STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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Red Shield Acquisition, LLC
Penobscot County
Old Town, Maine
A-180-77-5-A

Departmental
Findings of Fact and Order
New Source Review
NSR #3

FINDINGS OF FACT

After review of the air emissions license amendment application, staff investigation reports, and other documents in the applicant's file in the Bureau of Air Quality, pursuant to 38 M.R.S.A., Section 344 and Section 590, the Maine Department of Environmental Protection (Department) finds the following facts:

I. REGISTRATION

A. Introduction

FACILITY	Red Shield Acquisition, LLC (Red Shield)
LICENSE TYPE	06-096 CMR 115 Minor Modification, NSR
NAICS CODES	322110 Wood Pulp Manufacturing 221119 Electric Power Generation
NATURE OF BUSINESS	Pulp Manufacturing
FACILITY LOCATION	24 Portland Street, Old Town, Maine

Red Shield manufactures pulp in Old Town, Maine using the Kraft process. Red Shield also produces energy and process steam, and operates support facilities including the wastewater treatment plant, labs, and shipping and receiving operations. The facility is considered an existing Part 70 Major Source as defined in *Definitions Regulations*, 06-096 CMR 100 (as amended) and currently operates under the Part 70 license A-180-70-A-I (December 2, 2009) and associated amendments.

Red Shield has submitted a major modification application to allow for the installation and operation of a demonstration-scale cellulosic biorefinery at the facility, with a corresponding actual increase in pulp and steam production from the existing mill to support the biorefinery process. The licensed allowed pulp mill emissions will not be changing and the pulping equipment will not be modified.

The project has been undertaken with assistance from a U.S. Department of Energy grant, with an ultimate goal of converting wood to biofuel. Pilot tests have occurred at the mill for various steps in the biorefinery process.

B. Amendment Description

Red Shield has submitted an amendment proposing to produce sugars in new cellulosic biorefinery equipment using a side stream of washed and screened brown stock from the existing Kraft pulp mill. The stream of deconstructed woody biomass, taken from the brown stock decker with expected brown stock use of approximately 100 bone-dried short tons per day, will undergo enzymatic hydrolysis converting cellulose to sugars. The sugars will be further processed to remove impurities and then will be concentrated. The current expectation is that two-thirds of the finished sugar product will be provided to third parties for conversion to a biofuel, and one-third will remain on-site to be further converted to green oil using algal fermentation, oil extraction, solvent recovery, and oil conditioning.

The main processes of the biorefinery will include a sugar conditioning process, a fermentation process, and an oil extraction and solvent recovery process. The processes will consist of new equipment located inside existing mill buildings. The additional brown stock and power needed for the biorefinery process will be produced from the existing pulp mill equipment and power boilers.

The biorefinery equipment is considered new and is subject to control technology review; however, the existing equipment is considered 'affected' by the project, but not 'modified' as part of the project since the existing equipment is capable of the expected 18% increase in production attributed to the biorefinery without undergoing any physical modifications. In addition to the control technology review for the new equipment, an ambient air quality analysis was included as part of the license amendment application.

C. Emission Equipment

This amendment addresses the following equipment:

EMISSION UNIT ID	UNIT CAPACITY	UNIT TYPE
Biorefinery Process (includes various unit operations and associated tanks)	100 bone-dried short tons per day of screened brown stock fiber	Process Equipment

The existing pulp mill equipment is addressed in this amendment for emissions comparisons purposes, but the existing equipment is not being modified. The Recovery Boiler, Smelt Dissolving Tank, #5 Power Boiler, Biomass Boiler, Lime Kiln, and five generators/fire pumps were included in the calculations for determining baseline actual to projected actual emissions.

D. Application Classification

The modification of a major source is considered a major modification based on whether or not expected emissions increases exceed the "Significant Emission Increase Levels" as given in *Definitions Regulation*, 06-096 CMR 100 (as amended).

For this project, the affected sources underwent an "actual-to-projected actual" applicability test in accordance with 06-096 CMR 100 (as amended), *Minor and Major Source Air Emission License Regulations,* 06-096 CMR 115 (as amended), and 40 CFR Part 52, §52.21 (*Prevention of Significant Deterioration of Air Quality*). The emission increases were determined by subtracting the average baseline actual emissions of the 24 months preceding the modification (or representative 24 months) from the projected actual emissions from the proposed project. The following presents the results of this determination and the basis for the calculations:

Pollutant	Average Baseline Actual Emissions for 2010 and 2011 (tons/year)	Future Projected Actual Emissions (ton/year)	Net Change (ton/year)	Significant Emissions Increase Level (ton/year)
PM	36.4	42.9	6.5	25
PM_{10}	32.7	38.5	5.9	15
$PM_{2.5}$	30.3	35.8	5.5	10
SO_2	50.8	59.9	9.1	40
NO_X	555.4	655.4	**100.0**	40
CO	563.4	664.8	**101.4**	100
VOC	56.2	67.5	11.3	40
CO_2e	564,934	672,631	**107,696**	75,000
H_2S	3.6	4.2	0.6	10
TRS	3.6	4.2	0.6	10

The data in the table above was based on the following:

- Average baseline actual emissions estimates for 2010 and 2011 were calculated using continuous emissions monitoring (CEM) data for those

stacks equipped with CEMS. EPA AP-42 factors were used to estimate the emission rates for all other parameters.

- Future projected actual emissions from existing units were determined as stated below:
  - Adding 100 tons/day of brown stock production required for the biorefinery represents an 18% increase in digester loading (from 535 to 635 bone-dried short tons per day).
  - Approximately 18% more black liquor solids will be burned in the Recovery Boiler (from 170 to 201 gallons per minute).
  - For conservative estimates, the emissions from the entire pulp mill are projected to increase by 18%, including energy requirements as developed from the 2012 Energy Model with Sugars and Algal Oils prepared by Red Shield.
- Based on process calculations provided by the technology developer, it was estimated that approximately 1.31 tons per year of biorefinery-specific VOC emissions (1.04 tons/year from evaporator and 0.27 tons/year from scrubber) and 6,009 tons per year of biorefinery-specific CO_2e emissions would result from operation of the proposed project. For the proposed new biorefinery equipment, baseline actual emissions were assumed to be zero and the future projected actual emissions were assumed to be the proposed license limits.
- No eligible emissions increases or decreases were identified in the five-year contemporaneous period for inclusion in the netting analysis.

