DOE/EA-1418 (DRAFT)

ENVIRONMENTAL ASSESSMENT

OTTER TAIL POWER COMPANY

ADVANCED HYBRID PARTICULATE COLLECTOR

BIG STONE CITY, GRANT COUNTY, SOUTH DAKOTA

MAY 2002

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

National Environmental Policy Act (NEPA) Compliance
Cover Sheet

Proposed Action:
The U.S. Department of Energy (DOE) proposes to provide cost-shared financial support, through a cooperative agreement with Otter Tail Power Company, for retrofit of an existing electrostatic precipitator at Otter Tail's Big Stone Power Plant with an advanced hybrid particulate collector (AHPC) for reducing particulate emissions. The Big Stone Power Plant, near Big Stone City, South Dakota, is a 450-megawatt coal-fired power station that currently uses an electrostatic precipitator to capture particulate emissions. The AHPC proposed for installation within the housing of the existing electrostatic precipitator would increase particulate collection efficiency to at least 99.99% over the entire range of particle sizes, which would reduce particulate emissions to a level well below particulate control standards. DOE would provide approximately 49% of the estimated $13.4 million cost of the project, which would comprise a 3-year effort under DOE support. Following completion of the technology demonstration under the agreement with DOE, Otter Tail Power Company would be expected to continue operation of the AHPC system for controlling emissions at the Big Stone Power Plant.

Type of Statement: Draft Environmental Assessment

Lead Agency: U.S. Department of Energy; National Energy Technology Laboratory

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Abstract:

DOE's objective in participating in the cooperative agreement is to support demonstration of technology potentially capable of substantially reducing particulate emissions, particularly emissions of fine particulate, from coal-fired power plants. The AHPC project was selected from a competitive solicitation (DE-PS26-01NT41104) developed to respond to a National policy (the "Power Plant Improvement Initiative") for demonstrating technologies capable of maintaining the viability of coal as a stable domestic resource for electric power generation.

The environmental analysis identified that the most notable changes to result from the proposed action would occur in the following areas: air emissions, construction impacts, and solid waste disposal. No adverse environmental effects were identified in analyzing the potential consequences of these changes.

Public Participation:
DOE encourages public participation in the NEPA process. This Draft Environmental Assessment (EA) is being released for public review and comment. The public is invited to provide oral, written, or e-mail comments on this draft Environmental Assessment to DOE by the close of the comment period on June 7, 2002. Copies of the draft EA are also being distributed to cognizant Federal and State agencies. Comments received by the close of the comment period will be considered in preparing a final Environmental Assessment for the proposed DOE action.

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LIST OF ACRONYMS

A/C	air-to-cloth ratio
acfm	actual cubic feet per minute
AHPC	advanced hybrid particulate collector
APS	aerodynamic particle sizer
CAAA	Clean Air Act Amendments of 1990
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
COHPAC	compact hybrid particulate collector
CO	carbon monoxide
DENR	Department of Environment and Natural Resources (South Dakota)
DOE	U.S. Department of Energy
EA	Environmental Assessment
EERC	Energy & Environmental Research Center (University of North Dakota)
EPA	U.S. Environmental Protection Agency
ESP	electrostatic precipitator
ft	feet
gpm	gallons per minute
gr/acf	grains per actual cubic feet
gr/scf	grains per standard cubic feet
HAP(s)	Hazardous Air Pollutant(s)
kW	kilowatts
lb	pound
MWh	megawatt hours
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NETL	National Energy Technology Laboratory (DOE)
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NSPS	New Source Performance Standards
Pb	lead
PCB	polychlorinated biphenyl
PJBH	pulse-jet baghouse
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 micron aerodynamic diameter
PM_{10}	particulate matter less than 10 micron aerodynamic diameter
PSD	Prevention of Significant Deterioration
scfm	standard cubic feet per minute
SIP	State Implementation Plan
SMPS	scanning mobility particle sizer
SO_2	sulfur dioxide
tpy	tons per year
TR	transformer-rectifier
μm	micron
$\mu g/m^3$	micrograms per cubic meter

1.0 INTRODUCTION

This Environmental Assessment (EA) provides the results of an evaluation by the U.S. Department of Energy (DOE) of the potential environmental consequences from installation and operation of an advanced hybrid particulate collection (AHPC) system at Otter Tail Power Company's 450-megawatt, coal-fired, Big Stone Power Plant near Big Stone City, South Dakota. DOE is proposing (the Proposed Action) to provide cost-shared financial support, through a cooperative agreement with Otter Tail Power Company, to install and operate an AHPC system for demonstrating the technical, environmental, and economic performance of AHPC technology. If approved, DOE would provide 49% of the estimated $13.4 million cost for the project.

The purpose of the EA is to determine if the Proposed Action could potentially cause significant impacts to the environment. If potentially significant, adverse environmental impacts are identified, and if they cannot be reduced to insignificance or avoided, then a more detailed Environmental Impact Statement would be prepared. If no significant impacts are identified, a Finding of No Significant Impact would be prepared and made available to the public, along with the final EA, before DOE proceeds with the Proposed Action.

Otter Tail Power Company proposed the project, entitled "Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector," to DOE in response to competitive solicitation DE-PS26-01NT41104, the "Power Plant Improvement Initiative." Otter Tail Power and its partners, Montana-Dakota Utilities and NorthWestern Public Service, proposed to retrofit AHPC technology into an existing electrostatic precipitator (ESP) at the Big Stone Power Plant; this application was selected for negotiations leading to award of a cooperative agreement with specific objectives to demonstrate ultra-low fine particulate emissions, low pressure drop, overall reliability of the technology, and long-term bag life.

AHPC technology provides a new approach to particulate collection. The technology, which was tested at a smaller scale under funding from the DOE, combines the best features of electrostatic precipitators and baghouses in a novel manner. The AHPC concept integrates fabric filtration and electrostatic precipitation into one particulate collection device, providing synergism in the particulate collection step and in transfer and handling of collected particles. An AHPC system provides ultra-high collection efficiency, overcomes problems of excessive fine-particle emissions with conventional ESPs, and solves problems of re-entrainment and re-collection of dust in conventional baghouses.

AHPC technology has been tested on a small stream of flue gas at the Big Stone Power Plant for the past 1½ years. The potential to achieve collection efficiencies exceeding 99.99% by one to two orders of magnitude was verified over a range of particle sizes from 0.01 to 50 microns. The resulting flue gas was as clean as pristine ambient air with a fine particulate matter level of 5 micrograms per cubic meter (ìg/m^3), which would be below current particulate emission standards. Preliminary economic analysis indicates that AHPC is economically competitive with conventional ESPs and baghouses for meeting current standards; for meeting possible stricter fine-particle standards requiring, for example, 99.99% control of total particulate, AHPC is the economic choice over either ESPs or baghouses by a wide margin.

AHPC systems, which combine high particulate collection efficiency with a small footprint and potential economic advantages, would provide superior technology for new or existing plants. Due to the age and efficiency of many existing ESPs, a substantial need for this type of retrofit technology exists.

This study was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code 4321 *et seq*.), the Council on Environmental Quality's Regulations [Title 40, Code of Federal Regulations (CFR), Parts 1500-1508], and Department of Energy's NEPA Implementing Procedures

(Title 10, CFR, Part 1021).

2.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

2.1 DOE'S PURPOSE

DOE, in partnership with its stakeholders, supports efforts by industry to improve electricity reliability and energy security in the United States. The purpose of this AHPC project is to demonstrate technology capable of improving the performance of existing and new coal-fired electric power plants. Improved performance includes increasing the efficiency of electric production, reducing environmental impacts, and improving the cost-competitiveness of coal-fired power generation.

Particulate emissions control, a component of the NETL Environmental and Water Resources Product Line*, seeks to develop cost-effective control technology for: (1) primary fine particulates and associated trace metals (e.g., lead, arsenic, etc.); (2) gaseous precursors that react in the atmosphere to form secondary fine particles; and (3) acid gases (e.g., H_2SO_4, HF, and HCl) that can create visible plumes and are reportable under the Toxic Release Inventory.

To comply with current particulate emission limits, the majority of coal-fired electric utility boilers control primary particulates with electrostatic precipitators (ESPs), which use electric fields to remove particulates from boiler flue gas. A smaller, but growing, number of boiler operators uses fabric filter collectors (baghouses). Baghouses control particulate matter by passing the flue gas through a tightly woven fabric, which collects the particles in the form of a dust cake. When operating properly, ESPs and baghouses can achieve overall collection efficiencies of 99.9% of primary particulates (over 99% control of PM_{10} and 95% control of $PM_{2.5}$), which is below the 1978 New Source Performance Standard (NSPS)-required limit of 0.03 lb/million Btu. In addition, a high level of trace element removal usually accompanies high efficiency particle collection because, with the exception of mercury and selenium, the trace elements are typically associated with the particulate phase.

However, even with high performing particulate control systems, submicron particle size collection is less efficient. Particles in the 0.1 to 0.5 micron size range pose an especially challenging control problem for stationary sources that employ wet scrubbers and ESPs. In addition, ultra-fine (less than 1 micron) particulate matter can be comprised of trace metals and other suspected hazardous air pollutants (HAPs). Moreover, more than half of the existing population of ESPs installed on electric-utility boilers in the United States have been in operation for more than 30 years, with almost 17% historically operating for at least 40 years. The increased age of these ESP systems has led to decreased particulate collection efficiency. Current control projects are chosen on the basis of the need for technology to improve the efficiency of particle collection in the ultra-fine size range, and to develop retrofit technologies to enhance the performance of existing ESPs that are not achieving acceptable overall efficiencies.

The specific performance target for technologies, processes, and concepts directed at the control of primary particulate matter is 99.99% capture for all particle sizes ranging from 0.01 to 10 microns and an emissions rate not to exceed 0.01 lb/million Btu. Advanced systems must be capable of meeting these stringent compliance requirements while achieving a levelized cost savings target of at least 25% over

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* **The Environmental and Water Resources Product Line** is focused on the development of highly efficient and cost-effective environmental control technologies for retrofitting to existing power plants, with application to new plants as well. The Product Line also provides key scientific and technical data on emerging environmental regulatory and policy issues.

conventional state-of-the-art controls (i.e., ESPs and baghouses). Levelized cost is based on uncontrolled particulate matter levels and includes the total cost of all particulate control systems required to achieve the specified performance targets.

Based on pilot-scale data, AHPC technology not only achieves an ultra-high collection efficiency for fine particles, but also uses resources more efficiently. AHPC technology can be applied to older, high-emission plants to attain current standards, but is also capable of meeting more stringent environmental goals. During pilot-scale tests, the AHPC concept demonstrated better than 99.99% fine-particulate capture and achieved control of particulate-phase air toxics that were concentrated in submicron particles. In addition, AHPC appears to qualify as a technology for "zero emission" boilers for the 21^{st} century. The vapor phase component of air toxic metals (primarily mercury) would not be captured by the AHPC unless an effective sorbent was available. Sorbent development is not an objective of the proposed demonstration. However, previous data indicate that vapor phase trace metals can be effectively captured with sorbents in an AHPC system without impairing performance.

In general, retrofitting or designing new electric utilities with advanced particulate collection technologies, such as the AHPC, would provide a number of benefits that have the potential to increase electric performance and output in the United States. In a retrofit scenario, such as proposed by Otter Tail Power, the electric generating station would have a much greater flexibility in the selection of coals with out derating the plant because of opacity requirements. In this way, a utility may be able to supply more power over a longer period of time. For construction of a new plant, the overall permitting process may become easier if the utility is able to assure the public and permitting agencies that emissions would be very low, even for the finest particles.

2.2 DOE'S NEED FOR ACTION

Currently, coal-fired electric utility boilers built or modified after August 17, 1971, must comply with a New Source Performance Standard (NSPS) limit on primary particulate emissions of 0.10 lb/million Btu. Units built or modified after September 18, 1978, must comply with a more stringent standard of 0.03 lb/million Btu, or 1 percent of the potential combustion concentration (99 percent reduction). Average primary particulate emissions from coal-fired utility boilers are about 0.043 lb/million Btu. Airborne particles are also regulated as "criteria pollutants" under EPA's National Ambient Air Quality Standards (NAAQS) program, so the emissions of primary PM_{10} (particles smaller than 10 micrometers) and $PM_{2.5}$ (particles smaller than 2.5 micrometers) from coal power plants are also subject to limitations set forth under State Implementation Plans (SIPs) for achieving the ambient standards for these pollutants.

Impact of $PM_{2.5}$ NAAQS Regulations

Although most of the primary particulate matter produced by coal-fired power plants is captured by existing pollution control devices, the portion that does escape falls mostly into the $PM_{2.5}$ size category, as does almost all of the secondary particulate matter formed from SO_2 and NO_x. EPA promulgated new ambient standards for $PM_{2.5}$ in July 1997. The schedule for implementing the $PM_{2.5}$ standards requires the collection and analysis of data from a nationwide ambient monitoring network through 2003. Contingent upon the outcome of a five-year scientific review of the standards to be completed in 2002, EPA will designate non-attainment areas starting in 2002 and ending by 2005. States that contain areas that are not in compliance with the standards will be required to submit SIPs by 2008; full compliance with the $PM_{2.5}$ NAAQS will be required by 2017.

