 lists the proposed BACT determination for the facility.

Table 4-5. PM-2.5 BACT Limits for the Mid-Sized Diesel-Fired Boilers

Facility	EU ID	Process Description	Capacity	Fuel	Limitation	Control Method
UAF	3	Dual Fuel-Fired Boilers	100 – 250 MMBtu/hr	Diesel	0.012 lb/MMBtu[19]	Good Combustion Practices
	4			Diesel	0.012 lb/MMBtu[19]	Limited Operation

[19] Emission factor from AP-42 Table's 1.3-2 (total condensable particulate matter from No. 2 oil, 1.3 lb/1,000 gal) and 1.3-6 (PM-2.5 size-specific factor from distillate oil, 0.25 lb/1,000 gal) converted to lb/MMBtu.
[20] Emission factor from AP-42 Table 1.4-2 for total particulate matter and converted to lb/MMBtu.

				Natural Gas	0.0075 lb/MMBtu[20]	Good Combustion Practices

4.3 PM-2.5 BACT for the Small Diesel-Fired Boilers (EUs 19 through 21)

Possible PM-2.5 emission control technologies for small diesel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 13.220, Commercial/Institutional Size Boilers (<100 MMBtu/hr). The search results for diesel-fired engines are summarized in Table 4-6.

Table 4-6. RBLC Summary of PM-2.5 Control for Small Diesel-Fired Boilers

Control Technology	Number of Determinations	Emission Limits
Good Combustion Practices	3	0.25 lb/gal
		0.1 tpy
		2.17 lb/hr

RBLC Review
A review of similar units in the RBLC indicates good combustion practices are the principle PM-2.5 control technologies installed on diesel-fired boilers. The lowest PM-2.5 emission rate listed in the RBLC is 0.1 tpy.

Step 1 - Identification of PM-2.5 Control Technology for the Small Diesel-Fired Boilers
From research, the Department identified the following technologies as available for control of PM-2.5 emissions from the small diesel-fired boilers:

(a) Scrubbers
The theory behind scrubbers was discussed in detail in the PM-2.5 BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers scrubbers as a technically feasible control technology for the small diesel-fired boilers.

(b) Limited Operation
The theory behind limited operation was discussed in detail in the NOx BACT for the small diesel-fired boilers and will not be repeated here. The Department considers limited operation a technically feasible control technology for the small diesel-fired boilers.

(c) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of PM-2.5 emissions. The Department considers GCPs a technically feasible control technology for the small diesel-fired boilers.

Step 2 - Eliminate Technically Infeasible PM-2.5 Control Technologies for the Diesel-Fired Boilers
All identified control devices are technically feasible for the small diesel-fired boilers.

Step 3 - Rank the Remaining PM-2.5 Control Technologies for the Small Diesel-Fired Boilers

The following control technologies have been identified and ranked by efficiency for the control of PM-2.5 emissions from the small diesel-fired boilers:

(a) Scrubber (70% - 90% Control)
(c) Good Combustion Practices (Less than 40% Control)
(b) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF provided an economic analysis of the installation of a scrubber. A summary of the analysis is shown below:

Table 4-7. UAF Economic Analysis for Technically Feasible PM-2.5 Controls

Control Alternative	Captured Emissions (tpy)	Emission Reduction (tpy)	Capital Cost ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
Scrubber	0.01	0.93	$300,000	$42,713	$47,939
Capital Recovery Factor = 0.1424 (7% for a 10 year life cycle)					

UAF contends that the economic analysis indicates the level of PM-2.5 reduction does not justify the use of a scrubber to be used in conjunction with limited operation on the small diesel-fired boilers based on the excessive cost per ton of PM-2.5 removed per year.

UAF proposes the following as BACT for PM-2.5 emissions for the small diesel-fired boilers:

(a) PM-2.5 emissions from the operation of the small diesel-fired boilers will be controlled by limiting the combined operation to no more than 19,650 hours per 12-month rolling period; and

(b) PM-2.5 emissions from the small diesel-fired boilers shall not exceed 7.06 g/MMBtu.

Department Evaluation of BACT for PM-2.5 Emissions from the Small Diesel-Fired Boilers.

The Department reviewed UAF's proposal and finds that the 3 small diesel-fired boilers have a combined potential to emit (PTE) of less than one ton per year (tpy) for PM-2.5 based on a limit on operation of 19,650 hours per 12 month rolling period. The Department does not agree with all of the assumptions made by UAF in their cost analysis. However, the Department believes that at 0.9 tpy, the cost effectiveness in terms of dollars per ton for add-on pollution control for these units is economically infeasible.

Step 5 - Selection of PM-2.5 BACT for the Small Diesel-Fired Boilers

The Department's finding is that BACT for PM-2.5 emissions from the diesel-fired boilers is as follows:

(a) PM-2.5 emissions from the operation of the small diesel-fired boilers will be controlled by limiting the combined operation to no more than 19,650 hours per 12-month rolling period;
(b) PM-2.5 emissions from EUs 19 through 21 shall not exceed 0.012 lb/MMBtu[19]; and
(c) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation.

Table 4-8 lists the proposed PM-2.5 BACT determination for this facility along with those for other small diesel-fired boilers rated at less than 100 MMBtu/hr in the Serious PM-2.5 nonattainment area.

Table 4-8. PM-2.5 BACT Limits for the Small Diesel-Fired Boilers

Facility	Process Description	Capacity	Limitation	Control Method
UAF	3 Diesel-Fired Boilers	< 100 MMBtu/hr	0.012 lb/MMBtu[19]	Limited Operation Good Combustion Practices
Fort Wainwright	27 Diesel-Fired Boilers	< 100 MMBtu/hr	0.012 lb/MMBtu[19]	Good Combustion Practices
Zehnder Facility	2 Diesel-Fired Boilers	< 100 MMBtu/hr	0.012 lb/MMBtu[19]	Good Combustion Practices

4.4 PM-2.5 BACT for the Large Diesel-Fired Engine (EU 8)

Possible PM-2.5 emission control technologies for large diesel-fired engines were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process codes 17.110-17.190, Large Internal Combustion Engines (>500 hp). The search results for large diesel-fired engines are summarized in Table 4-9.

Table 4-9. RBLC Summary of PM-2.5 Control for the Large Diesel-Fired Engines

Control Technology	Number of Determinations	Emission Limits (g/hp-hr)
Federal Emission Standards	12	0.03 – 0.02
Good Combustion Practices	28	0.03 – 0.24
Limited Operation	11	0.04 – 0.17
Low Sulfur Fuel	14	0.15 – 0.17
No Control Specified	14	0.02 – 0.15

RBLC Review
A review of similar units in the RBLC indicates that good combustion practices, compliance with the federal emission standards, low ash/sulfur diesel, and limited operation are the principle PM-2.5 control technologies installed on large diesel-fired engines. The lowest PM-2.5 emission rate in the RBLC is 0.02 g/hp-hr.

Step 1 - Identification of PM-2.5 Control Technology for the Large Diesel-Fired Engine
From research, the Department identified the following technologies as available for control of PM-2.5 emissions diesel-fired engines rated at 500 hp or greater:

(a) Diesel Particulate Filter (DPF)
DPF is a control technology that are designed to physically filter particulate matter from the exhaust stream. Several designs exist which require cleaning and replacement of the

filter media after soot has become caked onto the filter media. Regenerative filter designs are also available that burn the soot on a regular basis to regenerate the filter media. The Department considers DPF a technically feasible control technology for the large diesel-fired engine.

(b) Positive Crankcase Ventilation
Positive crankcase ventilation is the process of re-introducing the combustion air into the cylinder chamber for a second chance at combustion after the air has seeped into and collected in the crankcase during the downward stroke of the piston cycle. This process allows any unburned fuel to be subject to a second combustion opportunity. Any combustion products act as a heat sink during the second pass through the piston, which will lower the temperature of combustion and reduce the thermal NOx formation. Positive crankcase ventilation is included in the design of EU 8. The Department considers positive crankcase ventilation a technically feasible control technology for the large diesel-fired engine.

(c) Diesel Oxidation Catalyst (DOC)
DOC can reportedly reduce PM-2.5 emissions by 30% and PM emissions by 50%. A DOC is a form of "bolt on" technology that uses a chemical process to reduce pollutants in the diesel exhaust into decreased concentrations. They replace mufflers on vehicles, and require no modifications. More specifically, this is a honeycomb type structure that has a large area coated with an active catalyst layer. As CO and other gaseous hydrocarbon particles travel along the catalyst, they are oxidized thus reducing pollution. The Department considers DOC a technically feasible control technology for the large diesel-fired engine.

(d) Low Ash Diesel
Residual fuels and crude oil are known to contain ash forming components, while refined fuels are low ash. Fuels containing ash can cause excessive wear to equipment and foul engine components. EU 8 is fired exclusively on distillate fuel which is a form of refined fuel. The potential PM-2.5 emissions are based on emission factors for distillate fuel. EU 8 is capable of firing either diesel or heavy fuel oil (non-low ash fuel) according to manufacturer specifications. The Department considers low ash diesel as a technically feasible control technology for the large diesel-fired engine.

