

PERMIT BOOK

STATE OF MISSOURI



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.

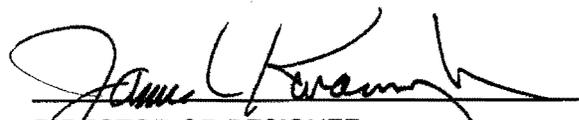
Permit Number: **042010-002** Project Number: 2009-05-030
Parent Company: Curators of the University of Missouri
Parent Company Address: 8 Research Park Development Building, University of Missouri - Columbia, Columbia, MO 65211-3050
Installation Name: University of Missouri – Columbia (MU) Power Plant
Installation Address: Fifth & Stewart, Columbia, MO 65211-2030
Location Information: Boone County, S13, T48N, R13W

Application for Authority to Construct was made for:
Replacement of the existing coal-fired boiler (Boiler 11) with a biomass-fired bubbling fluidized bed boiler (BFB 1) as well as replacement of most of the existing fuel and storage system with a new enclosed fuel handling and storage system. An analysis was conducted for this project that determined the net emissions increase for the project did not exceed the significant level associated with any air pollutant. 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.

APR 05 2010

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 not more than 60 days but at least 30 days in advance of this date. 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, 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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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."

**MU Power Plant
Boone County, S13, T48N, R13W**

1. The conditions of this permit supersede all special conditions found in the previously issued construction permit (Permit Number 0886-004) from the Air Pollution Control Program.
2. Specifications, Operating Limits and Emission Limits for the biomass-fired bubbling fluidized bed boiler (BFB 1)
 - A. The boiler shall be fired with biomass as the primary fuel. Heat input to the main boiler shall not exceed 227 million British thermal units per hour (MMBtu/hr).
 - B. The boiler (BFB 1) shall not use more than 195 million cubic feet (MMcf) per year of natural gas.
 - C. The boiler (BFB 1) shall use no other fuels other than the biofuels listed below and natural gas without receiving prior written authorization from the Air Pollution Control Program.
 - 1) Acceptable biomass fuels include:
 - A) Woody biomass,
 - B) Agricultural fiber by-products,
 - C) Energy crops which include grasses and fiber crops,
 - D) Biomass fiber by-products including waste papers and fiber from biofuel production, and
 - E) A blend of any of the above fuels.
 - 2) Unacceptable biomass fuels include, but are not limited to:
 - A) Peat
 - B) Waste oil
 - C) Farm chemicals
 - D) Pesticide containers
 - E) Contaminated soil*
 - F) Demolition waste, except for untreated/unstained/unpainted clean wood,

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SPECIAL CONDITIONS:

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

- G) Treated wood [chromated copper arsenate(CCA), pentachlorophenol (PCP), painted and stained]
 - H) Contaminated feedstock*
 - I) Contaminated agricultural grains*
 - J) Waste from farms from an open dump
 - K) Tire derived fuel, tires
 - L) Non-agricultural industrial process wastes
- *Contaminated means it is no longer fit for its intended use due to contact with some chemical.

- D. The following controls will be utilized to reduce emissions from the the biomass-fired bubbling fluidized bed boiler (BFB 1). MU Power Plant shall effectively operate:
 - 1) Fabric filtration system (baghouse) for the control of filterable particulate matter less than ten (10) microns in diameter (filterable PM₁₀) and filterable particulate matter (PM) emissions.
 - 2) Selective Non-Catalytic Reduction (SNCR) for the control of nitrogen oxide (NO_x) emissions, as necessary, to comply with Special Condition 2.E.3).

- E. The following emission limits apply to the biomass-fired bubbling fluidized bed boiler (BFB 1):
 - 1) MU Power Plant shall emit less than ten (10.0) tons individually or twenty-five (25.0) tons combined of Hazardous Air Pollutants (HAPs) from the biomass-fired bubbling fluidized bed boiler (BFB 1) in any consecutive 12-month period.
 - 2) MU Power Plant shall emit less than 111.6 tons of nitrogen oxides (NO_x) from the biomass-fired bubbling fluidized bed boiler (BFB 1) in any consecutive 12-month period.
 - 3) MU Power Plant shall not discharge the following pollutant into the atmosphere in excess of the listed amounts:
 - A) PM₁₀ filterable – 1.14 pounds per hour
 - B) PM condensable – 3.86 pounds per hour
 - C) Carbon monoxide (CO) – 68.1 pounds per hour
 - 4) If an optional CO CEMS is installed, MU Power Plant shall comply with the following limit in lieu of Special Condition 2.E.3)C). MU Power Plant shall emit less than 298.28 tons of CO from the biomass-fired bubbling fluidized bed boiler (BFB 1) in any consecutive 12-month period.
 - 5) MU Power Plant shall emit less than 0.264 pounds of 2,3,7,8-Tetrachlorodibenzo-p-dioxins (TCDD) toxic equivalents (TEQ) from the biomass-fired bubbling fluidized bed boiler (BFB 1) in any consecutive 12-month period.