Opacity

Opacity created by the combined gas/particle releases from the coal-fired electricity generating units is regulated under the same section of NSPS that restricts the emission of particulate matter (40 CFR Chapter I, Part 60, Subpart D, Section 60.42 and 60.42a). All units built or modified after August 17, 1971, are prohibited from releasing any gases that exhibit greater than 20 percent opacity (6-minute average), except for one 6-minute period per hour of not more than 27 percent opacity.

Opacity in coal-fired utility boiler exhaust streams can be caused by many factors, including primary particulate matter escaping the particulate collection system, particles generated in flue gas desulfurization systems downstream of the primary particulate control device, condensable aerosols such as sulfuric acid in the flue gas, secondary particulate matter formation, and colored gases such as NO_2. Thus, some units can violate the opacity standard while still meeting the particulate matter emission standard. Development of appropriate control technologies would depend on accurate identification of the actual source(s) of stack opacity, which would be facilitated by use of AHPC technology.

2.3 DOE'S IMPLEMENTATION INITIATIVE

In response to the National need for assuring abundant and affordable electricity supplies, DOE initiated the "Power Plant Improvement Initiative," a precursor to the President Bush's Clean Coal Power Initiative, to develop leading edge clean coal technologies capable of improving the reliability and environmental performance of the Nation's 'coal-burning power plants. The U.S. Congress strongly supported the initiative as an approach to address intermittent electrical power supply disruptions and price increases. Funds were identified for supporting projects to improve the performance of existing and new coal-fired electric power plants. To establish such projects, the "Power Plant Improvement Initiative" was initiated through a competitive solicitation (DE-PS26-01NT41104) to identify showcase projects for demonstrating the ability of coal-fired plants to generate low-cost electricity while achieving improved performance and compliance with stringent environmental standards.

One objective of the solicitation was to demonstrate new approaches for achieving very high levels of capture for fine particles, while providing high reliability, smaller size, and economic benefits. In response to the solicitation, Otter Tail Power Company submitted a proposal entitled "Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector." Otter Tail Power and its partners, Montana-Dakota Utilities and NorthWestern Public Service, proposed to retrofit Advanced Hybrid Particulate Collector (AHPC) technology into an existing electrostatic precipitator (ESP) at the Big Stone Power Plant. The application from Otter Tail Power was selected for negotiations leading to award of a cooperative agreement with specific objectives to demonstrate ultra-low fine particulate emissions, low pressure drop, overall reliability of the technology, and long-term bag life.

The AHPC is a perfect match to this objective. The AHPC is also well-matched to boilers using any U.S. coal. High levels of SO_3 or HCl in the flue gas from any high-sulfur bituminous fuel would not be a problem. Similarly, emissions would not be significantly affected by ash resistivity. For very high ash coals, which is typical of some lignites, the AHPC is capable of handling extremely high dust loadings.

2.4 OTTER TAIL POWER COMPANY'S NEED FOR ACTION

Installation of AHPC technology at the Big Stone Power Plant would improve the overall reliability of the air pollution control system. For example, **Table 2-1** shows the derates that have occurred at the Power Plant because of maintenance and resistivity problems associated with the ESP.

Table 2-1. Derates at the Big Stone Power Plant Due to ESP Problems

YEAR	OPACITY DERATES, MWH*	ESP REPAIR DERATES, MWH	TOTAL DERATES, MWH
1999	7,786	16,004	23,790
2000	6,859	16,676	23,535
* Megawatt hours.			

Although no immediate need exists for improving particulate control at the Big Stone Power Plant, the project is attractive to Otter Tail Power Company for the following three reasons.

The internal components of the existing precipitator at the Big Stone Plant are beginning to fail at an unacceptable rate, which requires that the plant reduce electrical output and isolate certain sections for repair. The AHPC would replace failing electrodes and rappers, which cause an increase in emissions and reduced electrical output.

Otter Tail Power Company takes pride in being involved with projects that look to the future. Although the current particulate control device performs at levels acceptable under environmental regulations today, the AHPC would place the Big Stone Plant in a better position to meet future regulations for fine particulate control.

A successful demonstration of the AHPC project at the Big Stone Power Plant would strengthen Otter Tail Power Company's strong commitment to Environmental Stewardship. The operators of the Big Stone Plant have emphasized environmental stewardship and the importance of being a good neighbor to the surrounding communities. Although the Big Stone Plant has met all particulate control and air permit requirements by the State of South Dakota, a primary fuel switch in 1995 to Powder River Basin (Wyoming) subbituminous coal caused the average opacity to increase and created a "dirty" appearance of stack discharges at certain times. Installation of the AHPC would remove fine particulates, which are difficult to collect, and reduce emissions that contribute to flue gas visibility.

Table 2-2 identifies the proposed participants in the project and their respective responsibilities and interests in the proposed project.

2.5 DOE DECISION

The decision to be made by DOE is whether to provide approximately 49% of the estimated $13.4 million cost for installation and demonstration of a full-scale Advanced Hybrid Particulate Collector at the Big Stone Power Plant.

2.6 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

Based on the activities that would be conducted for installation of the AHPC system and the potential changes that would result from operation, the following environmental resources were considered to merit primary emphasis during analysis of the potential environmental consequences of the proposed action: air, noise, site infrastructure, transportation, waste management, socioeconomics, and cumulative impacts.

Safety and health impacts would be limited to potential accidents and environmental releases that could affect workers and the public. All personnel and contractors that would participate in construction and operation of the proposed AHPC system would be responsible for compliance with applicable Occupational Safety and Health Administration regulations concerning occupational hazards and protective measures for employees.

Table 2-2. Project Participants

PARTICIPANT	RESPONSIBILITY	OBJECTIVE(S)	COST SHARE
Otter Tail Power Company	Part owner of the Big Stone Power Plant and operator of the AHPC system	Improve reliability and environmental operations at the Big Stone Power Plant	51%
Montana-Dakota Utilities	Part owner, with Otter Tail Power and NorthWestern Public Service, of the Big Stone Power Plant	Improve reliability and environmental operations at the Big Stone Power Plant	-
NorthWestern Public Service	Part owner, with Otter Tail Power and Montana-Dakota Utilities, of the Big Stone Power Plant	Improve reliability and environmental operations at the Big Stone Power Plant	-
W.L. Gore and Associates	Supply particulate collector bags for use in the AHPC system and periodically determine performance and wear	Demonstrate market application of Gore's particulate collection bags	-
ELEX AG	Design and construction of the AHPC system		-
Univ. of North Dakota, EERC	Consulting services on the AHPC technology and plant sampling to determine particulate removal efficiency		-
U.S. Department of Energy	Co-fund installation and initial operation of the AHPC system	Demonstrate technology for improved environmental (particulate) control at a commercial scale	49%

3.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

3.1 BACKGROUND

Otter Tail Power Company was established in Minnesota in 1907 as an electric utility, but today is part of diversified Otter Tail Corporation, which provides electricity and other energy services to nearly a quarter million people in Minnesota, North Dakota, and South Dakota.

Otter Tail Power Company provides reliable, low-cost electricity to more than 126,000 customers, primarily through operation of three power plants: the Big Stone Plant at Milbank, SD; Coyote Station at Beulah, ND; and the Hoot Lake Plant at Fergus Falls, MN. Based on financial information and dividend payments, Otter Tail Power has been and continues to be a well-run, profitable company. The Big Stone Plant was listed in the October 1998 edition of Electric Light & Power as being among the top 20 steam-electric plants in the United States in terms of total production costs and overall operating performance.

The Big Stone Plant was commissioned for service in 1975. The Plant operates one 450-MW-rated, cyclone-fired boiler. All flue gas passes through a single ESP, which consists of four chambers each having four fields. Approximately 80 Otter Tail Power Company employees operate and maintain the plant. Their expertise and dedication are the major reasons for the plant's excellent record of availability, which is 6% above the national average for a plant of comparable size and type.

From 1975 to 1995, the primary fuel for the Big Stone Plant was North Dakota lignite. In 1995, the primary fuel was switched to subbituminous coal from the Powder River Basin (Wyoming). This coal has approximately one-third less moisture and one-third more heating value than North Dakota lignite. Almost all of the effects of this new fuel have been positive. However, the fuel change decreased the particulate collection efficiency of the ESP, because of an increase in resistivity of the fly ash. The combination of a very fine particle size produced from the cyclone-fired boiler and high ash resistivity resulted in problems both in terms of meeting opacity requirements and in maintaining the ESP.

Although coal remains the primary fuel at the Big Stone Power Plant, Otter Tail Power Company began evaluating alternative fuels, such as refuse- and tire-derived fuels, in 1990. These fuels tend to burn cleaner, are more economical than coal, and have comprised 2% to 10% of the total fuel burned at the Big Stone Power Plant since 1991.

Otter Tail Power Company, with project partners, W.L. Gore & Associates, Inc., and the University of North Dakota Energy and Environmental Research Center (EERC), have proposed to install an Advanced Hybrid Particulate Collector at the Big Stone Power Plant. The Big Stone Plant is located in Grant County, and the main plant building is located between 1 and 2 miles northwest of Big Stone City, SD, which borders the neighboring town of Ortonville, MN, resulting in a combined local population of about 2,800. State Highway 109 runs along the eastern side of Power Plant property.

3.2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is for the U.S. Department of Energy (DOE) to provide, through a cooperative agreement, cost-shared financial support for construction and operation of an AHPC system at the Big Stone Power Plant. DOE would fund about 49% of the estimated $13.4 million cost of the project.

The AHPC demonstration project would be conducted over 3 years. Design and construction would be completed during the first year of the project. For the remaining 2 years, the AHPC system would be operated as the primary particulate collection device for the Big Stone Plant. Otter Tail Power Company personnel would operate and maintain the unit. W.L. Gore and Associates, Inc., would periodically withdraw particulate collector bags to determine performance and wear. EERC, in addition to providing consulting services, would provide sampling activities to quantify the AHPC's ability to remove particulate matter at a very high efficiency.

3.3 DESCRIPTION OF THE PROPOSED PROJECT

Otter Tail Power Company, in a joint effort with W.L. Gore and Associates, Inc., ELEX AG, and the EERC, would retrofit AHPC technology into an existing ESP structure at the Big Stone Power Plant near Big Stone City, SD.

3.3.1 Project Design

The AHPC system would be retrofitted into the existing ESP at Big Stone Power Plant during a scheduled 5½-week outage of the power plant beginning in fall 2002. The first ESP field would remain as a standby with fields 2-4 converted to an AHPC. All internal parts of the ESP structure would be removed and replaced by AHPC components. The total system would have 12 single compartments with walk-in plenums, which would be isolated on the clean gas side with motorized dampers. This configuration would be appropriate for burning subbituminous coal with a gas volume of 1,824,000 acfm. The AHPC would be designed for an air-to-cloth (A/C) ratio of 12 ft/min when two of the twelve compartments are isolated. A total of four AHPC modules would be used in the demonstration project. **Tables 3-1 and 3-2** present design specifications for the AHPC. Appendix B provides conceptual design drawings for the AHPC demonstration facilities and views of equipment used in the AHPC pilot facility.

The ESP surface area for the total system would be designed for 144,280 ft^2 with a total of 3,108 discharging electrodes. Approximately 4,902 filter bags would be used.

Table 3-1. Design Flue Gas Specifications at the Inlet of the AHPC

PARAMETER	UNITS	AVERAGE VALUE
Flue Gas Volume	acfm	1,824,000
Flue Gas Temperature	°F	290 (250–380)*
Pressure	Inches of Water (gauge)	-15
Particulate Loading	grains/scf	1.5
Gas Concentrations:		
H_2O	%	12
CO_2	% dry	15
O_2	% dry	5
N_2	% dry	80
* The minimum and maximum temperatures are in parentheses.		

W.L. Gore and Associates would supply bag material for the AHPC, consisting of GORE-NO-STAT® (GORE-TEX® membrane, GORE-TEX® felt). This fabric would allow the AHPC to attain high efficiencies, withstand high-temperature, corrosive, and environmental conditions encountered in many coal-fired boiler pulsed-jet fabric filter dust collectors, and dissipate electrical charges generated in the AHPC chamber.

Table 3-2. Design Flue Gas Specifications at the Outlet of the AHPC

PARAMETER	UNITS	VALUE
Particulate Loading	grains/scf	<0.002
Minimum Collection Efficiency for Fine Particles	%	99.99
Maximum Tube Sheet Pressure Drop	Inches in Water Column	<8
Additional Pressure Drop for Ducting and Dampers	Inches in Water Column	<1.6

The GORE-TEX® membrane has high particle capture efficiency and excellent surface filtration, enabling the AHPC to attain particulate capture efficiencies greater than 99.99%. The enhanced cleaning of the membrane produces lower operating pressure drop across the fabric filter and higher airflow per filter bag.