(e) Federal Emission Standards
The theory behind the federal emission standards for EU 8 was discussed in detail in the NOx BACT for the large diesel-fired engine and will not be repeated here. Due to EU 8 not being subject to either 40 C.F.R. 60 Subpart IIII or 40 C.F.R. 63 Subpart ZZZZ the Department does not consider federal emission standards as a feasible control technology for the large diesel-fired engine.

(f) Limited Operation
The theory behind limited operation for EU 8 was discussed in detail in the NOx BACT for the large diesel-fired engine and will not be repeated here. Due to EUs 4 and 8 currently

operating under a combined NOx emission limit, the Department considers limited operation a technically feasible control technology for the large diesel-fired engine.

(g) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of PM-2.5 emissions. The Department considers GCPs a technically feasible control technology for the large diesel-fired engine.

Step 2 - Eliminate Technically Infeasible PM-2.5 Control Technologies for the Large Engine
As explained in Step 1 of Section 4.4, the Department does not consider meeting the federal emission standards as a technically feasible technology to control PM-2.5 emissions from EU 8. Additionally, EU 8 is equipped with SCR for controlling NOx emissions, which creates a backpressure. This backpressure does not allow for the operation of a DPF. Therefore, a DPF is not a technically feasible PM-2.5 control option for the large diesel-fired engine.

Step 3 - Rank the Remaining PM-2.5 Control Technologies for the Large Diesel-Fired Engine
The following control technologies have been identified and ranked by efficiency for the control of PM-2.5 emissions from the large diesel-fired engines:

(g)	Good Combustion Practices	(Less than 40% Control)
(c)	Diesel Oxidation Catalyst	(30% Control)
(b)	Positive Crankcase Ventilation	(~10% Control)
(d)	Low Ash/Sulfur Diesel	(~20% Control)
(f)	Limited Operation	(0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for PM-2.5 emissions from the large diesel-fired engine:

(a) PM-2.5 emissions from the large diesel-fired engine shall be controlled by operating with positive crankcase ventilation;

(b) PM-2.5 emissions shall not exceed 0.32 g/hp-hr;

(c) EU 8 shall combust only low ash diesel; and

(d) PM-2.5 emissions from EU 8 will be limited by complying with the combined annual NOx emission limit of 40 tons per 12 month rolling period for EUs 4 and 8.

Step 5 - Selection of PM-2.5 BACT for the Large Diesel-Fired Engine
The Department's finding is that the BACT for NOx emissions from the large diesel-fired engine is as follows:

(a) PM-2.5 emissions from EU 8 shall be controlled by operating positive crankcase ventilation at all time of operation;

(b) Limit non-emergency operation of EU 8 to no more than 100 hours per year for maintenance checks and readiness testing;

(c) Combined NOx emissions from EUs 4 and 8 shall not exceed 40 tons per rolling 12 month period;

(d) PM-2.5 emissions from EU 8 shall not exceed 0.32 g/hp-hr over a 3-hour period; and

(e) EU 8 shall combust only low ash diesel.

Table 4-10 lists the proposed BACT determination for this facility along with those for other diesel-fired engines rated at more than 500 hp located in the Serious PM-2.5 nonattainment area.

Table 4-10. Comparison of PM-2.5 BACT for the Large Diesel-Fired Engine at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
UAF	Large Diesel-Fired Engine	> 500 hp	0.32 g/hp-hr	Positive Crankcase Ventilation Limited Operation
Fort Wainwright	Large Diesel-Fired Engines	> 500 hp	0.15 – 0.32 g/hp-hr	Limited Operation Ultra-Low Sulfur Diesel Federal Emission Standards
GVEA North Pole	Large Diesel-Fired Engines	> 500 hp	0.32 g/hp-hr	Limited Operation Good Combustion Practices
GVEA Zehnder	Large Diesel-Fired Engines	> 500 hp	0.32 g/hp-hr	Limited Operation Good Combustion Practices

4.5 PM-2.5 BACT for the Small Diesel-Fired Engines (EUs 23, 24, and 26 – 29)

Possible PM-2.5 emission control technologies for small engines were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 17.210, Small Internal Combustion Engines (<500 hp). The search results for small diesel-fired engines are summarized in Table 4-11.

Table 4-11. RBLC Summary for PM-2.5 Control for the Small Diesel-Fired Engine

Control Technology	Number of Determinations	Emission Limits (g/hp-hr)
Federal Emission Standards	3	0.15
Good Combustion Practices	19	0.15 – 0.4
Limited Operation	7	0.15 – 0.17
Low Sulfur Fuel	7	0.15 – 0.3
No Control Specified	14	0.02 – 0.09

RBLC Review

A review of similar units in the RBLC indicates low ash/sulfur diesel, compliance with federal emission standards, limited operation, and good combustion practices are the principle PM-2.5 control technologies installed on small diesel-fired engines. The lowest PM-2.5 emission rate listed in the RBLC is 0.02 g/hp-hr.

Step 1 - Identification of PM-2.5 Control Technology for the Small Diesel-Fired Engines

From research, the Department identified the following technologies as available for control of PM-2.5 emissions from the diesel-fired engines rated at 500 hp or less:

(a) Diesel Particulate Filter
The theory behind DPF was discussed in detail in the PM-2.5 BACT for the large diesel-fired engine and will not be repeated here. The Department considers DPF a technically feasible control technology for the small diesel-fired engines.

(b) Diesel Oxidation Catalyst
The theory behind DOC was discussed in detail in the PM-2.5 BACT for the large diesel-fired engines and will not be repeated here. The Department considers DOC a technically feasible control technology for the small diesel-fired engines.

(c) Low Ash Diesel
Residual fuels and crude oil are known to contain ash forming components, while refined fuels are low ash. Fuels containing ash can cause excessive wear to equipment and foul engine components. The Department considers low ash diesel a technically feasible control technology for the small diesel-fired engines.

(d) Federal Emission Standards
The theory behind federal emission standards for the small diesel-fired engine was discussed in detail in the NOx BACT for the small diesel-fired engine and will not be repeated here. The Department considers federal emission standards a technically feasible control technology for the small diesel-fired engines.

(e) Limited Operation
The theory behind limited operation for the small diesel-fired engine was discussed in detail in the NOx BACT for the small diesel-fired engine and will not be repeated here. The Department considers limited operation a technically feasible control technology for the small diesel-fired engines.

(f) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of PM-2.5 emissions. The Department considers GCPs a technically feasible control technology for the small diesel-fired engines.

Step 2 - Eliminate Technically Infeasible PM-2.5 Control Technologies for the Small Engines
All identified control technologies are technically feasible for the small diesel-fired engines.

Step 3 - Rank the Remaining PM-2.5 Control Technologies for the Small Diesel-Fired Engines
The following control technologies have been identified and ranked by efficiency for the control of PM-2.5 emissions from the small diesel-fired engines:

(a) Diesel Particulate Filter (60% - 90% Control)
(b) Diesel Oxidation Catalyst (40% Control)

(c) Low Ash/ Sulfur Diesel (25% Control)
(f) Good Combustion Practices (Less than 40% Control)
(d) Federal Emission Standards (0% Control)
(e) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF provided an economic analysis for the installation of DPF on EU 27. A summary of the analysis is shown below:

Table 4-12. UAF Economic Analysis for Technically Feasible PM-2.5 Controls

Control Alternative	Potential to Emit (tpy)	Emission Reduction (tpy)	Total Capital Investment ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
DPF	0.26	0.22	$30,751	$4,378	$17,169
Capital Recovery Factor = 0.1424 (7% interest rate for a 10 year equipment life)					

UAF contends that the economic analysis indicates the level of PM-2.5 reduction does not justify the use of DPF for EU 27 based on the excessive cost per ton of PM-2.5 removed per year.

UAF proposes the following as BACT for PM-2.5 emissions from the small diesel-fired engine EU 27:

(a) PM-2.5 emissions from EU 27 will be controlled by limiting the operation to no more than 4,380 hours per 12-month rolling period;

(b) Comply with the federal emission standards of NSPS Subpart IIII, Tier 3; and

(c) NOx emissions from EU 27 will not exceed 0.11 g/hp-hr.

Department Evaluation of BACT for NOx Emissions from the Small Diesel-Fired Engine
The Department revised the cost analysis provided by UAF for the installation of DPF on EU 27 using a 20 year equipment life. A summary of the analysis is shown below:

Table 4-13. Department Economic Analysis for Technically Feasible PM-2.5 Controls

Control Alternative	Potential to Emit (tpy)	Emission Reduction (tpy)	Capital Cost ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
DPF	0.26	0.22	$30,751	$2,891	$13,139
Capital Recovery Factor = 0.094 (7% interest rate for a 20 year equipment life)					

The Department's economic analysis economic analysis indicates the level of PM-2.5 reduction does not justify the use of a DPF to be used in conjunction with the federal emission standards and limited operation.

