Alliant Energy's Environmental Permitting Plan for the Chariton Valley Biomass Project

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Prepared for: Iowa Department of Natural Resources

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Introduction

Meeting with IDNR on March 22, 2002

Chariton Valley Biomass Project (CVBP) partners had the opportunity to meet with several members of the Iowa Department of Natural Resources (IDNR) on March 22, 2002. Attendees to the March 22nd meeting were the following:

Catharine Fitzsimmons, IDNR
Ted Petersen, IDNR
Dave Phelps, IDNR
Sharon Tahtinen, IDNR
Alan Arnold, Alliant Energy
Cynthia Lord, Alliant Energy
Greg Hudson, Alliant Energy
Jim Klosterbuer, Alliant Energy
Iqbal Javed, Alliant Energy
Marty Braster, Biomass Project
Velvet Glenn, Biomass Project
Barclay Gibbs, Antares Group Inc.

The CVBP partners were thankful for the opportunity to discuss the permitting issues with IDNR. The meeting focused almost exclusively on air pollution permitting issues facing the CVBP at Alliant Energy's Ottumwa Generating Station (OGS).

Objective of the Environmental Permitting Plan

A few potential pathways for air permitting were discussed at the March 22nd meeting. These pathways are discussed in detail in this environmental permitting plan, with the intent of developing a flexible plan for proceeding toward commercial switchgrass cofiring operations.

The CVBP is a research and development project sponsored by the US Department of Energy (DOE). In exchange for project funding, the DOE requires several deliverables that chart the project's progress. One of the required deliverables is the submittal of an environmental permitting plan at the end of April 2002, which is recognized by the regulatory authorities as providing viable paths to commercial switchgrass cofiring operations. The **primary objective** of this environmental permitting plan is to form a basis for receiving a "letter-of-cooperation" from the IDNR, which would indicate to DOE that the IDNR recognizes the CVBP's environmental permitting plan as providing viable paths to commercial switchgrass cofiring operations. This "letter-of-cooperation" would in no way guarantee that permits to operate commercially will be granted. Permits to commercially cofire switchgrass at OGS will ultimately be granted only if intermediate outcomes indicate that commercial switchgrass cofiring operations can be conducted within the constraints of the Clean Air Act.

Chariton Valley Biomass Project - Background Information

Background and Motivations for the Chariton Valley Biomass Project

Alliant Energy is the utility partner in the Chariton Valley Biomass Project. The biomass project involves the cooperation of about two-dozen project partners, including the US Department of Energy and the Chariton Valley Resource Conservation and Development (RC&D) office. The primary goal of the biomass project is to develop grasses such as switchgrass as sources of renewable energy. The biomass project, initiated in 1995, currently involves more than 80 cooperating producers of bio-energy crops. In addition to developing a renewable energy resource, the motivations for the biomass project are the following:

1. To develop a productive use of marginal lands, which will benefit Iowa farmers and reduce Iowa's reliance on other states' primary energy resources.

2. To explore the possible criteria pollutant emissions benefits of displacing coal (up to 5% heat input) with switchgrass in cofiring applications.

3. To evaluate environmental benefits (other than those associated with criteria pollutants) of switchgrass production (e.g., water quality protection, wildlife habitat benefits relative to conventional cropping, carbon sequestration implications), through research conducted mostly by Iowa State University and the University of Iowa.

4. To explore an option for mitigating carbon dioxide emissions from coal-burning plants in order to prepare for the possibility that polices are enacted to constrain greenhouse gas emissions.

5. To better understand (and improve) the economics of switchgrass production relative to other renewable power options in Iowa.

In general, monitoring, measuring, and evaluating the environmental implications of the switchgrass cofiring project have been essential components of the project's research design.

Three R&D Cofiring Campaigns are Planned

The cofiring project is being conducted at Alliant's Ottumwa Generating Station (OGS) in Chillocothe, Iowa. The OGS boiler is a tangentially-fired unit originally designed and constructed by ABB-Combustion Engineering. The OGS boiler went into commercial operation in the early 1980s. The project's demonstration of the technical feasibility of cofiring has been organized into a series of three R&D campaigns. The term "campaign" includes a broad range of activities (planning, engineering, construction, cofire tests, etc.). Each R&D campaign is scheduled to conclude with a cofire test. These tests can only occur if the proper regulatory approval has been granted.

<u>1st Cofire Campaign</u>

- After several years of planning, the Chariton Valley Biomass Project successfully completed two months of switchgrass cofire testing at the Ottumwa Generating Station (OGS) in Chillicothe, Iowa. From November 30, 2000, through January 25, 2001, the switchgrass team cofired 1,269 tons (1,151 tonnes) of switchgrass at rates up to 16.8 tons/hour (15.2 tonne/hr), representing about 3% heat input to the 725 MW power plant.

- Stack testing was completed when cofiring switchgrass and when burning only coal. Fuel and ash samples were collected for analysis and boiler performance and emissions data were collected. Numerous improvements were made to the feed-handling equipment during testing, and the testing was completed with no environmental incidents, no injuries to personnel, and no loss in electricity output from OGS.

- The goals of this first of three rounds of cofiring tests were: 1) to identify the effects of cofiring on boiler performance, 2) to measure any changes in emissions during cofiring, and 3) to gather information to improve the design of the switchgrass handling equipment. All three of these goals were met with varying levels of success.

<u>2nd Cofire Campaign</u>

- Campaign 2 started in CY (calendar year) 2001 with engineering (preliminary design) work.

- Facility construction and installation of feedstock handling equipment for 12.5 tons per hour is planned to begin during early CY2003. Some of the equipment may be briefly tested during installation.

- During CY2003, construction of facilities and installation of equipment is planned to continue.

- Also during CY2003, commissioning of the 12.5 tons per hour feedstock handling system is planned. The primary goal of the commissioning will be to optimize the continual operation of an automated 12.5 tons per hour biomass cofiring system in preparation for Campaign 3. During commissioning of the feedstock handling equipment, up to 6,000 tons of switchgrass will be cofired in the OGS boiler. As originally planned, boiler performance during cofiring was not to be an R&D focus of Campaign 2. However, as discussed throughout this report, it is proposed that the scope of Campaign 2 has now been altered so that sufficient emissions testing would be performed during Cofire Test 2 in order to: 1) ensure that PSD thresholds are not violated during Cofire Test 2, and 2) to gather sufficient emissions data to evaluate the potential air emissions during Cofire Test 3 and commercial operation. Therefore, during Cofire Test 2, the CVBP will attempt to optimize boiler performance under cofiring operations in order to attain the best possible emissions results.

<u>3rd Cofire Campaign</u>

- After Campaign 2 is completed, a 2000-hour cofire test is planned to begin at the end of CY2004 and will perhaps continue into the beginning of CY2005. Cofire Test 3 would not occur without the consent of IDNR and/or EPA (consent would be based upon Cofire Test 2 emissions results, subsequent analysis, and subsequent regulatory filings). Cofire Test 3 would utilize the 12.5 tons per hour cofiring system optimized during Campaign 2. The goal of Cofire Test 3 is to assess the impacts of continuous biomass cofiring on OGS operations and performance (assessing emissions performance will be a crucial part of Cofire Test 3). As planned, Campaign 3 would result in the cofiring of 25,000 tons of switchgrass.

- Facility construction and equipment installation for the 2nd half of the permanent system (another 12.5 ton per hour system) is planned for installation during Campaign 3. The plan is to completely install the 25 tons per hour feedstock handling system by the end of 2005 (25 tons per hour is the target size for commercial cofiring operation at the OGS [representing about 5% of the OGS heat input], but test burns are not planned at this rate).

IDNR's Past Guidance with Permitting Issues for the Chariton Valley Biomass Project

Cofire Test 1 was approved at the OGS, without alteration of its operating permits, by way of a permit variance process granted by the IDNR on March 21, 2000. The IDNR was recognized as the lead agency on permit issues related to the biomass project, with the US EPA Region VII serving in a supportive role. The variance issued by IDNR specified several conditions including the request for a detailed emissions report from Cofire Test 1 (comparing cofiring emissions to coal-only emissions).

On March 16, 2001, Mr. Alan Arnold (Alliant Energy) sent a brief report summarizing the emissions findings from the Cofire Test 1, fulfilling IDNR's variance requirements. Mr. Arnold's report was noted as being a "preliminary" report in nature, as there were numerous data issues requiring further analysis.

Recently, the National Renewable Energy Laboratory (NREL) has completed a draft report entitled *Summary of Chariton Valley Switchgrass Co-Fire Testing at the Ottumwa*

Generating Station in Chillicothe, Iowa. A final technical report from NREL is anticipated in July 2002.

Status of the Chariton Valley Biomass Project

The CVBP is currently in a research and development (R&D) phase (Campaign 2). The CVBP could terminate for a variety of technical and non-technical reasons. There are many decision nodes in the project's future as the technical and economic successes of the project, as well as the regulatory decisions and project emissions characteristics, are uncertain (this plan primarily focuses on regulatory decisions and project emissions characteristics). The technical, economic, and regulatory uncertainties explain why DOE funding is required to support the R&D campaigns. Again, efforts to advance the project and to address the project uncertainties are justified by the following reasons:

1. Switchgrass cofiring represents an opportunity for increasing the penetration of a domestic, renewable power resource in Iowa's power generation mix; thus enhancing the sustainability and energy-independence of the US economy.

2. Switchgrass cofiring has the potential to reduce emissions of criteria pollutants (SO_2 in particular) without significantly increasing other pollutant emissions. Such results have been observed at other switchgrass cofiring projects.

3. Switchgrass cofiring represents an option for reducing the lifecycle CO_2-emissions intensity of power production. Although the US has not committed to CO_2 emissions reductions, efforts are underway to research and develop a portfolio of options for meeting these potential commitments.

4. Switchgrass cultivation potentially offers habitat and ecosystem benefits relative to conventional farming. Evaluating these benefits is complex, but has been an integral part of the CVBP research efforts (additional topical reports available upon request).

5. Switchgrass cultivation is a productive use of marginal lands, which will benefit Iowa farmers and reduce Iowa's reliance on other states' primary energy resources.

The emissions results from Cofire Test 1 were not conclusive – more testing is required to understand the emissions profile associated with a properly functioning switchgrass feed system operating in conjunction with the OGS boiler (optimized to cofire switchgrass). Quite simply, the steady-state emissions profile of the OGS during 5% switchgrass cofiring operations (on a heat input basis) is not yet understood.

As the CVBP completes its technical design, it begins to prepare for the commissioning of the 1st 12.5 tons per hour feed system. Although the R&D objective of Campaign 2 is to simply commission the feed system (to ensure that it works as designed), disposal is required for the 6000 tons of finely chopped switchgrass that will be produced. The only practical option for disposing of 6000 tons of switchgrass is to burn it in the OGS boiler as it was under the permit variance provided for during Cofire Test 1. Campaign 2 will effectively conclude with Cofire Test 2.

Scope of Environmental Permitting Plan

Since the air issues present the greatest permitting challenge to the CVBP, they are the principal focus of this environmental permitting plan. However, the DOE requires that the CVBP address permitting issues associated with all environmental media; therefore, non-air environmental permitting issues are briefly discussed herein. The environmental permitting issues are taken in the following order in this plan:

- Air (the principal focus of this plan)
- Storm Water
- Solid Waste (no IDNR action required - discussed briefly here for the sake of completeness)
- National Environmental Policy Act [NEPA] (no IDNR action required – discussed briefly here for the sake of completeness)
- Noise (no IDNR action required - discussed briefly here for the sake of completeness)

Fire prevention/suppression issues associated with the CVBP are also being addressed with the appropriate authorities, as part of engineering design activities, to ensure that the technical design meets all applicable standards. Fire prevention / suppression issues are not discussed any further in this document.

Summary Timeline for Alliant Energy's Environmental Permitting Needs Associated with the Chariton Valley Biomass Project

As discussed throughout this report, the timing of Alliant Energy's environmental permitting needs associated with the CVBP depends critically upon intermediate outcomes and decisions. As a simplification to the flexible (and complex) permitting plan presented later in this report, a summary table is given below. This summary table captures a timeline that the CVBP could proceed along in reaching commercial status. Potential rationale for IDNR issuing permit variance(s) to allow further R&D cofire testing is discussed in detail later in this report.

Summary of Alliant Energy's Environmental Permitting Needs at the OGS, Associated with the CVBP*

CVBP Permitting Need	Permit Issuance Date
AIR PERMITTING NEEDS	
After the construction permit process, IDNR issues variance to allow switchgrass to be burned during R&D Cofire Test 2. Issue construction permits to allow construction of switchgrass feed equipment (and buildings) during Campaign 2.	March 31, 2003
IDNR approves emissions test protocol before R&D Cofire Test 2 can begin.	September 30, 2003
IDNR issues variance to allow switchgrass to be burned during R&D Cofire Test 3. Issue construction permits to allow construction of switchgrass feed equipment (and buildings) during Campaign 3.	July 1, 2004
Title V permit amended to add switchgrass as an approved alternative fuel.	February 15, 2005
STORM WATER PERMITTING NEEDS	
IDNR issues storm water construction permit for construction taking place during Campaign 2.	March 31, 2003
(Possibly) amend NPDES permit to accommodate berm construction.	September 30, 2003
IDNR issues storm water construction permit for construction taking place during Campaign 3.	July 1, 2004

* No permitting actions by environmental regulators are necessary in the areas of solid waste, noise, NEPA, and fire protection / suppression. However, these issues are all being managed by the CVBP.

Air Permitting

Cofire Test 1 Emissions Results

At the March 22, 2002 meeting with IDNR, Cofire Test 1 emissions results were presented to the IDNR. These results were based on Wade Amos' (National Renewable Energy Laboratory, NREL) Draft Summary report on the Campaign 1 Cofire Test: *Summary of Chariton Valley Switchgrass Co-Fire Testing at the Ottumwa Generating Station in Chillicothe, Iowa (summary report already made available to IDNR during March 2002)*. The final complete technical report about Cofire Test 1 will be available during July 2002.

Cofire Test 1 involved the use of temporary or test feed equipment, some of which was rented – it was simply a proof-of-concept exercise. Unfortunately, the switchgrass feed process did not behave in a steady, consistent manner. The switchgrass feed rate varied between a few tons per hour up to 16.5 tons per hour (which is greater than the proposed feed rate during Cofire Test 2). As a result, the boiler was rarely able to achieve steady-state operation, and the boiler was not optimized for cofiring conditions. These conditions led to the collection of emissions data that would not be representative of continuous cofiring operations. In addition, because of the high-level of effort required to simply sustain switchgrass feed to the boiler, it was not possible to follow the data collection protocol as closely as planned. In particular, it is not possible to look back at the data set and correlate the continuous emissions monitoring (CEM) data with the cofiring rate. In short, this was a real-life pilot exercise – a learning experience from which emissions conclusions cannot be confidently drawn, but from which the lessons will be incorporated into future R&D cofire tests. The *preliminary* findings of Cofire Test 1 are as follows:

1. Opacity did not change significantly during cofiring.

2. PM and PM_{10} emissions appeared to decrease (by about 50% each) during cofiring. The large observed decrease in PM_{10} emissions, although desirable, is unexpected. This result warrants further testing.

3. A one-day stack test indicated that CO emissions appeared to increase 10-fold (note that even with the observed 10-fold increase during the stack test, PSD thresholds would not be exceeded during Cofire Test 2). Orsat Gas Analyzer results indicate that on the day of the stack test, the boiler was operating irregularly – the Orsat Gas Analyzer results suggest that CO emissions did not increase during cofiring on other test days (i.e., when stack tests were not conducted). The CO emissions implications of switchgrass cofiring at OGS are not well understood – further testing is required.

4. Daily-average NOx emissions appeared to increase by about 6% (as measured by the CEM) during cofiring. Although the nitrogen content of switchgrass is about 50% of that for the Powder River Basin coal burned at OGS, it is noted that NOx formation is a complex process (where much of the NOx is

produced via a thermal reaction mechanism and is heavily-dependent upon combustion conditions). Further emissions testing is required to understand the effect of cofiring on OGS NOx emissions during steady-state operation (using a boiler optimized for cofiring).

5. Small decreases in SO_2 emissions were observed during cofiring – this is consistent with the lower S content of switchgrass relative to coal.

Switchgrass Cofiring at Alabama Power Company's Plant Gadsden

It is useful to present the conclusions from another switchgrass / coal cofiring project. In March and April 2001, a switchgrass cofiring test was conducted at Alabama Power Company's Plant Gadsden (typically 7-8% heat input switchgrass at a 70 MW unit). The Alabama switchgrass project won the EPRI 2001 Technology Transfer award and the Southeastern Electric Exchange's Industry Excellence Award. (further information about these awards is available upon request). The main conclusions from the cofiring test were the following (the Gadsden plant report has been submitted along with this environmental permitting plan):

1. SO_2 emissions decreased during cofiring.

2. Hg emissions decreased during cofiring.

3. NOx emissions did not change during cofiring.

4. CO_2 emissions were reduced (on a lifecycle basis) roughly in proportion to the amount of biomass heat input substituted for coal.

5. Boiler efficiency penalties of 0.3% to 1.0% were measured (this is expected to be less of an issue at the lower cofiring rates planned at the OGS).

6. Opacity increased slightly during cofiring. Measurements indicated that this was not due to increased PM emissions. The higher carbon content of the fine material is believed to have increased the opacity indication.

7. CO emissions increased (as measured at the air preheater inlet). The CO emissions increases were not correlated with the cofiring rate; but instead, were positively correlated with the unit excess air (this is counter to expectation – normally as excess air is increased, CO emissions decline). It was observed that CO concentrations did not increase at the furnace outlet. Therefore, it is believed that the higher measured air preheater inlet CO emissions were due to unburned carbon falling out in the ductwork (the source of smoldering material was most-likely located between the furnace outlet and the air preheater inlet). As a result, one suggested measure to prevent the CO emissions increase was to achieve the proper fuel size distribution (it was observed that one of the mills was having trouble maintaining fineness).

The encouraging emissions results from the Alabama switchgrass cofiring test, offer some justification for the need to conduct a more thorough cofire test at the OGS.

As additional justification, it is noted that there are several examples of cofiring tests (involving a variety of biomass fuels) where the partial replacement of coal with biomass led to reduced NOx, SO_2, CO_2 (lifecycle), and Hg emissions (citations available upon request).

3 Main Air Permitting Approaches

As discussed at the March 22, 2002 meeting at the IDNR, there are 3 main approaches to proceeding with the CVBP air permitting activities:

1. To acquire an IDNR variance, in accordance with Iowa Administrative Code (IAC) 567-21.2(1), to allow switchgrass to be burned as an alternative fuel. The IDNR variance could potentially be applicable to Cofire Test 2 only, or Cofire Test 2 and Cofire Test 3 (depending upon Cofire Test 2 emissions results). An IDNR variance was the approach that was taken to allow Cofire Test 1, and is the approach highlighted in this environmental permitting plan. The justification for requesting another IDNR variance includes the following:

   a) Cofire Test 2, as planned (6000 tons of switchgrass to be fed) could most-likely be run to completion without jeopardizing the PSD emissions thresholds (see the next section and the Appendix).

   b) If limitations are placed on switchgrass feed quantities during both R&D Cofire Tests 2 & 3, it may be possible for the CVBP to proceed to commercial operation without ever exceeding the annual PSD thresholds or needing to amend its PSD permit. The switchgrass feed quantity restrictions would need to be federally enforceable for this approach to be viable. One way to achieve this federal enforceability could be to write the quantity restrictions into the switchgrass feed system's construction permits.

   c) As the project progresses through each campaign, the switchgrass feed restrictions could be relaxed if intermediate emissions test results indicated that it was appropriate to do so (e.g., although the switchgrass feed restriction for Cofire Test 2 would be 6000 tons/year, if Cofire Test 2 emissions results suggested that it were appropriate, the switchgrass feed restriction could be relaxed to 25,000 tons/year for Cofire Test 3).

2. To acquire a PSD variance. A PSD variance could potentially be applicable to Cofire Test 2 only, Cofire Test 2 and Cofire Test 3 only, or up to and including commercial switchgrass cofiring. The basis for requesting a PSD variance could be: a) the CVBP is potentially an environmentally beneficial

project, or b) the May 2001 Executive Order concerning energy-related projects. Construction permits would still be required before construction of any equipment could commence.

3. PSD revision.

Later in this environmental permitting plan, these approaches are elaborated upon and integrated within a more detailed flowchart.

Calculations to Demonstrate that the Chariton Valley Biomass Project Could Conduct Cofire Test 2 Without Exceeding the PSD Thresholds

The ability to proceed according to approach #1 in the preceeding section depends critically on whether or not Cofire Test 2 can be conducted without creating emissions increases in excess of the PSD thresholds. The calculations in the Appendix suggest that this is possible (see the Appendix at the end of this report).

Improving the Emissions Test Protocol

In the next section a detailed flowchart is presented, which elaborates upon the decisions (by CVBP and regulators) and Cofire Test outcomes that will ultimately determine the air permitting path for the CVBP. Irrespective of the path(s) taken, detailed emissions testing will be necessary during Cofire Test 2 and Cofire Test 3 (for CO, NOx, SO_2, PM, and PM_{10}). As previously discussed, due to operational difficulties, the emissions data from Cofire Test 1 are not as informative as the CVBP would have liked. The development of a comprehensive Emissions Test Protocol that incorporates lessons from Cofire Test 1 is vital to the success of the CVBP. Specifically, as a consequence of Cofire Test 1, the following recommendations would be incorporated into the development of the future Emissions Test Protocol:

1. A plan for "readying" the boiler the day before the stack test(s) is needed.

2. All control variables should be specified (and their levels chosen and recorded). For example, control variables should include boiler excess air, unit load, burner location, and rate of switchgrass addition. The rate of switchgrass addition should be targeted for the design maximum of 12.5 tph (per system).