GORE-TEX® felt is chemically inert and can withstand continuous operating temperatures as high as 500°F. The components of the felt include the fiber, scrim, and sewing thread. Fiber used in the felt has excellent chemical resistance to mineral and organic acids, alkalies, oxidizing agents, and organic solvents. The high tenacity and low shrinkage characteristics of the fiber allow the filter bags to retain optimum levels of durability and dust removal after extended operation.

GORE-NO STAT® fiber is an electrically conductive material, which would allow the filter media to dissipate charge build-up on the bags in the AHPC chamber due to the presence of electrical charges on the dust and in the air. The fiber would allow electrical charge to be transferred through the media to the grounded cage, thereby reducing the potential for static discharge.

The dissipating characteristics of the GORE-NO STAT® fiber media, along with the enhanced durability and chemical resistance of the GORE-TEX® felt and dust removal ability of the membrane, make the Gore media ideal for operation in an AHPC system.

3.3.2 Project Schedule

A summary of the anticipated schedule for installation and testing of an AHPC at the Big Stone Power Plant is provided in **Table 3-3**.

Table 3-3. Milestone Description and Work Breakdown Structure

Description	Completion Date*
AHPC Installation	
1. All Materials On-Site	August 1, 2002
2. Demolition Activities	August 31, 2002
3. Construction Activities	September 16, 2002
4. Installation of Filter Bags	October 10, 2002
5. Cold Commissioning	October 10, 2002
6. Hot Commissioning	October 12, 2002
7. Turn over unit to Big Stone Power Station	October 15, 2002
AHPC Operation and Testing	
1. Complete First Sampling Activity	February 15, 2003
2. Remove Bag(s) for Laboratory Analysis	May 30, 2003
3. Complete Second Sampling Activity	August 1, 2003
4. Remove Bag(s) for Laboratory Analysis	September 30, 2003
5. Remove Bag(s) for Laboratory Analysis	May 30, 2004
6. Complete Third Sampling Activity	June 1, 2004
Major Project Decision Points	
Meets Opacity Requirements, Pressure Drop, and Particulate Collection	March 1, 2003
* Tentative dates, based on project start at end of calendar year 2001.	

3.3.3 Project Location

The site proposed for the Advanced Hybrid Particulate Collector is Otter Tail Power Company's steam-electric generating facility near Big Stone City, SD (**Figure 3-1**). The Big Stone Plant is located in Grant County, and the main plant building is located between 1 and 2 miles northwest of Big Stone City, SD. Big Stone City borders the neighboring town of Ortonville, MN. State Highway 109 runs along the eastern side of Plant property. **Figure 3-2** provides an aerial view of the Power Plant.

Figure 3-1. Project Location and Proximity to Class I Areas

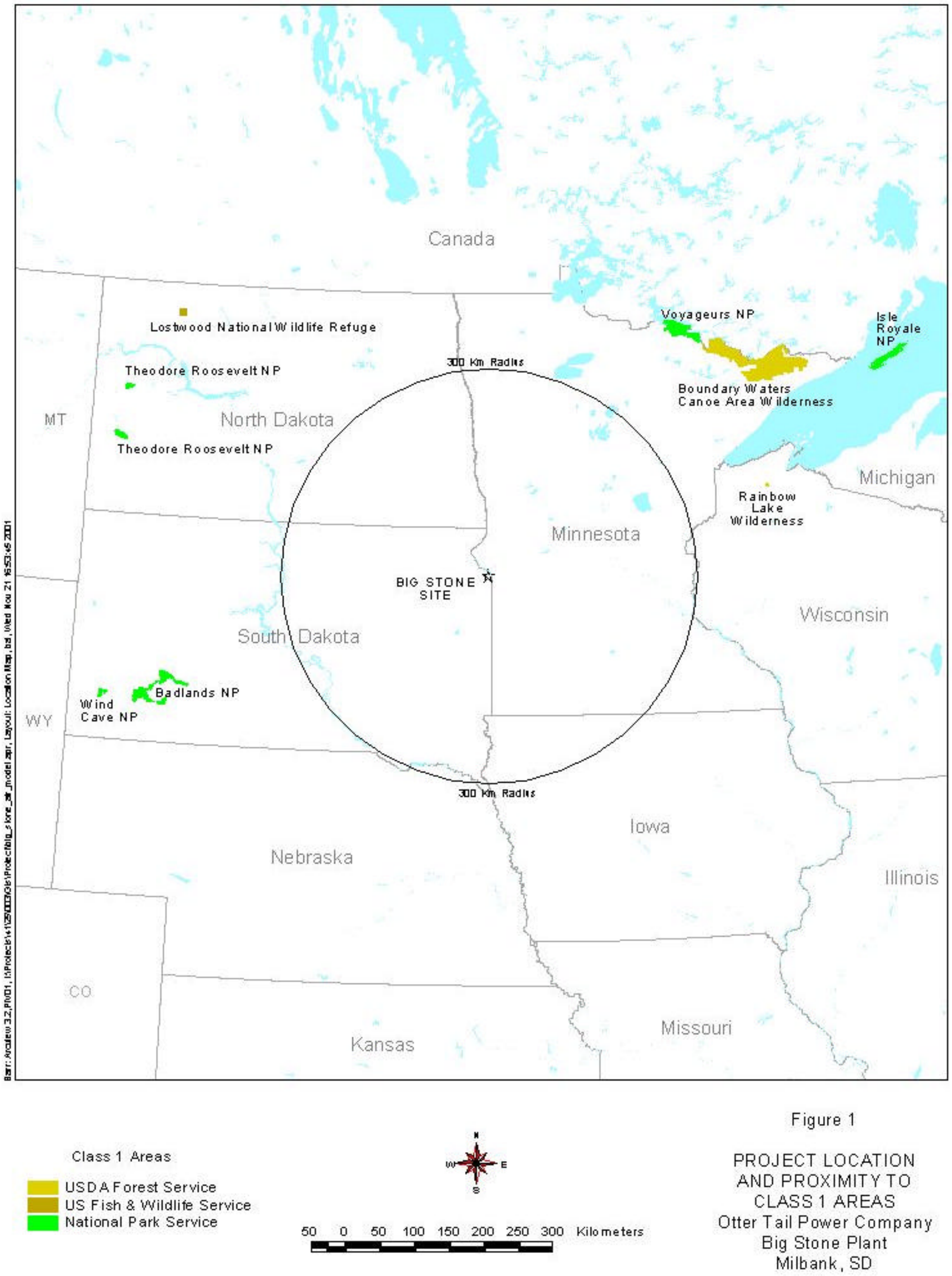
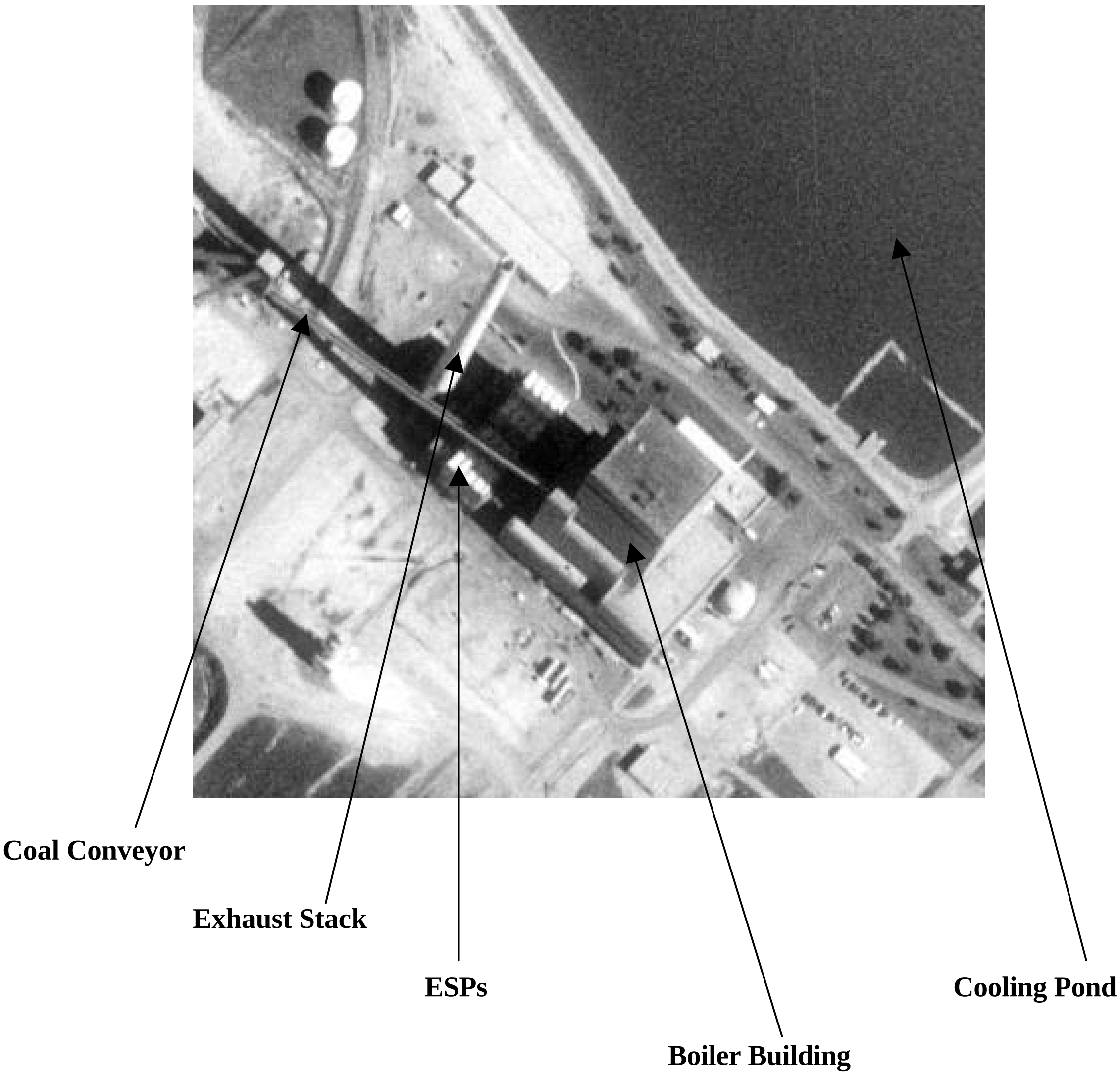


Figure 3-2. Aerial View of the Big Stone Power Plant



3.3.4 Technology Description

The goal in developing a new approach for particulate control is to achieve the highest possible level of control while simultaneously providing high reliability, smaller size, and economic benefits. For particulate matter that is primarily larger than 20 microns (ìm), inertial separation methods, such as cyclones, are reasonably effective and are much more economical than conventional ESPs or baghouses. However, particles smaller than 2.5 ìm pass through cyclones with little or no collection. Only ESPs and baghouses are capable of achieving any reasonable level of fine particulate control. Baghouses collect fine particles much better than ESPs because filter bags do not have the same theoretical (and actual) minimum collection efficiency for particles in the range from 0.1 to 0.3 ìm. For particles in this size range, the collection efficiency of a cyclone is close to zero, the efficiency of a modern ESP could approach about 99%, and the efficiency of a well-designed fabric filter would be about 99.9%. Higher levels of control might be possible with an ESP, but only by a significant increase in the size or specific collection area. Since the goal for the AHPC is to be much smaller and more economical than conventional approaches, achieving better fine-particle collection with only an ESP would not be viable. An advanced concept for ultra-high efficiency collection of fine particulate must use filtration or some combination of electrostatics and filtration.

Fabric filters cannot routinely achieve 99.9% fine-particle collection efficiency for all coals within economic constraints, and studies have shown that collection efficiency is likely to deteriorate significantly at high gas velocities. An approach to make fabric filters more economical is to use smaller baghouses that operate at much higher A/C ratios. The challenge is to increase the A/C ratio for economic benefits and to achieve ultra-high collection efficiency at the same time. To achieve high collection efficiency, the pores in the filter media must be effectively bridged (assuming they are larger than the average particle size). With conventional fabrics at low A/C ratios, the residual dust cake serves as part of the collection medium, but at high A/C ratios, only a very light residual dust cake is acceptable, so the cake cannot be relied on to help achieve high collection efficiency. A sophisticated fabric that can ensure ultra-high collection efficiency and endure frequent high-energy cleaning must be used. In addition, the fabric must be reliable under the most severe chemical environment likely to be encountered (such as high SO_3). A fabric that meets these requirements is GORE-TEX® membrane on GORE-TEX® felt, which can achieve very high collection efficiencies at high A/C ratios. Although GORE-TEX® membrane filter medium is more expensive than conventional fabrics, the much smaller surface area required for the AHPC will make the use of the GORE-TEX® membrane filter medium more economical.

While very large ESPs are required to achieve >99% collection of the fine particles, a small ESP can remove 90% to 95% of the dust. In the AHPC concept, only sufficient ESP plate area to remove approximately 90% of the dust is used, and the cloth area is minimized by operating at an A/C ratio of least 12 ft/min. In a typical AHPC design, the ESP plate surface area and filtration surface area are roughly equivalent, and the combined collection area in the AHPC would be 67% lower than either a conventional baghouse or ESP.

