Air Permitting Process Guidelines

for

Bio-Energy Projects

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The interest and need for bio-energy projects has increased dramatically in the past few years. One of the perceived obstacles to implementation of these projects is the permitting process, more specifically, the air permitting process. Several requirements associated with air quality regulations must be addressed early in the design phase of the project, since the permitting process can be as quick as a few months and as long as two years. Air quality permitting requirements can result in a need to add air pollution control equipment, fine tuning of the project conceptual design, limitations placed on the quantity of wastewater solids processed. For these reasons, interested parties need to consider the air permitting as a significant component of the overall project, and should be addressed upfront in the project planning process. Under the current regulatory climate, where global warming and climate change are increasingly becoming important issues, bio-energy projects have the potential to be looked upon favorably.

This paper discusses the air permitting related issues for bio-energy projects. Bio-energy projects that include wastewater solids incinerators, thermal dryers, and co-firing operations, along with biogas fired engines and boilers. These units are considered stationary sources, which require appropriate regulatory approval from federal, state and/or local agencies prior to being constructed. These approvals are typically referred to as air construction permits or permits to install (PTIs). A brief overview of the air construction permitting basics, applicability of specific air regulations, air emission estimation techniques and development of an air permitting strategy is presented.

Air Permitting Basics

The Clean Air Act Amendments of 1990 (CAAA) define stationary sources of air emissions as *"any building, structure, facility or installation which emits any air pollutant."* [1] Air construction permits are required prior to construction and operation of stationary sources and modification to existing stationary sources. The CAAA also defines modification as, "*Any physical change in, or change in the method of operation of, a stationary source which increases the amount of air pollution emitted by such source or which results in the emissions of any air pollutant not previously emitted.*" [2]

As previously discussed, wastewater solids dryers, incinerators and bio-gas fired boilers are stationary sources, and combustion of fuels of any form in these stationary sources

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[1] CAAA §111(a)(3)
[2] CAAA §111(a)(4)

will result in air emissions. Consequently air construction permits are required prior to implementing bio-energy projects.

The CAAA regulates six criteria air pollutants and 187 hazardous air pollutants (HAPs). The six criteria air pollutants are nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter (PM), particulate matter less than 10 microns(PM_{10}), Particulate Matter less than 2.5 microns ($PM_{2.5}$), ozone (volatile organic compounds (VOC); VOCs are considered surrogates for ozone and are regulated), and lead (Pb). In addition to these pollutants, some states/local agencies also regulate state specific air toxics.

The primary goal for affected parties and facilities contemplating the installation of a bio-energy project is to obtain an air construction permit with appropriate requirements and least number of permitting hurdles to overcome. Air construction permits are classified as minor and major source construction permits depending upon the amount of emissions change from either a new installation or modification to an existing installation. Typically minor source air construction permits have the fewest permitting hurdles to overcome and regulatory requirements to meet. Major source permits are implemented under the federal CAAA New Source Review (NSR) provisions under two programs: the Prevention of Significant Deterioration (PSD) program outlined in 40 CFR 52.21, and the Nonattainment NSR (NNSR) program outlined in 40 CFR 51 and 52. PSD regulations apply to new major stationary sources and major modifications at major existing sources undergoing construction in areas designated as attainment[3] or unclassifiable. The PSD regulations are designed to ensure that the air quality in attainment areas does not significantly deteriorate or exceed the NAAQS while providing a margin for future industrial and commercial growth. NNSR applies in regions that are classified as nonattainment[4] for a particular pollutant(s).

Major Stationary Source. A major stationary source under PSD is defined as any one of the listed major source categories which emits, or has the potential to emit (PTE), 100 tons per year (tpy) or more of any regulated pollutant, or 250 tpy or more of any regulated pollutant if the facility is not one of the listed named source categories. Bio-energy projects are not specifically listed in the list of named source categories.

Major Source Modification. The PSD program establishes requirements for existing major PSD sources of air pollutants to undergo pre-construction review for major modifications. The regulatory definition of a major modification is "*any physical change in or change in the method of operation of a major stationary source that would result in: a significant emissions increase of a regulated NSR pollutant; and a significant net*

[3] The air quality in a given area is designated as being in attainment for a pollutant if the monitored concentrations of that pollutant in the ambient air are less than the applicable National Ambient Air Quality Standards (NAAQS) or is designated as unclassifiable if sufficient monitoring data are not available to make an attainment decision. A given area is classified as non-attainment for a pollutant if the monitored concentrations of that pollutant in the ambient air in the area are above the NAAQS.