3. IDNR's preferred, experimental soot-blowing procedure should be executed.

4. For stack testing, baseline and cofiring tests should be conducted closer together

5. Data should be reviewed daily so procedures can be adapted during the test. In addition, it will be critical to ensure that none of the pollutants' PSD thresholds are in danger of being exceeded during the test.

It is noted that it may make sense to have two different emissions test protocols during Cofire Test 2 (the second being more comprehensive than the first). Cofire Test 2 can be conceptualized as having 3 stages: 1) simply getting the switchgrass feed system to operate properly, 2) continuing reliable switchgrass feed while optimizing the boiler for cofiring operations, 3) gathering emissions data for cofiring under steady-state operations. During the first 2 stages, the emissions testing objective will be simply to ensure that PSD thresholds will not be exceeded (to keep an approximate running total of emissions). During stage 3, in addition to verifying that the PSD thresholds are not in danger of being exceeded, the additional objective will be to gather an extended, comprehensive data set that can be used to determine the emissions impacts of Cofire Test 3 (with a high degree of certainty). Therefore, it is natural that the emissions test protocol for stage 3 (of Cofire Test 2) may be different (even more comprehensive) than that for stages 1 and 2 (of Cofire Test 2).

Air Permitting Flowchart: Decisions (CVBP and regulators) and Cofire Test Outcomes

A 5-page flowchart is presented in this section, detailing the CVBP's proposed air permitting plan. These flowcharts are based upon the three main permitting approaches previously discussed. The flowcharts should be read from left to right. Boxes denote actions or decisions taken by the CVBP. Hexagons denote actions or decisions taken by regulators (specific dates are always given for regulatory decisions, as per IDNR request). Circles denote outcomes from the cofiring emissions tests. The paths running along the top of some of the flowcharts denote the PSD variance approach (which originates in the first box on the first flowchart). These PSD variance paths are only shown on the flowcharts where they are most likely to be needed.

The five flowcharts make the air-permitting plan seem more complex than one might expect. However, their value to the CVBP is that many paths to commercial cofiring operations can be identified, depending upon intermediate outcomes. Despite the flowcharts' complexity, there are additional features of the proposed CVBP environmental permitting plan that could not be easily represented in the following flowcharts (some of the following features are depicted in the flowcharts but are included here for emphasis):

1. Construction permits are needed for multiple pieces of equipment and buildings. The complete list of equipment will be a product of current engineering design activities from the CVBP.

2. Conceivably, depending upon intermediate outcomes, there are situations where the CVBP could elect to commercially operate the cofiring process at less than 25 tph of switchgrass feed in order to avoid the PSD revision process.

3. Typically, the flowcharts indicate at least nine months between Cofire Test 2 and Cofire Test 3. There is flexibility in the CVBP schedule that is too

difficult to represent in the flowcharts – these flowcharts represent the desired timeline for regulatory decisions. The CVBP **will not** put IDNR in the position of having to make *hurried* decisions to allow Cofire Test 3 (the same is true for IDNR's decisions concerning commercial operation after Cofire Test 3). The CVBP respects IDNR's busy schedule and the necessary time involved in making regulatory decisions – there is flexibility built into the CVBP plan.

4. Conceivably, after having gone through PSD revision once, future emissions tests could indicate continuing PSD threshold problems. In this unlikely event, a second PSD revision would be required (or the project would terminate or proceed at reduced-scale).

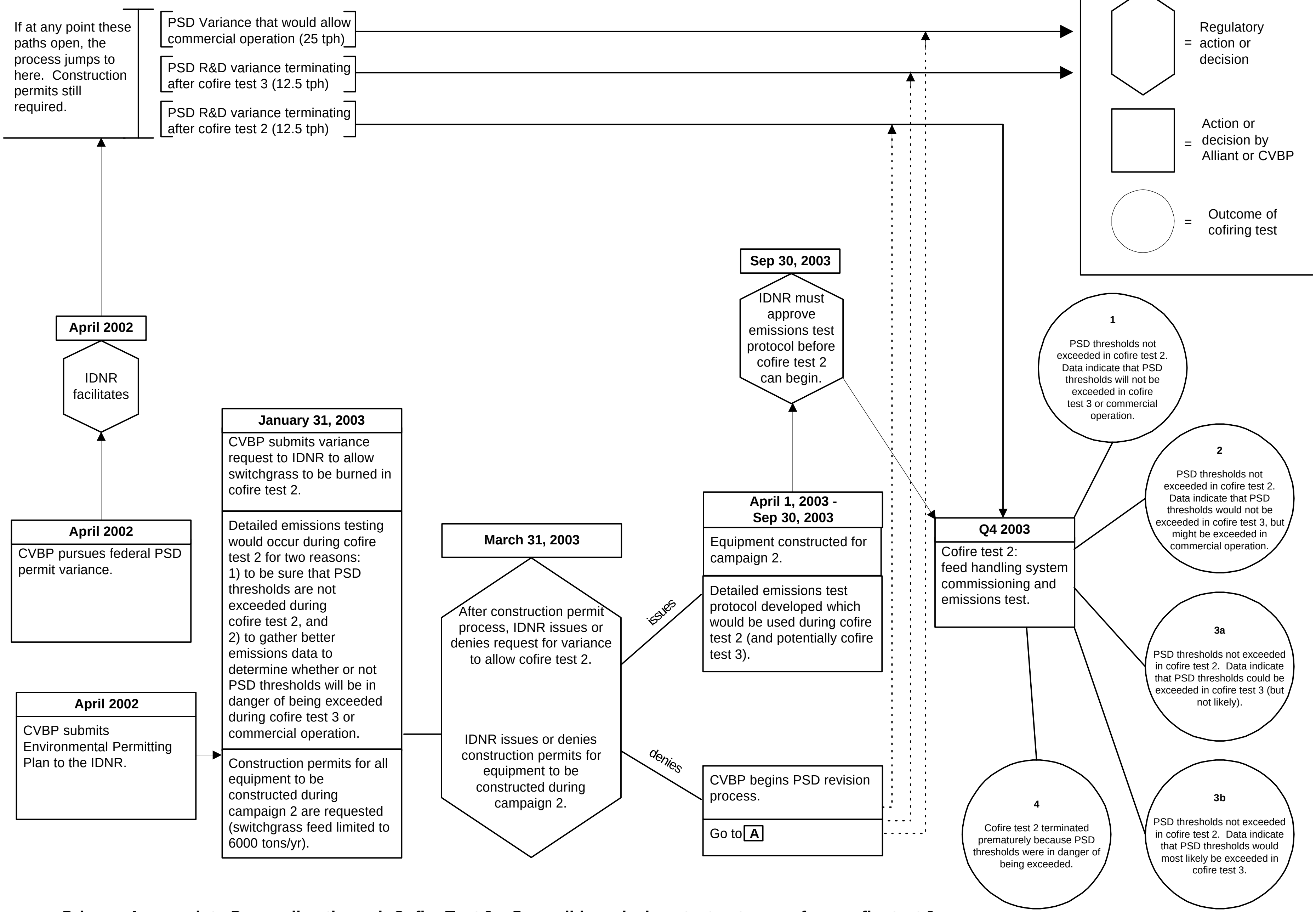
5. Along any of the PSD variance paths, construction permits would be obtained before any construction would commence.

6. In any cases where the flowcharts seem to depict that the IDNR does not have a choice (i.e., there is only one path into and out of a hexagon), this of course is not true. The choice to deny CVBP's request is understood but not shown explicitly because it is believed that there is a high probability that the IDNR would make the choice that is shown explicitly (typically IDNR choices are not shown where emissions results indicate no PSD problems).