The geometric configuration of the AHPC concept can be understood by comparison with a conventional pulse-jet baghouse (PJBH), where the individual bags or filtration tubes have 4-6 in. diameter and 8-26 ft length and are mounted in and suspended from a tube sheet. Particulate matter is collected on the outside of the bags while the flue gas passes through the fabric to the inside, exits through the top of the bags into a clean air plenum, and subsequently exits the stack. Cages are installed inside the bags to prevent collapse during normal filtration. Air nozzles are installed above each bag to clean the bags with a quick burst of high-pressure air directed inside the bags. The burst of air, or cleaning pulse, causes a rapid expansion of the bag and momentarily reverses the direction of gas flow through the bag, which helps to clean dust from the bags. Typically, pulse-jet bags are oriented in a rectangular array spaced only a few inches apart. The bags are usually pulse-cleaned one row at a time in sequence, with 15 or more bags per row. Because of the narrow bag spacing and forward filtration through the two adjacent rows, much of the dust removed from one row of bags is simply re-collected on the adjacent bags. Only very large agglomerates of dust reach the hopper after pulsing. The phenomenon of re-dispersion and re-collection of dust after bag cleaning is one of the major obstacles to operation of baghouses at higher filtration velocity (A/C ratio).

In the AHPC concept, approximately three out of every four rows of bags are removed from a conventional PJBH and replaced with a grounded plate. High-voltage corona discharge electrodes are installed between the plates.

Operation of the AHPC is a two-step process. In Step 1, the particles are collected on the grounded plates or the filtration surface, and in Step 2, the dust is transferred to the hopper. In Step 1, dirty gas flow enters the AHPC vessel and is directed into the ESP zone by appropriate baffling. The particles in the ESP zone become charged and migrate toward the grounded plate at a velocity (electrical migration velocity) dependent on the particle charge and electric field strength. For 10-ìm particles, the actual migration velocity is approximately 2 ft/s. This rapid movement of dust toward the grounded plate pulls some of the gas flow with it and, along with movement of charged gas molecules toward the plate, produces a "suction action" of the gas flow toward the plate. The gas cannot accumulate at the plate, so a re-circulation pattern results from combination of the forward entrance velocity parallel to the plate and the migration velocity perpendicular to the plate. Since all of the gas flow must eventually pass through the bags, a portion of the re-circulation flow is drawn toward the bags. The greater migration velocities of particles moving toward the plates ensure that most of the particles would first be exposed to the ESP zone and would collect on the plates before reaching the filter bags. The particles that do reach the filtration surface would likely retain some charge. Charged particles are more readily collected because there is an additional force to drive the particles to a grounded or neutral surface. In addition, a dust cake formed from charged particles would be more porous, which produces a lower pressure drop. In the AHPC system, ultra-high fine-particle collection is achieved by removing over 90% of the dust in the electrostatic zone, pre-charging the particles, and using a GORE-TEX® membrane fabric to collect particles that reach the filtration surface with a high efficiency.

In Step 2, the dust that accumulates on the grounded plates and filtration surfaces must be periodically removed and transferred from the bags and plates to a collection hopper. Bags are cleaned with a reverse pulse of pressurized air or gas with sufficient energy to dislodge most of the dust from the bags. Larger agglomerates fall directly to the hopper; however, much of the dust is re-entrained into the gas stream. These small particles are agglomerated into particles larger than those originally collected on the bags. In conventional baghouses, the particles would immediately be re-collected on the bags. In the AHPC, the unique method of bag cleaning and transfer of dust to the hopper would prevent re-collection of dust on the filter surface. The bags would be pulsed with sufficient energy and volume to propel the re-entrained dust back into the ESP zone, where they would become charged and trapped on the plates. Since this re-entrained cloud would be composed of agglomerated particles larger than originally collected on the bags, they would be trapped in the ESP zone much more easily than the original fine particles. The alternating rows of bags, wires, and plates would act as an "electronic trap" to prevent the re-entrained dust from being re-collected on the same bags, and the plates would prevent the dust from being re-collected on adjacent rows of bags. This effect would greatly reduce accumulation of a residual dust cake and make control of pressure drop at high A/C ratios much easier. The excess cleaning air would pass into the hopper area and eventually be filtered by adjacent rows of bags. Since most of the dust would collect on the grounded plates, the plates would be rapped periodically, and the dust would be released as large agglomerates that easily reach the hopper. Any fine dust that penetrates the ESP zone would be collected at an ultra-high efficiency by the bags. This procedure would eliminate any spike in emissions due to rapping and make redundant downstream fields completely unnecessary, compared to conventional ESPs that require multiple fields to minimize rapping re-entrainment. In the AHPC, a major synergism would exist between the ESP and filtration modes, with each improving operation of the other. The fabric filter would collect excess ESP emissions during normal operation and during rapping, and the ESP would collect re-entrained dust from the bags upon cleaning, which greatly enhances the ability to control pressure drop and operate at high A/C ratios. The AHPC is also superior to ESPs because all of the flow must pass through the bags.

3.3.5 Construction Activities

The AHPC system would be installed during a 5½-week outage scheduled to begin in the fall of 2002. Construction would have two main components: demolition of much of the existing ESP and installation of the AHPC.

3.3.6 Operation Activities

Following successful cold and hot tests for commissioning of the AHPC, personnel from the Big Stone Power Plant would assume responsibility for operation and maintenance. This would begin the demonstration phase of the proposed project. The pilot-scale AHPC system that was tested on a slipstream of gas from the Big Stone Power Plant would be maintained for use in troubleshooting if problems occur either during the commissioning tests or during operation.

During routine operation of the AHPC, the three most important parameters affecting operations at the Big Stone Power Plant would be pressure drop and bag life, which primarily result in operations and maintenance costs for the Power Plant, and opacity, which determines whether the unit can remain in operation. Pressure drop and opacity would be monitored on a near-continuous basis. In addition, the power plant would record temperatures at the inlet of the AHPC. Gas flow rates and flue gas composition (O_2, SO_2, and NO_x) and opacity would be recorded.

3.3.7 Monitoring and Measurement Activities

During the demonstration stage of the project, W.L. Gore and Associates would perform a filter bag evaluation to predict the life of the AHPC filter bags in terms of filtration performance, media permeability, and material strength. This evaluation would be performed by removing bags from the AHPC compartments during the Power Plant’s scheduled maintenance outages. Bags would be removed from various compartments and locations within a compartment. The bags would undergo an initial visual inspection during removal from the AHPC system. After packaging and shipping to Gore and Associates, the filter bags would be inspected and analyzed in a filter bag lab.

The schedule for bag removal would coincide with the Big Stone Power Plant’s outages, usually during the spring or fall of each year. A Gore and Associates application engineer would be on-site during the outage to inspect the AHPC components, including collecting plates, discharge electrodes, clean air plenums, and filter bags and cages. During each outage, a minimum of nine filter bags – three from each compartment in one section – would be removed for analysis. The bags to be removed would be selected from locations at the front side or side facing the flue gas inlet, the backside, and from the center of the compartment. Additional bags may be removed based on visual observations of the AHPC components and the clean air plenum. The removed bags would be packaged appropriately and shipped to Gore and Associates in Elkton, Maryland.

Upon arrival at the Elkton facility, the bags would be analyzed in a lab designed for filter bag evaluations. Visual observations of the entire bag would be completed. Cross sections (4-inch length) would be cut from the bag for permeability and material strength evaluation.

Three measurements of bag permeability would be recorded on a device that determines the amount of airflow through the media at a fixed pressure drop. The first measurement would represent the as-received condition of the bag. The second measurement would be made after lightly snapping the same piece of media, and a third measurement would be made after lightly brushing to remove any remaining particles. The permeability numbers would be averaged over at least three samples per bag and three locations per sample. Permeability values would be determined during the first few years of AHPC operation and compared to the permeability of the material when new.

The strength of the filter bag's felt material would also be analyzed. The filter media would be placed in a vice and subjected to a force either in a lateral direction or perpendicular to the surface. The maximum force or pressure required to produce failure would be recorded. The results of the strength tests would be averaged over at least three samples per bag and three locations per sample. These values would be compared to the benchmark for new material and tracked over the course of the first few years of AHPC operation. The results would be used to predict the life of the filter bags in terms of media strength.

Samples of the bags would be retained for future reference.

To confirm the AHPC's capability for fine-particle capture and particulate-bound trace element capture, EERC would sample gas at both the inlet and outlet of the AHPC on a minimum of three occasions during the 22 months of AHPC operation. The sampling activities shown in **Table 3-4** would be completed. The first sampling period would occur about 1 month following stable operation of the AHPC; the second would occur after about 8 months of operation; and the final sampling period would occur after about 18 months of operation. As shown in **Table 3-4**, the sampling activities would establish both the total particulate collection efficiency (EPA Method 5/17) and the fine particulate collection efficiency (using multicyclones) of the AHPC. In addition, EPA Method 29 would be applied at the inlet and outlet to measure the AHPC collection efficiency for trace elements, including mercury, arsenic, lead, selenium, nickel, chromium, and cadmium. The analysis technique (except for mercury) would be ion coupled plasma–mass spectroscopy. Cold-vapor atomic absorption would be used to analyze the samples for mercury. Only total mercury would be measured. In addition to using multicyclones to measure particle-size distribution, instruments would be used to determine the particle-size distribution and the number of particles in a given gas volume for particles ranging in size from 0.03 to 15 ìm.

A detailed quality assurance plan that includes chain-of-custody protocols and use of blank samples and spiked samples would be followed during sampling activities.

Table 3-4. EERC Sampling to Be Completed for Each Test Period

METHOD	SAMPLING LOCATION	NO. SAMPLES	RESULTS
EPA Method 5/17	AHPC outlet	3	Total fly ash mass loading
EPA Method 29	AHPC inlet	3	Trace elements[1]

EPA Method 29[2]	AHPC outlet	3	Trace elements[1]
Multicyclone	AHPC inlet	3	Size-fractionated mass loading
Multicyclone	AHPC outlet	3	Size-fractionated mass loading
APS/SMPS	AHPC outlet	3	Particle-size distribution

[1] Trace elements would include total mercury, cadmium, arsenic, lead, nickel, chromium, and selenium.
[2] At the inlet, EPA Method 29 would provide the total fly ash mass loading.

3.4 ALTERNATIVES TO THE PROPOSED ACTION, INCLUDING THE NO ACTION ALTERNATIVE

Under the No Action Alternative, DOE would not fund the AHPC project. As a result, Otter Tail Power Company would not proceed with installation of the AHPC system, and the existing ESP would continue to function as the primary particulate device.

Other alternatives for enhancing particulate control were considered by Otter Tail Power Company, including ESP rebuild, ESP enhancement, Pulse Jet Fabric Filter retrofit, and COHPAC II. These alternatives are described and discussed in Section 3.5 and summarized in **Table 3-5**.

3.5 COMPARISON OF ALTERNATIVES BY OTTER TAIL POWER COMPANY

Otter Tail Power Company compared particulate control alternatives using a base-case plant similar to the Big Stone Power Plant – a 450 MW plant that burns a Powder River Basin (Wyoming) subbituminous coal and contains a 25-year-old, four-field ESP that needs major upgrade modifications. The flue gas volume was 1,825,000 acfm. Several options were explored, including the following: complete rebuild of the existing ESP, complete rebuild of the ESP plus addition of two fields, and retrofitting either a Pulse-Jet Fabric Filter operating at 3.5:1 A/C, a COHPAC II operating at 8.5:1 A/C, or an AHPC system operating at 12:1-16:1 A/C into the existing ESP box.

The complete rebuild of the ESP, while the least expensive alternative, was eliminated from consideration because it would not address potential future regulations. The addition of extra fields to the ESP was by far the most costly alternative and was also eliminated from consideration. Therefore, focus was narrowed to the three retrofit alternatives.

The more compact AHPC design would allow economical retrofit into many of the smaller existing ESPs that would not be large enough for a Pulse-Jet Fabric Filter retrofit. The COHPAC II system, since it requires an ESP, would need additional space similar to the area for an AHPC system.

However, if the ESP is too small to be retrofitted with either a COHPAC II or an AHPC system, then a stand-alone technology would be required. For this situation, the AHPC was compared to an original COHPAC design (ESP followed by a high A/C ratio pulse-jet fabric filter). The AHPC offers several key advantages. First, since the AHPC does not require an existing ESP, substantially less ductwork would be needed. Second, the existing ESP would more than likely require significant maintenance, since good ESP performance would be needed for the COHPAC system to function. This would result in a significant cost (e.g., the Institute of Clean Air Companies estimated that an average ESP rebuild would cost about $17/kW). Finally, the AHPC technology would provide an order of magnitude higher efficiency than the COHPAC system because the AHPC can economically use the most durable, chemically resistant, and efficient filter bag on the market.