[4] A given area is classified as nonattainment for a pollutant if the monitored concentrations of that pollutant in the ambient air in the area are above the NAAQS.

emissions increase of that pollutant from the major stationary source."[5] The PSD program sets forth specific threshold levels, referred to as significant emission rates (SER) that are used to determine if an emissions increase constitutes a significant emissions increase for each PSD pollutant. The SERs for PSD pollutants that are typically of concern for facilities with combustion units are summarized in Table 1. At existing major PSD sources (such as large wastewater treatment plants), PSD is applicable if the emissions change results in a significant emissions increase and a significant net emissions increase.

Table 1: PSD Significant Emission Rates

Pollutant	Significant Emission Rate (tpy)
PM	25
NO_x	40
SO_2	40
PM_{10}	15
$PM_{2.5}$	10
CO	100
VOC (surrogate for ozone)	40
Sulfuric Acid Mist	7
Lead	0.6
Fluorides	3

Major Source Review Requirements. The primary provisions of the PSD regulations require that major modifications and new major stationary sources be carefully reviewed prior to construction to ensure compliance with the NAAQS, the applicable PSD air quality increments, other air quality related values and the requirements to apply Best Available Control Technology (BACT) to minimize the emissions of air pollutants from these sources. For nonattainment areas, as mentioned earlier, major source review falls under NNSR provisions. Major source thresholds for nonattainment areas are dependent on the severity of nonattainment classification and are lower than the PSD major source thresholds. NNSR major source review would require implementation of the Lowest Achievable Emission Rate (LAER), more stringent than BACT, and the purchase of offsets or emission reduction credits for the nonattainment pollutant exceeding the major source threshold. An ambient air quality impact analysis (AAQIA) may also be needed. Table 2 provides a summary of the typical major source review requirements.

[5] 40 CFR 52.21(b)(2)(i)

Table 2: Overview of Major Source Review Requirements

Major Source Review Requirements	Points to Note
BACT	• "Top" control in the country required unless it can be ruled out • Could be dispersion modeling and/or regional haze driven • Would require post-installation monitoring, recordkeeping and reporting
LAER (NNSR)	• "Top" proven control in the country required irrespective of costs
Dispersion Modeling (AAQIA)	• Impact assessment conducted using plume dispersion models with extensive meteorology, emissions data (criteria air pollutants and/or air toxics) and stack parameters, receptor grids, nearby sensitive receptors, terrain elevation data, source information (point/area/line/volume), and downwash effects from buildings • Could potentially drive the level of emissions control to be achieved and/or affect source characterization • Determines exemption from preconstruction monitoring • Time needed for running various modeling iterations
Class I Areas Visibility - Regional Haze	• Proximity to Class I areas triggers requirements • Visibility degradation resulting from regional haze contribution is an extremely sensitive issue • Primary pollutants of concern: NO_x, SO_2, and fine particulates • Could potentially drive the level of emissions control to be achieved and/or affect source characterization • Time needed for running various modeling iterations
Emissions Offsets (NNSR)	• Usually greater than 1:1 for the nonattainment pollutant depending on the severity of the nonattainment classification • Need to be procured prior to facility startup or sometimes be in place prior to permit issuance • Offset costs could be significant depending on the type of pollutant being offset and the prevailing market rates

Typical Air Permitting Process

The air permitting process is initiated by the owner or operator (hereinafter referred to as the Applicant) of the proposed bio-energy facility. The Figure 1 below summarizes the air permitting process in a flow chart.