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SPECIAL CONDITIONS:

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

3. Specifications, Operating Limits and Emission Limits for the Fuel Handling Fugitive Control System (EP38 through EP43)
 - A. MU Power Plant shall not operate any equipment listed in Table 1 in excess of 4,000 hours in any consecutive 12-month period.
 - B. MU Power Plant shall enclose and vent each PM₁₀ point source listed in Table 1 to either a baghouse, bin vent or filter receiver. The enclosure of the emissions units shall be constructed and maintained such that no visible emissions are allowed to occur from these sources except through the gases exiting from the baghouse, bin vent or filter receiver.

Table 1: Fuel Handling Point Sources Requiring PM₁₀ Control

ID #	Description	Maximum Flowrate (dscfm*)
EP38	DC1 Coal Receiving/Storage	3,000
EP39	DC2 Alternative Fuel/Emergency Coal	6,000
EP40-1	DC3A Coal/Alternate Fuel Reclaim System A	6,000
EP40-2	DC3B Coal/Alternate Fuel Reclaim System B	6,000
EP41	DC4 Biomass Receiving	9,000
EP42-1	DC301 Coal Silo	1,000
EP42-2	DC302 Coal Silo	1,000
EP42-3	BV601 Biomass Silo	1,500
EP42-4	BV602 Biomass Silo	1,500
EP43	FR5 Coal/Alternate Fuel Dust Return Pneumatic System	1,000

*dscfm = dry standard cubic feet per minute

- C. MU Power Plant shall conduct a detailed visual inspection of the enclosures listed in Table 1 at least once each week to ensure compliance with Special Condition 3.B. A record shall be maintained acknowledging that the enclosures have been inspected.
- D. MU Power Plant shall not emit more than 0.010 grains per dry standard cubic foot (gr/dscf) of filterable PM₁₀ from any emission point listed in Table 1.
- E. MU Power Plant shall not exceed the flowrate to the control device for any emission point listed in Table 1.
- F. The baghouses, bin vents and filter receiver shall be operated and maintained in accordance with the manufacturer's specifications. The baghouses, bin vents and filter receiver shall be equipped with a gauge or meter, which indicates the pressure drop across the control device. These gauges or meters shall be located such that the Department of Natural Resources' employees may easily observe them.

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

- G. A minimum of 15% of total filters for the baghouses, bin vents and filter receiver shall be kept on hand at all times to serve as replacement filters. The bags shall be made of fibers appropriate for operating conditions expected to occur (i.e. temperature limits, acidic and alkali resistance, and abrasion resistance).
 - H. MU Power Plant shall monitor and record the operating pressure drop across the baghouses, bin vents and filter receiver at least once every 24 hours either manually or recorded electronically in the facility's process control system. The operating pressure drop shall be maintained within the design conditions specified by the manufacturer's performance specifications.
 - I. MU Power Plant shall maintain an operating and maintenance log for the baghouses, bin vents and filter receiver which shall include the following:
 - 1) Incidents of malfunction, with impact on emissions, duration of event, probable cause, and corrective actions; and
 - 2) Maintenance activities, with inspection schedule, repair actions, and replacements, etc.
 - 3) A written record of regular inspection schedule, the date and results of all inspections including any actions or maintenance activities that result from that inspection.
4. Compliance Testing
- A. Initial performance testing shall be conducted for each different biofuel or biofuel blend in order to establish emission factors for aggregate HAPs and individual HAP in pounds per ton and pounds per MMBtu. These emission factors established in the performance testing shall be used in Attachments A and B in order to show compliance with special conditions 2.E.1) and 2.E.5).
 - B. Initial performance testing shall be conducted for each different biofuel or biofuel blend in order to verify that the emission rates listed in 2.E.3)A) and 2.E.3)B) are not exceeded from the biomass boiler (BFB 1) stack. In addition, testing shall be conducted on direct particulate matter less than 2.5 microns in diameter (PM_{2.5}). MU Power Plant shall show continued compliance with condition 2.E.3)A) by following the applicable monitoring or testing requirements listed in the Compliance Assurance Monitoring (CAM) plan.