7. It is emphasized that Cofire Test 3 would occur at 12.5 tph for 2000 hours. Commercial operation would occur at 25 tph for 8760 hours/year. These step-changes in operating schedule and intensity would of course figure into any regulatory / emissions calculations between Cofire Test 3 and commercial operation.

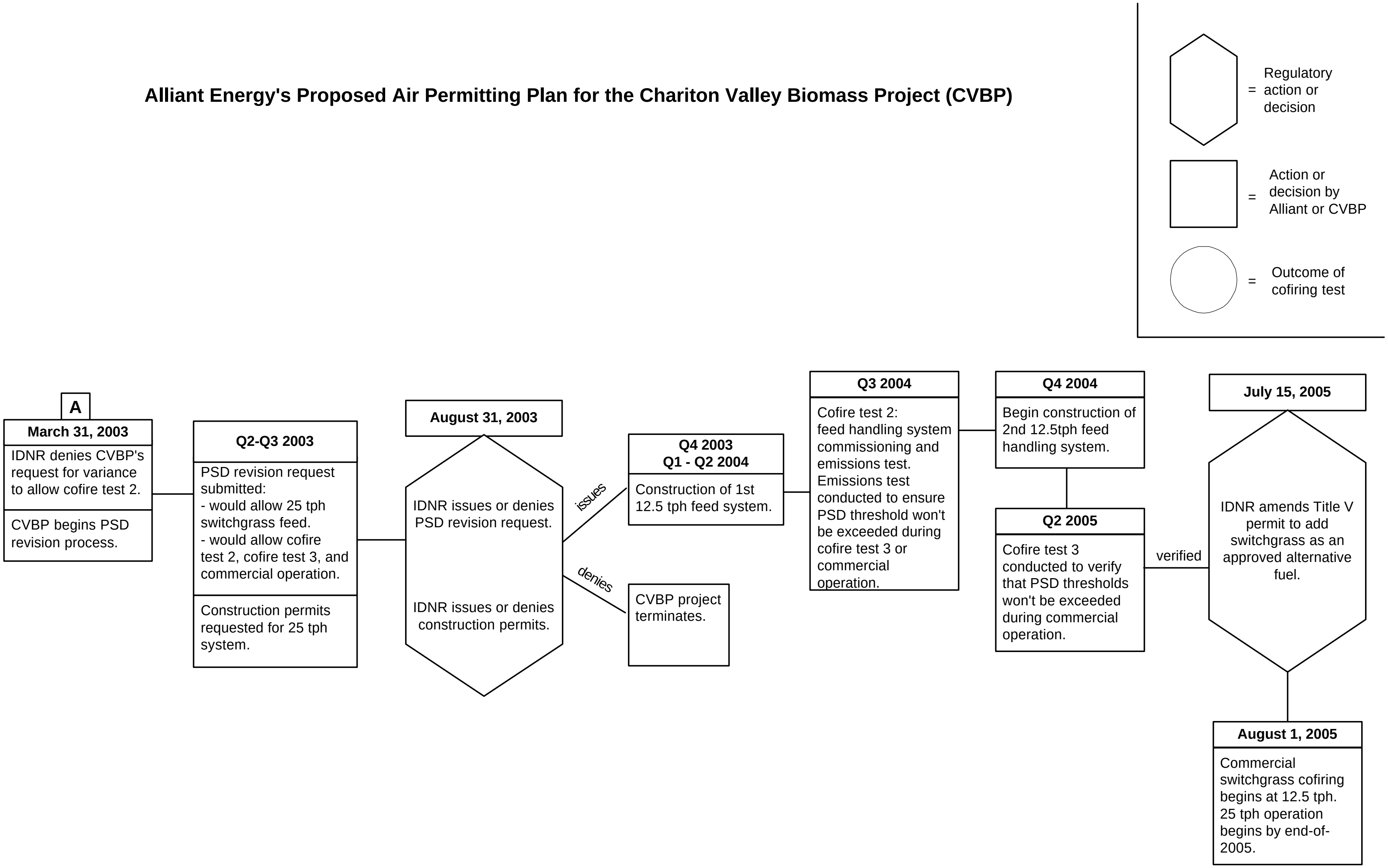
8. During both Cofire Test 2 and Cofire Test 3, running totals of emissions (for at least NOx and PM/PM_{10}) will be kept to ensure that PSD thresholds will not be exceeded. If the PSD thresholds are in danger of being exceeded, it is understood that the IDNR may terminate the cofire tests prematurely.

Alliant Energy's Proposed Air Permitting Plan for the Chariton Valley Biomass Project (CVBP)



Primary Approach to Proceeding through Cofire Test 2: 5 possible emissions test outcomes from cofire test 2.

Alliant Energy's Proposed Air Permitting Plan for the Chariton Valley Biomass Project (CVBP)



PSD Revision Path if IDNR denies initial request for variance to allow Cofire Test 2.

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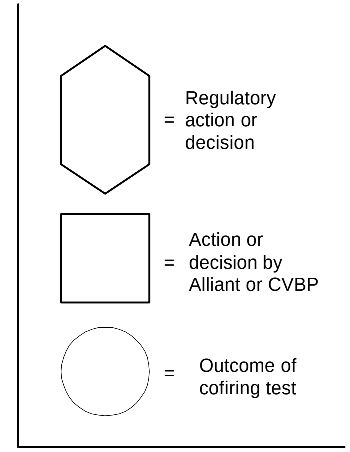