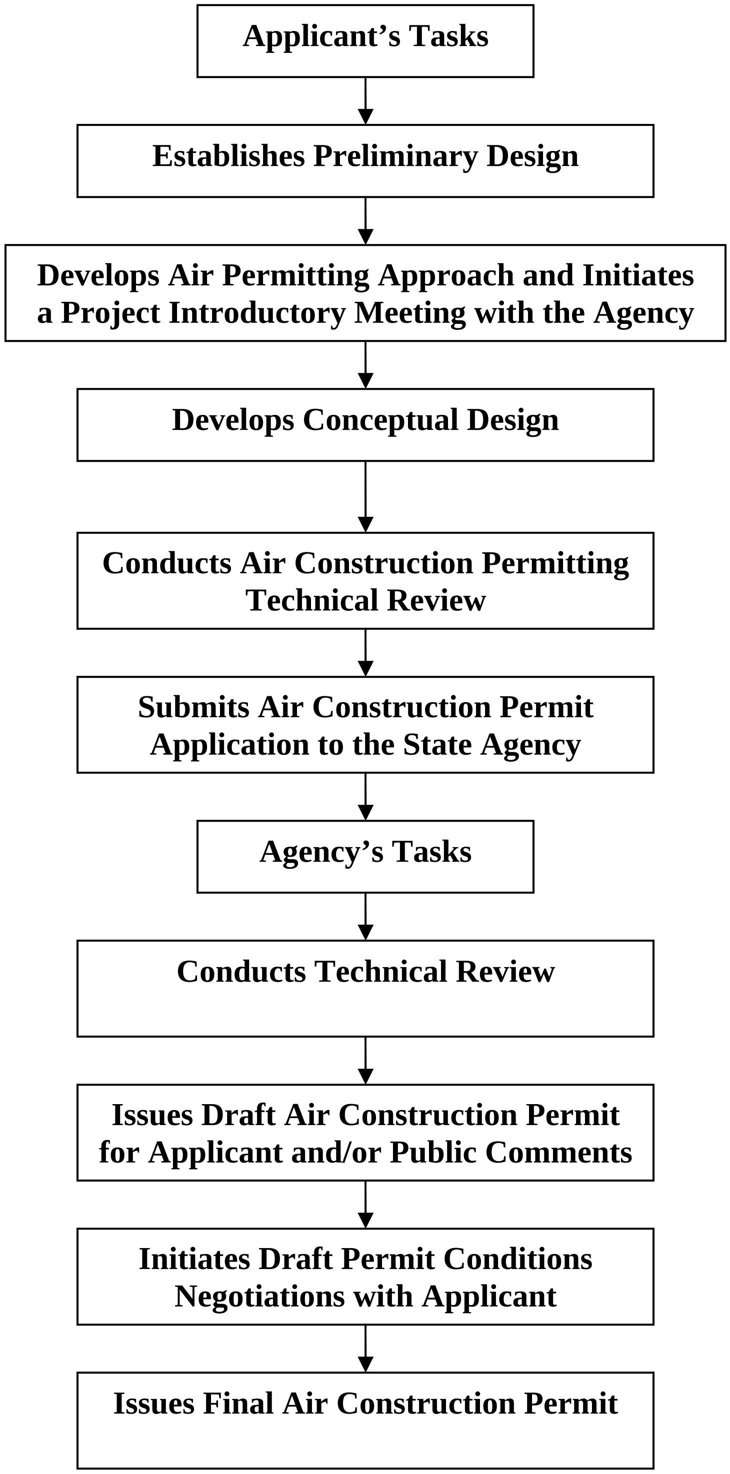

Figure 1 : Air Permitting Process Flow Chart

Establishing the Engineering Design

Establishing the preliminary/conceptual design for the project is a very important first step. It is strongly recommended that the air permit application is backed up by preliminary/conceptual engineering design. A Basis of Design (BOD) report indicates to the reviewing agency that the applicant is serious about the bio-energy project. It also provides information for the air permitting team (internal or external) to start developing the air permitting strategy. In most cases the project site is already determined based on wastewater solids management studies conducted by the applicant. The engineering design then typically identifies the technology, air emission sources, air quality control equipment and type of fuels (primary and supplemental) combusted for the given project site based on a set design criteria. The emission sources at a new bio-energy facility can be grouped into three main categories.

- Combustion Sources – Incinerators, dryers, engines, boilers
- Product conveying, handling, storage and transportation operations
- Odor emissions from the dewatering operation

Estimating Potential to Emit: Potential emissions of regulated pollutants are required to be estimated as part of the air construction permit application process. The major or minor source permit applicability for a bio-energy project is dependent usually on the potential annual emissions rate in tons per year from the proposed project (only, for Greenfield standalone facility), and the major or minor source classification of the current site (for modification).

Criteria Pollutants: The potential emissions of NO_x, CO, $PM/PM_{10}/PM_{2.5}$, VOCs and SO_x from a proposed project can be based on different sources of emissions data. These include emissions and performance guarantees provided by the process unit/emissions control equipment vendors, emission factors from USEPA's AP-42 Document (http://www.epa.gov/ttn/chief/ap42), emission factors based on stack tests conducted at other similar facilities, and/or other engineering calculations. If digester gas is used, a digester gas analysis needs to be performed to determine the level of sulfur and siloxanes in the digester gas.

Air Toxics and HAPs: In some states/local jurisdictions, air toxic regulations will require the Applicant to estimate emissions of specifically identified air toxic pollutants. Some of these air toxics may also be classified as federal HAPs. Bio-energy projects typically emit trace amounts of metallic particulates such as arsenic, cadmium, mercury and nickel; trace amounts of volatile organic HAPs; and other pollutants such as hydrogen sulfide and ammonia. Emissions of metallic particulates can occur from both the wastewater solids incineration/drying and materials handling operations. Emissions of the metallic particulates, are usually determined by multiplying the expected metal concentrations in the wastewater solids and the suspended $PM/PM_{10}/PM_{2.5}$ emission rates for the incinerators/dryers and solids storage/loadout, respectively. Wastewater solids metal concentration data is obtained from an analysis of a composite sample of the material.