This amendment is determined to be a major modification for NO_X, CO, and CO_2e (carbon monoxide equivalent, greenhouse gas). The amendment has been processed under 06-096 CMR 115 (as amended) since the changes being made are not addressed or prohibited in the Part 70 air emission license. An application to incorporate the requirements of this amendment into the Part 70 air emission license shall be submitted no later than 12 months from commencement of operations authorized under this amendment.

Prior to submitting the major modification application, Red Shield had contact with the Department various times for pre-application meeting purposes, held a public informational meeting on October 15, 2012 at the Black Bear Inn & Conference Center in Orono, Maine, and the Public Notice of Intent to File was published in the Bangor Daily News on October 5, 12, and 19, 2012. A public meeting on the draft license was not requested.

The Federal Land Managers (FLMs) from each of the affected Class I areas (Acadia National Park, Moosehorn National Wildlife Refuge, Roosevelt Campobello International Park, and Presidential Range/Dry River/Great Gulf Wilderness Area) were notified of the project in June of 2012. The FLM representatives responded with a determination that Class I Air Quality Related

Values (AQRV) analyses would not be required. The notification to the FLMs included a project summary, distances from the source to each of the Class I areas and the magnitude of proposed emissions increases on a pollutant-by-pollutant basis.

II. BEST PRACTICAL TREATMENT (BPT)

A. Introduction

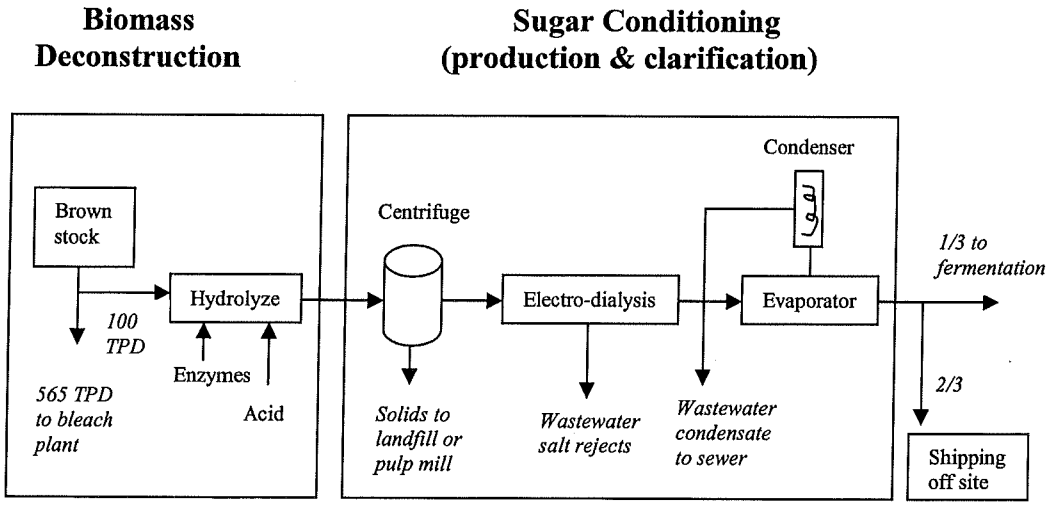
In order to receive a license the applicant must control emissions from each unit to a level considered by the Department to represent Best Practical Treatment (BPT), as defined in *Definitions Regulation*, 06-096 CMR 100 (as amended). Separate control requirement categories exist for new and existing equipment as well as for those sources located in designated non-attainment areas.

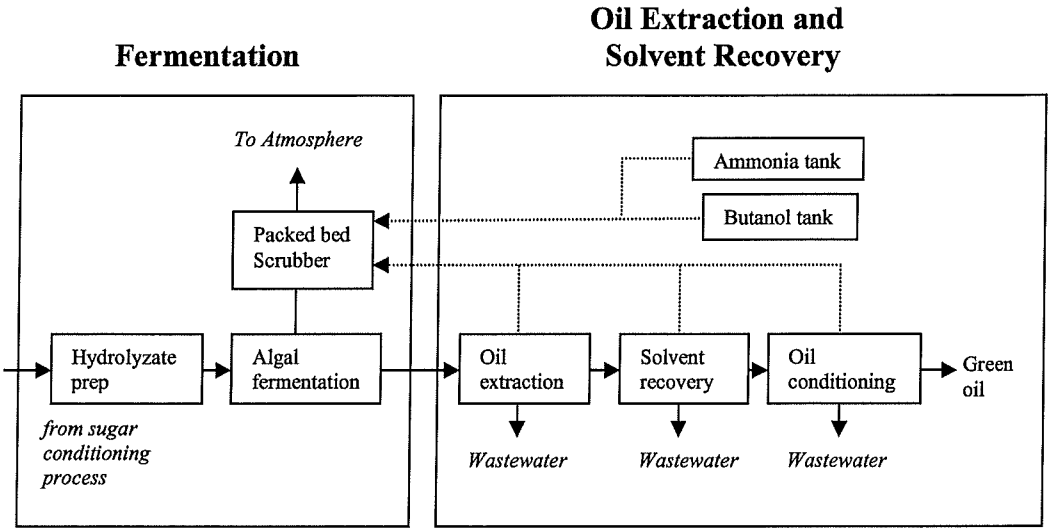
BPT for new sources and modifications requires a demonstration that emissions are receiving Best Available Control Technology (BACT), as defined in 06-096 CMR 100 (as amended). BACT is a top-down approach to selecting air emission controls considering economic, environmental and energy impacts.

B. Proposed Biorefinery

1. Process Overview

Red Shield's proposed demonstration-scale cellulosic biorefinery will convert cellulose to sugars, which will then eventually be used to produce oil. The four main processes of the proposed project are: biomass deconstruction, sugar conditioning, fermentation, and oil extraction and solvent recovery as shown in the following simplified diagram.





The primary raw material of brown stock fiber will come from the existing Kraft pulping process at the facility in which wood chips are digested chemically at elevated temperatures and pressure to dissolve the lignin that binds the cellulose fibers together. The process of digesting at Red Shield includes wood chips delivered, conveyed to storage silos, and then sent to the impregnation vessel (first digester) for partial cooking. The partially cooked chips are then sent to the second digester where cooking occurs in alkaline conditions to liberate the cellulosic fibers. The material goes from the second digester to the blow tank, to washing and screening, and then gets thickened at the decker raising the consistency from approximately 2% to approximately 16%. The remainder of the pulping process after the decker includes various washing and bleaching processes, pressing, and drying to produce a finished pulp product sold primarily to paper makers.

