ENVIRONMENTAL INTEGRITY PROJECT

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Via E-mail and First Class Mail
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RE: Public Stakeholder Process for Setting Reasonably Available Control Technology Limits for Nitrogen Oxides Emissions from Large Municipal Waste Combustors

Dear Mr. Aburn:

I am writing on behalf of the Environmental Integrity Project ("EIP"), Clean Water Action, Chesapeake Physicians for Social Responsibility, United Workers, Free Your Voice, Maryland Environmental Health Network, and the Sierra Club (collectively, "Commenters"). We write with regard to the public stakeholder process that the Maryland Department of the Environment ("MDE") is conducting to set Reasonably Available Control Technology ("RACT") limits for nitrogen oxides ("NO_x") emissions from Maryland's two large municipal waste combustors ("MWCs" or "incinerators"). MDE held an initial public stakeholder meeting on August 30, 2016. As far as we know, MDE has not scheduled any additional meetings that will allow stakeholders to participate in this process. We respectfully request that MDE:

(1) Schedule two more stakeholder meetings to allow additional concerned members of the public to attend and participate in this discussion, particularly as it pertains to NO_x limits for the Baltimore Refuse Energy Systems Company ("BRESCO") incinerator in Baltimore City; and
(2) Address at these meetings the different control technology options available, described in more detail below, for reducing NO_x at BRESCO in the context of the RACT rulemaking.

Each of our groups is extremely concerned about the effects of air pollution from the BRESCO plant on Baltimoreans, particularly vulnerable populations such as children, the elderly, and individuals with asthma. We wish to participate and provide input in this rulemaking process, which requires an opportunity for us to become fully informed about the options for controlling NO_x emissions at the plant as well as the emissions tests currently being run at BRESCO and the data produced by these tests. We thank MDE for initiating the public stakeholder process on this very important set of regulations, and we strongly urge the agency to set a final rule that requires Wheelabrator Baltimore, LP ("Wheelabrator"), the plant's owner and operator, to do its part to protect human health in Baltimore by more effectively controlling its emissions.

We appreciate MDE's hard work over the years to help reduce ozone levels in Maryland, and recognize that progress has been made. We think that the present RACT rulemaking presents an important opportunity to make further progress.

Background

Health Effects of Nitrogen Oxides (NO_x)

Nitrogen oxides (NO_x) emissions can affect human health in multiple ways. NO_x is the primary contributor to ground-level ozone, a pollutant that can cause airway constriction and chronic obstructive pulmonary disease and can aggravate cases of asthma.[1] Although not relevant to the legal standard at issue (which is for ozone), NO_x is also a precursor to fine particulate matter ($PM_{2.5}$), a pollutant that can cause premature mortality due to heart and lung disease,[2] aggravate asthma,[3] and increase the risk of adverse birth outcomes, including low birth weight and preterm birth.[4] $PM_{2.5}$ can cause adverse health effects even at levels below federal air quality standards, and experts who study this issue agree that there is no evidence of a "threshold" below which $PM_{2.5}$ is safe.[5] Children, older adults, and people with existing respiratory conditions, such as asthma, are at the greatest risk of suffering adverse effects from exposure to ozone and/or $PM_{2.5}$.[6] As MDE is aware, this puts Baltimore City residents at increased risk from exposure to these pollutants due to the extremely high rates of existing asthma in the city.[7]

Baltimore Ozone Levels

The Baltimore area has long been designated by the U.S. EPA as a "nonattainment area" for ground-level ozone, meaning that it does not meet federal air quality standards for this pollutant.[8] While ozone levels declined in 2013 and 2014 in the Baltimore area, in part because

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[1] U.S. EPA, Health Effects of Ozone Pollution, https://www.epa.gov/ozone-pollution/health-effects-ozone-pollution
[2] *See* Laden, F. et al., Reduction in Fine Particulate Air Pollution and Mortality: Extended Follow-Up of the Harvard Six Cities Study, 173 Am. J. Respir. Crit. Care Med. 667 (2006); Pope, C.A. et al., Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution, 287 JAMA 1132 (2002).
[3] U.S. EPA, Health and Environmental Effects of Particulate Matter (PM) https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm.
[4] R. Nachman, et. al., Intrauterine Inflammation and Maternal Exposure to Ambient PM2.5 during Preconception and Specific Periods of Pregnancy: The Boston Birth Cohort, Environ. Health Perspect., Advanced Publication, DOI:10.1289/EHP243: 4.
[5] *See generally*, U.S. EPA, Summary of Expert Opinions on the Existence of a Threshold in the Concentration-Response Function for PM2.5-related Mortality, Technical Support Document (June 2010), available at: http://www3.epa.gov/ttnecas1/regdata/Benefits/thresholdstsd.pdf.
[6] U.S. EPA, *supra* notes 1,3.
[7] Data recently released by the Maryland Department of Health and Mental Hygiene ("DHMH") shows that, in 2013, Baltimore City's asthma hospitalization rate was almost three times the state rate and the city's rate was almost twice that of the next-highest Maryland county (Dorchester County). DHMH Environmental Public Health Tracking website at http://phpa.dhmh.maryland.gov/OEHFP/EH/tracking/Pages/Home.aspx.
[8] The Baltimore ozone nonattainment area consists of Baltimore City and the following counties: Anne Arundel, Baltimore, Carroll, Harford, and Howard.

of cooler summers, they rose again in 2015 and 2016.[9] Commenters do not yet have access to ozone data from July through September of 2016, which will almost certainly include the highest ozone levels recorded in 2016 due to the fact that ozone formation is greatest in hot, sunny weather. Even without that data, however, it is clear that, during the 2014-2016 period,[10] Baltimore's ozone levels exceeded the federal air quality standard of 70 parts per billion ("ppb") that was finalized in 2015. The Padonia Elementary School monitor, located in Baltimore County, registered a design value of 72.3 ppb over the period from 2014 through 2016 (again, without including what are likely the highest values of the year) and the Aldino Road monitor in Harford County registered a value of 72 ppb. It is possible that, when the more recent data is included, other monitors will exceed the 70 ppb standard or even the older, more relaxed standard of 75 ppb that was passed by EPA in 2008 and is still in effect.

Legal Standard

Section 182 of the federal Clean Air Act requires states to adopt Reasonably Available Control Technology ("RACT") requirements for major sources of NO_x. RACT is defined as "the lowest emissions limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility."[11] EPA has described this standard as "technology forcing" and stated that "[i]n determining RACT for an individual source or group of sources, the control agency, using the available guidance, should select the best available controls, deviating from those controls only where local conditions are such that they cannot be applied there and imposing even tougher controls were conditions allow."[12]

Maryland Incinerator NO_x Controls

Maryland has two large municipal waste combustors that are subject to the current NO_x rulemaking: the Montgomery County Resource Recovery Facility ("MCRRF") and the Baltimore Refuse Energy Systems Company ("BRESCO") incinerator in Baltimore City. NO_x is controlled at both facilities using a technology called Selective Non-Catalytic Reduction. However, in 2008-2010, additional controls, referred to as "Low NO_x" were installed at MCRRF and this addition cut the facility's NO_x emissions by almost half. As shown in Table 1 below, this reduction in NO_x emissions was achieved while plant operations remained relatively constant.

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[9] The U.S. EPA makes ozone monitoring data available on its Airdata site at https://www.epa.gov/outdoor-air-quality-data. As of October 6, 2016, it appears that the 2016 Baltimore ozone data available on the Airdata site is from first and second quarters but that third quarter data has not yet been posted. EIP has also submitted a public records request to MDE for this data.

[10] The federal air quality standard for ozone is based on the fourth highest 8-hour ozone level recorded each year, averaged over a three-year period. U.S. EPA, National Ambient Air Quality Standards (NAAQS) table, at https://www.epa.gov/criteria-air-pollutants/naaqs-table.

[11] COMAR 26.11.01.01.B(40); *accord* U.S. EPA, State Implementation Plans; Nitrogen Oxides Supplement to the General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990, 57 Fed. Reg. 55,620, 55,624 (Nov. 25, 1992).

[12] Memorandum from Roger Strelow, Assistant Admin., Air and Waste Management, U.S. EPA, *Guidance for determining Acceptability of SIP Regulations in Non-attainment Areas*, to Regional Administrators, Regions I-X (Dec. 9, 1976), *available at* https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19761209_strelow_ract.pdf .

Table 1: MCRRF NO_x Emissions and Operating Data 2006-2015[13]				
Year	**NO_x emissions** (tons)	**Waste processed** (tons)	**% capacity** (waste burning)	**Power generated** (megawatt hours)
2006	1,041	620,666	94%	371,971
2007	1,009	578,804	88%	343,955
2008	998	573,293	87%	331,055
2009	554	527,623	80%	282,170
2010	499	551,670	84%	303,075
2011	512	556,266	85%	308,150
2012	479	544,647	83%	310,008
2013	388	555,716	85%	312,539
2014	427	Not available	Not available	315,450
2015	441	599,250	91%	Not available

MCRRF's annual average NO_x emissions from 2006-2008 were 1,016 tons per year. After the installation of the new Low NO_x controls, during the period from 2009 through 2011, average NO_x emissions were 522 tons per year. This is an average reduction of 494 tons per year or 48.6% of emissions. According to the U.S. EPA, the reduction at the plant was "equivalent to . . . the annual emissions of about 50,000 passenger cars."[14]

As shown in Table 2 below, the BRESCO incinerator, which lacks the Low NO_x controls installed at MCRRF currently emits NO_x in levels very similar to those that were produced by MCRRF before it installed the Low NO_x technology.

[13] Emissions data from Maryland Emissions Inventory. Capacity and power generation data from Northeast Maryland Power Waste Disposal Authority ("NMWDA") website at http://nmwda.org/montgomery-county/ ,except for 2014 power generation data from U.S. Energy Information Administration ("EIA") and 2015 waste processing data from MDE PowerPoint presentation dated August 30, 2016 on NOx RACT for Large MWCs.

[14] U.S. EPA, Clean Air Excellence Award Recipients: Year 2014 at 1, https://www.epa.gov/sites/production/files/2015-06/documents/clean_air_excellence_award_recipients_year_2014.pdf .

Table 2: BRESCO Emissions and Waste Processing 2006-2015[15]		
Year	**NO_x emissions** (tons)	**Waste processed** (tons)
2006	1,107	670,989
2007	1,065	657,404
2008	1,094	688,800
2009	1,159	688,489
2010	1,077	676,400
2011	1,133	701,636
2012	1,012	697,078
2013	1,067	713,410
2014	1,076	Not available
2015	1,124	730,150

While BRESCO is a bigger facility that burns more waste per year, the difference in its waste burning capacity does not account for its substantially increased NO_x emissions relative to MCRRF. Following MCRRF's installation of Low NO_x, it combusted an average of 555,862 tons of waste per year and emitted an average of 479 tons of NO_x per year (using data from years 2009-2015, excluding 2014 for consistency). BRESCO, by contrast, combusted an average of 701,194 tons of waste per year, 26.1% more than MCRRF, during those years but emitted an average of 1,095 tons of NO_x per year, 129% more than MCRRF. Thus, BRESCO is emitting a great deal more NO_x than MCRRF even when its increased burning capability is accounted for, and it appears that NO_x emissions from BRESCO could be substantially reduced from their current levels.

MDE Should Provide Additional Information to the Public Regarding NO_x Control Options for the BRESCO Incinerator

Commenters respectfully request that MDE schedule additional stakeholder meetings so that MDE, and Wheelabrator if necessary, can present information about options available for reducing NO_x emissions from the BRESCO incinerator. At minimum, we request that such a presentation address the following options:

(1) Selective Catalytic Reduction

Selective Catalytic Reduction ("SCR") is widely recognized as the most effective technology for controlling NO_x emissions from a variety of combustion sources, including

[15] Emissions data from Maryland Emissions Inventory. Waste data from NMWDA website at http://nmwda.org/baltimore-resco/, except for 2014 power generation data from U.S. Energy Information Administration ("EIA") and 2015 waste processing data from MDE NOx RACT PowerPoint presentation dated August 30, 2016.

municipal solid waste ("MSW") incinerators. SCR can achieve NO_x removal efficiencies of 90% at coal plants. According to the State of Maryland's own technical analysis, SCR can provide control efficiencies of 75% or greater at MSW incinerators.[16]

While we understand that MDE may determine that SCR does not meet the "economic feasibility" prong of the definition of Reasonably Available Control Technology, we request that MDE or Wheelabrator provide information about this option and explain why it is not economically feasible, if this is position of the agency or the company.

(2) Regenerative Selective Catalytic Reduction

Regenerative Selective Catalytic Reduction ("RSCR") is described by the State of Maryland's Power Plant Research Program ("PPRP") as "a variation of SCR that is far more energy efficient than standard SCR" which "substantially improves the cost-effectiveness of applying SCR to [municipal waste combustor] units."[17] PPRP explains further:

> With RSCR, supplemental fuel, such as natural gas, is combusted to re-heat the flue gas to the catalyst operating temperature, as with traditional SCR, However, with RSCR, over 95 percent of that heat is recovered using heat exchangers, and is then re-introduced back into the flue gas. This results in far less use of natural gas than with traditional SCR, and much lower, associated fuel costs.[18]

RSCR is the control technology that would have been used on the Energy Answers incinerator proposed for the Fairfield area of Baltimore City. According to PPRP, "the supplier of the RSCR technology [for that project], Babcock Power Environmental, anticipate[d] that a minimum 80 percent removal efficiency for NO_x" could be achieved at the MSW combustion units involved.[19] While the Energy Answers plant would have been a refuse-derived fuel incinerator utilizing spreader-stoker boilers, RSCR was also determined to be technically feasible for the proposed Frederick/Carroll County Renewable Waste-to-Energy Facility ("FCCRWTE"), which would have used mass burn waterwall combustors like the BRESCO plant.[20] This determination was made in a permit application for the FCCRWTE project submitted by Wheelabrator and NMWDA.

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[16] Maryland Power Plant Research Program ("PPRP"), Supplemental Environmental Review Document, Motion by Energy Answers Baltimore, LLC, to Amend the Construction Commencement Deadline in its Certificate of Public Convenience and Necessity, Maryland Public Service Commission Docket No. 9199 (June 2012) at 6-6 (Excerpt attached hereto as Attachment A).

[17] *Id.*at 6-6 to 6-7 (Attachment A).

[18] *Id.*

[19] Commenters understand that the Energy Answer project would have utilized different kinds of boilers than the BRESCO plant and would have shredded the MSW before combustion. However, these things should not affect the control efficiency of the NOx pollution controls.

[20] Frederick/Carroll County Renewable Waste-to-Energy Facility, Prevention of Significant Deterioration/Air Construction Permit Application, Prepared for NMWDA and Wheelabrator Technologies, Inc. by Environmental Consulting & Technology, Inc., Last Revised: October 2012, at 4-6, 6-12 (Excerpts attached here to as Attachment B).

We respectfully request that MDE or Wheelabrator address in a presentation the option of requiring the installation of RSCR at the BRESCO incinerator.

(3) Low NO_x Controls

As discussed in detail above, the MCRRF incinerator in Montgomery County installed in 2008-2010 a set of controls referred to as "Low NO_x," which reduced its NO_x emissions, already controlled at the time with Selective Non-Catalytic Reduction technology, by about 50%. Low NO_x is described in a recent MDE PowerPoint presentation as "a unique combustion system design, including modifications to combustion air flow, reagent injection and control systems logic."[21] MDE also states that system was installed at a capital cost of $6.7 million and the average operating costs over the last three years has been $566,000 per year.

There are a number of reasons to believe that installation of this system on the BRESCO plant would have a similar emissions reduction effect. BRESCO and MCRRF employ the same boiler technology (mass burn waterwall boilers) and both use Selective Non-Catalytic Reduction as the primary NO_x control. In addition, BRESCO's current NO_x emissions rate (per heat generation) is similar to MCRRF's rates in the years before it installed Low NO_x. BRESCO's average NO_x rate in the most recent three years for which we have data, 2012-2014, is 1.79 lbs/Mmbtu.[22] MCRRF's average NO_x rate from 2006-2008 was 1.71 lbs/Mmbtu.

For all of these reasons, it appears that installation of Low NO_x controls in the BRESCO incinerator would be extremely effective at reducing NO_x emissions in Baltimore as well as being technologically and economically feasible. We respectfully request that MDE address this option in a public presentation and we strongly urge MDE to consider setting an emissions limit that, at minimum, requires installation and operation of these controls

(4) Apparent Poor Performance of BRESCO's Existing Pollution Controls

Lastly, we request that MDE, or Wheelabrator, explain at a public stakeholder meeting why it appears that the existing NO_x controls at BRESCO are functioning poorly and below what would be expected of the kind of control technology. The controls currently installed at BRESCO are Selective Non-Catalytic Reduction ("SNCR"). According to the Maryland PPRP's analysis, when applied to MSW incinerators, SNCR "typically achieves minimum control efficiencies in the general range of 50 to 60 percent."[23]

However, according to the PowerPoint presentation made by MDE at its August 30, 2016 stakeholder meeting, BRESCO is achieving removal efficiencies of 14-21% under its original configuration and 25% with optimized operation of the system (based on increased urea utilization).[24] It is not clear from the presentation whether these numbers are total NO_x removal efficiency numbers or whether this is some subset of NO_x reductions. However, if BRESCO's

[21] MDE PowerPoint presentation dated August 30, 2016 on NOx RACT for Large MWCs.
[22] We are using pounds per mmbtu instead of pounds per megawatt hour in order to ensure an "apples to apples" comparison, as BRESCO generates both steam and electricity and MCRRF produces only electricity.
[23] Maryland PPRP, *supra*, note 15 at 6-7 (Attachment A).
[24] MDE PowerPoint presentation dated August 30, 2016 on NOx RACT for Large MWCs.

total NO_x control efficiency is, indeed, hovering between 14 and 25% when SNCR is supposed to be capable of 50-60% removal, we respectfully request that MDE explain, or require Wheelabrator to explain, why BRESCO's controls are performing so poorly. We also request that MDE make available to the public the raw emissions data that has been produced by the NO_x control optimization tests being run at BRESCO.

Conclusion

The groups listed below appreciate that MDE has initiated this rulemaking as a public stakeholder process. We collectively desire meaningful input into this set of regulations and share the goal of obtaining final emission limits for BRESCO that will result in a healthier Baltimore with reduced symptoms of asthma and other conditions that are worsened by exposure to air pollution. For these reasons, we respectfully ask that MDE schedule additional public stakeholder meetings at which MDE and/or Wheelabrator provide information about each of the topics described above.

Sincerely,

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MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

DRAFT

PPRP

Motion by Energy Answers Baltimore, LLC, to Amend the Construction Commencement Deadline in its Certificate of Public Convenience and Necessity

Supplemental Environmental Review Document

June 2012

MARYLAND POWER PLANT RESEARCH PROGRAM

- Emissions from the cooling tower will be controlled by the operation of high efficiency drift eliminators.

6.1.2 *LAER Determinations For MWC Units*

PPRP, in conjunction with MDE-ARMA, conducted an independent LAER assessment. The following sections summarize the State's determination of LAER for the proposed EA Fairfield project.

EA's proposed LAER determinations for the MWC units are summarized in Table 6-1.

Table 6-1 EA's Proposed LAER for Fairfield Project MWC Units

Pollutant	Control Technology [1]	Proposed LAER Limit (averaging period)	Originally Licensed Limit (Case 9199 Conditions Oct 2010)
NO_x	RSCR, GCPs	45 ppmdv @ 7% O_2 (24-hr daily arith. avg w/CEMS)	45 ppmdv @ 7% O_2 (24-hr daily arith. avg w/CEMS)
VOCs	GCPs	7 ppmdv @ 7% O_2 (avg of 3 tests)	18 mg/dscm @ 7% O_2 (avg of 3 tests)
PM2.5 (filterable and condensable)	Semi-dry scrubber, FF	22 mg/dscm @ 7% O_2 (avg of 3, 1-hr tests) Provisional limit [2]	24 mg/dscm @ 7% O_2 (avg of 3, 1-hr tests) Provisional limit [2]
SO_2	Semi-dry scrubber, FF	24 ppmdv @ 7% O_2 (24-hr daily geom. avg of hourly arith. avg w/CEMS)	24 ppmdv @ 7% O_2 (24-hr daily geom. avg of hourly arith. avg w/CEMS)

[1] RSCR = regenerative selective catalytic reduction; ppmdv = parts per million by volume on dry weight basis; GCP = good combustion practices; FF = fabric filter

[2] PM2.5 limit, inclusive of filterable and condensable fractions, is provisional and will be reviewed based on future stack tests to verify or refine the limit

6.1.2.1 *NO_x*

6.1.2.1.1 *LAER for NOx from the MWC Units*

A LAER analysis is required for emissions of NO_x as a precursor to the nonattainment pollutant, ozone. NO_x emissions are a product of combustion processes and there are two formative mechanisms for NO_x. The first is "thermal NO_x" formation, in which NO_x is formed from the high-temperature oxidation of nitrogen that is present in the combustion air. The second is "fuel NO_x" which forms when nitrogen and nitrogen compounds that are present in the fuel are oxidized during combustion.

MWC units combust fuel at a high temperature, with a substantial amount of ambient air ("excess air") being introduced to the combustion zone. Because emissions of thermal NO_x are determined principally by the percentage of excess air and the temperature, thermal NO_x production is normally greater at MWC units than fuel NO_x production. Fuel NO_x production is governed by the nitrogen content of the fuel, as well as by the combustion conditions, specifically temperature and amount of combustion air. Lower combustion temperatures, as well as good mixing of the fuel with the combustion air, reduce the opportunity for localized areas of high temperature spikes and excessive oxygen levels to develop in the combustion zone (i.e., the conditions that promote NO_x formation).

NO_x emissions from MWC units can be reduced by three methods: 1) lowering the nitrogen content of the fuel by source separation, where feasible, 2) managing the combustion conditions to minimize NO_x formation, and 3) applying an add-on control technology to remove NO_x.

Materials Separation

Because most constituents of solid waste (and fuels derived from it) contain nitrogen, source separation of nitrogen-bearing constituents of solid waste is generally not a feasible means for achieving NO_x emissions abatement. However, one exception is yard waste/leaves, which are generated in substantial amounts and are naturally high in nitrogen content. MWC operators prefer that yard waste/leaves in large quantities be diverted from combustion, with the preferred alternative disposition being municipal/county composting programs.

Combustion Control and Combustion Modifications

The generation of NO_x emissions in the combustion process can be minimized by the same MWC unit design and operating practices, referred to as GCPs, that were determined to be BACT for the control of CO emissions. In the BACT analysis for CO, it was explained that the combustion factors that minimize CO emissions (i.e., high temperature and abundant oxygen) will increase the formation and emissions of NO_x. Accordingly, GCPs for the control of NO_x entail ensuring that combustion occurs at sufficient temperature and with sufficient oxygen to keep CO emissions low, while preventing localized hot spots and pockets of high oxygen levels that can result in excessive production of NO_x. GCPs for NO_x control are achieved by:

- Maintaining a uniform distribution of primary (underfire) air to control the flame temperature and to prevent regions of high excess air;
- Promoting adequate mixing of the combustion gases; and

- Using secondary (overfire) air, with active control of the underfire-to-overfire air ratio, to ensure complete combustion and low CO formation, while preventing temperature and oxygen spikes that create excessive NO_x. The underfire-to-overfire ratio is adjusted and optimized, based on values of control parameters, such as combustion temperature, steam demand, CO concentration, and oxygen concentration.

GCPs are well demonstrated at MWC units to prevent excessive formation of NO_x. GCPs alone, however, are not sufficient to meet BACT or LAER requirements for MWC units. Further control is potentially achievable with the combustion modifications discussed below, and is achievable with add-on controls discussed subsequently.

Aside from combustion control discussed above, there are combustion modifications that could be considered for further reduction of NO_x emissions; i.e., flue gas recirculation (FGR) and gas re-burning. In FGR, a portion of the cooled flue gas (typically 20 – 30 percent) is recirculated back to the MWC unit to replace part of the MWC unit's secondary air supply. By diluting the secondary air with recirculated flue gas, the net oxygen content of the secondary air is lowered. Reducing the oxygen content lowers the peak flame temperature during combustion, suppressing the production of thermal NO_x. FGR can reduce NO_x emissions by approximately 10 – 25 percent. Experience with FGR at MWC units in the U.S. is limited to date.

With gas reburning, combustion is modified by injecting natural gas above the combustion grate, thereby creating a fuel-rich zone that suppresses NO_x formation. Air is introduced above the fuel-rich zone to complete combustion and ensure CO emissions remain low. This combustion modification requires substantial quantities of natural gas fueling, which is not energy efficient and, hence, is not utilized or demonstrated on MWC units in the U.S.

Combustion modification techniques such as FGR and gas reburning are not considered further as LAER for NO_x control, because there are add-on control techniques, to be evaluated below, that are demonstrated to afford substantially greater control of NO_x emissions from MWC units.

Add-On Controls

Two add-on control techniques are available for the control of NO_x, namely selective catalytic reduction (SCR) and non-selective catalytic reduction (SNCR). As SCR provides the more stringent level of control for NO_x, it is evaluated first.

With SCR, an ammonia-based reagent (aqueous ammonia or urea) is injected into the flue gas, where it mixes with nitrogen oxide (NO), the predominant compound of NO_x emanating from the combustion process. The mixture of NO and ammonia passes through a catalyst bed, using a catalyst material comprised of one of several metals, or zeolite (synthetic silica compound), or a ceramic material (molecular sieve). The catalyst chemically reduces the NO to nitrogen. Without the catalyst, this reaction would only occur efficiently at combustion temperatures, typically 1,600ºF to 1,800ºF. The catalyst, however, enables the reaction to occur at a much lower temperature, typically required to be in the range of 500ºF to 700ºF. This operating temperature requirement has important implications for SCR when applied to MWC units that combust fuel derived from MSW and other biomass fuels. This is because, when combusting such fuels, the SCR cannot be placed in the location where the flue gas temperature is in the proper temperature range; i.e., at the MWC unit exit, prior to the semi-dry scrubber. When combusting such fuels, the PM present in the flue gas exiting the MWC units contains sulfur compounds, alkaline compounds, and trace heavy metals that can chemically de-activate the catalyst. Accordingly, at MWC units, the SCR catalyst must be placed downstream of the emission control devices for acid gases and PM. At that location, however, the flue gas temperature has typically cooled to below 300ºF, and hence, must be re-heated to the operating temperature of the catalyst.

SCR applied to MWC units can provide a 75 percent or greater control efficiency for NO_x emissions. Of all available NO_x control methods demonstrated for MWC units, SCR provides the most stringent control efficiency.

SCR is routinely used today to control NO_x emissions from natural gas combustion turbines and boilers. SCR is also used on some coal-fueled power plants. SCR has been implemented effectively at MWC units in Europe and on one MWC unit in Canada. While SCR technology has been recently proposed in the U.S. for several planned new MWC units, it has not yet been demonstrated to date on a MWC unit in the U.S. The reason that SCR, while technically feasible for MWC units, has not yet been applied to MWC units in the U.S. is principally economic. For MWC units, traditional SCR has not met the cost-effectiveness criterion required for it to serve as the basis for setting a BACT emission limit. The reason that traditional SCR has been cost-ineffective to date is the need to re-heat the flue gas to the required operating temperature, which in turn, requires substantial, supplemental fuel combustion (e.g., natural gas), which would normally be cost-prohibitive.

A variation of SCR that is far more energy efficient than standard SCR, regenerative SCR (RSCR), is now available for application to MWC units, and accordingly, substantially improves the cost-effectiveness of applying

SCR to MWC units. With RSCR, supplemental fuel, such as natural gas, is combusted to re-heat the flue gas to the catalyst operating temperature, as with traditional SCR. However, with RSCR, over 95 percent of that heat is recovered using heat exchangers, and is then re-introduced back into the flue gas. This results in far less use of natural gas than with traditional SCR, and much lower, associated fuel costs. The RSCR uses cycling beds of ceramic media to recover, store, and transfer the heat. This same heat recovery and transfer technology has been used commercially for decades in regenerative thermal oxidizers (RTO). The RSCR technology has operated successfully on several biomass power plants fueled with wood in the U.S. since the mid-2000s, achieving NO_x removal efficiencies exceeding the nominal design values of 70 to 75 percent for those plants, according to the RSCR equipment supplier.

While RSCR has been demonstrated at biomass-fueled boilers in the U.S., it has not as yet been demonstrated at a MWC unit. RSCR is proposed for meeting LAER requirements for NO_x at the EA Fairfield MWC units, and this proposed application of RSCR would be among the first such application to a MWC unit. The supplier of the RSCR technology, Babcock Power Environmental, anticipates that a minimum 80 percent removal efficiency for NO_x can achieved at the Fairfield MWC units.

The second type of add-on control demonstrated for NO_x abatement at MWC units is SNCR. SNCR is the add-on NO_x control technology used at virtually all MWC units operating today in the U.S. Like SCR, SNCR reduces NO_x by injecting an ammonia based reagent (aqueous ammonia, urea) to convert NO present in the post-combustion gases to nitrogen via chemical reduction. However, unlike SCR, SNCR does not use a catalyst and its associated process chemistry is more complex. Because a catalyst is not used with SNCR, the required reaction temperature for NO_x reduction is much higher, with the desired reaction occurring most efficiently within a specific temperature range of approximately 1,700 to 1,850ºF. However, special reagent formulations are now available that can extend that range downward to approximately 1,300ºF. As reaction temperature is critical, SNCR requires the reagent to be injected into the combustion gases where the boiler temperatures are within the required range. This is typically a location within the combustion zone, or immediately following it. When applied to MWC units, SNCR typically achieves minimum control efficiencies in the general range of 50 to 60 percent. By comparison, SCR, again, can achieve a minimum 75 percent control.

6.1.2.1.2 *LAER for NOx from the MWC Units*

The 2010 CPCN had imposed a LAER emissions limit on NO_x emissions from each of the four MWC units of 45 ppmdv @7% O_2, as the 24-hour daily arithmetic average of hourly concentrations, with compliance to be demonstrated by means of a CEMS. That limit is substantially more stringent than the emission standards imposed by the NSPS for large MWC units (40 CFR 60, Subpart Eb) of 150 ppmdv @7% O_2, with 180 ppmdv allowed during the first year of operation. In its 2012 Motion to Amend, EA had proposed the same emission limit as LAER, with compliance to be demonstrated on the same basis. PPRP has independently evaluated the proposed LAER emission limitation, based on a review of the following:

- Recent permitting precedents for MWC units summarized by U.S. EPA in its national RBLC;
- Permits issued recently for MWC units that are not yet reflected in the RBLC database; and
- Proposed permit conditions for MWC project developments in progress of which PPRP is aware. (Note: Such proposed permit limits can serve as relevant benchmarks in a BACT/LAER analysis, but until the reference permit is issued, those proposed limits are not formal BACT/LAER precedents.)

The RBLC search revealed no permit with more stringent limits than that proposed for the EA Fairfield facility. PPRP identified no new MWC projects for which permits were recently issued, but are not yet reflected in the RBLC. However, three WTE projects currently in development were identified for which some information was available regarding proposed emissions limits. Those projects include a new WTE facility under development by EA in Puerto Rico, a new WTE facility under development in Frederick County, Maryland, and a WTE facility being re-developed in Harrisburg, Pennsylvania. The proposed LAER limit for the Frederick County project and the proposed BACT limit for the EA Puerto Rico project were the same as the LAER limit proposed for the EA Fairfield facility, 45 ppmdv @7% O_2, as the 24-hour daily arithmetic average of hourly concentrations. The BACT limit for NO_x proposed for the Harrisburg project was 135 ppmdv @7% O_2, as the 24-hour daily arithmetic average of hourly concentrations, which is less stringent than the LAER limit proposed for the EA Fairfield facility. The reference materials (i.e., RBLC listings, permits) reviewed by PPRP for this LAER analysis are included in Appendix D.

The combination of GCPs and RSCR is proposed for control of NO_x emissions from the Fairfield MWC units. GCPs are well demonstrated at MWC units nationally to prevent excessive NO_x generation. While SCR has been demonstrated on MWC units in Europe and Canada, the proposed application to the Fairfield MWC unit would be among the first in the U.S. SCR, including the proposed RSCR, is recognized to provide the most stringent level of control of flue gas NO_x emissions, including NO_x emissions from MWC units. The RSCR technology supplier anticipates NO_x emissions reductions from the Fairfield MWC units will exceed 80 percent. The emission limit proposed as LAER for each of the Fairfield MWC units is 45 ppmdv @ 7% O_2, as the 24-hour daily arithmetic average of hourly concentrations, with compliance to be demonstrated by means of a CEMS. This proposed limit is substantially more stringent than the emission standards imposed by the applicable NSPS for large MWC units (40 CFR 60, Subpart Eb) of 150 ppmdv @ 7% O_2, with 180 ppmdv allowed during first year of operation. The proposed limit is also more stringent than the limit imposed to date on any MWC unit in the U.S., and is as stringent as the most stringent limits proposed for MWC projects presently undergoing permitting review in the U.S. Accordingly, PPRP and MDE-ARMA concur that the proposed emission limit of 45 ppmdv @ 7% O_2, as the 24-hour daily arithmetic average of hourly concentrations, is LAER for NO_x, with compliance to be demonstrated by means of a CEMS. This LAER emission limit can be achieved through the application of emission controls consisting of the combination of RSCR and GCPs.

6.1.2.2 VOCs

6.1.2.2.1 LAER Evaluation for VOC Emissions from the MWC Units

A LAER analysis is required for emissions of VOC as a precursor to the nonattainment pollutant, ozone. As discussed below, emissions of VOCs are controlled by using good combustion design and operating practices, referred to as GCPs. VOC emissions can be further reduced by applying add-on controls.

Good Combustion Practices (GCP)

Emissions of VOCs result from the incomplete combustion of compounds containing carbon. The same factors related to poor combustion efficiency that create excessive emissions of CO are also responsible for excessive emissions of VOCs (i.e., insufficient oxygen and/or insufficient temperature during combustion of the fuel). As was explained previously, the best combustion efficiency, and hence the lowest VOC emission rates, results from higher combustion temperatures and greater amounts of combustion air (excess air). However, high temperatures and excess air levels also have the undesirable attribute of promoting the formation of excessive NO_x emissions. Accordingly, the combustion design and operating practices for a MWC unit must be optimized to enable the lowest possible emissions of CO and VOCs, without creating excessive emissions of NO_x. The specific design and operating factors required to optimize emissions of CO, NO_x, and also VOCs are referred to

FREDERICK/CARROLL COUNTY RENEWABLE WASTE-TO-ENERGY FACILITY

PREVENTION OF SIGNIFICANT DETERIORATION/AIR CONSTRUCTION PERMIT APPLICATION

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Typically SCR systems are installed in applications where the SCR catalyst is located downstream of the acid gas and particulate control devices, i.e.; a clean-side SCR system. This is due to the fact that the acid gases and PM in the exhaust gases will affect the performance as well as the service life of the catalyst. One adverse effect of placing the SCR catalyst downstream of the acid gas control and PM control systems is that the exhaust gas temperature will likely be below the optimum catalyst temperature for efficient NO_x control; i.e., approximately 600 to 750°F. The exhaust gas, therefore, must be reheated to reach this optimal SCR operating temperature.

There are basically two means of reheating the exhaust flue gas to this optimal SCR operating temperature. One method is to use process steam or heat in a noncontact heat exchanger to reheat the exhaust flue gas. The advantage of this method is that no additional fuel or combustion source is required. The other method is to provide a separate, dedicated fuel combustion source to directly reheat the exhaust flue gas.

Although SCR technology has not been demonstrated on MSW combustors in the United States to date, SCR is a proven NO_x control technology for MSW combustors in Europe and, therefore, is considered technically feasible for FCCRWTE.

4.1.3.2 Regenerative Selective Catalytic Reduction

RSCR uses the same scientific principles and chemical reactions as SCR to control NO_x emissions. RSCR provides comparable NO_x control efficiencies as SCR systems. The main advantage of RSCR technology, as compared to SCR, is that it provides higher thermal efficiencies in clean gas applications that require reheating of the flue gas to reach operating temperature.

RSCR provides a thermally efficient means of maintaining the optimal exhaust gas temperature by recovering and reusing the external thermal energy contained in the exhaust stream, thereby reducing the amount of supplemental heat that will be required.

Although RSCR technology has not been installed and operated or demonstrated on any type of MSW combustor in the United States to date, it has been determined to represent LAER or BACT for several refuse-derived fuel (RDF)-fired MSW combustors. Since SCR and RSCR operate under the same basic scientific principles and under the same basic operating conditions, RSCR may be considered technically feasible for FCCRWTE.

4.1.3.3 Proposed NO_x LAER Emissions Limit for FCCRWTE MSW Combustors

The analysis of NO_x LAER for FCCRWTE's MSW combustors was conducted to identify the most stringent NO_x emissions limits for recent MSW combustor projects.

Table 4-1 presents proposed NO_x limits or NO_x determinations for the two most recently permitted MSW combustor facilities in the United States: Energy Answers' Fairfield Project in Baltimore, Maryland; and Palm Beach Renewable Energy Facility in Palm Beach County, Florida. The lowest permitted NO_x emissions limit is 45 ppmvd corrected to 7-percent oxygen (24-hour block) and a corresponding ammonia slip limit of 20 ppmvd corrected to 7-percent oxygen (24-hour block) for the Energy Answers' Fairfield Renewable Energy facility located in Baltimore, Maryland. This NO_x limit was determined based on a LAER analysis and uses an RSCR system. Although the preprocessed fuel combusted and the combustion process proposed for the Fairfield Renewable Energy facility is significantly different than the fuel and mass burn combustion process used by FCCRWTE, this NO_x LAER emissions rate has been included in the LAER analysis. Table D-1 in Appendix D lists comprehensive NO_x determinations for MSW combustor facilities from EPA's RBLC database, issued permits and pending permit applications for MSW combustor facilities from 2000 to present.

Table 4-2 presents NO_x permit limits of several waste-to-energy facilities located in Europe, which propose SCR technology for NO_x emissions control. These facilities demonstrate a wide range of NO_x permit limits ranging from 50 to 135 ppmvd at 7-percent oxygen. These NO_x emissions levels are stated as permit limits and are not necessarily the NO_x emissions levels demonstrated in practice.

in accordance with MDE guidance, the most recent and most complete 5 years (i.e., 2001, 2003, 2004, 2006, and 2007) of readily available surface and upper air meteorological data from the IAD and Sterling stations were used for FCCRWTE's air quality impact analysis. This data, obtained from the Virginia Department of Environmental Quality, represents 5 years of complete (i.e., greater than 90 percent) representative meteorological data for the Facility.

Based on evaluation of aerial photographs and AERSURFACE output, the IAD surface characteristics provide representative data for the purpose of developing AERMET meteorological datasets for the FCCRWTE air quality impact analysis. Accordingly, the 5-year set of IAD/Sterling meteorological data, in conjunction with the AERMOD dispersion model, was used to determine FCCRWTE air quality impacts.

6.10 MODELED EMISSIONS INVENTORY

6.10.1 ON-PROPERTY SOURCES

The FCCRWTE dispersion modeling inventory includes the following emissions sources:

- Two 750-tpd MSW mass burn waterwall combustors (point sources of NO_x, CO, SO_2, and PM_{10}).
- Fly ash surge bin enclosure wet scrubber (point source of PM_{10}).
- Ash and Metal Recovery building wet scrubber (point source of PM_{10}).
- Three cell mechanical draft cooling tower (point source of PM_{10}).
- Emergency firewater pump diesel engine.

Plant roadways will be paved and swept as required. Accordingly, the air quality impacts due to fugitive PM_{10} emissions from vehicle travel on the plant roadways will be negligible.

FCCRWTE emissions sources listed previously were addressed in the air quality impact analysis. The primary FCCRWTE emissions sources are the two mass burn waterwall combustors. Excluding startups, shutdowns, and malfunctions, the combustors will normally operate between 60 and 100 percent of their maximum continuous rating (MCR). FCCRWTE's dispersion modeling analysis evaluated air quality impacts for the two