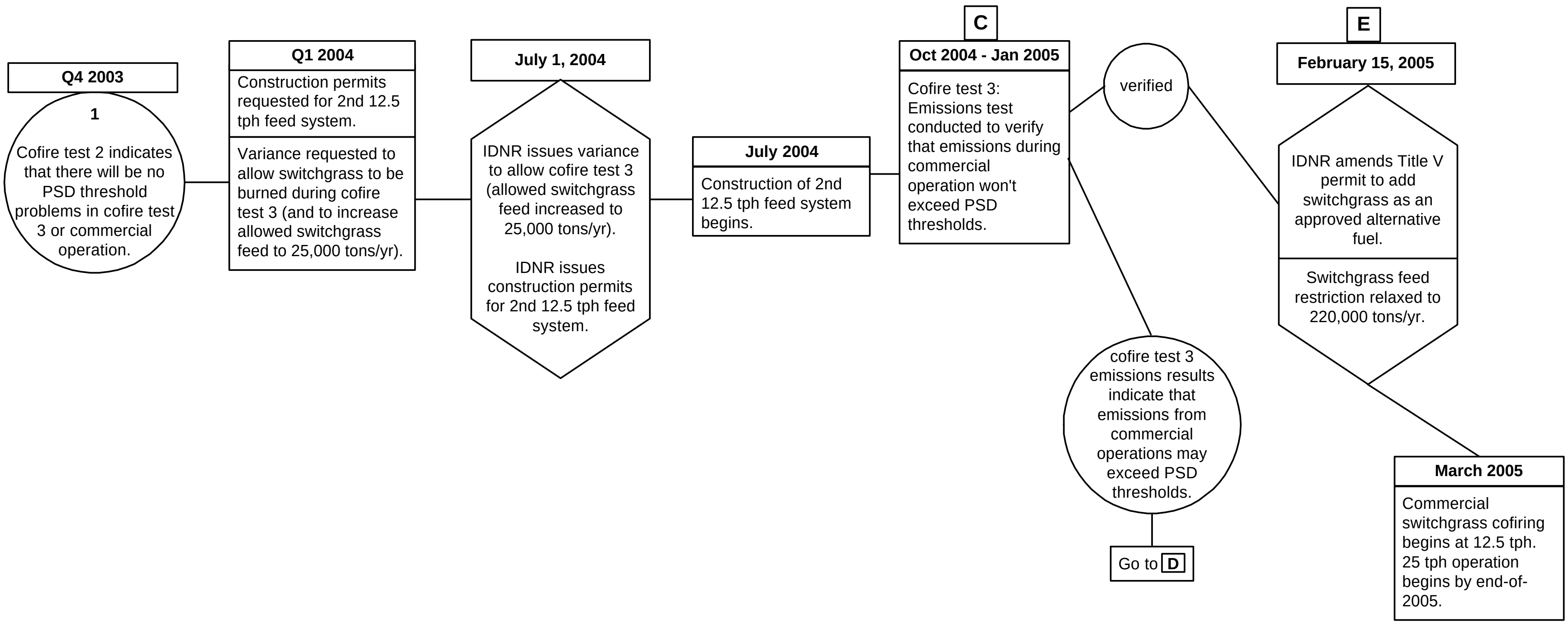

Path that follows Cofire Test 2, given the best possible emissions test outcome (most optimistic timeline).

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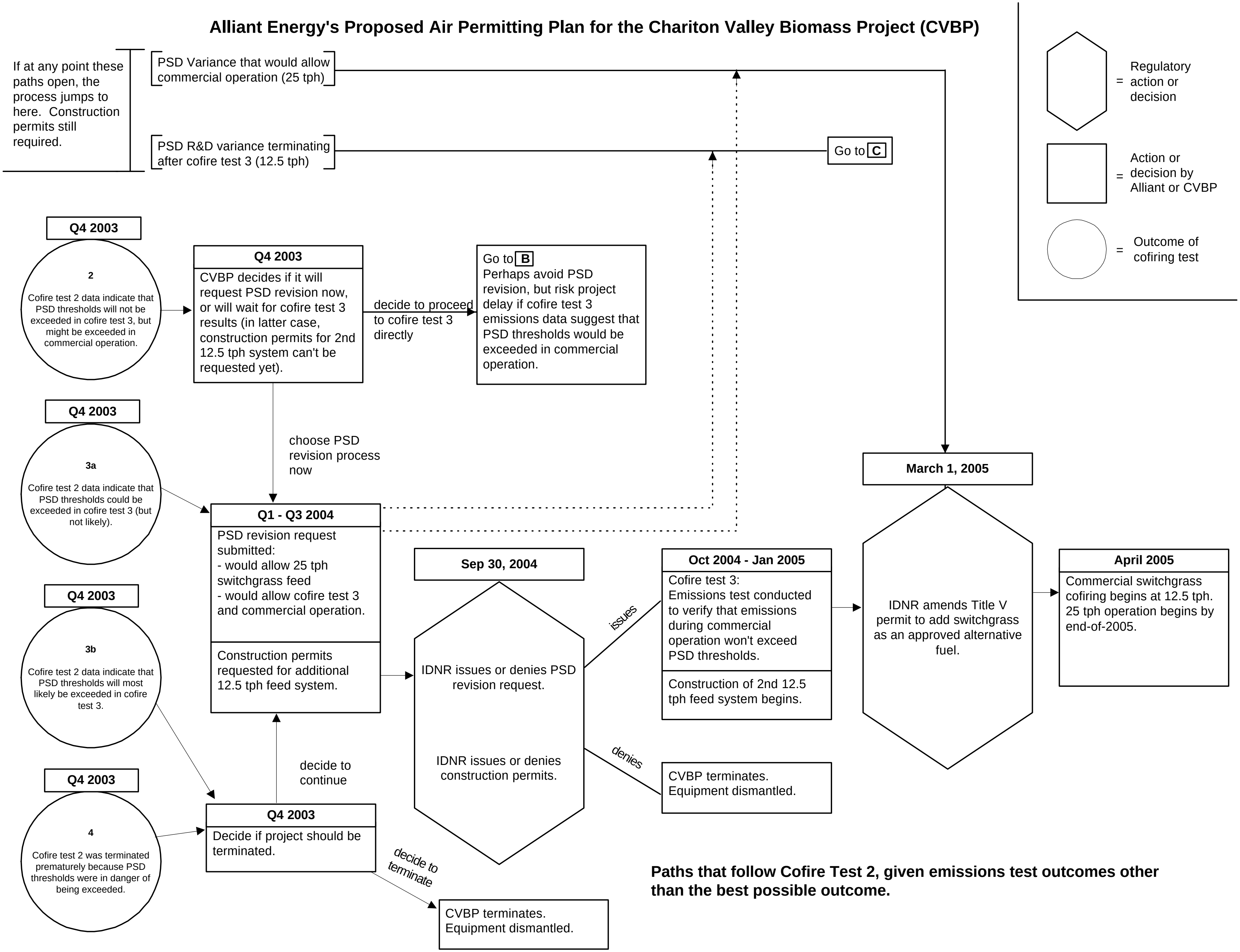
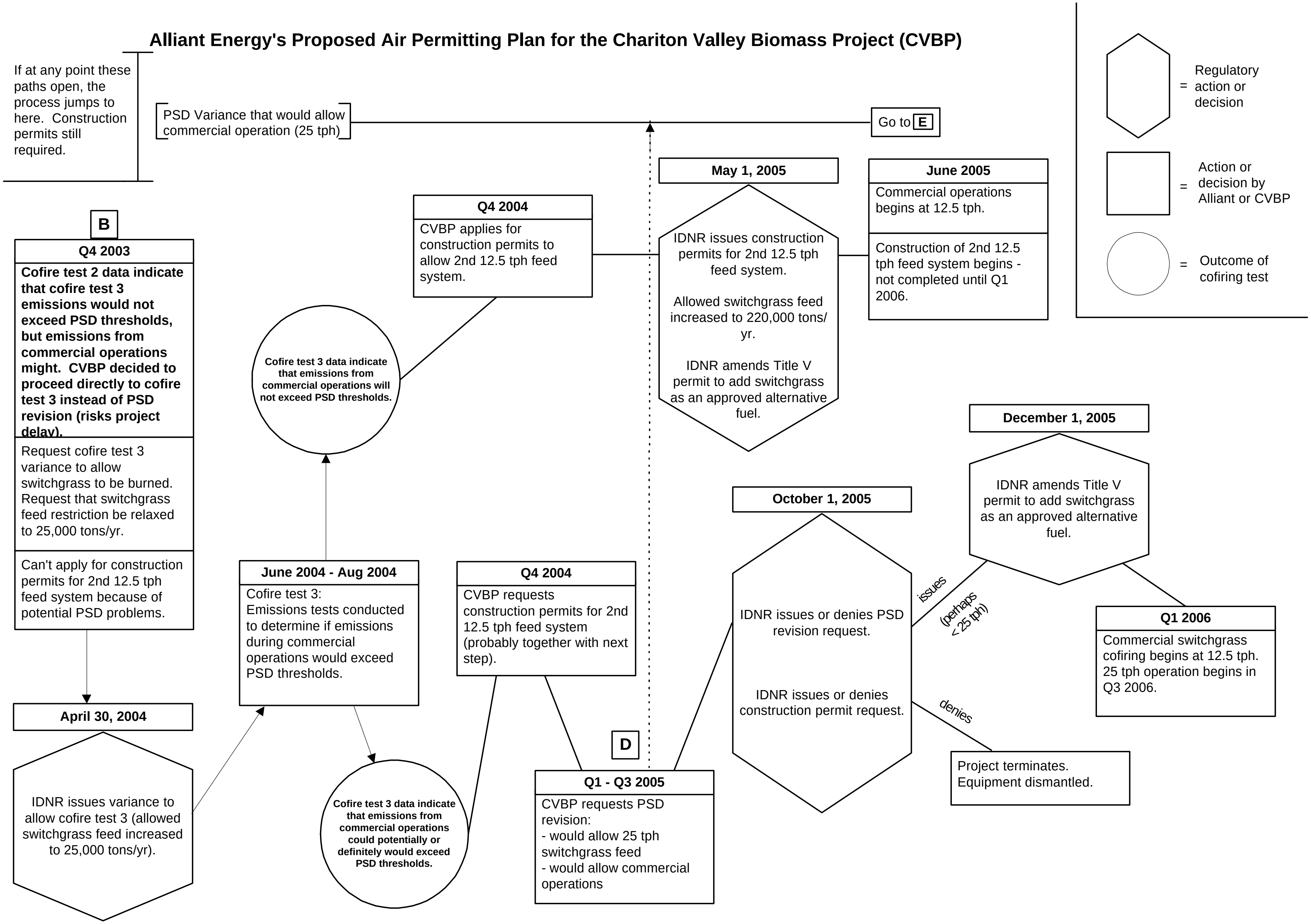