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

- C. The following HAPs shall be quantified in order to be used in demonstrating compliance with Special Condition 2.E.1):
- 1) Acetaldehyde
 - 2) Benzene
 - 3) Chlorine
 - 4) Dichloromethane
 - 5) Formaldehyde
 - 6) Hydrogen Chloride (HCl)
 - 7) Methanol
 - 8) Styrene
 - 9) Toluene
- D. Compliance with the NO_x emission limits given in Special Condition 2.E.2) for the biomass boiler shall be demonstrated through the use of the CEMS.
- E. Initial performance testing shall be conducted for each different biofuel or biofuel blend in order to verify that the CO emission rate listed in 2.E.3)C) is not exceeded from the biomass boiler (BFB 1) stack. The MU Power Plant shall conduct CO stack testing every five (5) years for each biofuel or biofuel blend in order to verify continued compliance with Special Condition 2.E.3)C).
- F. Optional: The MU Power Plant may install a CO CEMS to show compliance with the CO emission limit given in Special Condition 2.E.4). In the event that the MU Power Plant installs a CO CEMS, performance testing for CO as called for by Special Condition 4.E will not be required.
- G. In order to obtain a waiver from all or a portion of compliance testing as required in Special Condition 4.A, 4.B and/or 4.E, the MU Power Plant may submit an emissions analysis to the Department of Natural Resources. The analysis must contain sufficient documentation to show compliance with the emissions limits and/or rates specified in Special Condition 2.E while burning the new biofuel or biofuel blend. Upon review of the supplied documentation, the Department will provide written authorization in the event that they agree with the assessment provided. The emissions analysis documentation shall include at minimum the following:
- 1) A fuel analysis of the biomass including at minimum: moisture content, ash content, higher heating value, sulfur content, and chlorine content;

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

- 2) An analysis of each pollutant's expected potential emissions. Testing, studies or other resources may be used to make the justification for the proposed potential emissions.
 - 3) Optional: A mass balance method approved by the Department of Natural Resources showing compliance may be used in lieu of testing.
- H. Optional: MU Power Plant may establish an emissions profile for each specific HAP and filterable PM₁₀. To establish the emission profile, MU Power Plant shall conduct a minimum of one stack test per biofuel or biofuel blend conducted in accordance to Special Condition 4.A and 4.B is required. Based upon biomass sampling and the associated stack testing, the profile and a current biomass analysis may be used to show continued compliance with special condition 2.E.1) and 2.E.3)A).
- I. MU Power Plant shall conduct stack testing of the baghouses, bin vents, and filters listed below in order to verify compliance with special condition 3.D and 3.E.
- 1) Baghouse at coal receiving and storage (EP38)
 - 2) Baghouse at alternative fuel/emergency coal (EP39)
 - 3) One of two baghouses at coal/alternative fuel reclaim system (EP40-1 or EP40-2)
 - 4) Baghouse at biomass receiving (EP41)
 - 5) One of two baghouses at the coal silos (EP42-1 or EP42-2)
 - 6) One of two baghouses at the biomass silos (EP42-3 or EP42-4)
 - 7) Baghouse at Coal /Alternate Fuel Dust Return Pneumatic System Filter Receiver (EP43)
- J. The performance/certification tests shall be performed within 90 days of achieving the maximum production rate, but no later than 180 days after initial startup.
- K. The date on which performance/certification tests are conducted and the date on which the initial and subsequent stack tests are conducted shall be pre-arranged with the Air Pollution Control Program a minimum of 30 days prior to the proposed test so that a pretest meeting may be arranged if necessary, and to assure that the test date is acceptable for an observer to be present. A completed Proposed Test Plan form (copy enclosed) may serve the purpose of notification and must be approved by the Air Pollution Control Program prior to conducting the required emission testing.

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

- L. Two (2) copies of a written report of the performance test results shall be submitted to the Director of the Air Pollution Control Program within 30 days of completion of any required testing. The report must include legible copies of the raw data sheets, analytical instrument laboratory data, and complete sample calculations from the required EPA method for at least one (1) sample run.
 - M. If the performance testing required by Special Condition 4.A, 4.B and 4.E of this permit indicates that any of the emission limits specified in Special Condition 2.E.3) is being exceeded, MU Power Plant must propose a plan to the Air Pollution Control Program within 30 days of submitting the performance test results. This plan must demonstrate how MU Power Plant will reduce the emission rates below those stated in Special Condition 2.E.3). MU Power Plant shall implement any such plan immediately upon its approval by the Director.
5. Pre-Authorization of Additional Biomass Fuel Testing
- A. MU Power Plant is pre-authorized to conduct test burns of acceptable biomass fuels as stated in Special Condition 2.C.1) for the purposes of testing technical feasibility and developing emission factors.
 - B. The test burn shall not exceed 90 days from the first day the additional biomass is burned in BFB 1
 - C. MU Power Plant shall notify the Enforcement Section of the Air Pollution Control Program of any test burns. Performance testing during test burns shall be conducted in accordance with Special Condition 4.K and 4.L. Records of the amounts of biomass burned as well as the dates of the test burns shall be maintained.
6. Haul Road Silt Loading Testing and Maintenance Requirement
- A. The silt loading on the haul road shall not exceed 2.4 grams per square meter.
 - B. MU Power Plant shall develop, implement and maintain a Fugitive Dust Control Plan to control emissions from the haul road that insures compliance with Special Condition 6.A. The plan shall contain the following components:
 - 1) MU Power Plant shall conduct a survey of the haul roads on days when there is truck traffic at the facility to determine if visible emissions are being generated and are leaving the property.
 - 2) MU Power Plant shall maintain a daily log of all maintenance, corrective actions and observations from the surveys.

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SPECIAL CONDITIONS:

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

- C. Testing shall be conducted in accordance with method ASTM-C-136. A summary of this method is found in AP-42 Appendix C.
 - D. Testing shall be conducted once a quarter for four quarters following the issuance of this permit. If these four tests demonstrate compliance with Special Condition 6.A, no further testing is required.
 - E. If the performance testing required by Special Condition 6.C and 6.D of this permit indicates that the silt loading specified in Special Condition 6.A is being exceeded, MU Power Plant must amend the Fugitive Dust Control Plan and submit to the Air Pollution Control Program within 30 days of submitting the performance test results. The amended plan must demonstrate how MU Power Plant will reduce the silt loading below those stated in Special Condition 6.A MU Power Plant shall implement any such plan immediately upon its approval by the Director.
7. If the results of the performance testing shows that the emission rates for filterable PM₁₀, condensable PM, NO_x, or CO are greater than those used in the emissions analysis herein, then MU Power Plant shall evaluate what effects these higher emission rates would have had on the permit applicability of this project. MU Power Plant shall submit the results of any such evaluation in a timely manner for Air Pollution Control Program review and approval.
8. Recordkeeping and Reporting
- A. MU Power Plant shall maintain a record of emission verification data for all applicable pieces of equipment including CEMs data.
 - B. MU Power Plant shall maintain a record of fuel input to the biomass boiler (BFB 1) and have monthly fuel analysis available to include higher heat value (HHV) for demonstrating compliance with Special Condition 2.A.
 - C. MU Power Plant shall maintain a record of natural gas used in the biomass boiler to demonstrate compliance with Special Condition 2.B.
 - D. MU Power Plant shall maintain an operational log, which shall detail each startup, shutdown, and malfunction of the biomass boiler (BFB 1) and associated pollution control systems. This operations log shall include a running total of the hours per year the biomass boiler is on-line and a record of the amount and type of biomass.
 - E. MU Power Plant shall maintain inspection, maintenance, and repair log(s) for the biomass boiler (BFB 1).

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SPECIAL CONDITIONS:

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

- F. MU Power Plant shall record at minimum the analysis of higher heating value, ash, and moisture content of monthly fuel samples composited weekly of biomass that is delivered to the installation, using a sample that is collected in a manner representative of the month's shipment. Compliance with this condition may be demonstrated by recording the analytical results from the fuel supplier.
 - G. MU Power Plant shall maintain a log for each operational unit of the fuel handling system that includes a running total of the hours per year the associated dust collectors are in use.
 - H. MU Power Plant shall maintain weekly records of visual inspections of the fuel handling system as specified in Special Condition 3.C and pressure drop across the control devices as specified in Special Condition 3.H.
 - I. Attachment A and Attachment B or equivalent forms approved by the Air Pollution Control Program shall be used to demonstrate compliance with Special Conditions 2.E.1) and 2.E.5).
 - J. MU Power Plant shall maintain a log of the haul roads as specified in Special Condition 6.B.
 - K. MU Power Plant shall maintain all records required by this permit for not less than 5 years and shall make them available immediately to any Missouri Department of Natural Resources' personnel upon request.
 - L. MU Power Plant shall report to the Air Pollution Control Program's Enforcement Section, P.O. Box 176, Jefferson City, MO 65102, no later than 10 days after the end of the month during which operation of equipment at this installation is not in accordance with any operational limitation or condition established by this permit.
9. Shut Down of Existing Emission Units and Operations at Installation
- A. MU Power Plant shall render Boiler 11 (B11) and Cooling Towers CT6, CT7, CT8 and CT9 inoperable and shall discontinue the usage of these emission units before the date all shakedown related activities for the new biomass-fired bubbling fluidized bed boiler (BFB 1) and new enclosed fuel handling and storage system being added under this permit have been completed and becomes operational. Boiler 11 (B11) and Cooling Towers CT6, CT7, CT8 and CT9 may not be operated or utilized after the new biomass-fired bubbling fluidized bed boiler (BFB 1) and new enclosed fuel

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SPECIAL CONDITIONS:

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

handling and storage system becomes operational without first obtaining a New Source Review permit or a No Permit Required determination from the Air Pollution Control Program.

- B. MU Power Plant shall notify the Air Pollution Control Program's Enforcement Section, P.O. Box 176, Jefferson City, Missouri 65102, no later than 15 days after the following events occur:
- 1) The date of start-up of the new biomass-fired bubbling fluidized bed boiler (BFB 1),
 - 2) The date the new enclosed fuel handling and storage system becomes operational,
 - 3) The date the shake down period ends or 180 days after initial start-up of the new system following complete installation of the new system, whichever is sooner, and
 - 4) The date Boiler 11 (B11) and Cooling Towers CT6, CT7, CT8 and CT9 have been rendered inoperable and/or discontinued.

10. Amendment(s) to this Permit
MU Power Plant may at any time request an amendment to the permit in accordance with 10 CSR 10-6.060 (10)(B) in order to make changes such as a removal of an emission or operational limit. MU Power Plant shall supply sufficient information such as stack testing or other supporting documentation such that the Department of Natural Resources' staff can process the amendment request.

