



DEPARTMENT OF NATURAL RESOURCES

MISSOURI AIR CONSERVATION COMMISSION

PERMIT TO CONSTRUCT

Under the authority of RSMo 643 and the Federal Clean Air Act the applicant is authorized to construct the air contaminant source(s) described below, in accordance with the laws, rules and conditions as set forth herein.

Permit Number: **122009-002** Project Number: 2009-11-009

Parent Company: Associated Electric Cooperative, Inc.

Parent Company Address: P.O. Box 754, Springfield, MO 65801

Installation Name: Associated Electric Cooperative, Inc. Thomas Hill Energy Center

Installation Number: 175-0001

Installation Address: 5693 Highway F, Clifton Hill, MO 65244

Location Information: Randolph County, S55N, T19, R15W

Application for Authority to Construct was made for:
Construction of equipment associated with the CyClean process to lower mercury emissions from both boilers. This review was conducted in accordance with Section (5), Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required*.

- Standard Conditions (on reverse) are applicable to this permit.
- Standard Conditions (on reverse) and Special Conditions are applicable to this permit.

DEC - 2 2009

EFFECTIVE DATE



DIRECTOR OR DESIGNEE
DEPARTMENT OF NATURAL RESOURCES

STANDARD CONDITIONS:

Permission to construct may be revoked if you fail to begin construction or modification within two years from the effective date of this permit. Permittee should notify the Air Pollution Control Program if construction or modification is not started within two years after the effective date of this permit, or if construction or modification is suspended for one year or more.

You will be in violation of 10 CSR 10-6.060 if you fail to adhere to the specifications and conditions listed in your application, this permit and the project review. In the event that there is a discrepancy between the permit application and this permit, the conditions of this permit shall take precedence. Specifically, all air contaminant control devices shall be operated and maintained as specified in the application, associated plans and specifications.

You must notify the Departments' Air Pollution Control Program of the anticipated date of start up of this (these) air contaminant source(s). The information must be made available within 30 days of actual startup. Also, you must notify the Department of Natural Resources Regional office responsible for the area within which you are located within 15 days after the actual start up of this (these) air contaminant source(s).

A copy of this permit and permit review shall be kept at the installation address and shall be made available to Department of Natural Resources' personnel upon request.

You may appeal this permit or any of the listed special conditions to the Administrative Hearing Commission (AHC), P.O. Box 1557, Jefferson City, MO 65102, as provided in RSMo 643.075.6 and 621.250.3. If you choose to appeal, you must file a petition with the AHC within 30 days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed. If it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the AHC.

If you choose not to appeal, this certificate, the project review and your application and associated correspondence constitutes your permit to construct. The permit allows you to construct and operate your air contaminant source(s), but in no way relieves you of your obligation to comply with all applicable provisions of the Missouri Air Conservation Law, regulations of the Missouri Department of Natural Resources and other applicable federal, state and local laws and ordinances.

The Air Pollution Control Program invites your questions regarding this air pollution permit. Please contact the Construction Permit Unit at (573) 751-4817. If you prefer to write, please address your correspondence to the Missouri Department of Natural Resources, Air Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102-0176, attention: Construction Permit Unit.

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Project No.	2009-11-009

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

The special conditions listed in this permit were included based on the authority granted the Missouri Air Pollution Control Program by the Missouri Air Conservation Law (specifically 643.075) and by the Missouri Rules listed in Title 10, Division 10 of the Code of State Regulations (specifically 10 CSR 10-6.060). For specific details regarding conditions, see 10 CSR 10-6.060 paragraph (12)(A)10. "Conditions required by permitting authority."

Associated Electric Cooperative, Inc. Thomas Hill Energy Center
Randolph County, S55N, T19, R15W

1. Carbon Monoxide (CO) Emission Limitation
 - A. Associated Electric Cooperative, Inc. Thomas Hill Energy Center shall emit less than 1,236 tons of CO from Boiler Unit #1 (EP1) and less than 1,888 tons of CO from Boiler Unit #2 (EP2) in any consecutive 12-month period.
 - B. Associated Electric Cooperative, Inc. Thomas Hill Energy Center shall emit less than 3,024 tons of CO from Boilers Unit #1 and #2 combined (EP1 & 2) in any consecutive 12-month period.
 - C. Compliance with the CO emission limits given in Special Condition 1.A and 1.B for Boilers #1 & 2 shall be demonstrated through the use of the CO Continuous Emissions Monitoring System (CEMS).
 - D. Associated Electric Cooperative, Inc. Thomas Hill Energy Center shall maintain all records required by this permit for not less than five (5) years and shall make them available immediately to any Missouri Department of Natural Resources' personnel upon request.
 - E. Associated Electric Cooperative, Inc. Thomas Hill Energy Center shall report to the Air Pollution Control Program's Enforcement Section, P.O. Box 176, Jefferson City, MO 65102, no later than ten (10) days after the end of the month during which the records from Special Condition Number 1.C indicate that the source exceeds the limitation of Special Conditions No. 1.A and 1.B.
 - F. The requirements of Special Condition 1.A, 1.B and 1.C may be removed upon completion of any of the following and subsequent approval by the Director:
 - 1) Evaluation study as required by Special Condition 2 which demonstrates that boiler operation and emissions will remain the same before and after the application of the CyClean. The demonstration shall include parameter setpoint(s) and/or range(s)