The proposed biorefinery will utilize a side stream of approximately 100 bone-dried short tons per day of screened brown stock fiber from the discharge of the existing brown stock decker. The brown stock will be pumped through a chemical mixer where an enzyme will be added. The enzyme/brown stock mixture will be pumped to the existing Numbers 1 and 2 Brown Stock High Density Storage Towers (combined capacity of 425,000 gallons) to allow for the Enzymatic Hydrolysis process to take place. The pulp mill will need to supply pulp approximately 7 hours out of 48 hours to fill the two storage towers. The reaction to convert cellulose to sugars is 90% complete after 60 hours. The pulp/enzyme mixture from the Brown Stock High Density Storage Towers will be pumped to a new Post Hydrolysis

storage tank to be located in the former tissue building. The Post Hydrolysis storage tank will be used as a buffer to allow for operation of a continuous process rather than a batch process.

The Enzymatic Hydrolyzate will be pumped from the storage tank to a set of as many as six centrifuges arranged in parallel. The centrifuges will remove suspended solids, lignin, and unconverted fiber; dewatering them to 40% solids by weight. The fiber collected from the centrifuge process will be recovered and sent to the landfill or returned to the mill.

The sugar extract from centrifuge filtration will be pumped to an electrodialysis to remove salts and then the sugar extract will be concentrated in a single-effect evaporator. From the evaporator, the product will be split. One-third will continue through the remaining biorefinery processes at the facility, including algal fermentation, oil extraction, solvent recovery, and conditioning of the green oil. The other two-thirds of the concentrated sugar extract will be pumped to storage tanks then into rail cars or trucks to be sent off-site for conversion to biofuels by others.

The existing pulping, recovery, and power systems at the mill will have to operate at an 18% higher rate than the pulp sales production rate in order to support the biorefinery while meeting target pulp sales. All of the existing systems are capable of this higher production rate under the existing design and no process modifications are anticipated to the existing equipment at the higher production rate.

2. Applicability of Federal Rules

   a. 40 CFR Part 52, *Prevention of Significant Deterioration (PSD) of Air Quality*

      The proposed Red Shield major modification is subject to the federal PSD rules found in 40 CFR Part 52 as administered through 06-096 CMR 115 (as amended), including requirements for a Best Available Control Technology (BACT) analysis for emissions units being 'modified', an ambient air quality analysis, an analysis of the impact on soils, vegetation, and visibility, and public notification of the proposed project. This amendment includes the results of the required analyses.

   b. 40 CFR Part 63, Subpart S, *National Emission Standards for Hazardous Air Pollutants (NESHAPS) for the Pulp and Paper Industry*

Red Shield's digester system is subject to 40 CFR Part 63, Subpart S for the control of hazardous air pollutants (HAPS) from the Low Volume High Concentration (LVHC) system, including the digester and evaporators, and the High Volume Low Concentration (HVLC) system, including the chip bin, the brown stock washers, and some liquor storage vents. The LVHC gases are incinerated in the Lime Kiln, #5 Power Boiler, or the Biomass Boiler. The HVLC gases are controlled by incineration in the Lime Kiln. Subpart S also requires Red Shield to collect pulp processing condensates with specified HAP content and to establish a venting monitoring program. The changes occurring with the proposed biorefinery project will not constitute a reconstruction of any of the existing equipment subject to Subpart S nor affect the facility's compliance with Subpart S.

c. 40 CFR Part 63, Subpart MM, *National Emission Standards for Hazardous Air Pollutants (NESHAPS) for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills*

Red Shield is subject to 40 CFR Part 63, Subpart MM due to the facility's recovery system, including the Recovery Boiler, the Smelt Tank, and the Lime Kiln. The units subject to Subpart MM must meet particulate matter (PM) limits as surrogates to HAP metals. The existing control technology on the recovery system is rated for the production rate anticipated as a result of the addition of the biorefinery. The Recovery Boiler is not expected to exceed 10% of the production levels (24 hour basis) which occurred during the initial Subpart MM compliance testing for PM. The initial testing occurred on August 30, 2004 with an average black liquor solids firing of 2.29 MMlb/day. If operating levels are going to exceed levels greater than 10% of those which occurred during the initial testing, then Red Shield will notify the Department and EPA as required by §63.867(b)(3).

d. 40 CFR Part 60, Subpart BB, *Standards of Performance for Kraft Pulp Mills*

Red Shield is subject to 40 CFR Part 60, Subpart BB because its Kraft pulping processes were constructed or modified after September 24, 2976. Subpart BB limits the total reduced sulfur (TRS) emissions from the digester system to 5 ppmv (at 10% oxygen) unless the gases are combusted in a lime kiln or incinerator at a minimum temperature of 1200°F for at least 0.5 seconds. The digester gases are routed to the facility-wide low volume high concentration (LVHC) non-condensible gas (NCG) system and combusted in the Lime Kiln, the #5 Power Boiler, or

the Biomass Boiler; therefore, there is no limit placed on the digester off-gases. Red Shield is currently in compliance with Subpart BB, and the proposed project does not constitute a modification of any of the existing equipment at the mill for purposes of 40 CFR Part 60, §60.14 and 60.15 and will not affect compliance with the standard.

e. 40 CFR Part 60, Subpart NNN, *Standards of Performance for Volatile Organic Compound (VOC) Emissions from Synthetic Organic Chemical Manufacturing Industry (SOCMI) Distillation Operations*

The process vents for the biorefinery will not be subject to 40 CFR Part 60, Subpart NNN since the configuration does not include distillation processes as defined in the subpart.

f. 40 CFR Part 63, Subpart F, *National Emission Standards for Organic Hazardous Air Pollutants from the Synthetic Organic Chemical Manufacturing Industry (SOCMI)*

After review of 40 CFR Part 63, Subpart F, the biorefinery does not appear to be subject to the Subpart since the chemical manufacturing process unit does not meet the applicability requirement of manufacturing a chemical listed in Table 1 of Subpart F as the primary product.

g. 40 CFR Part 63, Subpart FFFF, *National Emission Standards for Hazardous Air Pollutants: Miscellaneous Organic Chemical Manufacturing*

After review of 40 CFR Part 63, Subpart FFFF, the biorefinery does not appear to be subject to the Subpart. Subpart FFFF applies to miscellaneous organic chemical manufacturing process units that produce material or a family of materials described in the Subpart. The proposed biorefinery project equipment does not meet the miscellaneous organic chemical manufacturing process unit definition.