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

Project Number: 2009-05-030
Installation ID Number: 019-0004
Permit Number:

University of Missouri – Columbia (MU)
Power Plant
Fifth & Stewart
Columbia, MO 65211-2030

Complete: May 15, 2009

Parent Company:
Curators of the University of Missouri
8 Research Park Development Building
University of Missouri - Columbia
Columbia, MO 65211-3050

Boone County, S13, T48N, R13W

REVIEW SUMMARY

- MU Power Plant has applied for authority to replace an existing coal-fired boiler (Boiler 11) with a biomass-fired bubbling fluidized bed boiler (BFB 1) as well as replacement of most of the existing fuel and storage system with a new enclosed fuel handling and storage system. An analysis was conducted for this project that determined the net emissions increase for the project did not exceed the significant level associated with any air pollutant.
- Hazardous Air Pollutant (HAP) emissions are expected from the biomass-fired bubbling fluidized bed boiler (BFB 1). The main HAPs of concern from this process are acetaldehyde, benzene, chlorine, dichloromethane, formaldehyde, hydrogen chloride, styrene and toluene.
- 40 CFR Part 60, Subpart Db, *Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units*, of the New Source Performance Standards (NSPS) applies to biomass-fired bubbling fluidized bed boiler.
- 40 CFR Part 60, Subpart Y, *Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units*, of the New Source Performance Standards (NSPS) does not apply to the new fuel handling and storage system since the system will neither crush nor dry coal.
- None of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) or currently promulgated Maximum Achievable Control Technology (MACT) regulations apply to the proposed equipment. The MU Power Plant has elected to limit individual and combined HAPs to below 10 and 25 tons per year, respectively.
- Baghouses, bin vents and a filter receiver are being used to control PM₁₀ emissions from the new biomass boiler and the fuel handling system. A selective non-catalytic reduction (SNCR) system will be used as necessary to control NO_x emissions from the biomass boiler.

- MU Power Plant is an existing major source for criteria pollutants. A net emissions increase analysis was submitted for PM₁₀, NO_x and CO in which the facility proposed to remove Boiler 11 and the existing fuel handling system at the installation. This net emissions increase analysis demonstrated that this project would not exceed the significant threshold associated with major review for these pollutants. Therefore, this review was conducted in accordance with Section (5) of Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required*.
- This installation is located in Boone County, an attainment area for all criteria air pollutants.
- This installation is on the List of Named Installations [10 CSR 10-6.020(3)(B), Table 2], as a fossil fuel fired steam electric plant of more than 250 million British thermal units per hour (Btu/hr).
- Ambient air quality modeling was not performed since potential emissions of the application are below de minimis levels.
- Emissions testing is required for the new equipment in this project.
- 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

The University of Missouri - Columbia (MU) owns and operates a Combined Heat and Power Plant in Columbia, MO, Boone County, that produces steam for electric generation and thermal energy for campus use.

This installation is an existing major source. A Part 70 operating permit (#OP2009-004) was issued to this installation in February of 2009.

The following construction permits have been issued to MU Power Plant from the Air Pollution Control Program.

Table 3: Previously Issued Construction Permits

Permit Number	Description
0886-004	Installation of Boiler 11.
0294-018	Installation of emergency generator for North Well.
0494-020	Installation of Boiler 12.
0296-007	Installation of emergency generator for Southwest Well and twin fuel oil storage tanks.
1096-021	Replacement IC engine for East Well.
0697-002	Installation of solvent-based parts washer.
072000-005	Installation of turbine and back-up diesel generator.
042007-019	Temporary permit to burn biomass fuel in boiler.
032008-002	The replacement of four (4) existing cooling towers with a new relocated cooling tower and a closed loop cooling system cooling tower.
042007-019A	Addition of a feedwagon for temporary burning of biomass.
032008-002A	Amendment to remove the closed loop heat-exchanger cooling tower permitted in Permit No. 032008-002 and to lower the drift loss limit to less than 0.0010% of the water circulation for the remaining cooling tower.

PROJECT DESCRIPTION

The MU Power Plant (MU) owns and operates a Combined Heat and Power Plant in Columbia, Missouri that produces steam for electric generation and thermal energy for campus use. MU is proposing to replace an existing coal-fired boiler (Boiler 11) with a new biomass-fired bubbling fluidized bed boiler (BFB 1). The existing boiler will be retired as part of this project. MU is also proposing to replace and upgrade a significant portion of the existing fuel handling and storage system currently serving all boilers with a new enclosed fuel handling and storage system. Fuel feed capacities to existing boilers will not be changed.