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SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

that can be monitored to demonstrate on a continual basis that boiler operation will remain within the boundaries of normal operation that was demonstrated prior to the application of the CyClean additives.

- 2) Issuance of a Prevention of Significant Deterioration (PSD) permit.
- 3) Permanent cessation of the application of the CyClean additives to the coal.

2. CyClean Evaluation Study Requirement

A. Associated Electric Cooperative, Inc. Thomas Hill Energy Center shall complete a study on the effects of the use of the CyClean coal additives on boiler operation and emissions. The comparison of boiler operations and emissions before and after the start date of application of the CyClean additives shall be conducted for a sufficient length of time in order to account for any variability due to typical boiler operation. The study shall include, but shall not be limited to, the following:

- 1) Comparison of boiler operation before and after application of the CyClean coal additives. The comparison shall include at minimum the maximum output, boiler efficiency and any other key boiler parameters that are necessary to demonstrate boiler performance and the affects of the CyClean additives on its operation.
- 2) Comparison of boiler emissions before and after application of the CyClean coal additives. At minimum, mercury, nitrogen oxides (NO_x) and CO emissions shall be evaluated.
- 3) The dates and duration that the CyClean additives are added to the coal.
- 4) Description of how the CyClean additives were added, quantities added and/or the ratio of CyClean additives to coal.

B. Associated Electric Cooperative, Inc. Thomas Hill Energy Center shall submit the CyClean evaluation study to the Director of the Air Pollution Control Program upon completion of the study as required in Special Condition 2.A but within 30 days after the first twelve months of the first application of the CyClean additives to the coal.

3. Control Device Requirement

Associated Electric Cooperative, Inc. Thomas Hill Energy Center shall control metal HAP emissions from Boiler Unit #1 & 2 using an electrostatic precipitator (ESP). The ESP shall be maintained in accordance with the manufacturer's specifications.

REVIEW OF APPLICATION FOR AUTHORITY TO CONSTRUCT AND OPERATE
SECTION (5) REVIEW

Project Number: 2009-11-009
Installation ID Number: 175-0001
Permit Number:

Associated Electric Cooperative, Inc.
Thomas Hill Energy Center
5693 Highway F
Clifton Hill, MO 65244

Complete: November 4, 2009

Parent Company:
Associated Electric Cooperative, Inc.
P.O. Box 754
Springfield, MO 65801

Randolph County, S55N, T19, R15W

REVIEW SUMMARY

- Associated Electric Cooperative, Inc. Thomas Hill Energy Center has applied for authority to construct equipment associated with the "Cycleclean" process to lower mercury emissions from both boilers located at the facility.
- Hazardous Air Pollutant (HAP) emissions are expected from the application of CyClean Additive A. The HAPs of concern are metal HAPs associated that are contained within the material.
- None of the New Source Performance Standards (NSPS) apply to the application of the CyClean additives.
- None of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) apply to this installation. None of the currently promulgated Maximum Achievable Control Technology (MACT) regulations apply to the application of the CyClean additives.
- The existing electrostatic precipitator is being used to control the metal HAP emissions associated with the application of the CyClean additives. All HAP emissions are below their respective RALs.
- This review was conducted in accordance with Section (5) of Missouri State Rule 10 CSR 10-6.060, Construction Permits Required. Potential emissions of all pollutants are below de minimis levels.
- This installation is located in Randolph County, an attainment area for all criteria pollutants.
- This installation is on the List of Named Installations found in 10 CSR 10-6.020(3)(B), Table 2. The installation's major source level is 100 tons per year and fugitive emissions are counted toward major source applicability.
- Ambient air quality modeling was not performed since potential emissions of the

application are below de minimis levels.

- Emissions testing is not required for the equipment.
- A revision to your Part 70 Operating Permit application is required for this installation within 1 year of equipment startup.
- Approval of this permit is recommended with special conditions.