Table 3-5. Comparison of Alternative Technologies

TECHNOLOGIES	COMMENTS
ESP Rebuild	Low operating costs, but limited ability to meet future regulations. Limited fuel options.
ESP Enhancement*	Low operating costs, but high installation costs and substantial amount of time required to install.
Pulse-Jet Fabric Filter	Reasonable capital and operating costs, but limited improvement in filtration efficiency. More fuel flexibility than either ESP options.
COHPAC II	Highly dependent on efficiency of existing ESP. Capital cost attractiveness depends on the amount of ESP work needed. Less fuel flexibility than the Pulse-Jet Fabric Filter.
AHPC	Reasonable installation and operating costs. An order of magnitude better filtration efficiency. Provides the greatest fuel flexibility. Capital cost depends on the final A/C.
No Action	No demonstration of Advanced Hybrid Particulate Collector.
* Adding additional fields.	

3.5.1 Resource Requirements

The overall resource requirements for the AHPC system when compared to the existing ESP with humidification system are presented in **Table 3-6**.

Table 3-6. Comparison of Resource Requirements

RESOURCE	AHPC SYSTEM	EXISTING PRECIPITATOR AND HUMIDIFICATION ARRANGEMENT	NET CHANGE WITH AHPC SYSTEM
Land Area	273,600 ft^2	273,600 ft^2	None
Feed Materials	All flyash particulate from 450 MW Coal fired boiler	All flyash particulate from 450 MW Coal fired boiler	None
Water Requirements	Less than 40 gpm	Less than 50 gpm	-10 gpm
Electrical Energy	8,947.5 kW	7,760 kW	+1,187.5 kW
- Electrostatics (estimate)	187.5 kW	1,000 kW	-812.5 kW
- Compressed Air	360 kW	360 kW	0 kW
- ID Fan	8,400 kW	6,400 kW	+2,000 kW

3.5.2 Land Area Requirements

The proposed project would be retrofitted into an existing ESP and would therefore require no additional land.

The additional flyash collected by the AHPC would result in 0.99%, or approximately 300 tons/year, increase in collected ash, which would not appreciably change the rate of fill to the landfill.

3.5.3 Feed Materials

The proposed project would be retrofitted into an existing ESP at the Big Stone Power Plant. No additional feed materials would be required.

3.5.4 Water Requirements

The existing operations at the Big Stone Power Plant use water for several flyash-related applications. A humidification system is used for controlling flyash resistivity and ESP performance. Water usage is approximately 10 gpm when the system is operating. Following installation of the AHPC system, humidification would not be required.

Flyash handling involves pneumatic transport from the ESP to a flyash silo. The flyash is then transported by a scraper-hauler to a landfill located on the plant site. The existing procedure uses water for ash wetting and dust control. This procedure would not change following installation of the AHPC system, and the 0.99% increase in flyash collected by the AHPC system would not appreciably change the amount of water usage for dust control.

3.5.5 Electrical Energy Requirements

Since the AHPC system would require a small electrostatic zone in comparison with the existing ESP, a reduction in electrical usage for flyash collection would result. The total required collection area would be reduced by 81.25%, from the current size of 806,400 ft^2 to 151,200 ft^2. Assuming equivalent energy reduction and constant current density, the present energy usage of 2,200 kW would be reduced to 412.5 kW or less. However, due to sparking and secondary voltage limitations, the present electrical energy usage is closer to 1,000 kW. Therefore, the actual electrical energy usage of the AHPC should be closer to 187.5 kW.

An additional electrical energy requirement would result from using an estimated 2,000 scfm of compressed air, which would require approximately 360 kW. The plant currently uses a humidification system to cool flue gas for flyash resistivity control and improved precipitator performance. The humidification system would not be needed with the AHPC system, and the overall net usage of plant air would decrease.

3.5.6 Outputs, Discharges, and Wastes

The only change in outputs, discharges, and wastes resulting from installation of the AHPC system would be an increase of 300 tons per year in the amount of collected particulate. Flyash collected at the plant undergoes disposal in a permitted on-site landfill. Between 1997 and 2000, the total ash placed in the landfill ranged from 85,000 tons to 169,000 tons annually, which is well below the permitted disposal allowance of 250,000 tons per year. The increase in ash to the landfill as a result of the AHPC system would be negligible.

The Big Stone Power Plant has burned approximately 1,978,000 tons of coal with an average ash content of 7.5% every year for the past five years. This would result in production of 148,000 tons per year of ash from boiler operation. Because the plant uses a cyclone boiler, the ash consists of both bottom ash and fly ash. Approximately 60% of the ash leaves the boiler as bottom ash and 40% leaves as fly ash. Both types of ash are marketed for sale to various industries. Due to market variability, the amount of ash requiring landfill disposal varies from year to year. The permitted landfill at the Big Stone Plant has sufficient capacity for an additional 35 years of usage at the present rate of fill. Addition of the AHPC project would only result in an additional 0.99% of ash being collected and have no appreciable effect on the rate of fill.

Construction waste would result from demolition and removal of steel components, including the collecting electrodes, emitting electrodes, rapping systems, and some casing from the existing ESP. An estimated 5,000 tons of steel would be removed and marketed as scrap material. Most of the remaining waste would be insulation, lagging, cabling, and other material, which would undergo disposal in a permitted off-site landfill.

Some of the existing electric cabling contains asbestos insulation. These cables would be marked prior to installation of the AHPC system. An electrical contractor would apply all appropriate safety measures for encapsulation of fraying material during demolition. A separate dumpster would be used for these cables, which would undergo disposal in a permitted off-site landfill.

The existing Transformer/Rectifiers (TRs) would be re-used. Since the AHPC would require less than the existing 24 TRs, some would be warehoused as potential spares. These TRs have been tested for polychlorinated biphenyls (PCBs) and determined to be non-PCB, per 40 CFR Part 761. Any units that require disposal would be handled according to the requirements of that regulation.

3.6 COMPARISON OF THE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION AND THE NO ACTION ALTERNATIVE

A comparison of the effects of the No Action Alternative and the proposed action, for supporting installation and operation of the AHPC system at the Big Stone Power Plant, is provided in **Table 3-7**. For this comparison, No Action would result in termination of plans for installation of the AHPC system.

Table 3-7. Comparison of the Environmental Effects of Alternatives

RESOURCE	NO ACTION	PROPOSED ACTION
Aesthetics and Visual Resources	No change from existing conditions.	Increased height of ductwork by 20 ft from 75 ft height of ESP, below 295 ft height of adjacent boiler building.
Air	No change from existing conditions.	Particulate reductions from 278 tpy to 6 tpy (0.0045 gr/acf to 0.0001 gr/acf).
Environmental Justice	No change from existing conditions.	No disproportionate adverse effect.

RESOURCE	NO ACTION	PROPOSED ACTION
Floodplains	No effect due to the absence of floodplains.	No effect due to the absence of floodplains.
Geology & Soils	No change from existing conditions.	No change from existing conditions.
Hazardous Waste	No change from existing conditions.	No change during operation. Demolition of existing facilities may result in small quantities of asbestos waste.
Historic and Cultural Resources	No effect due to the absence of historic and cultural resources.	No effect due to the absence of historic and cultural resources.
Infrastructure	No change from existing conditions.	No change from existing conditions.
Land Use	No change from existing conditions.	No change from existing conditions.
Noise	No change from existing conditions.	Construction noise would be generated during the 5½ week construction period. Intermittent and short-duration noise produced during bag cleaning.
Safety and Health	No change from existing conditions.	New occupational hazards would result from demolition and construction activities. Hazards during operation would be similar to existing hazards.
Socioeconomics	No change from existing conditions.	Maximum of 100 workers during construction stage.
Solid Waste (Non-hazardous)	No change from existing conditions.	Additional 300 tons per year (0.99%) flyash for disposal in on-site landfill. Demolition waste of 5,000 tons of steel.
Threatened & Endangered Species	No effect due to the absence of protected species.	No effect, due to the absence of protected species.
Traffic and Transportation	No change from existing conditions.	Short duration increase during construction.
Wastewater	No change from existing conditions.	No change from existing conditions.
Water	No change from existing conditions.	Reduction in usage of 10 gpm due to elimination of need for humidification to improve ESP performance.
Wetlands	No effect due to the absence of wetlands.	No effect due to the absence of wetlands.

4.0 AFFECTED ENVIRONMENT AND THE ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

4.1 APPROACH

Section 4.0 is organized by resource, beginning with Section 4.3. The relevant aspects of the existing conditions for each resource are described followed by the potential consequences of the proposed action on that resource.

4.2 SITE DESCRIPTION

The site proposed for the Advanced Hybrid Particulate Collector (AHPC) is Otter Tail Power Company's steam-electric generating facility near Big Stone City, SD. The Big Stone Power Plant is located in Grant County, and the main plant building is located less than 2 miles northwest of Big Stone City, which borders the neighboring town of Ortonville, MN, resulting in a combined local population of about 2,800. State Highway 109 runs along the eastern side of the Power Plant.

The Big Stone Plant lies on a glacial drift plain that stands 140 feet above Big Stone Lake to the east and the Whetstone River to the south. To the west, the ground surface rises 900 feet within 15 to 20 miles to the crest of Coteau des Prairies, a prominent regional highland. Approximately 200 feet of glacial drift, comprised primarily of sandy, gravelly clay, underlies the site.

No wetlands, flora, or fauna would be affected by construction or operation, because the proposed activities would occur in an already disturbed, actively used, non-vegetated area. No archaeological or historic resources are located at the site of the proposed project. The nearest Class I area is over 300 kilometers from the Big Stone Plant.

The Northern Corn Growers Association of Milbank, SD, leases approximately 40 acres of the Big Stone Plant site for establishing an ethanol plant with a production capacity of 40,000,000 gallons per year. The Big Stone Power Plant would supply steam, water, rail access, electricity, and other services to the ethanol plant, which is scheduled to begin production in mid-2002. Changes potentially resulting from the proposed action would neither affect nor be affected by ethanol plant operations.

Otter Tail Power Company is also preparing a feasibility study to evaluate the potential need for a second power plant at the Big Stone City location. Installation of the AHPC would have no relationship to any decision on installation of a second power plant unit.

4.3 AESTHETICS AND VISUAL RESOURCES

4.3.1 Affected Environment

The tallest structure at the Power Plant is the boiler exhaust stack, which has a 42-ft diameter base and a 498-ft height. The largest plant building is the main boiler building, which has a footprint of 218 ft by 323 ft and a height of 295 ft. The electrostatic precipitator (ESP) building, which would be affected by the AHPC project and is located adjacent to the boiler building, has a footprint of 210-ft by 100-ft and a height of 75 ft. All of the indicated structures are constructed of earth-tone colors to allow the Power Plant to blend with the environment.

4.3.2 Environmental Consequences

Construction Impacts

The main components of the AHPC would be constructed within the same dimensions as the existing ESP building. The only visible change would be addition of approximately 20 ft of ductwork above the AHPC. The additional ductwork would not cause a noticeable visual change, since it would be located next to the significantly larger boiler building.

Construction activities would be partially shielded by the existing boiler building, and would not be directly visible from Big Stone City.

Operation Impacts

Operation of the AHPC would not adversely affect the aesthetics of the area. Replacement of the existing ESP with the AHPC system would reduce or eliminate the frequency and magnitude of visible flue gas discharges caused by particulate releases from operation or maintenance of the ESP.

4.4 AIR QUALITY

The U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for the following seven criteria pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 micron size (PM_{10}), particulate matter less than 2.5 micron size ($PM_{2.5}$), and lead (Pb). NAAQS are expressed as concentrations of pollutants in ambient air (see insert).

National Ambient Air Quality Standards

Primary Standards establish the air quality level necessary to protect public health from known or anticipated adverse effects of a pollutant, allowing a margin of safety to protect sensitive members of the population. Secondary Standards establish the air quality level necessary to protect public welfare by preventing injury to agricultural crops and livestock, deterioration of materials and property, and adverse impacts on the environment.

Pollutant	Averaging Time	Standards[1]
Ozone	1 hr	235 $\mu g/m^3$
Carbon Monoxide	1 hr	40 mg/m^3
	8 hr	10 mg/m^3
Nitrogen Dioxide	Annual[2]	100 $\mu g/m^3$
Sulfur Oxides	Annual[3]	80 $\mu g/m^3$
	24 hr[3]	365 $\mu g/m^3$
	3 hr[4]	1300 $\mu g/m^3$
Suspended Particulate ($PM_{2.5}$)	Annual[2]	15 $\mu g/m^3$
	24 hr	65 $\mu g/m^3$
Suspended Particulate (PM_{10})	Annual[2]	50 $\mu g/m^3$
	24 hr	150 $\mu g/m^3$
Lead	3 year	1.5 $\mu g/m^3$

[1] Primary and Secondary Standards are the same for all pollutants, except for sulfur oxides
[2] Arithmetic mean
[3] Primary Standard
[4] Secondary Standard

Particulate matter is the only criteria pollutant that would be affected by the AHPC project. Although previous data have indicated that vapor-phase trace metals can be effectively captured with sorbents in the AHPC without impairing performance, sorbent development is not an objective of the AHPC demonstration.