Biomass-Fired Bubbling Fluidized Bed Boiler (EP19):

The proposed primary fuel for the new boiler is wood including, but not limited to, wood chips and ground wood waste. Other forms of biomass are also proposed to be used as fuel and will include, but not limited to, grasses, corn stover, waste paper and other similar biomass fuels. The new boiler (BFB 1) will have a design steam production rate of 150,000 pounds per hour and will require approximately 227 million British thermal units per hour (MMBtu/hr) heat input. It will be capable of operating on 100 percent biomass and will use natural gas as a start-up and supplementary fuel. The natural gas will be used during periods of startup, flame stabilization, emissions testing or in the event of an interruption to the ability to provide solid fuel to the boiler. Natural gas usage in the boiler is limited to 10% annual capacity as per the NSPS and Special Condition 2.B. The exhaust from BFB 1 will be routed to an existing fabric filter baghouse that was associated with Boiler 11 for particulate control. An SNCR system will be used as necessary to reduce NO_x emissions.

Fly Ash Conveying & Unloading:

The potential emissions from fly ash conveying and unloading are based on the amount of fly ash generated by the new boiler (BFB 1), assuming that 99% of the ash is captured by the baghouse and then conveyed and unloaded out of the plant for off-site disposal. The amount of fly ash generated is expected to equal approximately 1,585 pounds per hour uncontrolled.

Fuel Handling Dust Collectors (EP38 – EP43):

The new fuel handling system will consist of the equipment listed in Table 1. The fuel feed capacities to the existing boilers will not be changed. The conveyance of fuel to the existing boiler day bunkers remains the same as currently installed, two 100 ton per hour redundant conveyors in which only one conveyor can operate at a time. The limiting capacity for the existing boilers is the heat input to the boilers. Since the fuel burn rate of the boilers is much less than the capacity of the material handling system to supply the indoor storage bunkers; the material handling system will not need to operate continuously. MU has taken a limit on the hours of operation of the fuel handling system at 4,000 hours per year.

Fuel Unloading (EP45 – EP47):

The maximum fuel unloading rates for coal (EP45), tire-derived fuel (TDF) (EP46), and biomass (EP47) are based on the maximum heat input of the boilers and the heat

content of the fuel. The total feed rate for coal to Boilers 7 through 10 is estimated to be 724 tons per day. Maximum consumption of TDF or wood chips for these boilers is estimated to be 10 to 15 percent by mass of the total coal consumption which equates to approximately 110 tons per day. The unloading rate of wood chips is based on the maximum consumption by BFB 1 at 495 tons per day.

Biomass and Fly Ash Haul Road Traffic:

Haul road traffic emissions are based on the maximum amount of biomass, TDF and coal that can be consumed by all boilers. Fly ash disposal traffic is based on the maximum amount of fly ash that will be collected by the baghouse controlling PM₁₀ emissions from the biomass boiler.

NET EMISSIONS INCREASE ANALYSIS

A net emissions increase analysis examines all the emission increases and decreases that have occurred at the installation for the air pollutants of concern during a contemporaneous time period. The amount of these emission increases and decreases are determined by calculating the actual emissions (average of a representative two-year period), if available. Typically, if there are not two years of actual emissions data for an emissions unit, the potential emissions for the unit are used instead.

After the netting analysis has determined the amount of actual or potential emissions for all of the units where increases and decreases have occurred, or will occur during this period, the increases are added together and the decreases are subtracted from this total. If the resulting level of emissions from the netting are below the significant level for that air pollutant, then the project will be evaluated as a de minimis review instead of a major (PSD) review.

Contemporaneous emission changes are evaluated for the period beginning 5 years prior to the date construction on the project began through the date the new equipment actually starts operations. Construction on the new boiler is expected to start in late 2010 with a startup date scheduled for mid-2012. The contemporaneous period for this netting review is therefore determined to be between the dates November 2005 to April 2012.

In the netting analysis submitted by the company, all the emission increases and decreases that have occurred at the installation during the contemporaneous period were examined as well as the potential emissions of the new emission units. The following is a summary of the contemporaneous decreases and increases that will occur:

- MU plans to remove Boiler 11 and the existing fuel handling system. Additional emissions associated with Boiler 11, including truck traffic and fly ash conveying and unloading are also taken into account as emission decreases. The baseline actual emissions used for these emission units are taken from the 24-month time period of April 2006 to March 2008.
- Permit 032008-002 issued in March of 2008 allowed for the construction of two (2) cooling towers. One tower is a replacement for four (4) aging towers serving the steam turbines and the other is a closed loop heat-exchanger cooling tower

on the roof of the power plant building. The amendment issued in June of 2009 removed the closed loop heat-exchanger cooling tower from the permit (032008-002) and lowered the drift loss limit to less than 0.0010% of the water circulation for the remaining cooling tower. The replacement of the power plant cooling towers with a new cooling tower is occurring during the contemporaneous period and is not subject to PSD. Therefore, the old cooling towers (CT6, CT7, CT8 & CT9) constitute contemporaneous decreases and the new cooling tower (EP33) is a contemporaneous increase.