INSTALLATION DESCRIPTION

Associated Electric Cooperative, Inc. Thomas Hill Energy Center (AECI Thomas Hill) includes three base load coal-fired steam electric generating units – Unit 1, Unit 2, and Unit 3. The maximum gross heat input ratings listed in the Acid Rain Program monitoring plan is 2,180, 3,579, and 8,182 million Btus per hour, respectively. The units utilize Powder River Basin (PRB) coal, but have the option of burning fuel oil. The units currently control particulate matter emissions using an electrostatic precipitator, while selective catalytic reduction (SCR) is utilized year round to control NO_x emissions.

The installation is a major source for both construction and operating permits. AECI Thomas Hill is considered a Part 70 source by operating permits and was issued Permit No. OP1999-169 in November 1999. Part 70 Operating Renewals (Project No. 2007-07-090 and 2004-05-016) are currently under review.

The following permits have been issued to Associated Electric Cooperative, Inc. Thomas Hill Energy Center from the Air Pollution Control Program.

Table 1: Construction Permit History

Permit Number	Issue Date	Description
0278-001	2/6/1978	PSD permit issued by EPA for the construction of a 610 megawatt coal-fired electric generating unit.
0380-011	3/20/1980	Construction of a coal preparation plant and materials handling facility.
0181-002	12/29/1980	Increase in production of coal by 2,680,000 tons per year.
0380-011	1/24/1983	Permit delivery of 750,000 tons of washed coal per year through existing open air coal truck unloading dump to replace heavy machinery and coal piles.
0380-011	6/6/1983	Corrects and supersedes previous amendment 0380-011 issued 1/24/1983. Clarifies that coal will be handled by the open air coal truck unloading dump or by heavy machinery from coal piles.
0380-011	9/23/1987	Modifications to truck dump into hopper, new truck dump transfer conveyor, transfer belt conveyor, collecting belt conveyor, rotary breaker, stockpiles
0380-011	8/12/1988	Relocate rotary breaker from power plant to preparation plant, install transfer belt and collecting belt conveyors for rotary breaker, establish 0.75 acre storage pile, increase coal deliveries to 4,500,000 tons per year, allow deliveries at either preparation plant or power plant
0493-017	4/29/1993	All necessary modifications for fuel switch from high sulfur to low sulfur coal.
0493-017A	6/4/1993	Delete radial stacker for coal transfer.
0493-017A	8/30/1993	Contingent condition to reevaluate dusting from coal transfer operations. Restore dustless unloader requirement omitted from 6/4/1993 amendment.
0596-041	5/24/1996	SO ₃ injection system addition to the Unit 3 precipitator to improve precipitator performance.
0596-041A	10/24/2000	Amendment to 0596-041 to remove SO ₂ emission limitation.

PROJECT DESCRIPTION

AECI Thomas Hill is proposing to burn refined coal in order to reduce emissions of mercury from Unit #1 & #2 boilers at the Thomas Hill Power Plant. The coal is refined by adding a coal additive called CyClean to improve combustion of sub-bituminous coal and remove mercury in cyclone boilers. Typically, Powder River Basin (PRB) coal combustion yields mercury (Hg) species of Hg^0 or Hg^{2+} and only Hg^{2+} can be captured. Additional mercury removal by the CyClean additive occurs by oxidizing the elemental mercury (Hg^0 to Hg^{2+}) and capturing the Hg^{2+} in the native carbon of the ash where it is collected with the particulate emissions in the ESP. In addition to mercury removal, the addition of CyClean can allow for the optimization of the combustion process and allow for the boiler to operate with reduced NO_x if the operator chooses, although the addition of CyClean by itself does not lower NO_x emissions. Lower NO_x emissions are possible because CyClean A improves the bottom slag properties allowing for sustainable operation with deeper combustion staging. When air is redirected to the overfire air (OFA), less oxygen is available at the burner resulting in lower NO_x at the lower section of the boiler where the cyclones are located. Lower oxygen at the burner will result in a higher ratio of CO to CO_2 . However, a properly tuned OFA system converts CO to CO_2 in the upper section of the main boiler (there the OFA ports inject the remaining combustion air). Thus, although CO emissions are not expected to increase, the addition of CyClean could indirectly result in an increase in carbon monoxide emissions.

CyClean has two components: A and B. CyClean Additive A is a granular material, while CyClean Coal Additive B is a liquid. The Additive A is delivered by covered truck and unloaded onto a stockpile. A front-end loader transfers the material from the stockpile to a hopper. From the hopper, the material is transferred to a screw conveyor and delivered via a bucket elevator to the main coal conveyor belt. The Additive B is added to Additive A at the top of the bucket elevator. The CyClean coal additives are then routed along with the coal on the coal conveyor belt to the boilers.