Odor: Most state and local agencies have nuisance odor regulations that limit odor emissions beyond the property line. Odor emissions can be estimated based on design input and outlet loading rates for odor control units. Hydrogen sulfide is widely accepted as a surrogate for odor emissions. In some cases reduced sulfur compounds (RSCs) may also need to be estimated.

Development of Air Permitting Strategy

There is a strong interdependence between air permitting and engineering design for bio-energy projects. Several iterative steps may be needed before an optimal process design is developed that would result in an installation that can smoothly sail through the air permitting waters. These iterative steps where air permitting and engineering design drive each other is captured in Figure 2. As mentioned earlier, the goal for most applicants is to minimize the air permitting hurdles that need to be overcome prior to obtaining an air construction permit, or in other words qualify for permitting as a minor source.

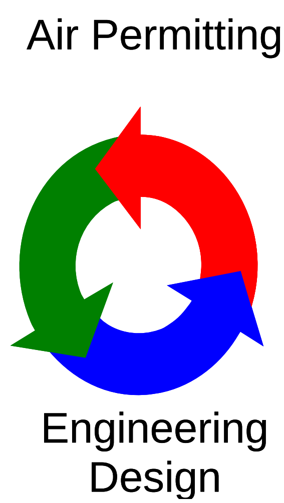

Figure 2: Air Permitting and Engineering Design

Interested parties and their engineering design teams need to work closely with their own air quality permitting staff or permitting consultants from the earliest project development phase. Optimal project characterization is an important first step in the air permitting process since it can affect:

- Facility location – Feasibility of locating a source in attainment or nonattainment area, proximity of the source to sensitive receptors, locating at a greenfield site or co-locating at an existing plant
- Facility size – How big of an emissions unit can be permitted without tripping major source thresholds or violating ambient air impact thresholds
- Facility layout – How many units can be built, finding room to install additional units or equipment

- Emission rates – Negotiating guaranteed emission rates from vendors to meet potential permit limits or obtaining data from test-burns.
- Fuels – Determining primary and supplemental fuels, optimal fuel blends and firing rates
- Stack parameters - For new units, determine stack heights, inside diameter and flow rates that would result in ambient air impacts below thresholds (if AAQIA is needed). For existing units, determine if co-firing would change stack parameters that could minimize plume buoyancy and result in higher modeled downstream ambient air impacts
- Type of fuel pre-treatment and/or add-on emissions control technology to be selected – Fuel treatment for digester gas may be needed to strip it of constituents such as sulfur and siloxanes. Lowest emissions are obtained by using natural gas in lieu of fuel oil or digester gas.
- Operational flexibility - Determining optimal hours of operation such as how many hours to operate on the primary and supplemental fuels.

Some of the bulleted items identified above are discussed in further detail.

Facility Location: The location for a bio-energy project is usually on the same site as the wastewater treatment operations or on an adjacent property. Due to co-location and common control issues with the WWTP, it is recommended that the applicant approach the appropriate agencies with a source determination request. Unless enough details are provided to the state/local agencies, it is likely that state/local agencies could potentially classify the wastewater solids incineration/drying operations and the WWTP operations as one source. In other words, the bio-energy facility will be considered as a modification to the existing WWTP. Under this situation, the existing source status of the WWTP (major or minor source under PSD/NNSR) will dictate whether or not the bio-energy project will be subject to major or minor modification rules.

Local Ambient Air Quality Classification: The air quality in a given area is designated as being in attainment for a pollutant if the monitored concentrations of that pollutant in the ambient air are less than the applicable NAAQS or is designated as unclassifiable if sufficient monitoring data are not available to make an attainment decision. A given area is classified as non-attainment for a pollutant if the monitored concentrations of that pollutant in the ambient air in the area are above the NAAQS. Bio-energy projects locating in nonattainment areas, for ozone and/or $PM_{2.5}$ will need to meet the requirements of major source NNSR if they are classified as either new major sources or trigger major modification.

Air Dispersion Modeling: An ambient air quality impact analysis (AAQIA) commonly referred to as air dispersion modeling is usually required for projects subject to major source review. An AAQIA will need to evaluate ambient air impacts at Class I and Class II areas and compare these against established thresholds. In some cases, state and local agencies on a case-by-case basis may also require an AAQIA for projects subject to minor source review.