- The lime storage silo was installed in 2006 and operation of the new silo began in January 2007. The lime silo's potential emissions (EP32) are a contemporaneous increase.
- A new natural gas-fired engine (South Well, EP31) began operation in April of 2006 and is a contemporaneous increase.

Evaluation of emissions increases from the current project was also conducted. Installation of the new biomass boiler including emissions associated with fly ash conveying and unloading, fuel unloading and biomass hauling as well as the new fuel handling system that feeds all boilers caused an increase in potential PM₁₀ emissions above de minimis levels. In order to obtain a new emission increase below de minimis levels, limitation on hours of operation were taken for the biomass boiler and the new fuel handling system. The results of this net emission increase analysis for NO_x, PM₁₀ and CO are provided in Table 4.

Table 4: Netting Calculation (tpy)

		NO _x	PM ₁₀	CO
Contemporaneous Decreases	Boiler 11 (EP11)	(72.71)	(16.40)	(310.52)
	Truck Traffic to Boiler 11		(0.27)	
	Fly ash Conveying (EP12)		(0.04)	
	Fly ash Unloading (EP13)		(0.12)	
	Existing Fly ash Haul Road Traffic - Boiler 11		(0.001)	
	Fuel Handling (EP01, EP02A, EP02B, EP04)		(1.72)	
	Cooling Towers (CT6, CT7, CT8, CT9)		(6.51)	
Project Emissions	BFB 1 (EP19)	111.60	21.87	298.28
	Fuel Handling Dust Collectors (EP38-EP43)		5.74	
	Fly ash Conveying (EP12)		0.02	
	Fly ash Unloading (EP13)		0.05	
	Fly ash Haul Road Traffic from BFB 1		0.03	
	Fuel Unloading (EP44-EP46)		0.94	
	Biomass Hauling (EP47)		0.75	
Contemporaneous Increases	South Well Engine (EP31)	1.10	0.002	0.084
	Lime Silo (EP32)		0.02	
	Cooling Tower (EP33)		4.52	
	Increase (Decrease)	39.99	8.88	(12.16)
	PSD Threshold	40	15	100

EMISSIONS/CONTROLS EVALUATION

Biomass-Fired Bubbling Fluidized Bed Boiler (EP19):

The emission factors for all pollutants used for the boiler, with the exception of some

HAPs, CO, NO_x and H₂SO₄ were obtained from the Environmental Protection Agency (EPA) document AP-42, *Compilation of Air Pollutant Emission Factors*, Fifth Edition, Section 1.6, *Wood Residue Combustion in Boilers* (September 2003). The remaining HAP emission factors were obtained from the National Council for Air and Stream Improvement (NCASI) Technical bulletin No. 858, Table 20A. The NACSI paper reassessed emission factors for many HAPs based on data pertaining to only those boilers that were considered relevant to the burning of wood residues in forest products industry boilers. Although total HAP potential emissions are estimated to be less than 25 tons per year, this permit is covering a variety of biomass fuels. In order to verify that total HAPs remain below 25 tons per year, a limitation was put into the permit. Emissions of CO are based on vendor estimates. H₂SO₄ emissions assume that 10% of SO₂ emissions are converted to SO₃ and 100% of SO₃ is converted to H₂SO₄. Emissions of NO_x will be limited in order to remain below major source levels for the project. The existing baghouse system for Boiler 11 will be used to control PM₁₀ emissions at 99% efficiency. An SNCR is being used, as necessary, to control NO_x emissions from the boiler. Potential emissions of this system are based on 8,760 hours per year of operation.

Fly ash Conveying and Unloading (EP12, EP13)

The emission factors used for fly ash conveying and unloading are taken from FIRE (SCC# 3-05-011-07 and 3-05-011-10)

Fuel Handling Dust Collectors (EP38 – EP43):

The new fuel handling system will be enclosed and all particulate matter generated at transfer points will be captured and controlled by baghouses, bin vents or a filter receiver to a level of 0.010 grains per dry standard cubic foot (gr/dscf) of air exhausted. Potential emissions of this system are based on 4,000 hours per year of operation and the flowrates listed in Table 1.

Fuel Unloading (EP44-EP46):

Emissions were calculated for unloading to the storage system for TDF and biomass using EPA document AP-42, Fifth Edition, Section 13.2.4, *Aggregate Handling and Storage Piles* (November 2006). Emissions for coal unloading are based on FIRE (SCC # 3-05-010-08).

Biomass (EP47) and Fly ash Haul Road Traffic:

The emission factors used for haul road traffic associated with biomass delivery and fly ash disposal were obtained from the AP-42, Fifth Edition, Section 13.2.1, *Paved Roads* (11/2006). A silt loading of 2.4 g/m² was used in the calculations and will be verified with silt load testing.

The following table provides an emissions summary for this project. The existing potential emissions were taken from Construction Permits 032008-002. The existing actual emissions were taken from the 2008 Emission Inventory Questionnaire (EIQ). Potential emissions of the application represent the potential of the new equipment, assuming 4,000 hours of operation for the new fuel handling system and all other equipment operating continuously (8,760 hours per year).