CyClean B contains one of two halide salts in solution: sodium bromide or potassium iodine. Once in the boiler, the salts will thermally decompose in the same way as a native halide in the coal and produce HBr, Br, or the analogous iodine acid/iodine. Total halogens from the CyClean and PRB are below that of bituminous coal. Since Additive B is in a liquid form and contains no VOCs or HAPs, there are no emissions associated with its handling.

CyClean Additive A is added to the coal at a ratio of 0.006 pound of CyClean Additive A to each pound of coal. Based on a coal maximum rate of 281.5 tons per hour, CyClean Additive A will be added at maximum hourly design rate of 1.69 tons per hour.

Because of the potential increase in CO emissions, AECI Thomas Hill will be required to evaluate the affects of the addition of CyClean on boiler operation and emissions. During the evaluation period, CO emissions will be limited to actual CO emission levels plus a de minimis increase of 100 tons per year.

EMISSIONS/CONTROLS EVALUATION

The emission factors used for the handling of CyClean Additive A were obtained from the Environmental Protection Agency (EPA) document AP-42, *Compilation of Air Pollutant Emission Factors*, Fifth Edition, Section 13.2.1, *Paved Roads* (11/2006), Section 13.2.4, *Aggregate Handling and Storage Piles* (11/2006) and Section 13.2.5, *Industrial Wind Erosion* (11/2006).

A mass balance approach was used to determine the amount of HAP emissions from the addition of CyClean Additive A. Per the CyClean manufacturer, a minimum of 40 percent of the manganese is depleted by the slag/bottom ash and thus will not be emitted out the boiler stack. The existing ESP is used to control the metal HAPs associated with the CyClean Additive A with the exception of mercury. The ESP will obtain a control efficiency of greater than 95 percent. Although CyClean is expected to reduce emissions from mercury by 75 percent, no control was attributed to the mercury emissions.

Existing actual emissions were obtained from the 2008 Emission Inventory Questionnaire (EIQ). Potential emissions of the application represent the potential of the equipment associated with the application of the CyClean additives, assuming continuous operation (8,760 hours per year). The following table provides an emissions summary for this project.

Table 2: Emissions Summary (tons per year)

Pollutant	Regulatory De Minimis Levels ¹	Existing Potential Emissions	Existing Actual Emissions (2008 EIQ)	Potential Emissions of the Application	New Installation Conditioned Potential ²
PM ₁₀	15.0	Major	446.1	0.95	N/A
SO _x	40.0	Major	15,100	N/A	N/A
NO _x	40.0	Major	12,120	N/A	N/A
VOC	40.0	Major	169.4	N/A	N/A
CO	100.0	Major	4,486	N/A	<3,024
HAPs	10.0/25.0	Major	125.9	1.82	N/A
Antimony	5.0	N/D	N/D	0.003	N/A
Arsenic	0.005	N/D	N/D	0.007	N/A
Beryllium	0.008	N/D	N/D	0.0003	N/A
Cadmium	0.01	N/D	N/D	0.0004	N/A
Total Chromium	5.0	N/D	N/D	0.30	N/A
Hexavalent Chromium	0.002	N/D	N/D	0.00001	N/A
Lead	0.01	N/D	N/D	0.0015	N/A
Manganese	0.8	N/D	N/D	1.33	N/A
Mercury	0.01	N/D	N/D	0.04	N/A
Nickel	1.0	N/D	N/D	0.14	N/A
Selenium	5.0	N/D	N/D	0.0015	N/A

N/A = Not Applicable; N/D = Not Determined

¹ The regulatory level listed for each individual HAP is the Screen Modeling Action Level (SMAL).

² This limit applies only to Boiler #1 & 2 and may be removed upon completion of evaluative study.

PERMIT RULE APPLICABILITY

This review was conducted in accordance with Section (5) of Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required*. Potential emissions of PM₁₀ are below de minimis levels.

APPLICABLE REQUIREMENTS

Associated Electric Cooperative, Inc. Thomas Hill Energy Center shall comply with the following applicable requirements. The Missouri Air Conservation Laws and Regulations should be consulted for specific record keeping, monitoring, and reporting requirements. Compliance with these emission standards, based on information submitted in the application, has been verified at the time this application was approved. For a complete list of applicable requirements for your installation, please consult your operating permit.