Step 5 - Selection of PM-2.5 BACT for the Small Diesel-Fired Engines

The Department's finding is that BACT for PM-2.5 emissions from the small diesel-fired engines is as follows:

(a) Limit operation of EU 27 to no more than 4,380 hours per 12-month rolling period;

(b) Limit non-emergency operation of EUs 24, 28, and 29 to no more than 100 hours per year each for maintenance checks and readiness testing;

(c) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation;

(d) EU 27 shall comply with the federal emission standards of NSPS Subpart IIII, Tier 3; and

(f) Comply with the numerical BACT emission limits listed in Table 4-14.

Table 4-14. Proposed PM-2.5 BACT Limits for the Small Diesel-Fired Engines

EU	Year	Description	Size	Status	BACT Limit	Proposed BACT
23	2003	Detroit Diesel	235 kW	AP-42 Table 3.3-1	1.0 g/hp-hr	Good Combustion Practices
26	1987	Mitsubishi-Bosh	45 kW	AP-42 Table 3.3-1	1.0 g/hp-hr	
27	TBD	Caterpillar C-15	500 hp	Certified Engine	0.11 g/hp-hr	Limit Operation to 4,380 hours per year, Turbo Charger and Aftercooler, & Good Combustion Practices
24	2001	Cummins	51 kW	AP-42 Table 3.3-1	1.0 g/hp-hr	Limit Operation for non-emergency use (100 hours each per year) and Good Combustion Practices
28	1998	Detroit Diesel	120 hp	AP-42 Table 3.3-1	1.0 g/hp-hr	
29	2013	Cummins	314 hp	Certified Engine	0.015 g/hp-hr	

Table 4-15 lists the proposed BACT determination for this facility along with those for other diesel-fired engines rated at less than 500 hp located in the Serious PM-2.5 nonattainment area.

Table 4-15. Comparison of PM-2.5 BACT for the Small Engines at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
UAF	Six Small Diesel-Fired Engine	< 500 hp	0.015 – 1.0 g/hp-hr	Good Combustion Practices Limited Operation
Fort Wainwright	41 Small Diesel-Fired Engines	< 500 hp	0.015 – 1.0 g/hp-hr	Good Combustion Practices Limited Operation

4.6 PM-2.5 BACT for the Pathogenic Waste Incinerator (EU 9A)

Possible PM-2.5 emission control technologies for waste incinerators were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 21.300 for Hospital, Medical and Infectious Waste Incinerators. The search results for pathogenic waste incinerators are summarized in Table 4-16.

Table 4-16. RBLC Summary of PM-2.5 Control for Pathogenic Waste Incinerator

Control Technology	Number of Determinations	Emission Limits (lb/hr)
Multiple Chamber Design	1	0.0400

RBLC Review
A review of similar units in the RBLC indicates multiple chamber design is the principle PM-2.5 control technology installed on pathogenic waste incinerators. The lowest emission rate listed in the RBLC is 0.0400 lb/hr

Step 1 - Identification of PM-2.5 Control Technology for the Pathogenic Waste Incinerator
From research, the Department identified the following technologies as available for control of PM-2.5 emissions from pathogenic waste incinerators:

(a) Fabric Filters
The theory behind fabric filters was discussed in detail in the PM-2.5 BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers fabric filters a technically feasible control technology for the pathogenic waste incinerator.

(b) ESPs
The theory behind ESPs was discussed in detail in the PM-2.5 BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers ESPs a technically feasible control technology for the pathogenic waste incinerator.

(c) Multiple Chambers
A multiple chamber incinerator introduces the waste material and a portion of the combustion air in the primary chamber. The waste material is combusted in the primary chamber. The secondary chamber introduces the remaining air to complete the combustion of all incomplete combustion products. Many of the volatile organic compounds from waste material are completely combusted in the secondary chamber. Solid waste incinerators can reduce PM-10 emissions up to 70 percent using multiple chambers. The expectation is that less than 70 percent control of PM-2.5 would be removed. The Department considers multiple chambers a technically feasible control technology for the pathogenic waste incinerator.

(d) Limited Operation
The theory behind the limited operation for EU 9A was discussed in detail in the NOx BACT for the pathogenic waste incinerator and will not be repeated here. The Department considers limited operation a technically feasible control technology for the pathogenic waste incinerator.

(e) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of PM-2.5 emissions. The Department considers GCPs a technically feasible control technology for the pathogenic waste incinerator.

Step 2 - Eliminate Technically Infeasible PM-2.5 Controls for Pathogenic Waste Incinerator
The applicant provided information from the manufacturer of the pathogenic waste incinerator that an ESP is a technically infeasible PM-2.5 control for the pathogenic waste incinerator due to the high moisture content of the exhaust.

Step 3 - Rank the Remaining PM-2.5 Control Technologies for the Pathogenic Waste Incinerator
The following control technologies have been identified and ranked by efficiency for the control of PM-2.5 emissions from the pathogenic waste incinerator:

(a) Fabric Filter (99.9% Control)
(e) Good Combustion Practices (Less than 40% Control)
(c) Multiple Chambers (0% Control)
(d) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF provided an economic analysis for the installation of a fabric filter. A summary of the analysis is shown below:

Table 4-17. UAF Economic Analysis for Technically Feasible PM-2.5 Controls

Control Alternative	Captured Emissions (tpy)	Emission Reduction (tpy)	Capital Cost ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
Fabric Filter	0.01	0.24	$1,300,000	$217,011	$761,441
Capital Recovery Factor = 0.1424 (7% interest rate for a 10 year equipment life)					

UAF contends that the economic analysis indicates the level of PM-2.5 reduction does not justify the use of a fabric filter in conjunction with the multiple chamber design and limited operation based on the excessive cost per ton of PM-2.5 removed per year.

UAF proposes the following as BACT for PM-2.5 emissions from the pathogenic waste incinerator:

(a) PM-2.5 emissions from the operation of EU 9A will be controlled with a multiple chamber design and by limiting operation to no more than 109 tons of waste combusted per 12-month rolling period;

(b) PM-2.5 emissions from EU 9A shall not exceed 4.67 lb/ton; and

(c) Compliance with the operating hours limit will be demonstrated by monitoring and recording the weight of waste combusted on a monthly basis.

Step 5 - Selection of PM-2.5 BACT for the Pathogenic Waste Incinerator
The Department’s finding is that BACT for PM-2.5 emissions from the pathogenic waste incinerator is as follows:

(a) PM-2.5 emissions from EU 9A shall be controlled with a multiple chamber design;

(b) PM-2.5 emissions from EU 9A shall not exceed 4.67 lb/ton;

(c) Limit the operation of EU 9A to 109 tons of waste combusted per 12 month rolling period;

(d) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation; and

(e) Compliance with the proposed operational limit will be demonstrated by recording pounds of waste combusted for the pathogenic waste incinerator.

Table 4-18 lists the proposed BACT determination for this facility along with those for other waste incinerators located in the Serious PM-2.5 nonattainment area.

Table 4-18. Comparison of PM-2.5 BACT for Pathogenic Waste Incinerators at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
UAF	One Pathogenic Waste Incinerator	83 lb/hr	4.67 lb/ton	Multiple Chambers Good Combustion Practices Limited Operation

4.7 PM-2.5 BACT for the Material Handling Units (EUs 105, 107, 109 through 111, 114, and 128 through 130)

Possible PM-2.5 emission control technologies for material handling were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process codes 99.100 - 190, Fugitive Dust Sources. The search results for material handling units are summarized in Table 4-19.

Table 4-19. PM-2.5 Control for Material Handling Units

Control Technology	Number of Determinations	Emission Limits
Fabric Filter / Baghouse	10	0.005 gr/dscf
Electrostatic Precipitator	3	0.032 lb/MMBtu
Wet Suppressants / Watering	3	29.9 tpy
Enclosures / Minimizing Drop Height	4	0.93 lb/hr

RBLC Review

A review of similar units in the RBLC indicates good operational practices, enclosures, fabric filters, and minimizing drop heights are the principle PM-2.5 control technologies for material handling operations.

Step 1 - Identification of PM-2.5 Control Technology for the Material Handling Units

From research, the Department identified the following technologies as available for PM-2.5 control of the material handling units:

(a) Fabric Filters

The theory behind fabric filters was discussed in detail in the PM-2.5 BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers fabric filters a technically feasible control technology for EUs 105, 107, 109, 110, 114, and 128 through 130. The ash unloading to disposal trucks (EU 111) occurs in a building with large doors. During ash unloading the doors remain closed to prevent the release of fugitive emissions.

Therefore, the Department does not consider a fabric filter a technically feasible control technology for EU 111.

(b) Scrubbers
The theory behind scrubbers was discussed in detail in the PM-2.5 BACT for the large dual fuel-fired boiler and will not be repeated here. The Department considers scrubbers a feasible control technology for the material handling units, except for EU 111. EU 111 does not have collected emissions and therefore a scrubber is not considered a technically feasible control technology.