The NAAQS standards for particulate matter apply to statistical values of air quality that are derived from 3 years of data. Sufficient air quality data are not yet available for evaluating compliance with the $PM_{2.5}$

standards.

For areas that are in attainment with NAAQS, EPA has established standards for Prevention of Significant Deterioration (PSD) of air quality (40 CFR, Part 51.166). The PSD standards provide maximum allowable increases in concentrations of pollutants for areas already in compliance with NAAQS and are expressed as allowable increments in the atmospheric concentrations of pollutants. Allowable PSD increments currently exist for SO_2, NO_2, and PM_{10}.

One set of allowable PSD increments exists for Class II areas, which include most of the United States, and a more stringent set of allowable increments exist for Class I areas, which are defined under the Clean Air Act (Title 42, United States Code, Part 7472, Section 162) as international parks, national parks that exceed 6,000 acres in size, or national wilderness areas or national memorial parks that exceed 5,000 acres in size. These PSD increments are shown in the insert.

The EPA has also established New Source Performance Standards (NSPS) that set forth emission standards, monitoring requirements and reporting requirements for a number of individual industrial or emission source categories. The applicability of NSPS requirements are based on date of construction and size of the new emission source. The Big Stone Power Plant is not regulated under NSPS requirements.

Allowable Increments for PSD

Prevention of Significant Deterioration (PSD) increments establish the maximum allowable increases in pollutant concentrations in areas where the National Ambient Air Quality Standards have been achieved.

		Allowable Increment (mg/m^3)	
Pollutant	**Averaging Time**	**Class I Area[1]**	**Class II Area[2]**
SO_2	3 hr (max)	25	512
	24 hr (max)	5	91
	Annual[3]	2	20
NO_2	Annual[3]	2.5	25
PM_{10}	24 hr (max)	8	30
	Annual[3]	4	17

[1] Designated areas (e.g., international parks, national parks over 6,000 acres, national wilderness areas over 5,000 acres)
[2] Remainder of the United States
[3] Arithmetic mean

Under Title III (Hazardous Air Pollutants) of the Clean Air Act Amendments (CAAA) of 1990, EPA was required to identify source categories or subcategories that emit any quantity of 189 chemicals initially listed for air toxics emission regulation. Subsequent to identification of these sources, EPA was required to issue National Emission Standards for Hazardous Air Pollutants (NESHAPs) based on use of “maximum achievable control technology” for new sources (and possibly less stringent standards for existing sources). Emissions from specific source categories are contained in the NESHAPs (40 CFR, Parts 61 and 63).

The State of South Dakota has incorporated standards and procedures required by EPA into its environmental regulations. PSD, NSPS, and NESHAPs regulations have been incorporated into State law, and the State of South Dakota has adopted the NAAQS for all pollutants.

4.4.1 Affected Environment

Regulatory oversight of the Big Stone Power Plant falls within the jurisdiction of the South Dakota Department of Environment and Natural Resources (DENR), which is headquartered in Pierre, SD. The offices in Pierre provide the point of contact for dealing with air quality regulations.

For air quality designation purposes, Grant County is included among areas of the State of South Dakota that have been determined to be either unclassifiable or in attainment with the NAAQS for all criteria pollutants. Grant County borders two counties in Minnesota, Lac Qui Parle and Big Stone, which have similar air quality. The nearest Class I areas are over 300 kilometers from the Big Stone Power Plant, as shown on **Figure 3-1**.

The Big Stone Plant is approximately 5 miles from the Big Stone Refuge, Big Stone County, Minnesota, which should not be affected by operation of the AHPC system. The AHPC project would be expected to reduce emissions and deposition in the vicinity of the plant.

The AHPC demonstration project at the Big Stone Plant would control particulate matter air emissions from a 450-MW cyclone-fired boiler (Unit #1). Currently, flue gas from Unit #1 passes through the ESP (consisting of four chambers each having four fields) to remove particulate, and a flue gas conditioning agent may be used to help control particulate and opacity emissions.

From 1975 to 1995, the primary fuel for Unit #1 was North Dakota lignite, but in 1995 the primary fuel was switched to Powder River Basin (Wyoming) subbituminous coal, which contains approximately one-half of the moisture and one-third more heating value than North Dakota lignite. The fuel switch created a decrease in the particulate collection efficiency of the ESP due to increased resistivity of the fly ash. The combination of a very fine particle size produced from the cyclone-fired boiler and high ash resistivity resulted in problems both in terms of meeting opacity requirements and in maintaining the ESP. Unlike the ESP, the AHPC can provide very high collection efficiency for different types of coals, since emissions are not significantly affected by ash resistivity.

Although coal remains the primary fuel at the Big Stone Power Plant, in 1990, Otter Tail Power Company began evaluating alternative fuels such as refuse- and tire-derived fuels. These fuels tend to burn cleaner and are more economical than coal. Since 1991, these materials have provided 2% to 10% of the total fuel burned at the Big Stone Power Plant.

The Big Stone Plant operates under air quality requirements established by the State of South Dakota, including requirements specified in a Title V Air Quality Operating Permit and an Acid Rain Permit. Pertinent conditions and requirements relating to air emissions (although only particulate and opacity emissions would be affected by the AHPC project) for Unit #1 are indicated in **Table 4-1**.

Table 4-1. Selected Permit Requirements Enforced by the State of South Dakota

EMISSION SOURCE	REQUIREMENT
Unit #1 Cyclone Boiler	Operation of continuous opacity monitoring system to record the opacity. A yearly audit must be conducted on the monitoring system.
	Operation of continuous emission monitoring system for nitrogen oxides, sulfur dioxide, opacity, and flue gas flow.

	Maximum particulate matter emissions of 0.26 lb per million Btu.
	Maximum sulfur dioxide emissions of 3 lb per million Btu.
	Maximum nitrogen oxides emissions of 0.86 lb per million Btu.
	Opacity limit of 20%.

4.4.2 Environmental Consequences

Construction Impacts

Construction of the proposed AHPC system would produce short-term, low-level, intermittent, and transient emissions of NO_x, PM_{10}, and CO from the coming and going of trucks and operation of construction machinery. Due to the small and temporary increase in traffic that would be needed for facility construction, no appreciable affects on ambient air pollutant concentrations from vehicle emissions would be expected. Construction activities would be substantially confined to the inside of the existing the ESP building and would not be expected to create substantial dust.

Operation Impacts

A Title V Air Quality Operating Permit from the State of South Dakota DENR defines air emission limits during facility operation. This permit would establish controls and emission limits for the AHPC. Discussions with South Dakota's permitting authorities have been initiated; regulatory personnel consider installation of the AHPC to be an action that would not constitute a modification under Title I of the Clean Air Act. Therefore, the AHPC project would require a minor permit application. Otter Tail Power will continue to coordinate with regulatory officials on permitting and compliance matters.

The major environmental consequence of the proposed AHPC system would be a reduction in particulate matter air emissions when compared to emissions from the current operations using an ESP. Much of the additional particulate matter collected by the AHPC, as compared to the ESP, would be in the form of fine particulate. Research indicates that AHPC technology provides at least an order of magnitude better particulate removal efficiency than an ESP, which becomes even more magnified for very fine particulate collection. AHPC technology has shown an ability to achieve 99.99% particulate collection efficiency for all particle sizes from 0.01 to 50 μm in pilot-scale tests.

Table 4-2 compares the particulate emission levels on a grains-per-actual-cubic-ft (gr/acf) and a ton-per-year basis for the ESP and the AHPC system. Since the proposed AHPC system would be the first, full-scale unit in this application, the level of emissions that would ultimately be achieved cannot be precisely predicted.

Table 4-2. Comparison of Unit #1 Emissions

CRITERIA POLLUTANT	ESP*		AHPC**	
	Gr/acf	tons/year	gr/acf	tons/year
Particulate Matter	0.0045	278	0.0001	6

*Emissions based on most recent stack test

**Projected emissions based on tests from an on-site pilot unit

As shown in **Table 4-2**, the AHPC is projected to reduce the current particulate concentration in flue gas (gr/acf) by an order of magnitude and to reduce total annual particulate emissions by over 95%.

Since the AHPC project would only control the emissions from Unit #1, the project would not affect emissions from other facility sources (non-combustion sources). The long-term benefit of cumulative particulate reductions would be dependent on the life of the AHPC. Any short-term or long-term effect that the AHPC system has on Class I areas would be positive since the AHPC system would decrease particulate emissions.

4.5 SURFACE/GROUND WATER RESOURCES/SPILL CONTROL PLANS

4.5.1 Affected Environment

Surface water is used at the Big Stone Power Plant for plant operations and condenser cooling. The water source is Big Stone Lake. The Power Plant uses a 340-acre man-made pond for cooling purposes, with makeup water being supplied throughout the year under certain conditions. Water is pumped from the lake at intervals, as specified in the water appropriations permit, when lake levels allow. The appropriations permit allows up to 7,000 acre-feet of water to be taken annually from Big Stone Lake. The Grant/Roberts Rural Water System supplies the domestic water to the plant.

A ground water monitoring program has been in place at the plant since 1971. Since the Power Plant began operation on May 1, 1975, the ground water monitoring program has been changed as conditions warranted. The current solid waste permit requires groundwater monitoring near disposal areas. In addition, the plant monitors additional sites for informational purposes. A total of 19 wells and four surface water sites are sampled three times per year. Water monitoring reports are submitted annually to the South Dakota Department of Environment and Natural Resources.

An SPCC spill control plan is in place for the plant and is updated at least every three years as required by regulation.

4.5.2 Environmental Consequences

Construction Impacts

The AHPC would be installed within the footprint of the existing ESP. No surface water or ground water issues would result from construction of the AHPC system. Spills, if any, would be handled by the existing spill plan.

Operation Impacts

The existing operations use water for several flyash-related applications. A humidification system is used for resistivity control and precipitator performance. The approximate flow rate is 10 gpm when the system is operating. Resistivity issues would not be concern following AHPC operation, and the humidification system would not be used.

Currently, flyash handling involves pneumatic transport from the ESP to a flyash silo. The flyash is then transported by a scraper-hauler to a landfill located on the plant site. The existing procedure uses some plant water for ash wetting and dust control, and this procedure would not be changed subsequent to AHPC operation. Since the increase in collected flyash would be only 0.99%, the increase, if any, in water used for dust control would be negligible.

4.6 WASTEWATER

4.6.1 Affected Environment

Wastewater currently generated by operations at the Big Stone Plant is all handled on site. The plant is a zero discharge facility, which precludes the need for a NPDES permit. The cooling pond handles most of the wastewater on the site, and holding and evaporation ponds are used to contain excess wastewater. A brine concentrator is used to process a portion of the wastewater, and treated water is returned to plant for reuse. A NPDES Stormwater permit has been obtained for the site. Wastewater quantities would not change as a result of AHPC installation and operation.

4.6.2 Environmental Consequences

Construction Impacts

No wastewater would be generated from construction of the AHPC.

Operation Impacts

No additional wastewater would be generated as a result of AHPC operation.

4.7 SOLID AND HAZARDOUS WASTE MANAGEMENT

4.7.1 Affected Environment

The Big Stone Plant currently holds a solid waste permit, which includes approval for an ash fill site on the Plant's property, from the South Dakota Department of Environment and Natural Resources. The ash fill site is permitted for a maximum of 250,000 tons per year of ash generated from fuel combustion. The solid waste permit also approves disposal of wood products, rubble, construction and demolition debris, and similar non-malodorous wastes from the Big Stone Plant in a Restricted Use Landfill, which is permitted to accept 100 tons per year. The permit is currently in the process of being renewed.

4.7.2 Environmental Consequences

Construction Impacts

Construction waste, which would result from removal of existing equipment, would be examined for potential reuse, salvage, removal by the construction contractor, or placement in the Restricted Use Landfill. Waste materials determined to be inappropriate for such applications would be transported for disposal in a permitted off-site landfill.

Operation Impacts

The types of wastes produced at the Big Stone Plant would not substantially change from current conditions as a consequence of operations of the proposed AHPC.

Subbituminous coal and other alternative fuels burned each year at the Big Stone Plant result in the production of fly ash and bottom ash. The on-site landfill is permitted to accept up to 250,000 tons per year of these by-products. The total amount of ash material landfilled is dependent on quantities of fly ash and bottom ash that are sold for beneficial uses and removed from the site. From 1997 through 2000, the amount of landfilled fly ash and bottom ash has ranged from 85,000 tons to 169,000 tons, which is well below the permitted maximum of 250,000 tons per year.

The existing electrostatic precipitator emits flyash at a stack gas loading of approximately 0.0045 grains/acf. The AHPC would remove 99.99% of the particulates from the stack gas and reduce ash loading to approximately 0.0001 grains/acf. The AHPC would generate less than 300 tons of additional fly ash per year, which would not pose any problems for disposal in the existing landfill.

4.8 LAND USE

4.8.1 Affected Environment

The Advanced Hybrid Particulate Collector would be installed in the same location as the current electrostatic precipitator. No change in land use would result from installation of the Advanced Hybrid Particulate Collector.

