Workgroup Recommendations and Other Potential Control Measures
Stationary Combustion Sources Workgroup

SCS009 – Municipal Waste Combustors

Control Measure Summary	**Emissions (tons/year) in NJ State**	
2002 existing measure: Federal performance standards and emissions guidelines for large MWCs (40 CFR 60 Subparts Cb and Eb). To meet the emissions limits in Subparts Cb and Eb, no new control technology was needed. EPA approved state programs as facility-wide averaging for NOx compliance. *Emission Reductions prior to 2002*: 1,489 tons/yr reduction in NOx emissions due to installation of SNCR in 10 MWC units. 10,200 tons/yr reduction in SO2 emissions due to installation of Scrubbers in all MWC units. 23,700 tons/yr reduction in particulate emissions due to installation of Baghouse/ESPs in all MWC units. *Control Cost*: $7.20 per Mg municipal solid waste combusted for SNCR installation. *Timing of Implementation*: Compliance required December 19, 2000. *Implementation Area*: New Jersey Statewide.	**Actual NOx in 2002**	1,803
	Actual SO2 in 2002	198
	Actual VOC in 2002	18
	Actual Particulate in 2002	125
Candidate Measure(s) Adopt Revised NSPS Emission Limits: NOx: EPA's May 10, 2006, final revision of Subpart Cb does not propose any change in NOx emission limits for the existing units and therefore, with the implementation of the rule there will be no NOx reduction in New Jersey.	**NOx 2002 PTE** **PTE reduction after 4/28/09**	3,541 0
SO_2: EPA's May 10, 2006, final revision of Subpart Cb did not change SO2 emission limits for the existing units of 29 parts per million dry volume or SO2 control efficiency from 75% after 4/28/09. Therefore, there will not be an SO2 reduction in New Jersey.	**SO2 2002 PTE** **PTE reduction after 4/28/09**	2,040 0
PM: EPA's May 10, 2006, final revision of Subpart Cb change PM emission limits for the existing units from 27 mg/dscm to 25 mg/dscm after 4/28/09. Therefore, with the implementation of the rule there will be a PM reduction of 17 tons/yr (PTE) in New Jersey.	**PM 2002 PTE** **PTE reduction after 4/28/09**	237 17

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Policy Recommendation of State:

All of the New Jersey MWC units except Camden CRRF are equipped with SNCR. Camden CRRF does not have SNCR but the facility already accepted a facility-wide emission cap for NOx equivalent to SNCR at other plants. However, the Department is considering proposing a NOx standard in the range of 100 to 150 ppm for MSW incinerators reflective of the capability of SNCR to obtain greater emission reductions than are currently being achieved at a reasonable cost of $2,000 to $3,000 per ton of NOx removed. The Department anticipates that 130 ppm NOx emission limits will reduce approximately 63 tpy emissions and 100 ppm will reduce approximately 500 tpy emissions. NJDEP is working with other OTC states to develop the regulatory strategy for this source category for the region. Further details on the OTC efforts can be found at http://www.otcair.org/.

All of the New Jersey MWC units have scrubbers for SO2 control and ESP or baghouses for PM control. Most of them are already achieving the revised NSPS emission limits. The units with ESP control may install baghouses for mercury control, which will help in further reductions of PM. Some units may need minor adjustments of the controls, if they are not achieving the final limits.

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BACKGROUND INFORMATION

New Jersey has five (5) facilities with thirteen (13) municipal waste combustors (MWC) units. Owners and operators of the New Jersey's MWC units were required to comply with the facility specific NOx emission limits according to New Jersey's NOx Regulations adopted in January 1994.

In December 1995, United States Environmental Protection Agency (EPA) adopted New Source Performance Standards (NSPS) (40 CFR 60 Subpart Eb) and Emission Guidelines (Subpart Cb) for MWC units with a combustion capacity greater than 250 tons per day. Both the NSPS and Emission Guidelines require compliance with emission limitations for nine pollutants including NOx that reflect the performance of maximum achievable control technology (MACT). The Emission Guidelines required compliance by December 2000 for all existing MWC units, while the NSPS apply to new MWC units. As mandated by the Clean Air Act, on November 12, 1998, EPA adopted a Federal Plan to implement and enforce the December 19, 1995, MWC guidelines for existing municipal waste combustors (40 CFR 60 subpart Cb).

On November 9, 1999, New Jersey requested the delegation of authority from EPA. On March 17, 2000, the EPA approved New Jersey's request for delegation of the Federal Plan. On January 24, 2001, New Jersey DEP agreed to the terms and conditions of the Memorandum of Agreement (MOA) to implement and enforce the Federal Plan for municipal waste combustor (MWC) facilities in New Jersey. Currently, all New Jersey MWC units are in compliance with the Federal Plan standards.

Owners and operators of eleven (11) of the thirteen (13) MWC units in New Jersey with a combustion capacity greater than 250 tons per day were required to comply with the EPA emissions limits no later than December 19, 2000. Three facilities (Essex, Union and Gloucester) with 8 MWC units that are subject to 40 CFR 60 Subpart Cb have installed selective non-catalytic reduction (SNCR) as NOx control device. One facility (Warren) with two MWC units (combustion capacity less than 250 tons per day), though not subject to Subpart Cb, also installed SNCR. One facility (Camden) with 3 MWC units did not install SNCR, however it is in compliance with the Subpart Cb requirements. The following potential NOx emissions reductions have been achieved in New Jersey after installation of SNCRs at the ten (10) MWC units:

- 1,489 tons per year;
- 624 tons per ozone season; and
- 4.08 tons per day during the ozone season.[1]

[1] Assumes 100% rule effectiveness, which is reasonable given that the MWCs are operated with continuous emissions monitoring.

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On May 10, 2006, USEPA adopted revisions to the Emissions Guidelines to reflect the levels of performance achieved due to the installation of control equipment (70 FR 75348). Selective non-catalytic reduction (SNCR) is considered MACT for NOx under both the guidelines and the 2006 rule. New Jersey will review the guidelines, and may request another delegation to implement and enforce these standards.

All New Jersey MWC units are equipped with Scrubbers for SO_2 control. Most of these units are already in compliance with the emission limits. However, some units may need minor adjustments to achieve the emission limits. A potential SO_2 emissions reduction of 10,200 tons/yr has been achieved in New Jersey after installation of Scrubbers in all MWC units prior to 2002.

Six (6) of the eleven (11) MWC units in New Jersey (Essex and Camden) that are subject to 40 CFR 60 Subpart Cb have installed Electrostatic Precipitator (ESP) for PM control and rest of the units have installed Baghouse. A potential PM emissions reduction of 23,700 tons/yr has been achieved in New Jersey after installation of ESP/Baghouse in all MWC units prior to 2002. All units are achieving the revised emission limits. In order to achieve the mercury emission limits, the units with ESPs may install polishing baghouse, which will help further reduction of PM emissions.

Add-on NOx Control

The number of NOx-reduction technologies for MWC units are limited as these units use a heterogeneous, wet fuel; are less thermally efficient than fossil fuel-fired boilers of comparable heat input; and require larger amounts of excess air and less densely-packed heat recovery systems. Low-NOx burners, fuel switching and load curtailment are not possible control options.

The only generally applicable and feasible add-on control technology for reducing NOx emissions from MWC units is SNCR. SNCR is a chemical process for removing NOx from flue gas. In the SNCR process, a reagent, typically liquid urea or anhydrous gaseous ammonia, is injected within a boiler or in ducts in a region where the temperature is between 900 and 1,100 degrees Celsius. The reaction converts NOx to nitrogen gas and water vapor. SNCR performance depends on factors specific to each type of combustion equipment, including flue gas temperature, residence time for the reagent and flue gas, amount of reagent injected, reagent distribution, uncontrolled NOx level and carbon monoxide and oxygen concentrations.

Some disadvantages arise from the use of SNCR including: the high operating temperatures required; ineffectiveness at high temperatures with low concentrations of NOx; the need to accommodate enough residence time to complete the chemical reaction at high temperatures; and undesirable excess ammonia and urea emissions (ammonia slip) that arise from an incomplete chemical reaction (Thermal Energy International, 2000).

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Cost

The capital cost of installing SNCR on a MWC unit is approximately $1,500 per million British Thermal Units per hour (MMBtu/hr) (see, e.g., Institute of Clean Air Companies, 2000). Most of the cost of using SNCR is in operating expenses (Institute of Clean Air Companies, 2000), which EPA estimates as falling between $680 and $1,200 per MMBtu/hr (1993 dollars). Thus, SNCR is well suited for seasonal control in that it may provide significant reductions in NOx emissions but incurs little cost when the system is not in use. EPA has assigned an ozone season cost effectiveness to SNCR operated on MWC units of $2,140 per ton of NOx reduced (1990 dollars)(EPA, 1999, Table 16). Please also see attached letter from ICAC on SNCR updated cost.

Emissions reductions

In New Jersey, MWC facility owners report potential NOx emissions reductions of 24 to 42% from the operation of SNCR; a typical reduction of 35 to 40% is usually assumed from the installation and operation of SNCR/ammonia injection to MWC units of similar size and type. Other combustors of varying technologies and capacities but with similar baseline NOx emissions have reported reductions ranging from 35 to 75% from the operation of urea-based SNCR (Appendix 1, Institute of Clean Air Companies, 2000). EPA assigns a typical 45% emission reduction to the effectiveness of SNCR at MWC units (EPA, 1999, Table 16).

In New Jersey, MWC facility owners report actual SO2 emissions reductions of 83% to 98% from the operation of Scrubbers, which already exceeds the EPA limits. Also, the actual PM emission reductions of greater than 99% have been reported by the owners from the operations of the ESP/Baghouse.

REFERENCES

Institute of Clean Air Companies. May 2000. *Selective Non-Catalytic Reduction (SNCR) for Controlling NOx Emissions*. http://www.fueltechnv.com/pdf/TPP-534.pdf.

U.S. Environmental Protection Agency. November 1999. Nitrogen Oxides (NOx), *Why and How They are Controlled*. Clean Air Technology Center: EPA 456/F-99-006R.

U.S. Environmental Protection Agency. December 19, 2005. *Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Large Municipal Waste Combustors; Proposed Rule*. 70 FR 75348.

Ozone Transportation Commission. *Summary of OTC NOx Control Measures at the MWC Units* http://www.otcair.org/projects_details.asp?FID=92&fview=stationary.

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1730 M Street NW
Suite 206
Washington, DC 20036-5603
Telephone 202.457.0911
Fax 202.331.1388

David C. Foerter, *Executive Director*
Email: dfoerter@icac.com

Chad S. Whiteman, *Deputy Director*
Email: cwhiteman@icac.com

Memorandum

TO: Sunila Agrawal, New Jersey DEP
Bill O'Sullivan, New Jersey DEP
FROM: David C. Foerter, Executive Director, ICAC
DATE: March 12, 2007
SUBJECT: NO_x Control Costs for Municipal Solid Waste Incinerators

The Institute of Clean Air Companies (ICAC) is the national trade association of companies that supply air pollution control and monitoring technologies for electric power plants and other stationary sources. ICAC represents more than ninety of the leading manufacturers of emissions control and measurement solutions for stationary sources who provide clean air technologies to address emissions of NO_x, SO_2, PM, HAPs, and greenhouse gases.

ICAC would like to take this opportunity to provide some additional information concerning NO_x control costs as New Jersey and other states prepare NO_x control strategies to reduce ozone and protect public health. There are several NO_x control technology strategies that may be pursued for industrial sources including precombustion, combustion, and post combustion control options. There are numerous options for each category of NO_x control technologies that range from fuel switching, advanced low NO_x burners, selective non-catalytic reduction (SNCR), selective catalytic reduction, improving the performance of existing controls, and many more.

For industrial sources, low capital cost alternatives are often installed as they provide highly cost effective reductions. SNCR has proven to be one such technology that has become commercially institutionalized around 1990. Approximately 400 applications have since been deployed worldwide by our members. Applications include utility boilers and a broad range of industrial applications including installations on the following: wood-fired boilers, coal-fired boilers, co-generation boilers, pulp and paper, steel industry, refinery process units, process heaters, cement kilns, municipal solid waste combustors, hazardous waste incinerators, and other combustion sources.

As with many emissions control technologies, control optimization or replacement with advanced designs can often result in additional emission reductions at a low capital cost. There are several means of obtaining additional NO_x reductions from existing SNCR technology installations including the application of computational fluid dynamic modeling, addition of reagent injection ports, and/or upgrades to urea-based SNCR for units currently using ammonia-based SNCR.

Below is a brief description of the typical costs and anticipated incremental NO_x reductions for SNCR control optimization and replacement for typical MSW sources:

Assumptions:

1. Capacity factor of 80 percent utilized.
2. Capital recovery factor of 0.20 (higher than EGU's because of higher equity financing).
3. Urea costs using current prices.
4. Capital additions for current Ammonia (NH_3)-SNCR replacements with urea-SNCR are on an "All-In" basis (50 percent higher than "supplier scope"). Equipment must be totally replaced. New control limit is assumed to be 130 ppm.
5. Current Urea-SNCR users control to 130 ppm with injector additions.

Cost Estimate Scenarios:

A. For this scenario, it was assumed that MSW plants were using urea-SNCR systems and have a NO_x emissions target of 130 ppm and 10 ppm ammonia slip. The calculations were made for the average of two different plants in the 250 TPD capacity range.

Additional Annual Capital Charge at 0.20	=	\$40,800/yr
Additional O&M at 6.3 gph urea solution	=	\$62,300/yr
Additional NO_x Reduction	=	47 tpy
NO_x Control Cost Effectiveness	=	\$2,200/ton NO_x reduced

B. MSW Plants Replacing NH_3-SNCR Systems with Urea-SNCR Systems and Controlling NO_x from 260 ppm down to 130 ppm. Ammonia slip is controlled to 10 ppm.

i. Large Plant

Annualized Capital "All-In" @ 0.20	=	\$537,700/yr
O&M, Annual (38 gph urea solution)	=	\$395,500/yr
Additional NO_x Reduction	=	317 tpy
NO_x Control Cost Effectiveness	=	\$2,943/ton NO_x reduced

C. MSW Plants Replacing NH_3-SNCR Systems with Urea-SNCR Systems and Controlling NO_x from 300 ppm down to 130 ppm. Ammonia slip is controlled to 10 ppm.

ii. Small Plant:

Annualized Capital "All-In" @ 0.20	=	\$354,000/yr
O&M, Annual (27 gph urea solution)	=	\$286,800/yr
Additional NO_x Reduction	=	253 tpy
NO_x Control Cost Effectiveness	=	\$2532/ton NO_x reduced

Please let me know if you have any further questions or comments.

Best Regards,

David C. Foerter
ICAC, Executive Director

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March 2007

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