(c) Suppressants
The use of dust suppression to control particulate matter can be effective for stockpiles and transfer points exposed to the open air. Applying water or a chemical suppressant can bind the materials together into larger particles which reduces the ability to become entrained in the air either from wind or material handling activities. The Department considers the use of suppressants a technically feasible control technology for all of the material handling units.

(d) Enclosures
An enclosure prevents the release of fugitive emissions into the ambient air by confining all fugitive emissions within a structure and preventing additional fugitive emissions from being generated from winds eroding stockpiles and lifting particulate matter from conveyors. Often enclosures are paired with fabric filters. The RBLC does not identify a control efficiency for an enclosure that is not associated with another control option. The Department considers enclosures a technically feasible control technology for the material handling units.

(e) Wind Screens
A wind screen is similar to a solid fence which is used to lower wind velocities near stockpiles and material handling sites. As wind speeds increase, so do the fugitive emissions from the stockpiles, conveyors, and transfer points. The use of wind screens is appropriate for materials not already located in enclosures. Due to all of the material handling units being operated in enclosures the Department does not consider wind screens a technically feasible control option for the material handling units.

(f) Vents/Closed System Vents/Negative Pressure Vents
Vents can control fugitive emissions by collecting fugitive emissions from enclosed loading, unloading, and transfer points and then venting emissions to the atmosphere or back into other equipment such as a storage silo. Other vent control designs include enclosing emission units and operating under a negative pressure. The Department considers vents to be a technically feasible control technology for the material handling units, except for EU 111. EU 111 does not have collected emissions and the vent system would be ineffective when trucks enter and departed the loading area.

Step 2 - Eliminate Technically Infeasible PM-2.5 Controls for the Material Handling Units
As explained in Step 1 of Section 4.7, the Department does not consider fabric filters, scrubbers, and vents as technically feasible PM-2.5 control technologies for EU 111. The Department does not consider wind screens as technically feasible PM-2.5 control technologies for the material handling units.

Step 3 - Rank the Remaining PM-2.5 Control Technologies for the Material Handling Units
The following control technologies have been identified and ranked for control of particulates from the material handling equipment:

(a)	Fabric Filters	(50 - 99% Control)
(d)	Enclosures	(50 - 99% Control)
(b)	Scrubber	(50% - 99% Control)
(e)	Cyclone	(20% - 70% Control)
(c)	Suppressants	(less than 90% Control)
(f)	Vents	(less than 90% Control)

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for PM-2.5 emissions from the material handling units:

(a) PM-2.5 emissions from EUs 105, 107, 109 through 111, 114, and 128 through 130 will be controlled by enclosing each EU.

(b) PM-2.5 emissions from the operation of the material handling units, except EU 111, will be controlled by installing, operating, and maintaining fabric filters and vents.

(c) PM-2.5 emissions from EUs 105, 107, 109, 110, and 128 through 130 shall not exceed 0.003 gr/dscf.

(d) PM-2.5 emissions from EU 111 shall not exceed 5.5×10^{-5} lb/ton.

(e) PM-2.5 emissions from EU 114 shall not exceed 0.05 gr/dscf.

Step 5 - Selection of PM-2.5 BACT for the Material Handling Units
The Department's finding is that BACT for PM-2.5 emissions from the material handling equipment is as follows:

(a) PM-2.5 emissions from EUs 105, 107, 109 through 111, 114, and 128 through 130 will be controlled by enclosing each EU;

(b) PM-2.5 emissions from the operation of the material handling units, except EU 111, will be controlled by installing, operating, and maintaining fabric filters and vents;

(c) PM-2.5 emissions from EUs 105, 107, 109, 110, and 128 through 130 shall not exceed 0.003 gr/dscf;

(d) PM-2.5 emissions from EU 111 shall not exceed 5.5×10^{-5} lb/ton;

(e) PM-2.5 emissions from EU 114 shall not exceed 0.05 gr/dscf; and

(f) Initial compliance with the emission rates for the material handling units, except EU 111, will be demonstrated with a performance test to obtain an emission rate.

Table 4-20. PM-2.5 BACT Control Technologies Proposed for the Material Handling Units

Facility	Process Description	Capacity	Limitation	Control Method
UAF	7 Material Handling Units	Varies	0.003 gr/dcf	Fabric Filter & Enclosure & Vent
UAF	Ash Loadout to Truck (EU 111)	N/A	5.50E-05 lb/ton	Enclosure
UAF	Dry Sorbent Handing Vent Filter Exhaust	5 acfm	0.050 gr/dcf	Fabric Filter & Enclosure & Vent

5. BACT DETERMINATION FOR SO_2

The Department based its SO_2 assessment on BACT determinations found in the RBLC, internet research, and BACT analyses submitted to the Department by GVEA for the North Pole Power Plant and Zehnder Facility, Aurora for the Chena Power Plant, US Army for Fort Wainwright, and UAF for the Combined Heat and Power Plant.

5.1 SO_2 BACT for the Large Dual Fuel-Fired Boiler (EU 113)

Possible SO_2 emission control technologies for the large dual fuel-fired boiler were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 11.110, Coal Combustion in Industrial Size Boilers and Furnaces. The search results are summarized in Table 5-1.

Table 5-1: RBLC Summary of SO_2 Control for Industrial Coal-Fired Boilers

Control Technology	Number of Determinations	Emission Limits (lb/MMBtu)
Flue Gas Desulfurization / Scrubber / Spray Dryer	10	0.06 – 0.12
Limestone Injection	10	0.055 – 0.114
Low Sulfur Coal	4	0.06 – 1.2

RBLC Review

A review of similar units in the RBLC indicates flue gas desulfurization and low sulfur coal are the principle SO_2 control technologies installed on large dual fuel-fired boilers. The lowest SO_2 emission rate in the RBLC is 0.055 lb/MMBtu

Step 1 - Identification of SO_2 Control Technology for the Large Dual Fuel-Fired Boiler

From research, the Department identified the following technologies as available for control of SO_2 emissions from the large dual fuel-fired boiler:

(a) Flue Gas Desulfurization (FGD)/Scrubber/Spray Dryer
Two basic types of FGD systems exist, dry and wet scrubbing. In the wet scrubbing system, flue gas is contacted with a solution or slurry of alkaline material in a vessel providing a relatively long residence time. Generally, particulate matter has not been removed prior to entering into the adsorber, and the spray drying process acts as a combined SO_2/PM removal system. The SO_2 in the flue reacts with the alkali solution or slurry by adsorption and/or absorption mechanisms to form liquid-phase salts. These salts are dried to about one percent free moisture by the heat in the flue gas. These solids are entrained in the flue gas and carried from the dryer to a PM collection device, such as a baghouse.

Spray drying technology is less complex mechanically, and no more complex chemically, than wet scrubbing systems. The main advantages of the spray dryer is that this technology avoids two problems associated with wet scrubbing, corrosion and liquid waste treatment. A PM collection device is also required for dry scrubbing.

The vendor for the large dual fuel-fired boiler, Babcock & Wilcox, indicated that this new boiler design can accommodate a wet or dry FGD system. The wet FGD system is a spray dry adsorber (SDA) that would be located at grade between the air heater and the baghouse. The current baghouse and filter media is capable of handling the higher solids loading from an SDA. The system would utilize a baghouse fly ash recycle system which would activate a portion of the un-reacted lime in the fly ash. The recycled slurry, when sprayed through the atomizer, will reduce the SO_2 emissions, possibly without the need for any additional reagent depending on the level of SO_2 reduction required. The proposed SDA technology is expected to achieve an SO_2 emission rate of 0.04 lb/MMBtu, which is approximately 92 percent SO_2 control. The Department considers SDA a technically feasible control technology for the large dual fuel-fired boiler.

Babcock & Wilcox indicated that the large dual fuel-fired boiler design should include a small dry sorbent injection (DSI) system to reduce hydrofluoric acid (HF) and hydrochloric acid (HCl) emissions. This small DSI system is not designed for and is not expected to control SO_2 emissions. An add-on DSI system would be required for SO_2 control.

An add-on DSI system is possible and would use sodium bicarbonate or specialized hydrated lime as a reagent to react with SO_2. This form of a dry FDG system would likely require a silo for reagent storage, a mill building, pneumatic conveying, and reagent distribution upstream of the baghouse. Potentially, the baghouse ash handling system capacity would also need to be increased, depending on the sorbent injection rate. The add-on DSI system could achieve approximately a 75 percent SO_2 control. The Department considers an add-on DSI system for SO_2 emissions control to be a feasible control technology for the large dual fuel-fired boiler.

(b) Limestone Injection

In the limestone injection process, crushed coal and limestone are suspended in a boiler by an upward stream of hot air. The coal is burned in this bubbling fluidized mixture. The temperature in the combustion chamber of between 1,500 and 1,600 degrees is the correct temperature for the limestone to react with SO_2 to form a solid compound that is collected in a particulate matter collection device. The sulfur reduction can be achieved with either limestone or hydrated lime. Limestone injection technology has the benefits of low capital costs, low feed rates, and low operating costs.