Class II Analysis: For each pollutant subject to major source review, and for which a standard exists, air dispersion modeling to determine maximum predicted ambient air quality impacts must be performed. This modeling needs to be performed using USEPA's latest preferred regulatory air dispersion model appropriate for such an application (typically AERMOD). In addition to defining the appropriate source input parameters, the AERMOD model utilizes a file of surface boundary layer parameters and a file of profile variables including wind speed, wind direction, and turbulence parameters to define the atmospheric conditions which govern plume dispersion. The model produces maximum predicted ambient air quality impacts which are then compared to defined criteria to determine which, if any, pollutants are above the Class II NSR/PSD significant impact levels (SILs), PSD increment levels, de minimis ambient monitoring levels, and/or state/national ambient air quality standards.

Class I Analysis: Class I Areas include National Parks, national Wilderness Areas, and Fish and Wildlife Refuge areas. Class I areas are afforded special attention based on their value from a natural, scenic, recreational, or historic perspective. Emission sources subject to major source review are analyzed to determine their potential for deteriorating the particular properties that make these areas worthy of their Class I designation. These properties are known as air quality related values (AQRVs), and typically include such attributes as regional haze and sulfur/nitrogen deposition. Class I area analyses are typically required based on the magnitude of a project (including the anticipated pollutant emissions) and the proximity of the project to a Class I area (usually within 200 kilometers). Class I area analyses, when required, are often a crucial detail of the application process as very often the analyses can dictate the emission requirements from a new or modified source.

Air Toxics and Health Impacts: As mentioned earlier, some states and local agencies also regulate emissions of air toxics, including ambient air impacts from air toxic emissions measured as carcinogenic and non-carcinogenic impacts on human health. The ambient air impacts can potentially result in limitations of emissions of regulated air pollutants, including air toxics.

The air dispersion models utilize parameters such as local topography, land uses in the area, meteorology, site layout, nearby buildings, and stack exhaust parameters. While factors such as meteorology and topography cannot be changed, the preliminary/conceptual design can factor in good engineering practices in designing the plant layout, air quality control equipment and stack exhaust characteristics (stack inside diameter, height, volumetric flow and exhaust temperature).

Other Specific Regulations: Other specific regulations that could apply are:

- New Source Performance Standards (NSPS) for wastewater solids incinerators
- National Emission Standards for Hazardous Air Pollutants (NESHAP) for mercury, and beryllium emissions
- Maximum Achievable Control Technology (MACT)

Project Economics: Project economists for bio-energy projects may include factors such as raw materials cost, transportation costs, fuel savings, alternate fuels, electricity rates, heat rates, and annual operational costs in their economic models to study the viability of the project. It is also important that along with the engineering design team, the air permitting staff or permitting consultants interact closely with the project economists so that they can include other capital and operating costs associated with add-on emissions control equipment, fuel pre-treatment equipment (such as sulfide and siloxanes removal in digester gas), and costs for buying emission offsets, if required, (in nonattainment areas only) into the economic model. Costs for obtaining offsets could be very high depending on the type of nonattainment pollutant for which the offsets are required and the prevailing market rates for such offsets. Similarly, add-on emissions control capital and operational costs can be high, and a detailed economic analysis may be necessary to justify inclusion or exclusion of such technologies as part of the engineering project design.

Project Schedule: An air construction permit is needed prior to start of construction and operation of a bio-energy project. As part of the project schedule and planning, it is important to budget the time for:

- Iterations to be performed during the preliminary/conceptual design phase when the project is being optimally characterized
- Preparing air construction permit application documents
- Agency review.

Minor source permit reviews typically take three to six months for approval after a complete application has been submitted. Major source review can take from 12 to 24 months for agency review and approval. It is therefore very important to insert an air permitting schedule into the overall project schedule. The time budgeted for air permitting can then be used to develop a sound air permitting strategy, including allowing the interested parties time to engage the air permitting agencies early with the nature of the project being planned, engaging public with the benefits of the project and allowing the air permitting staff or the permitting consultant to conduct all relevant and required analyses, and assemble the permit application for submittal to the state agencies for their review and approval.

Negotiating Draft Permit Conditions: Regulatory agencies typically provide a copy of the draft air construction permit to the applicant for review and comments prior to the issuance of a final air construction permit. It is very important that the applicant utilize this opportunity to clarify and if required, negotiate draft permit conditions related to emission limits, averaging times, testing, monitoring, recordkeeping and reporting requirements. A positive working relationship between the permit engineer and the applicant will be an asset.

Contributing Reviewers

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