Paths that follow Cofire Test 2, given emissions test outcomes other than the best possible outcome.

Alliant Energy's Proposed Air Permitting Plan for the Chariton Valley Biomass Project (CVBP)



Storm Water Permitting

Storm Water Permit Changes Associated with Building and Equipment Construction – Campaign 2 and Campaign 3

In order to construct the buildings that will store switchgrass and the equipment that will feed the switchgrass into the OGS boiler, land-clearing will occur over an estimated total of 3 acres. This land clearing and construction will result in some changes to the storm water flow patterns at the OGS.

The construction acreage threshold that triggers the need for storm water permits in Iowa is going to change soon. Before March 2003 the threshold is 5 acres. After March 2003 the threshold is 1 acre. The construction area at OGS will be larger than 1 acre. Since construction in Campaign 2 will take place after March 2003, storm water permits for construction will be necessary. In late 2002 and early 2003, Alliant will obtain the necessary storm water permits for Campaign 2 construction activities from the IDNR.

For construction activities during Campaign 3 (to occur during CY2004-2005), storm water permits for construction activities will also be required. Alliant will take the necessary steps during CY2003 and CY2004 to obtain these permits.

Once the facilities are operational and final stabilization of the construction activities has occurred, the construction permits will be terminated and the facility's industrial storm water plan will be updated to reflect the new activities.

The CVBP **would like to request** that the IDNR confirm (for the purposes of communicating with DOE) that acquiring the necessary storm water permits related to Campaign 2 and Campaign 3 construction is a routine procedure under the Iowa Administrative Code (storm water construction permits are not needed until March 2003 when the acreage threshold changes).

Storm Water Permit Changes Associated with Planned Berm Construction

Alliant is planning to construct an additional berm around the on-site switchgrass storage / processing area at the OGS. This may require Alliant to amend its storm water NPDES permit with the IDNR.

The CVBP **would like to request** that the IDNR confirm (for the purposes of communicating with DOE) that amending OGS' NPDES permit to reflect stormwater flow changes associated with the construction of a berm around the on-site switchgrass storage / processing area is a routine procedure under the Iowa Administrative Code.

Proposed Timeline for Storm Water Permitting

A proposed timeline for storm water permitting activities is given on the next page. The precise timing of these activities depends upon project progress (which, in part, depends upon air permitting progress).

Proposed Timeline for Chariton Valley Biomass Project Water Permitting Activities

	CURRENT and FUTURE YEARS						
	Q1, 2002	Q2, 2002	Q3&Q4, 2002	Q1-Q4, 2003	Q1&Q2, 2004	Q3&Q4, 2004	Q1, 2005
STORM WATER							
Storm water Construction Permits, and Industrial Storm Water Plan	Discuss storm water permits for Campaign 2 and Campaign 3 construction		Begin permit application process for Campaign 2.	**Complete Campaign 2 permit process (March 31, 2003).** Campaign 2 construction through Q3. Begin permit application process for Campaign 3.	Continue permit application process for Campaign 3.	**Complete Campaign 3 permit process (July 1, 2004).** Campaign 3 construction.	Complete Campaign 3 construction. Update OGS industrial storm water plan
NPDES Permit / Berm Construction	Discuss berm construction and NPDES permit.		Berm construction. Begin NPDES permit amendment process (if necessary)	Complete berm construction. **Complete amendment (September 30, 2003).**			

Solid Waste Issues

Fly-Ash from Coal / Switchgrass Cofiring

The major, potential solid waste issue faced by Alliant related to the switchgrass cofiring project is in regard to its effect on the unit's fly ash. The sale and management of fly ash for cement aggregate, under coal-only operation, is an important part of the OGS revenue stream. Until the ASTM C618 standard that precludes the sale of coal/switchgrass cofired (fly) ash as a cement aggregate is changed (or a new comparable-value market for coal/switchgrass cofired (fly) ash is identified), this issue will remain important. For now, the coal/switchgrass cofired ash will continue to be managed by Alliant and its ash affiliates.

Project partners have initiated development of the scope of work with ISG Resources, Inc. and ISU to conduct research on the cofire fly ash in support of efforts to address limitations placed on its use by ASTM C618.

Baling Twine Disposal/Recycling

The only other solid waste issue created by the switchgrass cofiring project at OGS, in addition to those addressed under coal-only operation, is the need to dispose of the twine that bounds the switchgrass bales. This twine will be collected and either disposed of into the municipal waste stream or recycled.

National Environmental Policy Act (NEPA) Process

The National Environmental Policy Act (NEPA) is the basic national charter for protection of the environment. It establishes policy, sets goals (section 101), and provides means (section 102) for carrying out the policy. Section 102(2) contains "action-forcing" provisions to make sure that federal agencies act according to the letter and spirit of the Act. The regulations that implement section 102(2) direct federal agencies about what they must do to comply with the procedures and achieve the goals of the Act. The President, the federal agencies, and the courts share responsibility for enforcing the Act so as to achieve the substantive requirements of section 101.

NREL and the CVRCD have been handling the NEPA process with DOE. NREL and the CVRCD will continue to ensure that NEPA requirements are being met.

Noise Issues

There are no significant noise issues created by the switchgrass cofiring project at the OGS.

APPENDIX

Calculations to Demonstrate that the Chariton Valley Biomass Project Could Conduct Cofire Test 2 Without Exceeding the PSD Thresholds

The ability for the CVBP to proceed under and IDNR variance approach depends critically on whether or not Cofire Test 2 can be conducted without creating emissions increases in excess of the PSD thresholds. The calculations below suggest that this is possible.

Pb emissions (requested by Dave Phelps, IDNR):

Because worst-case Pb emission increases are low, this Pb emissions question is addressed assuming commercial operation (25 tph, 8760 hours/year).