3. Best Available Control Technology (BACT)

Red Shield submitted a BACT analysis addressing the air emissions from the biorefinery. The regulated air pollutants from the biorefinery consist of volatile organic compounds (VOC), hazardous air pollutants (HAPS) and greenhouse gases (GHG). The existing pulp mill sources are not proposed to be modified and therefore, were not required to be included in the BACT analysis; however, the existing sources were included as affected sources for

the purposes of determining whether the project was a major or minor modification.

Biorefinery process equipment resulting in air emissions includes the evaporator, the sparge air for the fermenters, and various process tanks. Red Shield proposes to use a packed bed scrubber as control for some emission sources, although most of the tank vents are under the insignificant activity threshold level of one ton per year per Appendix B of 06-096 CMR 115.

The sugar conditioning process includes seven tanks and one evaporator, with each tank venting an insignificant amount of VOCs in the form of formic acid, acetic acid and gluconic acid. The fermentation process equipment consists of seed tanks, pre-fermentation tanks, an algae harvest tank, an oil extraction tank, a separator feed tank, and other process tanks. During fermentation, the metabolic process of the algae converts O_2 to CO_2. Under normal operation, there will be insignificant emissions of VOCs, ammonia, and CO_2 as a result of the fermentation process. However, an upset condition with a full reactor could release larger quantities of VOCs which represents a worse-case scenario and is the primary reason the fermentation vapors will be collected and routed through the packed scrubber.

The biorefinery will also include two additional storage tanks, one with butanol and one with 20% aqueous ammonia. The butanol will be used as a solvent in the oil extraction process. Both tanks will be routed through the packed scrubber.

The BACT analysis submitted by Red Shield for the biorefinery emissions was based on reviews of recent Maine air emission licenses, EPA's RACT/BACT/LAER Clearinghouse, EPA's AP-42 database, and other industry guidance documents.

a. VOC and HAPs

As described above, the biorefinery VOC and HAPs emissions are mainly from the fermentation process. Existing in-place mill control technologies were reviewed for feasibility of routing biorefinery emissions back into the mill's systems. Currently, HAPs, TRS, and VOC are controlled from the pulp mill digester and evaporator processes using the LVHC system (incineration in the Lime Kiln, #5 Power Boiler, or Biomass Boiler), the HVLC system (incineration in the Lime Kiln), and the condensate collection system (hard pipe to biological wastewater treatment system). A review of other air emission licenses in Maine showed that similar

technologies were used to control HAPs and VOCs from digester and evaporator systems by collection and incineration.

Red Shield concluded that it is not economically feasible to direct the emissions from the biorefinery processes to any of the existing incineration sources due to the distance of the biorefinery to the existing non-condensable gas collection and control systems. Therefore, only stand-alone control technologies specific to the vented emissions from the fermentation process were reviewed.

A search of the RACT/BACT/LAER Clearinghouse (RBLC) database was conducted for VOC control technologies and associated percent removal efficiency rates from fermentation processes. The control technologies found included: wet scrubber, CO_2 scrubber, distillation scrubber, regenerative thermal oxidizer, distillation non-condensable gas scrubber, and absorption column as shown in the following table:

VOC Control Technology Review Summary of Sources with a Fermentation Process from the RBLC

Facility	Permit Date	Basis	Percent Efficiency	Control Description
Vernium Highlands Ethanol Facility	12/10/2009	BACT	98%	Wet scrubber
Tate & Lyle Ingredients Americas, Inc.	9/19/2008	BACT	98%	CO_2 scrubber, distillation scrubber, and regenerative thermal oxidizer
Aventine Renewable Energy	9/27/2007	BACT	99%	CO_2 scrubber
Aventine Renewable Energy	9/27/2007	BACT	99%	Regenerative thermal oxidizer
Homeland Energy Solutions, LLC	8/08/2007	BACT	97%	Scrubber
Archer Daniels Midland Adm. Corn Processing	6/29/2007	BACT	98%	CO_2 scrubber, distillation NCG scrubber, and regenerative thermal oxidizer
Sunnyside Ethanol, LLC	5/07/2007	Other case-by-case	98%	Packed bed counterflow scrubber
Southwest Iowa Renewable Energy	4/19/2007	BACT	95%	Wet scrubber
Cargill, Inc.	9/08/2006	BACT	98%	Wet scrubber
Asalliance Biofuels, LLC	8/10/2006	BACT	98.5%	High efficiency CO_2 wet scrubber
Heartland Corn Products	12/22/2005	BACT	95%	Wet scrubber

Heartland Corn Products	12/22/2005	BACT	95%	Adsorption column
Aventine Renewable Energy	11/01/2005	BACT	98.5%	CO_2 scrubber, purge scrubber
Red Trail Energy, LLC	8/04/2004	BACT	97%	Wet scrubber
Abenoa Bioenergy Corporation	1/21/2004	BACT	98%	Wet scrubber
Ace Ethanol, LLC	1/21/2004	BACT	98%	Wet scrubber (packed tower)
United Wisconsin Grain Procedures	8/14/2003	Other case-by-case	98.7%	Wet scrubber (packed tower)
Michigan Ethanol, LLC	11/04/2002	Other case-by-case	97%	Fermentation scrubber

For the biorefinery, ethanol will be the only VOC emitted at a production rate above the insignificant activity threshold in 06-096 CMR 115, Appendix B (as amended). Although there are numerous VOC control technologies that can efficiently control ethanol emissions, Red Shield proposed BACT as the use of a packed bed wet scrubber designed to control ethanol emissions from the biorefinery at an efficiency rate greater than 99%. This conclusion was based on the relatively small amount of VOC to be controlled, the design of the proposed biorefinery equipment, and additional environmental emissions and cost associated with other control options (i.e. - thermal oxidizer fuel use).

The packed scrubber will control vent stream emissions from the fermentation process, oil extraction, solvent recovery, oil conditioning, and ammonia and butanol tanks. The vent streams will primarily be composed of air and carbon dioxide with small quantities of ethanol, acetaldehyde, acrolein, formaldehyde, and methanol. The actual projected emissions were calculated from mass balance, historical operating data from other non-algae fermentation facilities, and biorefinery operations of 8760 hours/year. The table below shows estimated actual emissions from the packed scrubber.