4.8.2 Environmental Consequences

Construction Impacts

The AHPC would use the same footprint as the existing ESP.

Operation Impacts

Operation of the AHPC would result in the generation of less than 300 tons per year of additional solid waste, which would be disposed of at Big Stone Plant’s permitted landfill. This quantity of additional waste would not substantially impact land use at the landfill.

4.9 FLOODPLAINS & WETLANDS

4.9.1 Affected Environment

The AHPC would be located within a developed area of the Big Stone Plant. No wetland areas are located in the vicinity of the proposed project.

4.9.2 Environmental Consequences

Due to the lack of wetlands in the AHPC project area, no effect on wetlands would result from the AHPC project.

4.10 BIODIVERSITY AND ENVIRONMENTALLY SENSITIVE RESOURCES

Biodiversity in an ecosystem or community is characterized by the richness of the natural flora and fauna in terms of the number of habitat types or diversity of species.

4.10.1 Affected Environment

The biodiversity of the land in the vicinity of the proposed project can be characterized as relatively low because of the historic nature of land use and human activities in the area. Installation and operation of the AHPC would occur in a developed area of the facility. Environmentally sensitive resources do not exist in these areas.

4.10.2 Environmental Consequences

Since the impacts from the proposed project would be confined to currently developed areas with no environmentally sensitive resources and low biological diversity, no adverse impact would be expected.

4.11 ECOLOGICAL RESOURCES

4.11.1 Affected Environment

The land surrounding the proposed site for the AHPC consists of developed property used to support industrial operations at the Big Stone Plant. Terrestrial and aquatic ecosystems are not threatened, and endangered species are not present.

4.11.2 Environmental Consequences

Since the impacts from the proposed project would be confined to currently developed areas, no adverse impacts to fish, plant, or wildlife species would be anticipated from construction or operation of the proposed project. Contact with the U.S. Fish and Wildlife Service (USFWS) confirmed that the proposed project would not be likely to involve any Federally listed threatened or endangered species or their habitats, and thus would have no impact on protected fish and wildlife resources (Section 11.1).

While the threatened bald eagle may nest in areas throughout South Dakota, the construction activities would occur within an area of industrial activity where nesting would not be anticipated.

The USFWS did express a concern regarding potential contamination of surface water or ground water due to leaching of metals from landfilled ash. Section 4.5 describes the water monitoring and reporting program implemented by at the Big Stone Power Plant to protect water resources from contamination.

4.12 HISTORIC AND CULTURAL RESOURCES

4.12.1 Affected Environment

No archaeological, cultural, or traditional use sites are affected by the Big Stone Plant.

4.12.2 Environmental Consequences

No archaeological, cultural, or traditional use sites would be impacted by the proposed project.

4.13 SOCIOECONOMIC RESOURCES

4.13.1 Affected Environment

Within the nearby cities of Big Stone (SD) and Ortonville (MN), the combined population is about 2,800. The total population of cities within a 10-mile radius is approximately 6,500, with the largest city being Milbank, SD.

The Big Stone Plant employs over 70 Otter Tail Power Company employees to achieve 24 hour-per-day operation of the Power Plant.

4.13.2 Environmental Consequences

Construction Impacts

The contractors anticipated for project construction would not be headquartered in the local area, although area workers may be hired to participate in the construction. Approximately 100 workers would be required for the project. The local communities would be expected to be capable of accommodating the needs of the workforce for a construction project of this relatively short duration.

Operation Impacts

No additions to the existing workforce at the Power Plant would be required for operation of the AHPC. All labor requirements for the new system would be provided from the existing workforce.

No impact on traffic patterns, housing, or other infrastructure would be expected in the Big Stone community or in surrounding communities.

4.14 SAFETY AND HEALTH

4.14.1 Affected Environment

The affected environment pertaining to the safety and health of workers and the public would be limited to areas involving construction and operation of the AHPC.

The Big Stone Plant maintains a trained rescue squad in case of emergencies. Any emergencies that arise during hours when the plant workers are not on site are typically handled by the local fire department in Big Stone City.

4.14.2 Environmental Consequences

All Occupational Safety and Health Administration regulations would be followed for AHPC system installation and operation. An existing safety program at the Big Stone Plant, including a policy manual, monthly safety meetings, a safety committee, lockout/tagout procedures, and a confined space entry program, would be applicable to operations required for the AHPC system.

Construction Impacts

Potential health impacts to workers during construction would be limited to normal hazards associated with routine construction or repair of power plant equipment during a scheduled outage.

All contractors on site would be provided with a mandatory safety review meeting, and the contractor would be required to sign work guidelines. As a standard practice for construction activities, worker guidelines that summarize the more important safety concerns of the Big Stone Power Plant are issued at the start of each project, and each guideline must be signed and returned by every contract worker on the Power Plant site.

Operation Impacts

During operation of the AHPC, health and safety risks would result from potential exposures to hot flue gases, compressed air, high and low voltage electrical systems, and falls.

Most of the identified exposure risks are present with the existing ESP, and Plant employees are trained in the safe operation and maintenance of this type of equipment. Additional training would be completed to instruct employees on all aspects of operating and maintaining an AHPC. This training would specifically review new equipment, such as clean air plenums, compressed air headers, and new rapper, electrode, and plate styles. Similar equipment currently exists at the Big Stone Power Plant.

4.15 TRAFFIC AND TRANSPORTATION

4.15.1 Affected Environment

The Big Stone Plant is located in a rural area and experiences few traffic concerns. The principal traffic arteries around the Big Stone Plant are South Dakota Highway 109 and U.S. Highway 12.

4.15.2 Environmental Consequences

Construction Impacts

Approximately 100 workers would be required for construction of the AHPC project, which is typical of the workforce involved during a normal plant shutdown. Due to the availability of hotel rooms, most of the AHPC construction workers would travel by U.S. Highway 12 or S.D. Highway 109 and would only slightly increase the traffic on these roads. The level of increase would be consistent with changes typical of past plant outages.

Operation Impacts

The operating requirements of the AHPC would be provided by the existing Big Stone Plant staff. No increase in traffic would result.

4.16 NOISE

4.16.1 Affected Environment

The Big Stone Plant is located in a rural area between 1 and 2 miles Northwest of Big Stone City/Ortonville, which has a combined population of about 2,800.

4.16.2 Environmental Consequences

Construction Impacts

During construction of the AHPC project, noise levels would increase at the plant due to routine construction activities. Since this project would be completed during a plant outage, the net effect on the environment would likely decrease.

Operation Impacts

The only change in noise level following installation of the AHPC system would be the occasional operation of solenoid valves for cleaning the bag components.

4.17 POLLUTION PREVENTION

Construction of the AHPC system would result in removal of an estimated 5,000 tons of steel from the existing ESP structure. Priorities for disposition of this material would be reuse or salvage. Removed steel that could not be reused or salvaged would undergo disposal using an off-site permitted landfill or the on-site Restricted Use Landfill.

Approximately 300 tons per year of flyash would be collected by the proposed AHPC system. Consistent with on-going efforts by Otter Tail Power Company to market flyash collected from the existing ESP, markets for the additional material would be sought. Flyash that cannot be marketed would undergo disposal using the approved on-site ash landfill.

The existing character of the Big Stone Power Plant as a zero-discharge facility for wastewater would not be affected by installation and operation of the AHPC system.

4.18 ENVIRONMENTAL JUSTICE

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that Federal Agencies identify and address any disproportionately high and adverse human health or environmental effects on minority or low-income populations that result from Federal actions. **Table 4-3** presents population demographics relevant to consideration of environmental justice concerns.

Table 4-3. Comparison of Demographics for Geographic Areas in 2000

CHARACTERISTIC	GEOGRAPHIC AREA		
	USA	SOUTH DAKOTA	GRANT COUNTY
Population under 5 years	6.8%	6.8%	5.9%
Population over 65 years	12.4%	14.3%	19.1%
White persons	75.1%	88.7%	98.6%
Black persons	12.3%	0.6%	-
Native American persons	0.9%	8.3%	0.4%
Asian persons	3.6%	0.6%	0.2%
Hispanic or Latino persons	12.5%	1.4%	0.5%
Population Change (1990-2000)	13.1%	8.5%	-6.3%
Median household income	$37,005	$31,354	$34,381
Persons below poverty	13.3%	14.0%	10.4%
Children below poverty	19.9%	19.0%	13.4%

As shown in the Table, the demographics of Grant County indicate a population loss since 1990 and an area of relatively low minority population. Poverty levels of individuals and children in Grant County are substantially lower than levels for the U.S. and South Dakota. Based on these demographics, the proposed action is considered to represent an activity that would not result in any disproportionate adverse impact to low-income or minority populations.

4.19 UNAVOIDABLE ADVERSE EFFECTS

For installation and operation of the AHPC system, the following unavoidable adverse impacts would be anticipated:

- Increase in noise levels during construction (short duration)
- Potential short-duration increase in airborne dust and particulate during operation of construction equipment

5.0 REGULATORY COMPLIANCE

5.1 FEDERAL REQUIREMENTS

This Environmental Assessment was prepared in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA regulations, and the DOE's NEPA Implementing Procedures. A brief summary of key Federal laws, regulations, executive orders, permits, and licenses that may be applicable to the proposed project is provided in the following paragraphs. Air quality and water quality management for compliance with the Federal Clean Air and Clean Water Acts, as amended, is provided by the State of South Dakota; State requirements are identified in Section 5.2.

5.1.1 Environmental Policy

The NEPA of 1969 (42 United States Administrative Code [U.S.C.] p. 4321 *et seq*.) establishes a national policy to encourage harmony between man and his environment and to promote efforts to prevent, mitigate, or eliminate damage to the environment and stimulate the health and welfare of man. NEPA procedures ensure that environmental information related to Federal action is made available to public officials and citizens, and that the environmental information, along with public input, is considered in the Federal decision-making process.

Executive Order 11514, Protection and Enhancement of the Environmental Quality, as amended by Executive Order 11991, sets policy for directing the Federal government in providing leadership in protecting and enhancing the quality of the Nation's environment. The CEQ Regulations (40 CFR 1500 to 1508) implement the procedural provisions of the NEPA. DOE's NEPA Implementing Procedure (10 CFR 1021) establishes the specific procedural requirements for DOE implementation of NEPA.

5.1.2 Biological Resources

The Endangered Species Act (16 U.S.C. 1531 – 1544) requires Federal agencies to determine the effects of their actions on threatened or endangered species of fish, wildlife, and plants, and their critical habitats and to take steps to conserve and protect these species. Executive Order 11990, Protection of Wetlands, requires Federal agencies to take action to avoid or minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.

5.1.3 Public Health

Executive Order 12088, Federal Compliance with Pollution Control Standards, directs Federal agencies to comply with Federal, state and local laws and regulations concerning air, water, noise pollution, and hazardous materials and substances to the same extent as any private party.

5.1.4 Environmental Justice

Executive Order 12898, requires that each Federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low income populations.

5.1.5 National Historic Preservation Act – Section 106 Compliance

Cultural resources (archaeological and historical sites and structures) must be examined according to Section 106 of the National Historic Preservation Act and implementing regulations at 36 CFR 800, in addition to review under NEPA. Significant historical and archaeological properties and sites that may be impacted by a proposed action or alternatives must be identified. Significant sites are defined as those listed on, or determined eligible for listing on, the National Register of Historic Places (NRHP).

The South Dakota State Historic Preservation Officer (SHPO) must be consulted regarding impacts to significant resources and means to mitigate the impact, if necessary. If significant resources are identified and potential impacts defined, any necessary mitigation measures are stipulated in a Memorandum or Agreement. Depending on the resources encountered, Native American Indian groups may also be consulted.

5.1.6 Toxic Substances Control Act

The Toxic Substances Control Act mandates EPA approval of manufactured or imported chemical substances that could potentially pose an environmental or human health hazard.

5.1.7 Resource Conservation and Recovery Act

This Act provides authority for EPA to control hazardous substances from "cradle to grave." Regulatory requirements under the Act cover generation, transportation, treatment, storage, and disposal of hazardous waste, and management of non-hazardous waste.

5.2 STATE REQUIREMENTS

The State of South Dakota mandates the following permit requirements for Electric Generating Plants:

- Air Quality Permit
  Varied permit application forms are required depending on the characteristics of the planned emission source. Based on discussions between Otter Tail Power Company and representatives from the South Dakota Department of Environment and Natural Resources, installation of the AHPC system would require submittal of an application for a minor emission source. An Air Quality Permit Application for installation of a baghouse may also be required.
- Ground Water Permit
- NPDES Surface Water Permit
- Solid Waste Permit
  For operation of the Big Stone Power Plant, Otter Tail Power Company has received permits for on-site disposal of a maximum of 250,000 tons per year of ash and for disposal of up to 100 tons per year of non-malodorous solid waste in an on-site Restricted Use Landfill.
- Water Rights Permit
  Otter Tail Power Company possesses a water appropriation permit for withdrawal of a maximum of 7,000 acre-feet of water per year from Big Stone Lake.

6.0 CUMULATIVE EFFECTS AND LONG-TERM ENVIRONMENTAL CONSEQUENCES

6.1 SECONDARY EFFECTS

Secondary, or indirect, effects caused by actions are effects that occur later in time or farther removed in distance, but which are reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate. The project, as proposed, considers effects associated with disposition of collected flyash and employment changes during AHPC system construction. No other secondary effects would be expected.

6.2 CUMULATIVE EFFECTS

A cumulative impact, as defined by the CEQ (40 CFR 1508.7) is the "impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of which agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

The proposed action would result in addition of about 300 tons per year to the current amount of flyash collected at the Big Stone Power Plant. This would equate to less than 1% change in total flyash collection at the Power Plant, which would not be expected to produce adverse effects. Flyash recovered at the Power Plant is

6.3 LONG-TERM ENVIRONMENTAL CONSEQUENCES

The proposed action, if supported, would result in establishing a facility to improve the efficiency of particulate removal from flue gas at the Big Stone Power Plant. Upon completing a projected 3-year project for DOE, Otter Tail Power Company would be expected to continue operation of the AHPC system. Currently, collected flyash from the Big Stone Plant that cannot be marketed is landfilled in an existing on-site landfill. The landfill has sufficient capacity for an additional 35 years of use at the current disposal rates. The 300 additional tons of ash that would be collected per year by the AHPC system would result in an additional 10,500 tons of ash during the 35-year lifetime of the landfill. At recent landfill addition rates of 85,000 to 169,000 tons per year, and a permitted disposal rate of 250,000 tons per year, the additional ash that would be produced by the proposed project would have a negligible long-term consequences.

7.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Resource requirements for the proposed action would comprise the materials and labor required to install and operate the AHPC system, which would include an estimated 4,902 filter bags. All filter bags would be obtained from W.L. Gore and Associates, which possesses more than 25 years experience in developing and supplying filter bags for use in baghouses to control particulate emissions. Filter bags for over 200 combustion systems have been supplied by Gore and Associates, and no problems would be expected in providing filter bag resources for the proposed AHPC system.

For operation of the AHPC system, additional electrical energy would be required in comparison to existing usage at the Big Stone Power Plant. The increased usage would be 2,000 kW, which is comparable to the annual level of derates that the AHPC system would be installed to avoid.

The current water usage of 10 gallons per minute, which is needed for flue gas humidification to improve particulate collection by the existing ESP, would be eliminated.

8.0 ENVIRONMENTAL CONSEQUENCES OF THE NO ACTION ALTERNATIVE

Under the No Action Alternative, the DOE would not contribute funds to support installation and initial operation of a full-size AHPC system at the Big Stone Power Plant. In the absence of DOE's contribution of 49% of the estimated $13.4 million cost for demonstrating the AHPC system, Otter Tail Power Company would be expected to abandon plans for the AHPC project and continue to use the existing electrostatic precipitator for particulate control. Under these circumstances, a near-term demonstration of AHPC technology and reduction of particulate emissions from the Big Stone Power Plant would not occur.

9.0 SIMILAR ACTIONS AND ACTIONS BEING CONSIDERED UNDER OTHER NATIONAL ENVIRONMENTAL POLICY ACT REVIEWS

The proposed action, for DOE support in demonstrating AHPC technology to improve particulate removal, including removal of fine particulate, from a coal-fired boiler is not similar to any other action being considered (or currently being implemented) by DOE. This action is not a segment of any other action for which review under NEPA would be required.

10.0 RELATIONSHIP OF THE PROPOSED ACTION TO APPLICABLE FEDERAL, STATE, REGIONAL, OR LOCAL LAND USE PLANS AND POLICIES

The proposed action would not require additional land use, and no changes in the existing use of land would be required. The additional 300 tons per year of ash recovered from flue gas by the AHPC would not appreciably increase the quantity of solid waste produced by the Big Stone Power Plant and would not require any expansion of the approved on-site landfill for combustion ash.

11.0 CONSULTATION AND PUBLIC PARTICIPATION

11.1 CONSULTATION

The agencies and organizations contacted during environmental analysis of the proposed project are identified in **Table 11-1**. Copies of correspondence exchanged with those agencies and organizations are provided in Appendix A.

Table 11-1. Agency and Organization Contacts

NO.	AGENCY CONTACTED	DATE	AUTHOR	DATE OF AGENCY RESPONSE	AUTHOR
1	South Dakota Department of Environment and Natural Resources	03/18/2002	Lorenzi		
2	South Dakota State Historic Preservation Office	03/18/2002	Lorenzi		
3	Minnesota Health Vital Communities Initiative	03/18/2002	Lorenzi		
4	Minnesota Department of Commerce	03/18/2002	Lorenzi		
5a	U.S. Fish and Wildlife Service	03/19/2002	Lorenzi	04/17/2002	Gober
5b				04/25/2002	Gober

11.2 PUBLIC PARTICIPATION

(Reserved for Final Environmental Assessment)

APPENDIX A

AGENCY CONSULTATION CORRESPONDENCE

APPENDIX B

CONCEPTUAL DRAWINGS OF AHPC DEMONSTRATION AND VIEWS OF AHPC PILOT UNIT

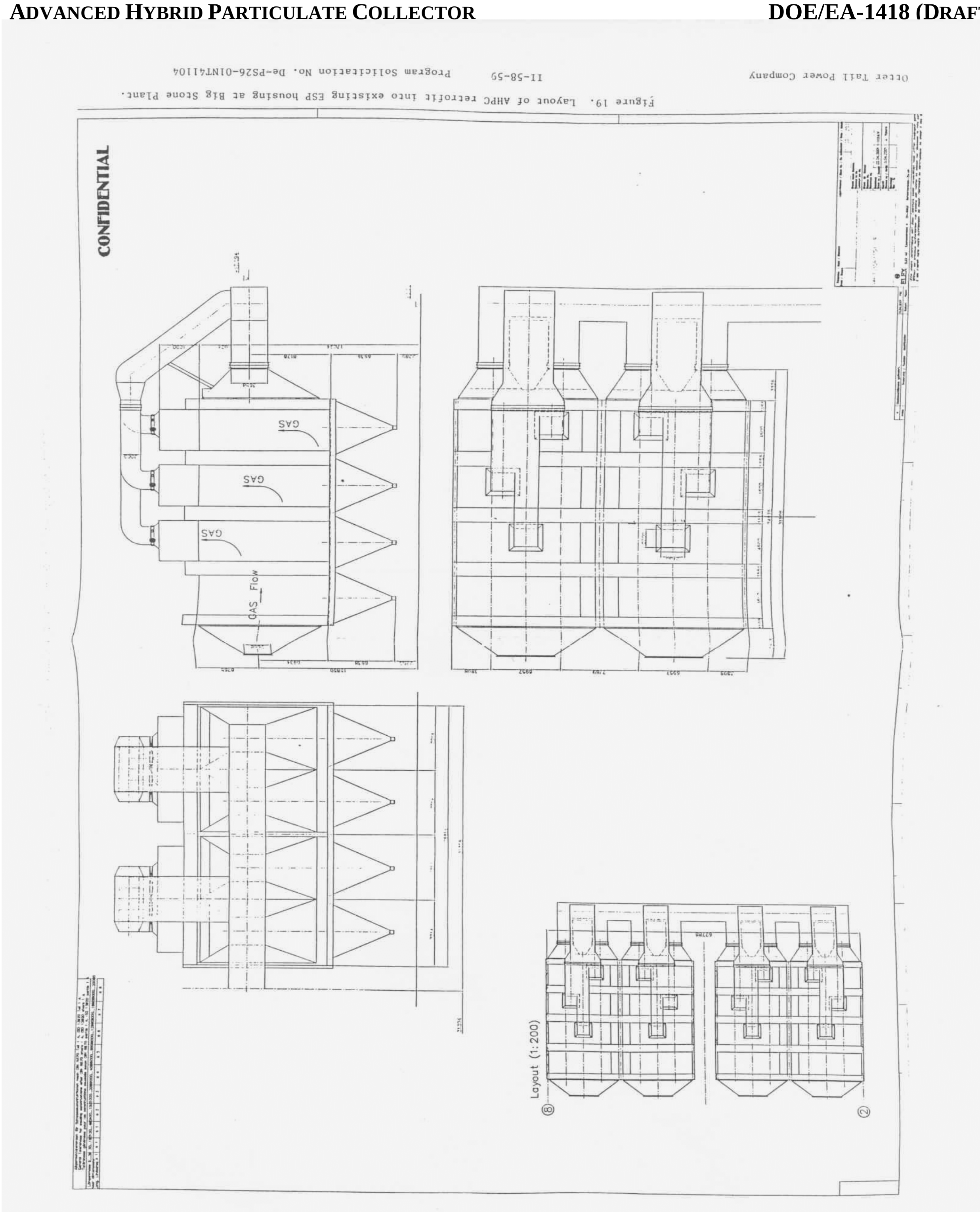


Figure B-1. Conceptual Elevation Drawing of AHPC (Layout of AHPC Retrofit in ESP Housing)

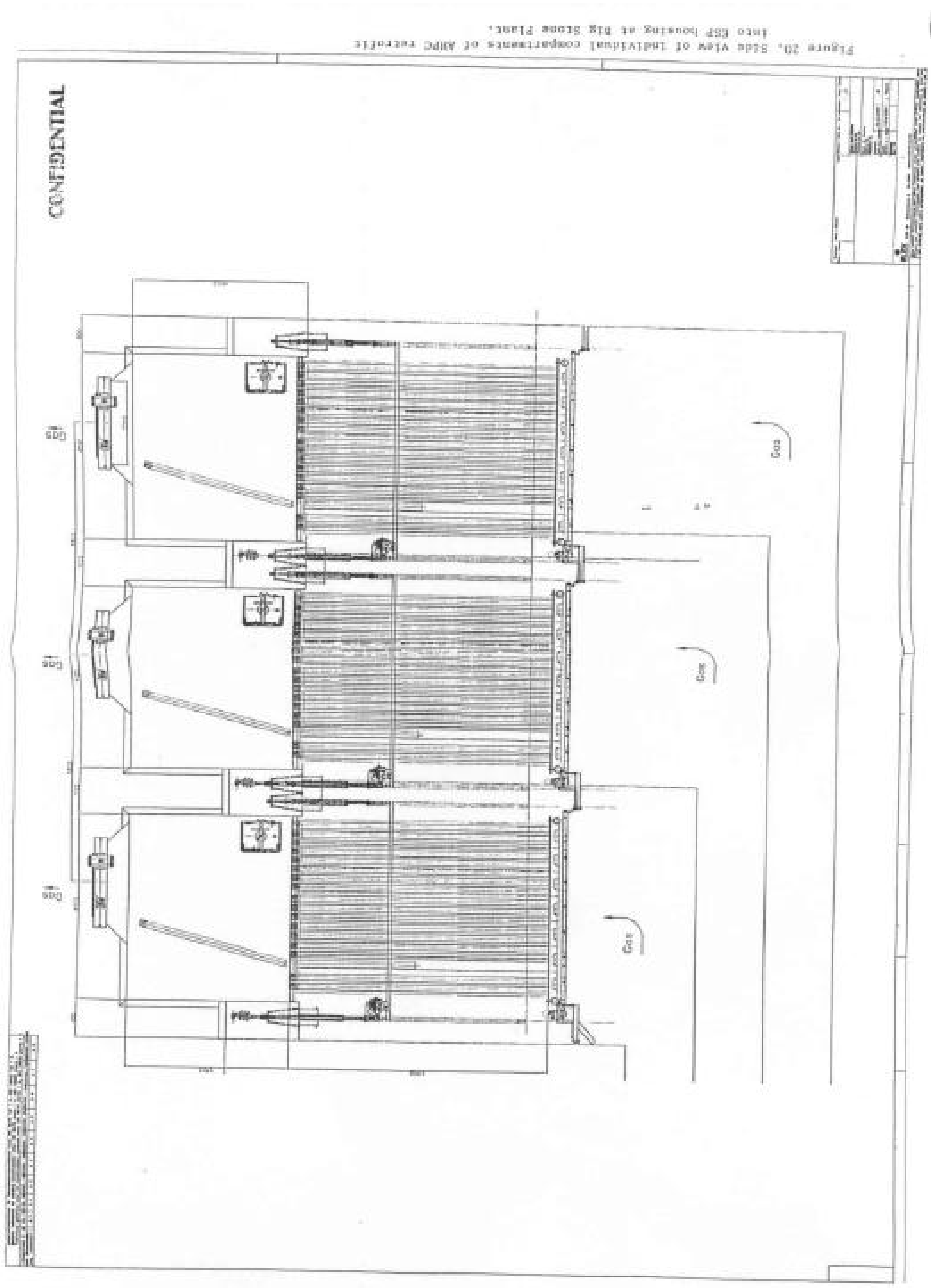


Figure B-2. Conceptual Equipment Drawing of the AHPC (Side View of Individual AHPC Compartments in ESP Housing)

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