Calculate the quantity of switchgrass fed to the boiler during commercial operation (design constraint):

8760 hours * (25 tons/hr) * <2000 lbs/ton> * (7458 BTU/lb switchgrass) = 3.267×10^{12} BTU

For the coal that would be displaced, calculate the counterfactual emissions based on AP-42 Table 1.1-16:

C_{Pb} = 33 ppmwt (for coal)
A = wt fraction of ash in coal = 0.055
PM = site-specific emissions factor = 0.1 lb/MMBTU (Title V permitted constraint)

Pb emissions counterfactual (for coal displaced by switchgrass) =
$3.4 * (C/A * PM)^{0.8} * 10^{12}$ BTU = $3.4 * ((33/0.055)*0.1)^{0.8} * 3.267$ * <ton/2000 lbs> =
0.147 tons Pb / year from coal displaced by switchgrass

Calculate the Pb emissions from the switchgrass being burned:

C_{Pb} = 47 ppmwt (for switchgrass – conservatively assumes that the Pb content for switchgrass is that for the nodes [it's lower for the balance of the switchgrass])
A = 0.054
PM = 0.1 lb / MMBTU (Title V permitted constraint)

Pb emissions from switchgrass being burned = 0.198 tons/year

Calculate the net increase in Pb emissions from cofiring switchgrass under commercial operating conditions (25 tph, 8760 hours/year):

net Pb emissions increase = 0.198–0.147 = 0.051 tons Pb / year < PSD threshold = 0.6 tons/year

<u>Conclusion:</u> Pb emissions increases will not exceed the PSD threshold, even under commercial operation.

# of Cofiring Hours Proposed for Cofire Test 2:

6000 tons * (hr / 12.5 tons) = 480 hours

CO emissions:

For 2000 and 2001, the coal-only average CO emissions factor at OGS was 0.0182 lb/MMBTU.

During the switchgrass stack test, CO emissions were 0.0043 lb/MMBTU. Therefore, the implied decrease in CO emissions during cofiring is 0.0139 lb/MMBTU. Assuming a heat rate of 10,200 BTU/kWh, and converting to tons/hr:

0.0139 lb/MMBTU * (725 MW) * <1000 kW/MW> * (10,200 BTU/kWh) *
<MMBTU / 10^6 BTU> * <ton / 2000 lbs> = 0.0514 tons CO / hr decrease during cofiring

Over 480 hours (Cofire Test 2 duration), this would be a 25 ton decrease in CO emissions. Since the Cofire Test 2 cofiring rate would be a little more than 3x the cofiring rate during the stack test in Cofire Test 1, the expected decrease in CO emissions during Cofire Test 2 would be about 75 tons.

For an unknown reason, the coal-only CO emissions were 2 orders of magnitude lower during the coal-only stack test (0.0004 lb/MMBTU) relative to the annual average (0.0139 lb/MMBTU). Taking this as a worst-case, the CO emissions increase during cofiring is (0.0043 – 0.0004 = 0.0039 lb/MMBTU). Assuming a heat rate of 10,200 BTU / kWh during cofiring, the maximum increase in CO emissions would be:

0.0039 lb/MMBTU * (725 MW) * <1000 kW/MW> * (10,200 BTU/kWh) *
<MMBTU / 10^6 BTU> * <ton / 2000 lbs> = 0.0144 tons CO / hr increase

Over 480 hours, this translates into a 6.9 ton increase in CO emissions. Since the Cofire Test 2 cofiring rate would be a little more than 3x the cofiring rate during the stack test in Cofire Test 1, the expected increase in CO emissions during Cofire Test 2 (under this extreme scenario) would be about 21 tons (which is less than the 100 tpy PSD threshold).

<u>Conclusion:</u> CO emissions during Cofire Test 2 are unlikely to exceed the PSD threshold.

NOx Emissions:

Based on the January 2001 CEM data, daily average NOx emissions during cofiring were 6% higher than during coal-only operation. Cofiring did not occur around the clock (and the switchgrass feed rate varied from 5 tph to 16.5 tph) - given the limitations of the Cofire Test 1 data set, it is not possible to correlate NOx emissions increases or decreases with the cofiring rate.

For 2000 and 2001, the coal-only average NOx emissions factor at OGS was 0.341 lb/MMBTU. A 6% increase would be 0.0205 lb/ MMBTU. Assuming a heat rate of 10,200 BTU/kWh during cofiring (and using the same calculation as for CO), the increase in NOx emissions would be 0.0757 tons/hr. Over 480 hours, this translates to a 36-ton increase in NOx emissions (which is less than the 40 tpy PSD threshold).

<u>Conclusion:</u> It does not appear that NOx emissions during Cofire Test 2 would exceed the PSD threshold (40 tpy). However, given the limitations of Cofire Test 1, this cannot be said with

100% certainty. Therefore, the CVBP suggests that it keep a running total of NOx emissions during Cofire Test 2, agreeing that the IDNR may terminate Cofire Test 2 prematurely if the NOx PSD threshold is in danger of being exceeded.

SO_2 Emissions:

Based on the January 2001 CEM data, daily average SO_2 emissions during cofiring were 0.85% lower than during coal-only operation. Cofiring did not occur around the clock (and the switchgrass feed rate varied from 5 tph to 16.5 tph) - given the limitations of the Cofire Test 1 data set, it is not possible to correlate SO_2 emissions increases or decreases with the cofiring rate. Since S emissions in cofiring applications are typically reduced in proportion to the displaced feed S (switchgrass has 68% less S than PRB coal per MMBTU; therefore, for every 1% heat input supplied by switchgrass, SO_2 emissions would be expected to decrease by 0.68%).[1] The observed SO_2 emissions reductions during Cofire Test 1, while small, are expected.

For 2000 and 2001, the coal-only average SO_2 emissions factor at OGS was 0.659 lb/MMBTU. A 0.85% decrease would be 0.0056 lb/ MMBTU. Assuming a heat rate of 10,200 BTU/kWh during cofiring (and using the same calculation as for CO), the decrease in SO_2 emissions would be 0.021 tons/hr. Over 480 hours, this translates to a 10-ton decrease in SO_2 emissions.

Conclusion: SO_2 emissions during Cofire Test 2 are expected to decrease.

PM/PM_{10} Emissions:

Even though Cofire Test 1 showed PM/PM_{10} emissions decreases of about 50%, this large reduction in PM_{10} emissions was unexpected and calls the validity of the data into doubt. Therefore, the CVBP would like to proceed with caution during Cofire Test 2 in regard to PM/PM_{10} emissions.

Even though Cofire Test 1 suggests that PM/PM_{10} emissions will decrease during Cofire Test 2, the CVBP suggests that it keep an approximate running total of PM/PM_{10} emissions during Cofire Test 2, agreeing that the IDNR may terminate Cofire Test 2 prematurely if either of the PSD thresholds is in danger of being exceeded (25 tpy PM and 15 tpy for PM_{10}). *Since PM/PM_{10} emissions results are not produced in real time, this will be a practical challenge.* For the 480-hour Cofire Test 2, the PM_{10} PSD threshold would be exceeded if PM_{10} emissions increased by more than 0.00845 lb/MMBTU on average. For the 480-hour Cofire Test 2, the PM PSD threshold would be exceeded if PM emissions increased by more than 0.01409 lb/MMBTU on average.

[1] In some cases, SO_2 emissions reductions during herbaceous biomass cofiring have been observed to be greater-than-expected. SO_2 emissions have been reduced by more than the reduction in feed S would suggest. The reason for this extra emissions benefit (sometimes observed) is the high K (potassium) content of the switchgrass – the increase in SO_2 capture is the result of potassium sulphate formation.