Estimated Actual Emissions from the Cellulosic Biorefinery Scrubber

Pollutant	Scrubber inlet (lb/hr)	Removal Efficiency	Scrubber Outlet (lb/hr)	Scrubber Outlet (tons/yr)*
Fermentation Gases				
Ethanol	15.0000	99.7%	0.045000	0.19710
Iso-Amyl Alcohol	0.0800	99.7%	0.000240	0.00105
Acetic Acid	0.0055	99.7%	0.000017	0.00007
Acetaldehyde	0.0184	18.0%	0.015088	0.06609
Acrolein	0.0001	16.0%	0.000084	0.00037
Formaldehyde	0.0002	99.7%	0.000001	0.00000
Methanol	0.0002	99.7%	0.000090	0.00039
Others	0.0001	10.0%	0.060661	0.00039
Storage tank				
Butanol	0.0090	90.0%	0.000900	0.00394
Total VOC				**0.27**
Ammonia	0.2100	90.0%	0.021000	0.092
CO_2				5646

* based on 8760 hours/year

Except for ethanol, the pollutants entering the scrubber inlet are below the insignificant activity threshold of VOC and HAPs: one ton/year of VOC and 1800 lb/yr of acetaldehyde, 80 lb/yr of acrolein, 1600 lb/yr of formaldehyde, and 2000 lb/hr of methanol. However, these streams will be required to be vented to the scrubber due to the equipment placement and the worst case situation of an upset condition.

The following table shows that emissions from the evaporator used in the sugar conditioning process are just above the insignificant activity threshold. Based on the amount of emissions, no additional control was proposed for the evaporator.

Emission Estimates from the Evaporator

Emission Source	H_2S (tpy)	CO (tpy)	Formic Acid (tpy)	Acetic Acid (tpy)	Gluconic Acid (tpy)	Total VOC (tpy)
Evaporator	0.0151	0.0864	0.3887	0.6205	0.0278	**1.037**

For informational purposes, the following table is included to document those emissions that are under the insignificant activity threshold of one ton per year from the biomass deconstruction and sugar conditioning processes. These are not required to be included in the BACT analysis or addressed further in the license:

Insignificant Activities (less than one ton per year)

Emission Source	Formic Acid (tpy)	Acetic Acid (tpy)	Gluconic Acid (tpy)	Total VOC (tpy)
Hydrolysis Tank	0.0091	0.0205	0.0017	0.0313
Hydrolyzate Storage Tank	0.0036	0.08	0.0007	0.0123
Separator/Filter Collection Tank	0.00015	0.00033	0.00003	0.00051
Electrodialysis Feed Tank	0.007	0.0159	0.0013	0.0242
Evaporator Feed Tank	0.0023	0.0052	0.0004	0.0079
Conditioned Hydrolyzate Storage Tank	0.0019	0.0042	0.0003	0.0064

Based on emissions estimates and scrubber efficiency, licensed VOCs emissions from the biorefinery shall be limited to 2.5 tons/year (0.27 tons/yr scrubber outlet and 1.037 tons/yr evaporator emissions, plus an allowance for variables in the estimations). Compliance with this limit shall be based on a brown stock feed rate to the biorefinery not to exceed an average of 100 bone-dried short tons per day on a monthly basis and the use of the packed bed wet scrubber.

Records shall be maintained documenting the daily brown stock feed rate to the biorefinery. Red Shield shall calculate the biorefinery brown stock flow rate by recording the operating rate and time during which brown stock fiber is directed to either No. 1 or No. 2 brown stock towers. This time shall be recorded in the data reporting system in association with the on/off settings of the hydrolysis enzyme pump.

Red Shield shall operate the scrubber in accordance with manufacturer's specifications and shall maintain records including a log of daily average pressure readings at the scrubber inlet and daily average scrubber water level readings. Emissions equipment from the fermentation process, oil

extraction, solvent recovery, and oil conditioning process, as well as the ammonia and butanol tanks shall vent to the scrubber.

Once the demonstration scale biorefinery process begins operation, Red Shield may be required to test, upon the Department's request with methods approved by the Department, to verify compliance with both the basis for the calculation estimates and the VOC biorefinery emission limit.

b. Greenhouse Gases

Red Shield is subject to Prevention of Significant Deterioration (PSD) review, including BACT, for greenhouse gases (GHG) since GHG emissions are over the significant emissions thresholds. Greenhouse gases are considered regulated pollutants as of January 2, 2011 through 'Tailoring' revisions made to EPA's *Approval and Promulgation of Implementation Plans,* 40 CFR Part 52, Subpart A, §52.21 Prevention of Significant Deterioration of Air Quality rule. "Greenhouse gases" as defined in 06-096 CMR 100 (as amended) means the aggregate group of the following gases: Carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Greenhouse gases (GHG) for purposes of licensing are calculated and reported as carbon dioxide equivalents (CO_2 e). However, a July 20, 2011 rulemaking deferred for three years the application of PSD requirements to biogenic CO_2 emissions from bioenergy and other biogenic stationary sources. For this project, a PSD GHG BACT analysis is not required.

Although the federal rule excludes biogenic GHG emissions from undergoing PSD requirements, Red Shield submitted information on GHG BACT as a State requirement. In a review of GHG information, Red Shield found there was very little data related to existing BACT determinations for control of GHGs from fermentation processes. GHG BACT analyses addressing fuel burning units were more readily found, with various CO_2e control technologies identified including carbon capture and storage, energy efficiency, combined heat and power options, changes to the fuel burning unit's operations, fuel type alternatives, and good operating and maintenance practices. Of these, the use of combined heat and power, changing fuel type, or modifying a fuel burning unit's operations are not applicable to process operations such as those proposed in this biorefinery project. Carbon capture and storage is a developing technology, but at this time is still not technically feasible. In addition, there can be a significant energy penalty in moving a gas stream under high pressure to the underground geological formations for sequestration.

Energy efficiency and good operating and maintenance practices are possible CO_2e control options for the proposed fermentation process. Red Shield has proposed BACT for GHG emissions to be the operation of the demonstration scale biorefinery processes in an efficient manner, using good operating and maintenance practices. CO_2 emissions have been calculated to be 6009 tons/year from the biorefinery: approximately 363 tons/year from the hydrolysis tank and approximately 5646 ton/year from the scrubber controlling the fermentation process.

4. Future Projected Actual Emissions Records for $PM_{2.5}$

Red Shield estimated the future projected actual emissions for all modified and affected emission units to determine PSD applicability. Future projected actual emissions of some regulated NSR pollutants did not trigger PSD applicability, specifically PM_{10}, $PM_{2.5}$, SO_2, and VOC. However, the provisions of 40 CFR Part 52, §52.21(r)(6) apply to any regulated NSR pollutant emitted from projects at existing emissions units at a major stationary source when there is a reasonable possibility that a project that is not a part of a major modification for that pollutant may result in a significant emissions increase of such pollutant. For the purposes of this subpart, per §52.21(r)(6)(vi), a reasonable possibility occurs when the facility's calculations show the project will result in a projected actual emissions increase of at least 50% of the amount defined as a "significant emissions increase" under paragraph (b)(40) of this section (without reference to the amount that is a significant net emissions increase), for the regulated NSR pollutant. Because the difference between the calculated baseline actual to projected actual emissions of $PM_{2.5}$ are at least 50% of the PSD significance levels, Red Shield shall calculate and maintain records to document the annual $PM_{2.5}$ emissions, in tons per year on a calendar year basis, for a period of 5 years following resumption of regular operations after the change.

The net change of greater than 50% of the significance level can be seen in the information already presented in the previous table, as reiterated below:

Pollutant	Average Baseline Actual Emissions for 2010 and 2011 (tons/year)	Future Projected Actual Emissions (ton/year)	Net Change (ton/year)	Significant Emissions Increase Level (ton/year)
$PM_{2.5}$	30.3	35.8	5.5	10

If the actual annual emissions exceed the baseline actual emissions by an amount greater than the PSD significant increase threshold and differ from the

preconstruction projection (i.e. – actual emissions of $PM_{2.5}$ are greater than 35.8 tons/year), a report must be submitted to the Department within 60 days after the end of such year per §52.21.

Red Shield shall calculate $PM_{2.5}$ annually in the same manner as the calculation of baseline emissions, including use of AP-42 factors and the feed brown stock flow rate diverted to the biorefinery. Red Shield shall maintain records of the calculated daily feed brown stock flow rate to the biorefinery and the annual $PM_{2.5}$ emissions calculations for 5 years for PSD compliance purposes.

C. Incorporation into the Part 70 Air Emission License

The requirements in this 06-096 CMR 115 New Source Review amendment shall apply to the facility upon amendment issuance. Per *Part 70 Air Emission License Regulations*, 06-096 CMR 140 (as amended), Section 1(C)(8), for a modification that has undergone NSR requirements or been processed through 06-096 CMR 115, the source must then apply for an amendment to the Part 70 license within one year of commencing the operations authorized under this amendment as provided in 40 CFR Part 70.5.

D. Annual Emissions

1. For this specific biorefinery project, the licensed allowed emissions from the existing pulp mill sources are not changing. The table below reiterates the current licensed allowed emissions from the existing sources at the mill, as well as biorefinery licensed allowed emissions. Red Shield shall be restricted to the following annual emissions, based on a 12 month rolling total.

Total Licensed Annual Emissions (Tons/year) –
(used to calculate the annual license fee)

Equipment	PM	PM_{10}	SO_2	NO_X	CO	VOC
Boiler #5	87	87	556.2	306	120	55
Biomass Boiler	35.0	35.0	29.0	290.3	929.3	19.7
(Firing NCGs in either #5 or biomass boiler)	-	-	343.4	-	-	-
Riley Power Boiler	3.22	3.22	5.64	21.46	3.97	0.2
Gas Turbine	1.1	1.1	0.5	20.9	12.8	5.7
#4 Recovery Boiler	177.2	177.2	768.3	812.3	1396.6	92.4
#4 Smelt Tank	33.07	33.07	14.61	0.28	0.28	0.28
Lime Kiln	144.1	144.1	31.1	157.7	357.8	5.3
Total Services Backup Sump Pump	0.1	0.1	0.02	1.4	0.3	0.1
Boiler Bdg Fire Water Backup Pump	0.1	0.1	0.02	1.6	0.3	0.1
Power House Fire Backup Pump	0.1	0.1	0.02	1.5	0.3	0.1
#4 Turbine Backup Gen.	0.09	0.09	0.02	1.3	0.3	0.1
Back-up gen. for biomass boiler	0.1	0.1	0.14	5.1	1.4	0.3
Screw Press Steam Generator	2.2	2.2	5.5	81.1	17.5	6.6
Biorefinery	-	-	-	-	-	2.5
TOTALS	**483.4**	**483.4**	**1754.5**	**1700.9**	**2840.9**	**188.4**

Notes:

- The gas turbine tpy emissions were calculated with the operating hour restriction of 2628 hours per year.
- The #4 Recovery Boiler tpy emissions were based on adding the tpy from firing oil only to the tpy from firing black liquor only.
- PM_{10} and CO are not used in calculating the annual fee, but are noted for completeness.
- The table above does not include process emission units or insignificant activities which have no licensed emission units.

2. Greenhouse Gases

CO_2e is not used to calculate the annual fee and is not listed in the above table since the source is already classified as major for greenhouse gases and does not currently have annual restrictions imposed.

III. AMBIENT AIR QUALITY ANALYSIS

A. Overview

A refined modeling analysis was performed to show that emissions from Red Shield, in conjunction with other sources, will not cause or contribute to violations of National Ambient Air Quality Standards (NAAQS) or increment standards for NO_2.

Federal regulation 40 CFR Part 52, §52.21(m) requires an analysis of ambient air quality in the area that the major modification would affect for each pollutant for which it results in a significant net emissions increase. PM_{10}, $PM_{2.5}$, and SO_2 are below significant net emissions increase levels; thus, no further modeling for these pollutants is required. NO_X, CO, and GHG are above significant net emission increase levels; however, CO was adequately addressed as part of a previous recent modeling analysis (A-180-77-4-A, October 12, 2012) and the modeled short term licensed allowed CO emission limits are not changing, and GHG emissions are not required to be modeled. Only NO_X modeling is included in this amendment to address the new 1 hour standard and the annual standard.

Note that the licensed allowed emissions for the existing pulp mill units are not changing; therefore, the ambient air quality analysis requirements in 06-096 CMR 115, Section 7 are met with the NO_X modeling submitted with this amendment and the previous modeling analyses submitted for the facility in support of amendments A-180-71-AJ-A (May 6, 2005) and A-180-77-4-A (October 12, 2012).

The current licensing action for Red Shield represents a major modification to an existing major source. Based upon the magnitude of proposed emissions increase and the distance from the source to any Class I area, the affected Federal Land Managers (FLMs) and MEDEP-BAQ have determined that an assessment of Class I Air Quality Related Values (AQRVs) is not required.

B. Model Inputs

The AERMOD-PRIME refined model was used to address standards and increments in all areas. If applicable, the modeling analysis accounted for the potential of building wake and cavity effects on emissions from all modeled stacks that are below their calculated formula GEP stack heights.

All modeling was performed in accordance with all applicable requirements of the Maine Department of Environmental Protection, Bureau of Air Quality (MEDEP-BAQ) and the United States Environmental Protection Agency (USEPA).

A valid 5-year hourly on-site meteorological database was used in the AERMOD-PRIME refined modeling analysis, since the Department determined that on-site meteorological data was the most representative information to use for this modeling analysis. The following parameters and their associated heights were collected at the Red Shield meteorological monitoring site during the 5-year period 1991-1995:

TABLE III-1 : Meteorological Parameters and Collection Heights

Parameter	Sensor Height(s)
Wind Speed	10 meters, 76.2 meters
Wind Direction	10 meters, 76.2 meters
Temperature	10 meters, 76.2 meters
Standard Deviation of Wind Direction (Sigma A)	10 meters, 76.2 meters
Vertical Velocity	10 meters
Standard Deviation of Vertical Velocity (Sigma W)	10 meters
Standard Deviation of Vertical Wind (Sigma E)	10 meters
Delta Temperature	76.2 meters minus 10 meters

Per USEPA guidance, any small gaps (two hours or less) of missing on-site data were filled in using linear interpolation. Larger gaps of missing data (three or more hours) were coded as missing.

In addition, hourly Bangor NWS data, from the same time period, were used to supplement the primary surface dataset for the required variables (cloud cover and ceiling height) that were not explicitly collected at the Red Shield meteorological monitoring site. Concurrent upper-air data from the Caribou NWS site were also used in the analysis. Missing cloud cover and/or upper-air data values were interpolated or coded as missing, per USEPA guidance.

All necessary representative micrometeorological surface variables for inclusion into AERMET (surface roughness, Bowen ratio and albedo) were calculated using AERSURFACE from procedures recommended by USEPA.

Point-source parameters, used in the modeling are listed in Table III-2.

TABLE III-2 : Point Source Stack Parameters

Facility/Stack	Stack Base Elevation (m)	Stack Height (m)	GEP Stack Height (m)	Stack Diameter (m)	UTM Easting NAD83 (km)	UTM Northing NAD83 (km)
CURRENT/PROPOSED						
Old Town Fuel & Fiber						
• Biomass Boiler	26.95	41.15	94.01	1.98	528.774	4973.860
• #5 Boiler	27.68	54.86	97.61	2.29	528.763	4973.939
• Recovery Boiler	24.87	76.20	114.18	2.95	528.906	4973.901
• Lime Kiln	27.28	49.68	111.77	1.22	528.826	4974.053
• Smelt Dissolving Tank	24.93	76.20	114.12	1.50	528.904	4973.913
• Gas Turbine	27.64	24.38	40.50	2.44	528.749	4973.729
U Maine						
• Stack #1	26.12	42.06	24.76	3.20	525.767	4971.758
• Stack #4	26.12	45.72	24.76	1.52	525.779	4971.789
Juniper Ridge Landfill						
• Flare	63.00	26.77*	--	1.81*	522.204	4980.353

* Flare effective release height and diameter, calculated per USEPA guidance

Emission parameters for NAAQS and increment modeling are listed in Table III-3. The emission parameters for Red Shield are based on the maximum license allowed (worst-case) operating configuration. For the purpose of determining NO_2 impacts, the Ambient Ratio Method (ARM) was used. The ARM is the Tier-2 method prescribed by USEPA in which NO_x emissions are assumed to convert to NO_2 at a default value of 0.8.

TABLE III-3 : Stack Emission Parameters

Facility/Stack	Averaging Periods	NOx (g/s)	Stack Temp (K)	Stack Velocity (m/s)
MAXIMUM LICENSE ALLOWED				
Red Shield				
• Biomass Boiler	All	8.35	444.00	15.31
• #5 Boiler	All	8.78	455.37	9.47
• Recovery Boiler	All	23.71	477.59	16.21
• Lime Kiln	All	4.54	338.71	10.29
• Smelt Dissolving Tank	All	0.01	348.71	3.78
• Gas Turbine	All	2.00	749.82	8.85
U Maine				
• Stack #1	All	6.02	449.82	1.66
• Stack #4		4.18	449.82	5.11
Juniper Ridge Landfill				
• Flare	All	0.91	1273.15	20.00

C. Single Source Modeling Impacts

AERMOD-PRIME refined modeling was performed for a total of three operating scenarios that represented a range of maximum, typical and minimum operations. Modeling results for Red Shield alone are shown in Table III-4.

Maximum predicted impacts that exceed their respective significance level are indicated in boldface type.

TABLE III-4 : Maximum AERMOD-PRIME Impacts from Red Shield Alone

Pollutant	Averaging Period	Max Impact ($\mu g/m^3$)	Receptor UTM E (km)	Receptor UTM N (km)	Receptor Elevation (m)	Class II Significance Level ($\mu g/m^3$)
NO_2	1-hour	**154.75**[a]	-	-	-	**10**[b]
	Annual	**3.67**	529.374	4973.560	28.37	**1**

[a] Value based on the 5-year arithmetic average of the H1H (highest-1st-high) concentrations
[b] Interim Significant Impact Level (SIL) adopted by NESCAUM states

D. Combined Source Modeling Impacts

For predicted modeled impacts from Red Shield alone that exceeded significance levels, as indicated in boldface type in Table III-4, other sources not explicitly included in the modeling analysis must be accounted for by using representative background concentrations for the area.

Background concentrations, listed in Table III-5, are derived from the MicMac site in Presque Isle which is the most representative rural background data for use in the Eastern Maine region.

TABLE III-5 : Background Concentrations

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)
NO_2	1-hour	49
	Annual	3

MEDEP examined other area sources whose impacts would be significant in or near Red Shield's significant impact area. Due to the applicant's location, extent of the significant impact area and other nearby source emissions, MEDEP has determined that two sources would be considered for combined source modeling: UMaine (Orono) and Juniper Ridge Landfill (Old Town).

For pollutant averaging periods that exceeded significance levels, the maximum modeled impacts for all sources were added with conservative rural background concentrations to demonstrate compliance with NAAQS, as shown in Table III-6. Because impacts for all pollutants using this method meet all NO_2 NAAQS, no further modeling analyses need to be performed.

TABLE III-6 : Maximum Combined Source Impacts

Pollutant	Averaging Period	Max Impact ($\mu g/m^3$)	Receptor UTM E (km)	Receptor UTM N (km)	Receptor Elevation (m)	Back-Ground ($\mu g/m^3$)	Max Total Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	1-hour	**78.62**	528.754	4973.620	26.36	**49**	**127.62**	**188**
	Annual	**3.04**	529.374	4973.560	28.37	**3**	**6.04**	**100**

E. Increment

AERMOD-PRIME refined modeling was performed to predict the maximum Class II NO_2 increment impacts. Red Shield conservatively assumed no credit would be taken for any Red Shield, UMaine or Juniper Ridge Landfill sources that existed during the baseline years.

Results of the Class II NO_2 increment analysis are shown in Table III-7. The modeled maximum increment NO_2 impact was below the increment standard. Because the predicted increment NO_2 impact met the increment standard, no further Class II increment modeling needed to be performed.

TABLE III-7 : Maximum Combined Source Class II Increment Consumption

Pollutant	Averaging Period	Max Impact ($\mu g/m^3$)	Receptor UTM E (km)	Receptor UTM N (km)	Receptor Elevation (m)	Class II Increment ($\mu g/m^3$)
NO_2	Annual	**3.04**	529.374	4973.560	28.37	**25**

Federal guidance and 06-096 CMR 115 require that any major new source or major source undergoing a major modification provide additional analyses of impacts that would occur as a direct result of the general, commercial, residential, industrial and mobile-source growth associated with the construction and operation of that source.

GENERAL GROWTH: The proposed modification will involve minimal exterior construction activities; therefore there will likely be an insignificant increase of NO_2 due to related activities (increased truck traffic, etc).

RESIDENTIAL, COMMERCIAL AND INDUSTRIAL GROWTH: Population growth in the impact area of a proposed source can be used as a

surrogate factor for the growth in emissions from combustion sources. Since the population in Penobscot County has decreased approximately 0.1% between 2000 and 2010 and the modification will create approximately 25 new jobs, no new significant residential, commercial and industrial growth will follow from the modification associated with this source.

MOBILE SOURCE AND AREA SOURCE GROWTH: Since area and mobile sources are considered minor sources of NO_2, their contribution to increment has to be considered. Technical guidance from USEPA points out that screening procedures can be used to determine whether additional detailed analyses of minor source emissions are required. Compiling a minor source inventory may not be required if it can be shown that little or no growth has taken place in the impact area of the proposed source since the baseline dates (1977/1988) were established. Very little growth has taken place in the area of Red Shield since the baseline dates were established. In addition, no increase in Vehicle Miles Travelled (VMT) is expected as a result of the modification. No further analyses of mobile or area source growth are needed.

F. Summary

In summary, it has been demonstrated that emissions from Red Shield, in conjunction with other sources, will not cause or contribute to violations of National Ambient Air Quality Standards (NAAQS) or increment standards for NO_2.

ORDER

Based on the above Findings and subject to conditions listed below, the Department concludes that the emissions from this source:

- will receive Best Practical Treatment,
- will not violate applicable emission standards,
- will not violate applicable ambient air quality standards in conjunction with emissions from other sources.

The Department hereby grants Air Emission License A-180-77-5-A pursuant to the preconstruction licensing requirements of 06-096 CMR 115 and subject to the standard and special conditions below.

Severability. The invalidity or unenforceability of any provision, or part thereof, of this License shall not affect the remainder of the provision or any other provisions. This

License shall be construed and enforced in all respects as if such invalid or unenforceable provision or part thereof had been omitted.

SPECIFIC CONDITIONS

(1) Biorefinery

A. Red Shield may construct and operate a demonstration-scale cellulosic biorefinery on-site at the Old Town facility. For purposes of this license, demonstration-scale shall be defined as no greater than an average of 100 tons/day brown stock feed entering the biorefinery on a monthly basis. Brown stock feed rate records shall be maintained per condition (1)(C)(1) below. [06-096 CMR 115, BACT]

B. Red Shield shall install and operate a packed bed wet scrubber to control, at a minimum, emissions from the fermentation process equipment; oil extraction, solvent recovery, and oil conditioning process equipment; and the ammonia and butanol tanks.
   1. Red Shield shall operate and maintain the scrubber in accordance with manufacturer's specifications.
   2. Red Shield shall keep records for scrubber operation including a log of daily average pressure readings at the scrubber inlet and daily average scrubber water level readings.

   [06-096 CMR 115, BACT]

C. Licensed VOCs emissions from the biorefinery shall be limited to 2.5 tons/year on a 12 month rolling total basis.
   1. Compliance with this limit shall be based on a brown stock feed rate to the biorefinery not to exceed an average of 100 bone-dried short tons per day on a monthly basis. Red Shield shall calculate and maintain records of the biorefinery brown stock feed rate by recording the operating rate and time during which brown stock fiber is directed to either No. 1 or No. 2 brown stock towers. This time shall be recorded in the data reporting system in association with the on/off settings of the hydrolysis enzyme pump.
   2. Once the demonstration scale biorefinery process begins operation, Red Shield may be required to test the biorefinery emissions, upon the Department's request using methods as approved by the Department, to verify compliance with both the basis for the calculation estimates and the biorefinery VOC emission limit.

   [06-096 CMR 115, BACT]

(2) **$PM_{2.5}$ Recordkeeping**

A. Red Shield shall meet the applicable requirements of 40 CFR Part 52, §52.21 (Prevention of Significant Deterioration) for calculating, recording, and reporting actual $PM_{2.5}$ emissions from the biorefinery project's modified and affected equipment.

B. Red Shield shall calculate $PM_{2.5}$ emissions annually with the same method used to calculate baseline emissions for this project, including use of AP-42 factors and the brown stock feed rate diverted to the biorefinery (as specified in condition (1)(C)(1) above), or another method approved by the Department.

C. Red Shield shall maintain records of the calculated daily brown stock feed rate to the biorefinery and the annual $PM_{2.5}$ emissions calculations for 5 years for PSD compliance purposes.

[40 CFR Part 52, §52.21 and 06-096 CMR 115, BACT]

(3) Red Shield shall submit an application to incorporate this amendment into the Part 70 air emission license no later than 12 months from commencement of operation of the demonstration-scale cellulosic biorefinery authorized under this amendment. [06-096 CMR 140, Section 1(C)(8)]

DONE AND DATED IN AUGUSTA, MAINE THIS 19 DAY OF March , 2013.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY: Marc Allen Robert Cone for
PATRICIA W. AHO, COMMISSIONER

PLEASE NOTE ATTACHED SHEET FOR GUIDANCE ON APPEAL PROCEDURES

Date of initial receipt of application: November 2, 2012
Date of application acceptance: November 5, 2012

Date filed with the Board of Environmental Protection:

This Order prepared by Kathleen E. Tarbuck, Bureau of Air Quality.

Filed
MAR 21 2013
State of Maine
Board of Environmental Protection