GENERAL REQUIREMENTS

- *Submission of Emission Data, Emission Fees and Process Information*, 10 CSR 10-6.110
The emission fee is the amount established by the Missouri Air Conservation Commission annually under Missouri Air Law 643.079(1). Submission of an Emissions Inventory Questionnaire (EIQ) is required June 1 for the previous year's emissions.
- *Operating Permits*, 10 CSR 10-6.065
- *Restriction of Particulate Matter to the Ambient Air Beyond the Premises of Origin*, 10 CSR 10-6.170
- *Restriction of Emission of Visible Air Contaminants*, 10 CSR 10-6.220
- *Restriction of Emission of Odors*, 10 CSR 10-3.090

SPECIFIC REQUIREMENTS

- *Restriction of Emission of Particulate Matter From Industrial Processes*, 10 CSR 10-6.400
- *Restriction of Emission of Sulfur Compounds*, 10 CSR 10-6.260
- *Maximum Allowable Emissions of Particulate Matter From Fuel Burning Equipment Used for Indirect Heating*, 10 CSR 10-3.060

AMBIENT AIR QUALITY IMPACT ANALYSIS

A Screen 3 modeling analysis was performed to determine if the Risk Assessment Level (RAL) for the following metal HAPs would be exceeded at or beyond the property line of the Associated Electric Cooperative, Inc. Thomas Hill Energy Center. The emission rates for the metal HAPs that exceeded their respective Screening Model Action Level (SMAL) are listed in the table below.

Table 3: Emission Rates for Metal HAPs (grams/second)

Constituent	Emission Rate for Unit 1	Emission Rate for Unit 2
Arsenic	7.096E-05	1.163E-04
Manganese	1.451E-02	2.379E-02
Mercury	3.548E-05	5.815E-05

The stack parameters as provided by the applicant are listed in the following table.

Table 4: Stack Parameters

Stack No.	Height (ft)	Diameter (ft)	Temperature (F)	Velocity (ft/sec)	Distance to closest receptor (ft)
Unit 1	411	16.0	300	300	475
Unit 2	400	16.0	315	315	581

The following table lists the air quality impact for the modeled metal HAPs.

Table 5: Air Quality Impact Analysis

Pollutants	Modeled Impact $\mu\text{g}/\text{m}^3$	RAL $\mu\text{g}/\text{m}^3$	Time Period
Arsenic	0.00010	0.19	8-Hour
	0.00006	0.03	24-Hour
	0.00001	0.002	Annual
Manganese	0.02147	0.89	8-Hour
Mercury	0.0015	0.14	24-Hour
	0.0003	0.07	Annual

As indicated in the above table, the HAP emissions from the addition of CyClean additive are expected to be in compliance with their respective RALs. Please note that mercury emissions and its modeled impact do not take into account the reductions expected by the use of the CyClean additives.

STAFF RECOMMENDATION

On the basis of this review conducted in accordance with Section (5), Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required*, I recommend this permit be granted with/without special conditions.

Susan Heckenkamp
Environmental Engineer

Date

PERMIT DOCUMENTS

The following documents are incorporated by reference into this permit:

- The Application for Authority to Construct form, dated October 10, 2009, received November 4, 2009, designating Associated Electric Cooperative, Inc. as the owner and operator of the installation.
- U.S. EPA document AP-42, *Compilation of Air Pollutant Emission Factors*, Fifth Edition.
- Thomas Hill 1 & 2 for CO data for CyClean” document received via email on November 30, 2009.
- “Permit Support Calcs_ThomasHillCyClean” spreadsheet received via email on October 30, 2009.
- “TH&NM Screen 3 CyCleanA vs. SMAL_RAL” spreadsheet received via email on October 30, 2009.

Mr. Todd A. Tolbert
Environmental Analyst II
Associated Electric Cooperative, Inc.
P.O. Box 754
Springfield, MO 65801

RE: New Source Review Permit - Project Number: 2009-11-009

Dear Mr. Tolbert:

Enclosed with this letter is your permit to construct. Please study it carefully. Also, note the special conditions, if any, on the accompanying pages. The document entitled, "Review of Application for Authority to Construct," is part of the permit and should be kept with this permit in your files. Operation in accordance with these conditions, your new source review permit application and with your amended operating permit is necessary for continued compliance. The reverse side of your permit certificate has important information concerning standard permit conditions and your rights and obligations under the laws and regulations of the State of Missouri.

If you have any questions regarding this permit, please do not hesitate to contact Susan Heckenkamp, at the Departments' Air Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102 or at (573) 751-4817. Thank you for your attention to this matter.

Sincerely,

AIR POLLUTION CONTROL PROGRAM

Kendall B. Hale
New Source Review Unit Chief

KBH:shl

Enclosures

c: Northeast Regional Office
PAMS File: 2009-11-009

Permit Number: