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NOx RACT for Municipal Waste Combustors (MWCs)

Stakeholder Meeting – January 17, 2017

Topics Covered

- Background Information
  - Air Quality Overview
  - MD Efforts to Reduce Pollution
- Municipal Waste Combustors (MWCs) in Maryland
  - Purpose of NOx RACT review
  - MWC sources
  - Control technology and emissions
- MDE NOx RACT update
  - NOx RACT Cost Analysis
- Regulation Timeline

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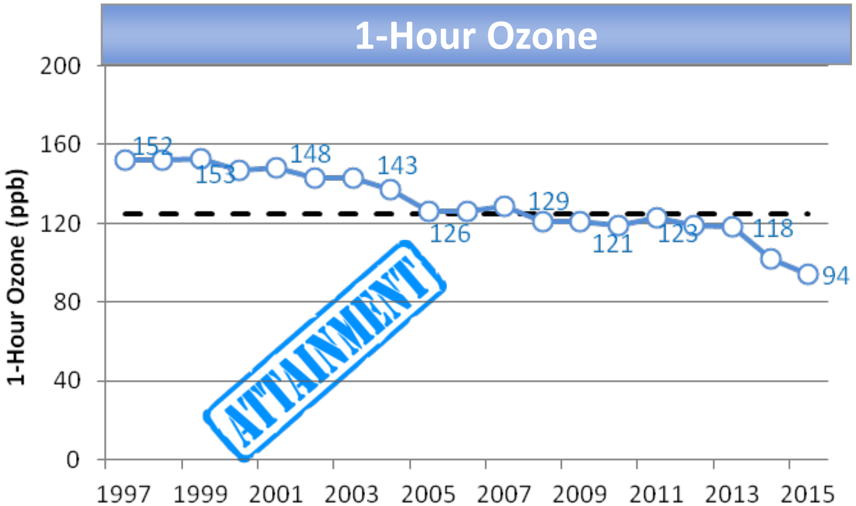
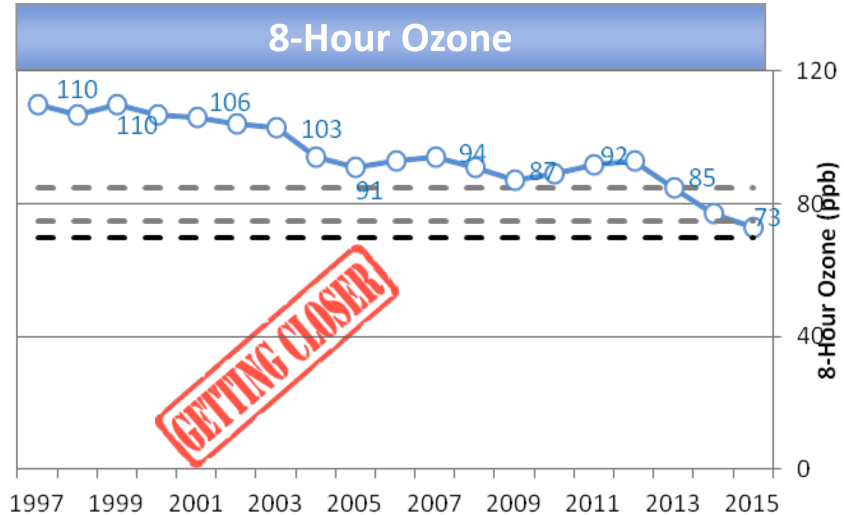
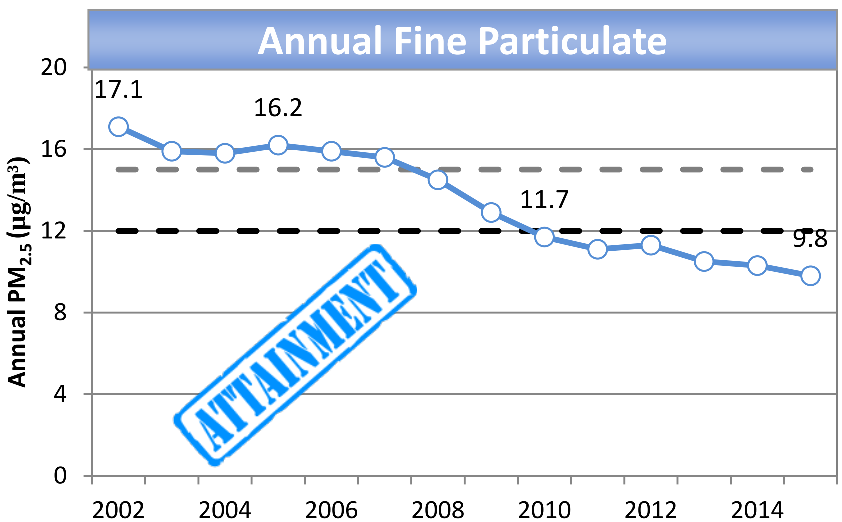
Why NOx?

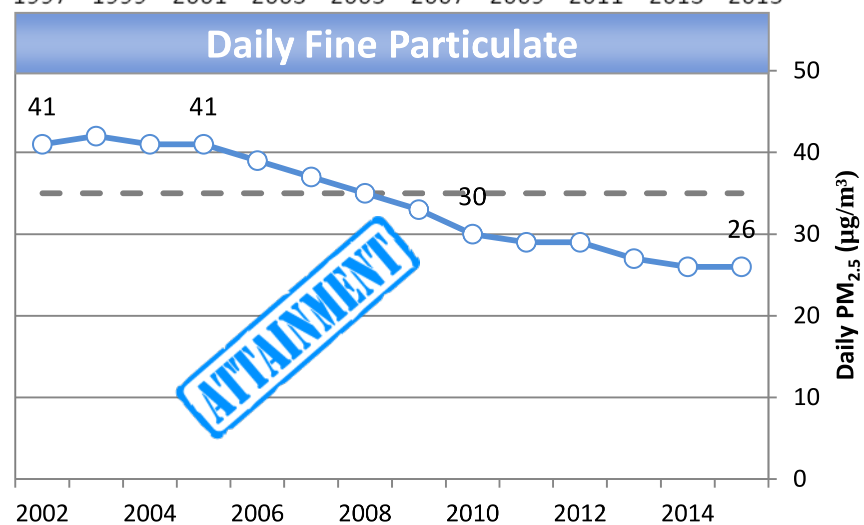
- Nitrogen oxide or NOx is the most important pollutant to reduce to continue to make progress on ground level ozone in Maryland
  - Ozone is formed when NOx and Volatile Organic Compounds react with sunlight
- There is very little doubt that the State's recent progress on cleaning up ozone air pollution is driven by NOx reductions
- NOx is also a contributor to nitrogen deposition into the Chesapeake Bay, fine particulate pollution in Maryland and regional haze

Progress in Cleaning Maryland's Air





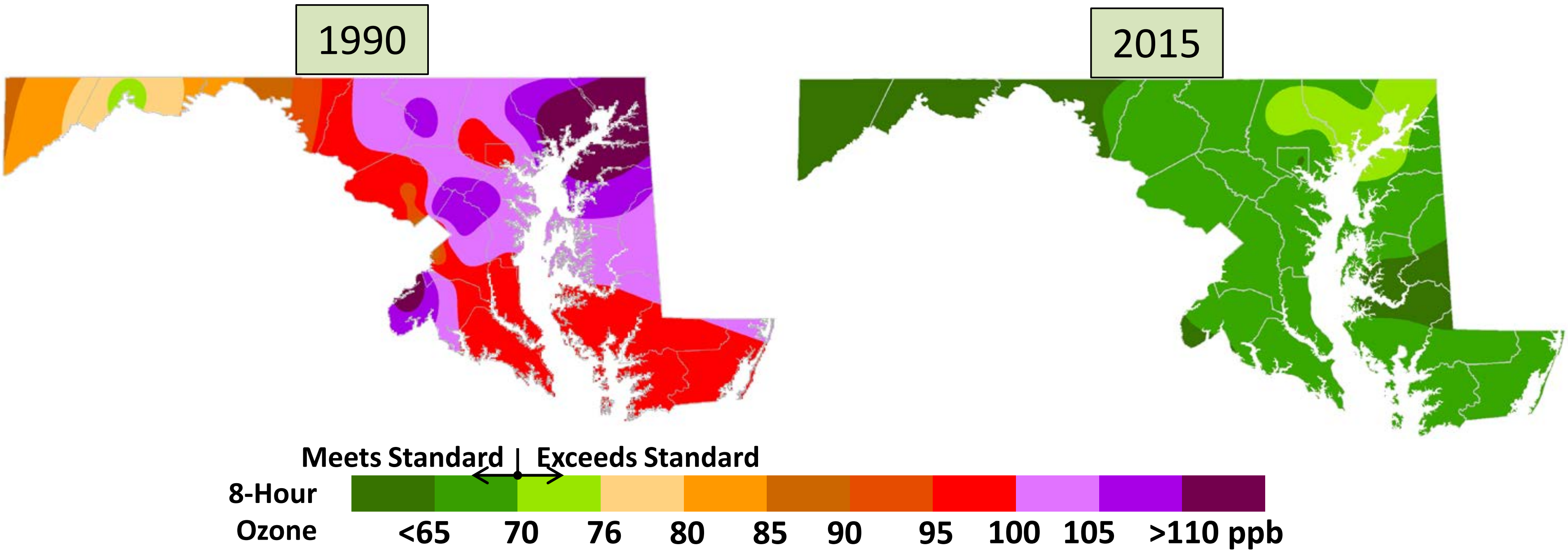




Clean Air Progress in Baltimore

- Baltimore has historically measured some of the highest ozone in the East
- From 2013 to 2015, the Baltimore area did not exceed the current ozone standard
  - First time in 30 years … weather did play a role
- EPA has now finalized a "Clean Data Determination"
- With hotter, less ozone friendly weather, Baltimore may see higher ozone … but continued progress is indisputable
- New, lower ozone standard begins in 2017

The Shrinking Ozone Problem



- In 2015 no monitors were above the 75 ppb threshold
- In 2015 only small areas of Baltimore, Harford and Cecil Counties were above the new ozone threshold of 70 ppb

Key Pollutants

- Over the past 10 years, MDE has worked to reduce emissions of many pollutants. Six of the most critical pollutants include:
  - Nitrogen oxide or "NO_x" - the key pollutant to reduce to further lower ozone levels. Also contributes to fine particle pollution and regional haze
  - Sulfur dioxide or "SO_2" - the key pollutant to reduce for fine particulates and the new SO_2 standard. Also a major contributor to regional haze
  - Carbon dioxide or "CO_2" - the primary greenhouse gas that needs to be reduced to address climate change
  - Mercury (Hg) - a very important toxic air pollutant
  - Diesel particulate - diesel exhaust
  - Volatile Organic Compounds or "VOC" - also a contributor to ground level ozone. Many VOCs are also air toxics

Key Emission Reduction Programs

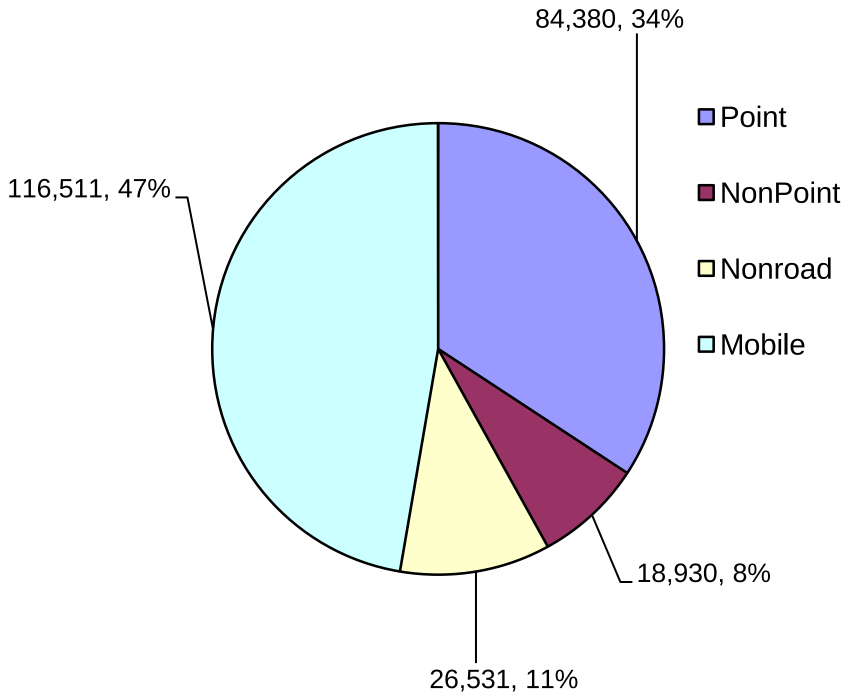
- Since around 2005, Maryland has implemented some of the countries most effective emission reduction programs
  - These efforts have worked
- Power Plants
- Cement Plants
- Cars and Trucks
- Consumer Products
- Area Source VOCs

2005 to 2017 Control Programs

- Power Plants
  - The Maryland Healthy Air Act of 2006
  - 2015 NOx reductions for coal plants
- Portland Cement Plants
  - 2017 NOx RACT updates
- VOC Regulations
  - Architectural and Industrial Coatings
  - Consumer Products
  - Autobody Refinishing
- Mobile Sources
  - The Maryland Clean Cars Act of 2007
  - Diesel Trucks, School Buses, Locomotives

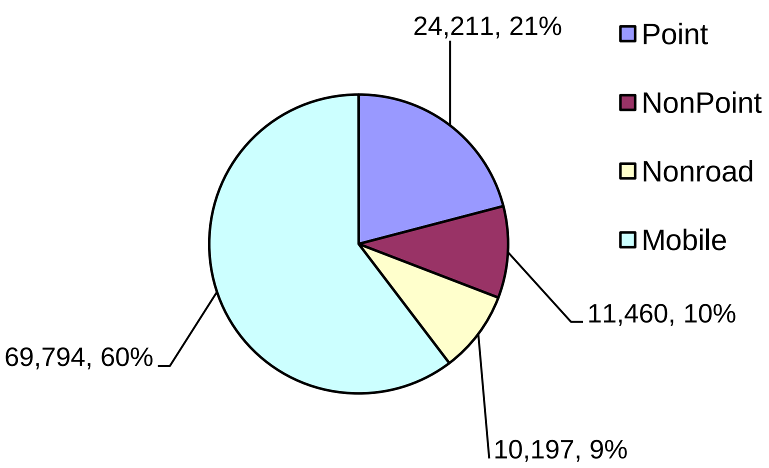
NO_x Emission Reductions 2005 – 2014

2005 Annual NO_x Emissions
246,000 tons per year



2014 Annual NO_x Emissions
115,000 tons per year

More than a 50% reduction



MD NOx RACT Review for Large MWCs

- The purpose of this review is to establish new NO_x RACT (Reasonably Available Control Technology) requirements for large MWCs with a capacity greater than 250 tons per day.

- There are two large MWCs in Maryland;
  - Wheelabrator Baltimore, L.P. and
  - Montgomery County Resource Recovery Facility (MCRRF).

- The Department has been meeting with affected sources and EPA since the summer of 2015 to discuss MWC operations, emissions data and NOx RACT proposals

- August 30, 2016 – 1st Stakeholder Meeting

- October 27, 2016 – Stakeholder comments received

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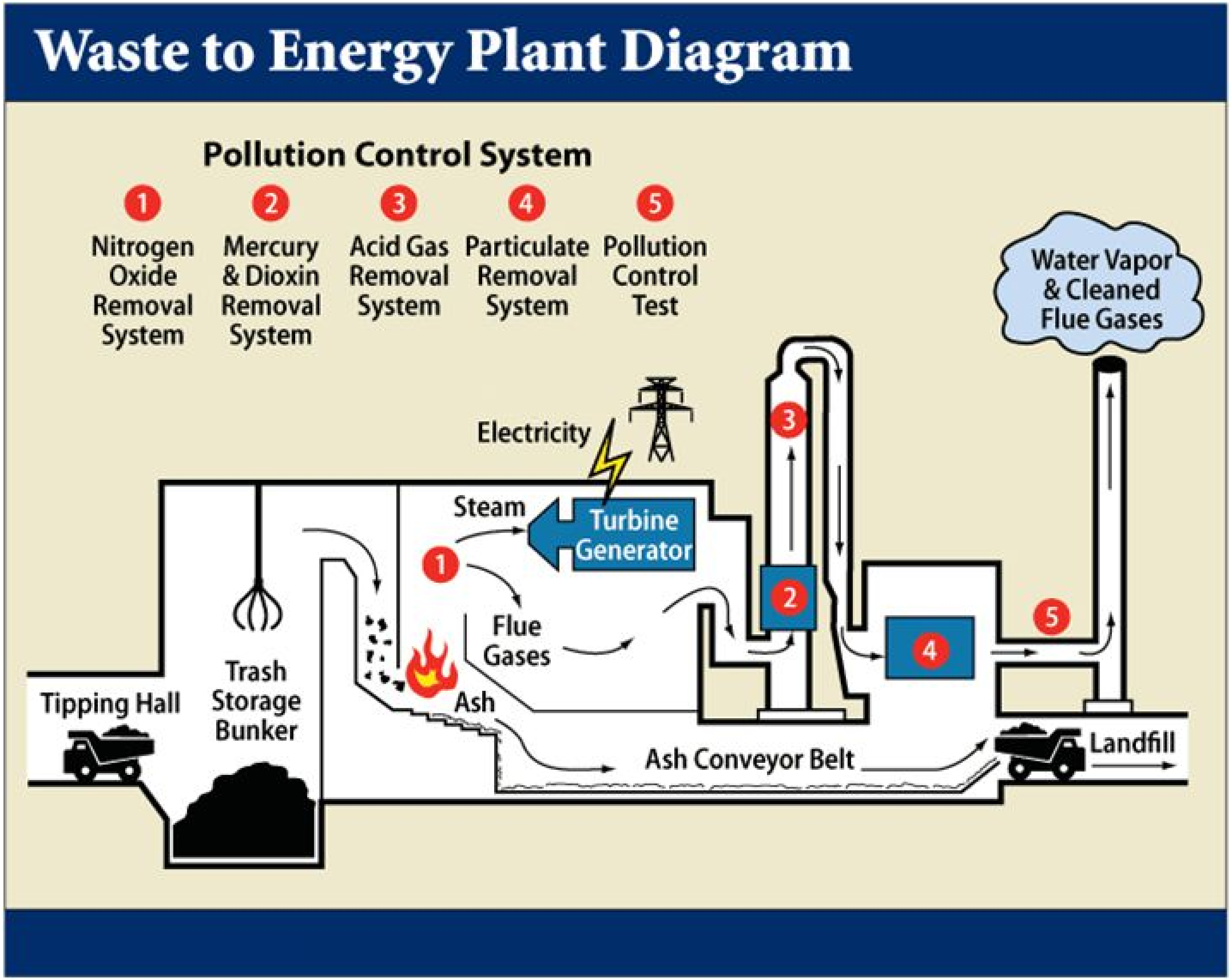
What is a MWC?



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Wheelabrator

2,250
Tons of Waste Processed per day

730,150
Tons of Waste Processed Last Year

64 MW
Energy Generation Capacity

40,000
Homes Powered

1985
Began Operations

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Wheelabrator 2015 NOx Emissions

No.	2015 Top 15 Nox Emissions Sources in MD	Nox Emissions (Tons Per Year)*
1	Fort Smallwood Road Complex	3,102
2	Lehigh Cement Company LLC	2,936
3	NRG Chalk Point Generating Station	2,126
4	Luke Paper Company	1,887
5	Holcim (US), Inc	1,225
6	**Wheelabrator Baltimore, LP**	**1,123**
7	C P Crane Generating Station	1,078
8	NRG Dickerson Generating Station	987
9	NRG Morgantown Generating Station	897
10	AES Warrior Run Inc	445
11	Montgomery County Resource Recovery Facility (MCRRF)	441
12	Harford County Resource Recovery Facility	262
13	Constellation Power - Perryman Generating Station	190
14	KMC Thermo-Brandywine Power Facility	144
15	Mettiki Coal, LLC	144

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* Facility-wide NOx emissions

Wheelabrator NOx Emissions

Year	NOx Tons	NOx 24-Hr Average
2013	1067	Annual 169 ppm
2014	1076	Annual 162 ppm Max values 190, 188, 183 31% of 24-Hr averages above annual average
2015	1124	Annual 168 ppm Max values, 190, 198, 196 50% of 24-Hr averages above annual average
Average	**1089**	**166 ppm**

Wheelabrator Optimization Study

- February 29 to March 4, 2016 - Wheelabrator conducted optimization tests of existing SNCR system
- Furnace temperature profiles developed and, as a result of the optimization tests, urea injection locations were modified

	NOx ppm	NOx Removal	Urea Utilization
Original Configuration	175	14-21%	25%
Optimized Configuration	150-165	25%	40%

MCRRF

1,800
Tons of Waste Processed per day

599,250
Tons of Waste Processed Last Year

52 MW
Energy Generation Capacity

37,000
Homes Powered

1995
Began Operations

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MCRRF 2015 NOx Emissions

No.	2015 Top 15 Nox Emissions Sources in MD	Nox Emissions (Tons Per Year)*
1	Fort Smallwood Road Complex	3,102
2	Lehigh Cement Company LLC	2,936
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MCRRF NOx Emissions

Year	NOx Tons	Long Term (Annual) Average NOx 24-Hr Block Concentration
2013	387.7	85 ppm
2014	426.7	88 ppm
2015	441.2	89 ppm

MCRRF NOx Control Technology

- An SNCR system is integrated to a combustion Low NOx (LN™) system with modifications to the location of the injectors
- The Covanta LN™ technology employs a unique combustion system design, including modifications to combustion air flows, reagent injection and control systems logic.
- The LN™ control system and SNCR result in lowering the NOx emission rate range to 85-89 ppm long-term (annual average) basis.
- Approximate 47 percent reduction on long term basis, but subject to high variability on daily basis, lesser can be assured on a short-term basis.
- The LN™ control system installation started in 2008 and was completed in 2010 at a capital cost of $6.7 million and the average operating costs over the last three years has been $566,000 per year.

MDE Updates to MWC NOx RACT

- Maryland MWCs are already well controlled.

- Based upon regional RACT amendments in other states, review of MWC NOx emissions data, and analysis of optimization studies the Department has concluded that the NOx RACT standards for MWCs can be strengthened within the definition of RACT

- MDE looking at pairing daily (24-hour) limits with longer (30-day rolling average) limits

Real World Complications

- While NOx emissions from MWCs may remain fairly consistent, there is inherent variability introduced in the waste stream (fuel) which may cause a spike in emissions.

- Because of this, should a RACT limit be set at a point to account for this variability…
  - The limit will allow higher emissions on most days when the emission controls and the waste stream are capable of achieving lower emissions.

- MDE is planning to set limits to ensure that emissions are minimized every day.

MDE Current Thinking

- Based upon review of federal rules, rules in other states, emissions & control technology data and the specific configurations of MWCs in Maryland … MDE's very preliminary thinking on updated RACT limits is below

- We are looking for input from stakeholders.

Unit	30 Day Rolling Average Limit	24 Hour Daily Limit
Wheelabrator	Somewhere between 145 and 175 ppmvd	Somewhere between 165 and 180 ppmvd
MCRRF	Somewhere between 105 and 130 ppmvd	Somewhere between 120 and 140 ppmvd

ppmvd = parts per million volume dry

RACT Cost Analysis – NOx Emissions Methodology

- The NOx Average Emissions Inputs for Wheelabrator facility using 2015 data:
  - Unit 1 - 165 ppm
  - Unit 2 – 171 ppm
  - Unit 3 – 168 ppm

- Methodology:
  - The potential NOx emission reductions were projected by calculating the emissions for every day that exceeded 170 ppm
  - For unit 1, for example, the range was 171 to 190 ppm
  - The average NOx emission was calculated for each 24-hr ppm over 170 ppm

    13 lb/day x number of days over 170 ppm x ppm over 170

  - Sum calculation for unit 1, 2 and 3

  - NOx emissions reduced = 18 tons annual

RACT Cost Analysis – NOx Optimization @ 178 24-hour Limit

- Inputs for Wheelabrator facility:
  - Based on 178 ppm 24-hour Daily NOx limit utilizing a 170 ppm upper control limit
  - 2015 average hourly urea injection rates = 5 gph
  - 2015 average urea cost per/gallon = $1.50
  - Urea injection rate increased only on days to meet compliance with 178 ppm 24-hour Daily NOx limit
  - Scenario applied to 2015 NOx emissions data for 3 units

- Results:
  - Urea usage increased by 7 gph as needed to meet 178 ppm 24-hour Daily NOx limit
  - Approximate additional urea used = 46,704 gallons
  - Approximate additional cost = $70,056
  - NOx emissions reduced = 18 tons annual
  - Cost-effectiveness is $ 3,196/ton of NOx reduced

RACT Cost Analysis – NOx Optimization @ 170 24-hour Limit

- Inputs for Wheelabrator facility:
  - Based on 170 ppm 24-hour Daily NOx limit utilizing a 160 ppm upper control limit
  - 2015 average hourly urea injection rates = 5 gph
  - 2015 average urea cost per/gallon = $1.50
  - Urea injection rate increased on all operating days to meet 160 ppm 24-hour Daily NOx upper control limit
  - Scenario applied to 2015 NOx emissions data for 3 units
- Results:
  - Urea usage increased by 5 gph to meet 160 ppm 24-hour Daily NOx upper control limit
  - Approximate additional cost = $179,469
  - NOx emissions reduced = 60 tons annual
  - Cost-effectiveness is $ 2,990/ton of NOx reduced

RACT Cost Analysis – Low NOx

- The NOx RACT analysis for the LN™ control system is based upon the following factors associated with the MCRRF installation:
  - Installation started in 2008 and was completed in 2010 at a capital cost of $6.7 million
  - Average operating costs (2013-15) at $566,000 per year
  - Capital cost projected to 2017 is $7.54 million
  - Life of LN™ control system assumed to 20 years
  - Capital cost on yearly basis $452,652
  - Total cost on yearly basis is capital cost + operating cost = $1.018 million
  - Emission reduction is 500 tons/year
- Cost-effectiveness is projected approximately to $2037/ton of NOx reduced.

RACT Cost Analysis – SCR

- MD's Large MWCs are controlled with SNCR
  - MCRFF also utilizes LN™ control system
- SCR operates similar to SNCR systems in that NOx is removed by injecting ammonia (urea) into the flue gas, but with the addition of passing the mixed gases through a catalyst bed
  - SCR requires additional equipment and impacts the energy production of the facility. SCR requires air-to air heat exchanger and steam reheat module to maintain needed temperature and bigger ID fan
  - High NOx reduction efficiencies can be achieved if the parameters such as residence time, space velocity, and the correct temperature window are controlled
- MDE worked with EPA to identify if any MWCs in the U.S. have been retrofitted with SCR
  - No sources have been identified
  - MDE believes that the potential costs of SCR does not meet the "economic feasibility" criteria of Reasonably Available Control Technology

Timeline

- Stakeholder Meetings
  - August 30, 2016
  - January 17, 2017
  - TBD
- Air Quality Control Advisory Council (AQCAC) Briefing
  - June 6, 2016
- AQCAC Potential Action Item
  - June 19, 2017
- Regulation Adoption
  - NPA – July 2017
  - Public Hearing – October 2017
  - NFA – November 2017
- Effective Date
  - January 2018

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Discussion

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