Table 5: Emissions Summary (tons per year)

Pollutant	Regulatory De Minimis Levels ¹	Existing Potential Emissions	Existing Actual Emissions (2008 EIQ)	Potential Emissions of the Application	Project Conditioned Potential
PM ₁₀	15.0	Major	106.84	29.41	N/A
SO _x	40.0	Major	8,884.75	24.86	N/A
NO _x	40.0	Major	423.97	111.61	<108.9
VOC	40.0	Major	4.78	16.90	N/A
CO	100.0	Major	681.51	298.28	N/A
H ₂ SO ₄	7.0	N/D	N/D	4.23	N/A
HAPs ²	10.0/25.0	Major	46.85	23.42	<10.0/25.0
Acetaldehyde	9.0	N/D	N/D	0.23	N/A
Benzene	2.0	N/D	N/D	0.27	N/A
Chlorine	0.10	N/D	N/D	0.79	N/A
Dichloro-methane	10.0	N/D	N/D	0.35	N/A
Formaldehyde	2.0	N/D	N/D	0.71	N/A
n-Hexane	10.0	N/D	N/D	0.29	N/A
Hydrogen chloride	10.0	N/D	N/D	18.89	<10.0
Methanol	10.0	N/D	N/D	0.86	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 All individual HAPs with emissions greater than 0.2 tpy are listed in the above table. For a complete list, see the project's emission calculations.

PERMIT RULE APPLICABILITY

This review was conducted in accordance with Section (5) of Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required*. A net emissions increase analysis was submitted for PM₁₀, NO_x and CO in which the company proposed to remove Boiler 11 and the existing fuel handling system at the installation. This net emissions increase analysis demonstrated that this project would not exceed the significant threshold associated with major review for these pollutants.

APPLICABLE REQUIREMENTS

MU Power Plant 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

- *New Source Performance Regulations*, 10 CSR 10-6.070 – *New Source Performance Standards (NSPS) for Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units*, 40 CFR Part 60, Subpart Db
- *Restriction of Emission of Sulfur Compounds*, 10 CSR 10-6.260

AMBIENT AIR QUALITY IMPACT ANALYSIS

A Screen 3 modeling analysis was performed to determine if the Risk Assessment Level (RAL) for the following HAPs emitted from the biomass boiler would be exceeded at or beyond the property line of the MU Power Plant. The emission rates for the HAPs that exceeded their respective Screening Model Action Level (SMAL) are listed in the table below.

Table 6: Emission Rates for HAPs that Exceeded SMALs (lb/hr)

Constituent	Emission Rate for BFB 1
Acrolein	0.02
Chlorine	0.18
Hydrogen chloride	4.31
Polycyclic organic matter (POM)	0.029
Dibenzo dioxins and furans	3.80E-4

The stack parameters as provided by the applicant are listed in the following table along with the calculated GEP stack height used in modeling.

Table 7: Stack Parameters

Stack No.	Height / GEP Height (ft)	Diameter (ft)	Temperature (F)	Velocity (feet/sec)	Distance to closest receptor (ft)
BFB 1	320 / 213.3	10.0	300	19.1	82

The following table lists the air quality impact for the modeled HAPs. A Screen 3 analysis was conducted for all HAPs except for the dibenzo dioxin and furans. A refined modeling analysis was conducted for the dibenzo dioxin and furans

Table 8: Air Quality Impact Analysis

Pollutants	Modeled Impact $\mu\text{g}/\text{m}^3$	RAL $\mu\text{g}/\text{m}^3$	Time Period
Acrolein	0.0041	6.90	24-Hour
	0.0008	0.02	Annual
Chlorine	0.042	3.95	24-Hour
	0.008	3.95	Annual
Hydrogen chloride	1.00	7.00	24-Hour
	0.20	7.00	Annual
POM	0.0014	0.16	Annual
Dibenzo dioxins and furans (TEQ)	3.65E-7	3.0E-7	24-Hour

As indicated in the above table, the HAP emissions from the biomass boiler (BFB 1) are expected to be in compliance with their respective RALs except for dibenzo dioxins and furans expressed as Tetrachlorodibenzo-p-dioxins (TCDD) toxic equivalents (TEQ). MU Power Plant will limit emissions from dioxins and furans to 0.264 pounds per year in order to achieve concentrations below the group's respective RAL.

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 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 May 13, 2009, received May 15, 2009, designating Curators of the University of Missouri as the owner and operator of the installation.
- U.S. EPA document AP-42, *Compilation of Air Pollutant Emission Factors*, Fifth Edition.
- Northeast Regional Office Site Survey, dated June 1, 2009.
- Responses to MDNR comments and questions on application and emission calculations, received via email on June 29, 2009, September 17, 2009, October 1 and 5, 2009, & November 17 & 23, 2009.
- Revised Application for Authority to Construct, received via email on September 17, 2009.
- Revised Application for Authority to Construct, received via mail on July 10, 2009.