The CFB design of the large dual fuel-fired boiler is capable of using limestone as part of the feed bed which controls the sulfur emissions released during coal combustion. The proposed fabric filter baghouse system would remove the particulate matter formed as calcium sulfate. The Department considers limestone injection a technically feasible control technology for the large dual fuel-fired boiler.

(c) Low Sulfur Coal
UAF purchases coal from the Usibelli Coal Mine located in Healy, Alaska. This coal mine is located 115 miles south of Fairbanks. The coal mined at Usibelli is sub-bituminous coal and has a relatively low sulfur content with guarantees of less than 0.4 percent by weight. Usibelli Coal Data Sheets indicate a range of 0.08 to 0.28 percent Gross As Received (GAR) percent Sulfur (%S). According to the U.S. Geological Survey, coal with less than one percent sulfur is classified as low sulfur coal. The Department considers the use of low sulfur coal a technically feasible control technology for the large dual fuel-fired boiler.

(d) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of SO_2 emissions. The Department considers GCPs a technically feasible control technology for the large dual fuel-fired boiler.

Step 2 - Eliminate Technically Infeasible SO_2 Controls for the Large Dual Fuel-Fired Boiler
All identified control technologies are technically feasible for the large dual fuel-fired boiler.

Step 3 - Rank the Remaining SO_2 Control Technologies for the Large Dual Fuel-Fired Boiler
The following control technologies have been identified and ranked by efficiency for control of SO_2 emissions from the large dual fuel-fired boiler:

(a-1) Wet Scrubber (99% Control)
(a-2) Spray Dry Absorbers (92% Control)
(a-3) Dry Sorbent Injection (75% Control)
(d) Good Combustion Practices (Less than 40% Control)
(b) Limestone Injection (0% Control)
(c) Low Sulfur Coal (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF provided an economic analysis of the installation of wet and dry scrubber systems. A summary of the analysis is shown below:

Table 5-2. UAF Economic Analysis for Technically Feasible SO_2 Controls

Control Alternative	Potential to Emit (tpy)	Emission Reduction (tpy)	Total Capital Investment ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
Spray Dry Absorber	258.9	238.2	$15,600,000	$3,270,753	$13,732
Dry Sorbent Injection	258.9	194.2	$2,535,000	$1,697,487	$8,742
Capital Recovery Factor = 0.1424 (7% interest rate for a 10 year equipment life)					

UAF contends that the economic analysis indicates the level of SO_2 reduction does not justify the use of spray dry absorbers or dry-sorbent injection for the dual fuel-fired boiler based on the excessive cost per ton of SO_2 removed per year.

UAF proposes the following as BACT for SO_2 emissions from the dual fuel-fired boiler:

(a) SO_2 emissions from the operation of EU 113 will be controlled by the operation of limestone injection at all times the unit is in operation;

(b) SO_2 emissions from EU 113 will be controlled by burning low sulfur coal at all times the dual fuel-fired boiler is combusting coal; and

(c) SO_2 emissions from EU 113 will not exceed 0.2 lb/MMBtu.

Department Evaluation of BACT for SO_2 Emissions from the Dual Fuel-Fired Boiler

The Department revised the cost analyses provided for the installation of spray dry absorbers and dry sorbent injection and created a new cost analysis for wet scrubbers, all using the unrestricted potential to emit for the dual fuel-fired boiler, a baseline emission rate of 0.2 lb SO_2/MMBtu,[21] a retrofit factor of 1.0 for a retrofit of average difficulty, a SO_2 removal efficiency of 99%, 90%, and 80% for spray dry absorbers and dry sorbent injection respectively, and a 15 year equipment life. A summary of the analysis is shown below:

Table 5-3. Department Economic Analysis for Technically Feasible SO_2 Controls

Control Alternative	Potential to Emit (PTE)	Emission Reduction (tpy)	Total Capital Cost ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
Wet Scrubber	259	257	$29,487,290	$6,081,181	$23,690
SDA	259	233	$27,132,570	$5,463,391	$23,411
DSI	259	207	$5,192,915	$1,731,023	$8,345
Capital Recovery Factor = 0.0996 (5.5% interest rate for a 15 year equipment life)					

The Department's economic analysis indicates the level of SO_2 reduction justifies the use of dry sorbent injection as BACT for the dual fuel-fired boiler located in the Serious PM-2.5 nonattainment area.

Step 5 - Selection of SO_2 BACT for the Large Dual Fuel-Fired Boiler

The Department's finding is that BACT for SO_2 emissions from the dual fuel-fired boilers is as follows:

(a) SO_2 emissions from EU 113 shall be controlled by operating and maintaining dry sorbent injection and limestone injection at all times the unit is in operation;

(b) EU 113 shall not exceed a SO_2 emission rate of 0.10 lb/MMBtu[22] averaged over a 3-hour period;

[21] Emission rate is SO_2 limit from 40 C.F.R. 60.42b(k)(1) [NSPS Subpart Db]

[22] BACT limit selected after evaluating existing emission limits in the RBLC database for coal-fired boilers, taking into account previous source test data from coal-fired boilers in Alaska and actual emissions data from other sources

(c) SO_2 emissions from EU 113 will be controlled by burning low sulfur coal (less than 0.2% S by weight) at all times the dual fuel-fired boiler is combusting coal;

(d) Maintain good combustion practices at all times of operation by following the manufacturer's operating and maintenance procedures; and

(e) Initial compliance with the proposed SO_2 emission rate for the dual fuel-fired boilers will be demonstrated by conducting a performance test to obtain an emission rate.

Table 5-4 lists the proposed SO_2 BACT determination for this facility along with those for other coal-fired boilers in the Serious PM-2.5 nonattainment area.

Table 5-4. Comparison of SO_2 BACT for Coal-Fired Boilers at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
UAF	Dual Fuel-Fired Boiler	295.6 MMBtu/hr	0.10 lb/MMBtu[22]	Dry Sorbent Injection Limestone Injection Low Sulfur Coal
Fort Wainwright	Six Coal-Fired Boilers	1,380 MMBtu/hr (combined)	0.10 lb/MMBtu	Low Sulfur Coal Dry Sorbent Injection Operational Limit
Chena	Four Coal-Fired Boilers	497 MMBtu/hr (combined)	0.10 lb/MMBtu	Dry Sorbent Injection Low Sulfur Coal

5.2 SO_2 BACT for the Mid-Sized Diesel-Fired Boilers (EUs 3 and 4)

Possible SO_2 emission control technologies for mid-sized diesel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 12.220, Industrial Size Distillate Fuel Oil Boilers (>100 MMBtu/hr and ≤ 250 MMBtu/hr). The search results for mid-sized diesel-fired boilers are summarized in Table 5-5.

Table 5-5. RBLC Summary of SO_2 Control for Mid-Sized Boilers Firing Diesel

Control Technology	Number of Determinations	Emission Limits (lb/MMBtu)
No Control Specified	2	0.0006

Possible SO_2 emission control technologies for mid-sized diesel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 12.310, Industrial Size Gaseous Fuel Boilers (>100 MMBtu/hr and ≤ 250 MMBtu/hr). The search results for mid-sized diesel-fired boilers are summarized in Table 5-6.

Table 5-6. RBLC Summary of SO_2 Control for Mid-Sized Boilers Firing Natural Gas

employing similar types of controls, using manufacturer data provided by Babcock & Wilcox, and in-line with EPA's pollution control Fact Sheets while keeping in mind that BACT limits must be achievable at all times.

Control Technology	Number of Determinations	Emission Limits
Low Sulfur Fuel	2	0.89 - 11.24 (tpy)
Good Combustion Practices	5	0.03 – 0.18 (lb/hr)
No Control Specified	4	0.01 – 0.09 (lb/hr)

RBLC Review
A review of similar units in the RBLC indicates low sulfur fuel and good combustion practices are the principle SO_2 control technologies installed on mid-sized boilers. The lowest SO_2 emission rate listed in the RBLC is 0.0006 lb/MMBtu.

Step 1 - Identification of SO_2 Control Technology for the Mid-Sized Diesel-Fired Boilers
From research, the Department identified the following technologies as available for SO_2 control for the mid-sized diesel-fired boilers:

(a) Ultra Low Sulfur Diesel
ULSD has a fuel sulfur content of 0.0015 percent sulfur by weight or less. Using ULSD would reduce SO_2 emissions because the mid-sized diesel-fired boilers are combusting standard diesel that has a sulfur content of up to 0.5 percent sulfur by weight. Switching to ULSD could reach a great than 99 percent decrease in SO_2 emissions from the mid-sized diesel-fired boilers. The Department considers ULSD a technically feasible control technology for the mid-sized diesel-fired boilers.

(b) Natural Gas
The theory of operating the mid-sized diesel-fired boilers on natural gas was discussed in detail in the NOx BACT for the mid-sized diesel-fired boilers and will not be repeated here. The Department does not consider operating the mid-sized diesel-fired boilers on natural gas as a technically feasible control technology.

(c) Limited Operation
The theory of limited operation for the mid-sized diesel-fired boilers was discussed in detail in the NOx BACT for the mid-sized diesel-fired boilers and will not be repeated here. The Department considers limited operation a technically feasible control technology for the mid-sized diesel-fired boilers.

(d) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of SO_2 emissions. The Department considers GCPs a technically feasible control technology for the mid-sized diesel-fired boilers.

Step 2 - Eliminate Technically Infeasible SO_2 Control Technologies for the Mid-Sized Diesel-Fired Boilers
Limited operation for EU 3 is a technically infeasible control technology as it is a backup unit.

Step 3 - Rank the Remaining SO_2 Control Technologies for the Mid-Sized Diesel-Fired Boilers
The following control technologies have been identified and ranked by efficiency for the control of SO_2 emissions from themed-sized diesel-fired boilers.

(a) Ultra Low Sulfur Diesel (99% Control)
(d) Good Combustion Practices (Less than 40% Control)
(c) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for SO_2 emissions from the mid-sized diesel-fired boilers:

(a) SO_2 emissions from EUs 3 and 4 shall combust ULSD while firing diesel fuel;

(b) SO_2 emissions from EU 4 shall not exceed 0.60 lb/MMscf while firing natural gas; and

(c) SO_2 emissions from EU 4 will be limited by complying with the combined annual NOx emission limit of 40 tons per 12 month rolling period for EUs 4 and 8.

Step 5 - Selection of SO_2 BACT for the Mid-Sized Diesel-Fired Boilers

The Department’s finding is that BACT for SO_2 emissions from the mid-sized diesel-fired boilers is as follows:

(a) SO_2 emissions from EUs 3 and 4 shall be controlled by only combusting ULSD when firing diesel fuel;

(b) SO_2 emissions from EU 4 will be limited by complying with the combined annual NOx emission limit of 40 tons per 12 month rolling period for EUs 4 and 8;

(c) SO_2 emissions from EU 4 while firing natural gas shall not exceed 0.60 lb/MMscf;

(d) Maintain good combustion practices by following the manufacturer’s maintenance procedures at all times of operation; and

(e) Compliance with the proposed SO_2 emission limit will be demonstrated through fuel shipment receipts and/or fuel testing for sulfur content.

Table 5-7 lists the proposed BACT determination for this facility along with those for other mid-sized diesel-fired boilers located in the Serious PM-2.5 nonattainment area.

Table 5-7. Comparison of SO_2 BACT for the Mid-Sized Diesel-Fired Boilers at Nearby Power Plants

Facility	EU ID	Process Description	Capacity	Fuel	Limitation	Control Method
UAF	3	Dual Fuel-Fired Boilers	100 – 250 MMBtu/hr	Diesel	15 ppmw S in fuel	Ultra Low Sulfur Diesel
	4			Diesel	15 ppmw S in fuel	Limited Operation
				Natural Gas	0.60 lb/MMscf	Ultra Low Sulfur Diesel

5.3 SO_2 BACT for the Small Diesel-Fired Boilers (EUs 19 through 21)

Possible SO_2 emission control technologies for small diesel-fired boilers were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code

13.220, Commercial/Institutional Size Boilers (<100 MMBtu/hr). The search results for small diesel-fired boilers are summarized in Table 5-8.

Table 5-8. RBLC Summary of SO_2 Control for Small Diesel-Fired Boilers

Control Technology	Number of Determinations	Emission Limits (lb/MMBtu)
Low Sulfur Content	5	0.0036 – 0.0094
Good Combustion Practices	4	0.0005
No Control Specified	5	0.0005

RBLC Review
A review of similar units in the RBLC indicates that good combustion practices and combustion of low sulfur fuel are the principle SO_2 control technologies installed on small diesel-fired boilers. The lowest SO_2 emission rate listed in the RBLC is 0.0005 lb/MMBtu

Step 1 - Identification of SO_2 Control Technology for the Small Diesel-Fired Boilers
From research, the Department identified the following technologies as available for SO_2 control for the small diesel-fired boilers:

(a) ULSD
The theory of ULSD was discussed in detail in the SO_2 BACT for the mid-sized diesel-fired boilers and will not be repeated here. The Department considers ULSD a technically feasible control technology for the small diesel-fired boilers.

(b) Limited Operation
The theory behind limited operation was discussed in detail in the NOx BACT for the small diesel-fired boilers and will not be repeated here. The Department considers limited operation as a technically feasible control technology for the small diesel-fired boilers.

(c) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of SO_2. The Department considers GCPs a technically feasible control technology for the small diesel-fired boilers.

Step 2 - Eliminate Technically Infeasible SO_2 Control Technologies for the Small Diesel-Fired Boilers
All identified control technologies are technically feasible for the diesel-fired boilers.

Step 3 - Rank the Remaining SO_2 Control Technologies for the Small Diesel-Fired Boilers
The following control technologies have been identified and ranked by efficiency for the control of SO_2 emissions from the small diesel-fired boilers:

(a) Ultra Low Sulfur Diesel (99% Control)
(c) Good Combustion Practices (Less than 40% Control)
(b) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for SO_2 emissions from the small diesel-fired boilers:

(a) SO_2 emissions from the operation of the small diesel-fired boilers will be controlled by limiting the combined operation to no more than 19,650 hours per 12-month rolling period;

(b) SO_2 emissions from the operation of the small diesel-fired boilers shall be controlled by using ULSD (0.0015 sulfur by weight) at all times of operation; and

(c) Compliance with the proposed SO_2 emission limit will be demonstrated through fuel shipment receipts and/or fuel testing for sulfur content.

Step 5 - Selection of SO_2 BACT for the Small Diesel-Fired Boilers

The Department's finding is that BACT for SO_2 emissions from the diesel-fired boilers is as follows:

(a) SO_2 emissions from EUs 19-21 shall be controlled by limited the combined operation to no more than 19,650 hours per 12-month rolling period;

(b) SO_2 emissions from the diesel-fired boilers shall be controlled by only combusting ULSD; and

(c) Compliance will be demonstrated with fuel shipment receipts and/or fuel tests for sulfur content.

Table 5-9 lists the proposed SO_2 BACT determination for this facility along with those for other small diesel-fired boilers rated at less than 100 MMBtu/hr in the Serious PM-2.5 nonattainment area.

Table 5-9. Comparison of SO_2 BACT for the Small Diesel-Fired Boilers at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
Fort Wainwright	Diesel-Fired Boilers	< 100 MMBtu/hr	15 ppmw S in fuel	Limited Operation Good Combustion Practices Ultra-Low Sulfur Diesel
	Waste Fuel-Fired Boilers		0.5 % S by weight	Good Combustion Practices
UAF	3 Diesel-Fired Boilers	< 100 MMBtu/hr	15 ppmw S in fuel	Limited Operation Ultra-Low Sulfur Diesel
GVEA Zehnder	2 Diesel-Fired Boilers	< 100 MMBtu/hr	15 ppmw S in fuel	Good Combustion Practices Ultra-Low Sulfur Diesel

5.4 SO_2 BACT for the Large Diesel-Fired Engine (EU 8)

Possible SO_2 emission control technologies for large engines were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process codes 17.100 - 17.190, Large Internal Combustion Engines (>500 hp). The search results for large diesel-fired engines are summarized in Table 5-10.

Table 5-10. RBLC Summary Results for SO_2 Control for Large Diesel-Fired Engines

Control Technology	Number of Determinations	Emission Limits (g/hp-hr)
Low Sulfur Diesel	27	0.005 – 0.02
Federal Emission Standards	6	0.001 – 0.005
Limited Operation	6	0.005 – 0.006
Good Combustion Practices	3	None Specified
No Control Specified	11	0.005 – 0.008

RBLC Review
A review of similar units in the RBLC indicates combustion of low sulfur fuel, limited operation, and good combustion practices are the principle SO_2 control technologies installed on large diesel-fired engines. The lowest emission rate listed in the RBLC is 0.001 g/hp-hr.

Step 1 - Identification of SO_2 Control Technology for the Large Diesel-Fired Engine
From research, the Department identified the following technologies as available for the control of SO_2 emissions from the large diesel-fired engine:

(a) Ultra Low Sulfur Diesel
The theory of ULSD was discussed in detail in the SO_2 BACT for the mid-sized diesel-fired boilers and will not be repeated here. The Department considers ULSD a technically feasible control technology for the large diesel-fired engine.

(b) Federal Standards
The theory of federal emission standards was discussed in detail in the NOx BACT for the large diesel-fired engine and will not be repeated here. The Department does not consider federal emission standards a technically feasible control technology for the large diesel-fired engine.

(c) Limited Operation
The theory of limited operation for EU 8 was discussed in detail in the NOx BACT for the large diesel-fired engine and will not be repeated here. The Department considers limited operation as a technically feasible control technology for the large diesel-fired engine.

(d) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of SO_2 emissions. The Department considers GCPs a technically feasible control technology for the large diesel-fired engine.

Step 2 - Eliminate Technically Infeasible SO_2 Control Technologies for the Large Diesel-Fired Engine
As explained in Step 1 of Section 5.4, the Department does not consider federal emission standards as a technically feasible control technology to control SO_2 emissions from the large diesel-fired engine.

Step 3 - Rank the Remaining SO_2 Control Technologies for the Large Diesel-Fired Engine

(a) Ultra Low Sulfur Diesel (99% Control)

(d) Good Combustion Practices (Less than 40% Control)
(c) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for SO_2 emissions from the large diesel-fired engine:

(a) SO_2 emissions from EU 8 shall be controlled by combusting ULSD (0.0015 weight percent sulfur); and

(b) SO_2 emissions from EU 8 will be limited by complying with the combined annual NOx emission limit of 40 tons per 12 month rolling period for EUs 4 and 8.

Step 5 - Selection of SO_2 BACT for the Large Diesel Fired-Engine

The Department's finding is that BACT for SO_2 emissions from the large diesel-fired engines is as follows:

(a) SO_2 emissions from EU 8 shall be controlled by combusting only ULSD (0.0015 weight percent sulfur);

(b) Limit the combined operation of EU 4 and 8 to no more than 40 tons of NOx per 12 month rolling average;

(c) Maintain good combustion practices by following the manufacturer's maintenance procedures at all times of operation; and

(d) Compliance will be demonstrated with fuel shipment receipts and/or fuel tests for sulfur content.

Table 5-11 lists the proposed BACT determination for this facility along with those for other diesel-fired engines rated at more than 500 hp located in the Serious PM-2.5 nonattainment area.

Table 5-11. Comparison of SO_2 BACT for Large Diesel-Fired Engines at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
Fort Wainwright	8 Large Diesel-Fired Engines	> 500 hp	15 ppmw S in fuel	Limited Operation Good Combustion Practices Ultra-Low Sulfur Diesel
UAF	Large Diesel-Fired Engine	13,266 hp	15 ppmw S in fuel	Limited Operation Good Combustion Practices Ultra-Low Sulfur Diesel
GVEA North Pole	Large Diesel-Fired Engine	600 hp	15 ppmw S in fuel	Good Combustion Practices Ultra-Low Sulfur Diesel
GVEA Zehnder	2 Large Diesel-Fired Engines	11,000 hp	500 ppmw S in fuel	Good Combustion Practices Ultra-Low Sulfur Diesel

5.5 SO_2 BACT for the Small Diesel-Fired Engines (EUs 23, 24, and 26 – 29)

Possible SO_2 emission control technologies for small engines were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 17.210, Small Internal Combustion Engines (<500 hp). The search results for small diesel-fired engines are summarized in Table 5-12.

Table 5-12. RBLC Summary of SO_2 Controls for Small Diesel-Fired Engines

Control Technology	Number of Determinations	Emission Limits (g/hp-hr)
Low Sulfur Diesel	6	0.005 – 0.02
No Control Specified	3	0.005

RBLC Review
A review of similar units in the RBLC indicates combustion of low sulfur fuel is the principle SO_2 control technology for small diesel-fired engines. The lowest SO_2 emission rate listed in the RBLC is 0.005 g/hp-hr.

Step 1 - Identification of SO_2 Control Technology for the Small Diesel-Fired Engines
From research, the Department identified the following technologies as available for control of SO_2 emissions from diesel-fired engines rated at less than 500 hp:

(a) Ultra Low Sulfur Diesel
The theory of ULSD was discussed in detail in the SO_2 BACT for the mid-sized diesel-fired boilers and will not be repeated here. The Department considers ULSD a technically feasible control technology for the small diesel-fired engines.

(b) Limited Operation
The theory of limited operation for EU 27 was discussed in detail in the NOx BACT for the small diesel-fired engine and will not be repeated here. The Department considers limited operation a technically feasible control technology for the small diesel-fired engines.

(c) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of SO_2 emissions. The department considers GCPs a technically feasible control technology for the small diesel-fired engines.

Step 2 - Eliminate Technically Infeasible SO_2 Control Technologies for the Small Engines
All identified control technologies are technically feasible for the small diesel-fired engines.

Step 3 - Rank the Remaining SO_2 Control Technologies for the Small Diesel-Fired Engines
The following control technologies have been identified and ranked by efficiency for the control of SO_2 emissions from the small diesel-fired engines.

(a) Ultra Low Sulfur Diesel (99% Control)
(c) Good Combustion Practices (Less than 40% Control)
(c) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for SO_2 emissions from the small diesel-fired engine EU 27:

(a) SO_2 emissions from the operation of the small diesel-fired engine shall be controlled by using ULSD at all times of operation (0.0015 weight percent sulfur); and

(b) SO_2 emissions from the operation of the small diesel-fired engine will be controlled by limiting operation to no more than 4,380 hours per 12-month rolling period.

Department Evaluation of BACT for SO_2 Emissions from Small Diesel-Fired Engines

The Department reviewed UAF's proposal and found that in addition to combusting only ULSD, and limiting operation of the small diesel-fired engine, good combustion practices is BACT for SO_2.

Step 5 - Selection of SO_2 BACT for the Small Diesel-Fired Engines

The Department's finding is that BACT for SO_2 emissions from the small diesel-fired engines is as follows:

(a) SO_2 emissions from small diesel-fired engines shall be controlled by combusting only ULSD at all times of operation;

(b) SO_2 emissions from the operation of EU 27 will be controlled by limiting operation to no more than 4,380 hours per 12-month rolling period;

(c) Limit non-emergency operation of EUs 24, 28, and 29 to no more than 100 hours per year each for maintenance checks and readiness testing;

(d) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation;

(e) Compliance will be demonstrated with fuel shipment receipts and/or fuel tests for sulfur content; and

(f) Compliance with the operating hours limit will be demonstrated by monitoring and recording the number of hours operated on a monthly basis.

Table 5-13 lists the proposed BACT determination for this facility along with those for other diesel-fired engines rated at less than 500 hp located in the Serious PM-2.5 nonattainment area.

Table 5-13. Comparison of SO_2 BACT for Small Diesel-Fired Engines at Nearby Power Plants

Facility	Process Description	Capacity	Limitation	Control Method
Fort Wainwright	41 Small Diesel-Fired Engines	< 500 hp	15 ppmw S in fuel	Limited Operation Ultra-Low Sulfur Diesel Good Combustion Practices
UAF	Six Small Diesel-Fired Engine	< 500 hp	15 ppmw S in fuel	Limited Operation

Facility	Process Description	Capacity	Limitation	Control Method
				Federal Emission Standards Ultra-Low Sulfur Diesel

5.6 SO_2 BACT for the Pathogenic Waste Incinerator (EU 9A)

Possible SO_2 emission control technologies for pathogenic waste incinerators were obtained from the RBLC. The RBLC was searched for all determinations in the last 10 years under the process code 21.300 for Hospital, Medical, and Infectious Waste Incinerators. The search results for pathogenic waste incinerators are summarized in Table 5-14.

Table 5-14. RBLC Summary of SO_2 Control for the Pathogenic Waste Incinerator

Control Technology	Number of Determinations	Emission Limits (lb/hr)
Natural Gas	1	0.0500

RBLC Review

A review of similar units in the RBLC indicates use of natural gas as fuel is the principle SO_2 control technology installed on pathogenic waste incinerators. The lowest emission rate listed in the RBLC is 0.0500 lb/hr.

Step 1 - Identification of SO_2 Control Technology for the Pathogenic Waste Incinerator

From research, the Department identified the following technologies as available for control of SO_2 emissions from pathogenic waste incinerators:

(a) Natural Gas
Natural gas combustion has a lower SO_2 emission rate than standard diesel combustion and can be a preferred fuel for this reason. The availability of natural gas in Fairbanks can be limited. The Department considers natural gas as a technically feasible control option for the pathogenic waste incinerator.

(b) Ultra Low Sulfur Diesel
The theory of ULSD was discussed in detail in the SO_2 BACT for the mid-sized diesel-fired boilers and will not be repeated here. The Department considers ULSD a technically feasible control technology for the pathogenic waste incinerator.

(c) Limited Operation
The theory behind the limited operation for EU 9A was discussed in detail in the NOx BACT for the pathogenic waste incinerator and will not be repeated here. The Department considers limited operation a technically feasible control technology for the pathogenic waste incinerator.

(d) Good Combustion Practices
The theory of GCPs was discussed in detail in the NOx BACT for the large dual fuel-fired boiler and will not be repeated here. Proper management of the combustion process will result in a reduction of SO_2 emissions. The Department considers GCPs a technically feasible control technology for the pathogenic waste incinerator.

Step 2 - Eliminate Technically Infeasible SO_2 Control Technologies for the Pathogenic Waste Incinerator

Natural gas is eliminated as a technically infeasible SO_2 control technology for the pathogenic waste incinerator due to the limited availability.

Step 3 - Rank the Remaining SO_2 Control Technologies for the Pathogenic Waste Incinerator

The following control technologies have been identified and ranked by efficiency for the control of SO_2 emissions from the pathogenic waste incinerator:

(b) Ultra Low Sulfur Diesel (99% Control)
(c) Good Combustion Practices (Less than 40% Control)
(c) Limited Operation (0% Control)

Control technologies already in practice at the stationary source or included in the design of the EU are considered 0% control for the purpose of the SIP BACT for existing stationary sources.

Step 4 - Evaluate the Most Effective Controls

UAF BACT Proposal

UAF proposes the following as BACT for SO_2 emissions from the pathogenic waste incinerator:

(a) SO_2 emissions from the operation of EU 9A will be controlled by limiting operation to no more than 109 tons of waste combusted per 12-month rolling period;

(b) SO_2 emissions from the operation of EU 9A shall be controlled by combusting ULSD at all times of operation; and

(c) Compliance will be demonstrated with fuel shipment receipts and/or fuel tests for sulfur content.

Department Evaluation of BACT for SO_2 Emissions from the Pathogenic Waste Incinerator

The Department reviewed UAF's proposal and found that in addition to combusting only ULSD, and limiting operation, good combustion practices is BACT for control of SO_2 emissions from the pathogenic waste incinerator.

Step 5 - Selection of SO_2 BACT for the Pathogenic Waste Incinerator

The Department's finding is that BACT for SO_2 emissions from the pathogenic waste incinerator is as follows:

(a) SO_2 emissions from the operation of EU 9A will be controlled by limiting operation to no more than 109 tons of waste combusted per 12-month rolling period;

(b) SO_2 emissions from the operation of EU 9A shall be controlled by combusting ULSD at all times of operation;

(c) Maintain good combustion practices by following the manufacturer's operational procedures at all times of operation; and

(d) Compliance shall be demonstrated by obtaining fuel shipment receipts and/or fuel tests for sulfur content.

6. BACT DETERMINATION SUMMARY

Table 6-1. NOx BACT Limits

EU ID	Description	Capacity	Proposed BACT Limit	Proposed BACT Control
3	Mid-Sized Diesel-Fired Boiler	180.9 MMBtu/hr	0.02 lb/MMBtu	Selective Catalytic Reduction Good Combustion Practices
4	Mid-Sized Diesel-Fired Boiler	180.9 MMBtu/hr	Diesel: 0.2 lb/MMBtu NG: 140 lb/MMscf	Limited Operation (EUs 4 and 8 combined 40 tons per rolling 12 month period) Good Combustion Practices
8	Large Diesel-Fired Engine	13,226 hp	1.3 g/hp-hr	Selective Catalytic Reduction Turbocharger and Aftercooler Limit Operation for non-emergency use (100 hours per year) Limited Operation (EUs 4 and 8 combined 40 tons per rolling 12 month period) Good Combustion Practices
9A	Pathogenic Waste Incinerator	83 lb/hr	3.56 lb/ton	Limited Operation (109 tons per rolling 12 month period) Good Combustion Practices
19	Small Diesel-Fired Boiler	6.13 MMBtu/hr	0.015 lb/MMBtu	Limited Operation (19,650 hours per rolling 12 month period combined) Good Combustion Practices
20	Small Diesel-Fired Boiler	6.13 MMBtu/hr	0.015 lb/MMBtu	
21	Small Diesel-Fired Boiler	6.13 MMBtu/hr	0.015 lb/MMBtu	
23	Small Diesel-Fired Engine	235 kW	14.1 g/hp-hr	Good Combustion Practices
26	Small `Diesel-Fired Engine	45 kW	14.1 g/hp-hr	
27	Caterpillar C-15	500 hp	3.2 g/hp-hr	Turbocharger and Aftercooler Good Combustion Practices Limited Operation (4,380 hours per year)
24	Cummins	51 kW	14.1 g/hp-hr	Limit Operation for non-emergency use (100 hours each per year) Good Combustion Practices
28	Detroit Diesel	120 hp	14.1 g/hp-hr	
29	Cummins	314 hp	0.3 g/hp-hr	
113	Large Dual Fuel-Fired Boiler	295.6 MMBtu/hr	0.02 lb/MMBtu	Fabric Filters

Table 6-2. PM-2.5 BACT Limits

EU ID	Description	Capacity	Proposed BACT Limit	Proposed BACT Control
3	Mid-Sized Diesel-Fired Boiler	180.9 MMBtu/hr	0.012 lb/MMBtu	Good Combustion Practices
4	Mid-Sized Diesel-Fired Boiler	180.9 MMBtu/hr	Diesel: 0.012 lb/MMBtu NG: 0.0075 lb/MMBtu	Limited Operation (EUs 4 and 8 combined 40 tons per rolling 12 month period) Good Combustion Practices
8	Large Diesel-Fired Engine	13,226 hp	0.32 g/hp-hr	Positive Crankcase Ventilation Limited Operation (EUs 4 and 8 combined 40 tons per rolling 12 month period)
9A	Pathogenic Waste Incinerator	83 lb/hr	4.67 lb/ton	Multiple Chambers Limited Operation (109 tons per rolling 12 month period) Good Combustion Practices
19	Small Diesel-Fired Boiler	6.13 MMBtu/hr	7.06 g/MMBtu	Limited Operation (19,650 hours per rolling 12 month period combined) Good Combustion Practices
20	Small Diesel-Fired Boiler	6.13 MMBtu/hr	7.06 g/MMBtu	
21	Small Diesel-Fired Boiler	6.13 MMBtu/hr	7.06 g/MMBtu	
23	Small Diesel-Fired Engine	235 kW	1.0 g/hp-hr	Good Combustion Practices
26	Small `Diesel-Fired Engine	45 kW	1.0 g/hp-hr	
27	Caterpillar C-15	500 hp	0.11 g/hp-hr	Turbocharger and Aftercooler Good Combustion Practices Limited Operation (4,380 hours per year)
24	Cummins	51 kW	1.0 g/hp-hr	Limit Operation for non-emergency use (100 hours each per year) Good Combustion Practices
28	Detroit Diesel	120 hp	1.0 g/hp-hr	
29	Cummins	314 hp	0.015 g/hp-hr	
105	Material Handling Unit	1,600 acfm	0.003 gr/dscf	Fabric Filters Enclosures Vents
107	Material Handling Unit	1,600 acfm	0.003 gr/dscf	
109	Material Handling Unit	1,600 acfm	0.003 gr/dscf	
110	Material Handling Unit	2,000 acfm	0.003 gr/dscf	
111	Material Handling Unit	N/A	$5.5x10^{-5}$ lb/ton	Enclosure
113	Large Dual Fuel-Fired Boiler	295.6 MMBtu/hr	0.006 lb/MMBtu	Fabric Filters
114	Material Handling Unit	5 acfm	0.05 gr/dscf	Fabric Filters Enclosures Vents
128	Material Handling Unit	1,650 acfm	0.003 gr/dscf	
129	Material Handling Unit	1,650 acfm	0.003 gr/dscf	
130	Material Handling Unit	1,650 acfm	0.003 gr/dscf	

Table 6-3. SO_2 BACT Limits

EU ID	Description	Capacity	Proposed BACT Limit	Proposed BACT Control
3	Mid-Sized Diesel-Fired Boiler	180.9 MMBtu/hr	15 ppmv S in Fuel	Ultra-Low Sulfur Diesel
4	Mid-Sized Diesel-Fired Boiler	180.9 MMBtu/hr	Diesel: 15 ppmv S in Fuel NG: 0.60 lb/MMscf	Ultra-Low Sulfur Diesel Limited Operation (EUs 4 and 8 combined 40 tons per rolling 12 month period)
8	Large Diesel-Fired Engine	13,226 hp	15 ppmv S in Fuel	Limited Operation (EUs 4 and 8 combined 40 tons per rolling 12 month period) Good Combustion Practices Ultra-Low Sulfur Diesel
9A	Pathogenic Waste Incinerator	83 lb/hr	15 ppmv S in Fuel	Ultra-Low Sulfur Diesel Limited Operation (109 tons per rolling 12 month period)
19	Small Diesel-Fired Boiler	6.13 MMBtu/hr	15 ppmv S in Fuel	Limited Operation (19,650 hours per rolling 12 month period combined) Ultra-Low Sulfur Diesel
20	Small Diesel-Fired Boiler	6.13 MMBtu/hr	15 ppmv S in Fuel	
21	Small Diesel-Fired Boiler	6.13 MMBtu/hr	15 ppmv S in Fuel	
23	Small Diesel-Fired Engine	235 kW	15 ppmv S in Fuel	Good Combustion Practices
26	Small `Diesel-Fired Engine	45 kW	15 ppmv S in Fuel	
27	Caterpillar C-15	500 hp	15 ppmv S in Fuel	Good Combustion Practices Limited Operation (4,380 hours per year)
24	Cummins	51 kW	15 ppmv S in Fuel	Limit Operation for non-emergency use (100 hours each per year) Good Combustion Practices
28	Detroit Diesel	120 hp	15 ppmv S in Fuel	
29	Cummins	314 hp	15 ppmv S in Fuel	
113	Large Dual Fuel-Fired Boiler	295.6 MMBtu/hr	0.10 lb/MMBtu	Dry Sorbent Injection Limestone Injection Low Sulfur Coal