Power Companies' Efforts to Comply with the NO_X SIP Call and Section 126

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PROGRESS REPORT

NESCAUM
Northeast States for Coordinated Air Use Management

EXCLAIMER

As this document awaits reproduction, we continue to learn of additional electric generating units that are moving forward with SCR retrofits. In addition to the 100 units identified in the analysis that follows, the Tennessee Valley Authority has publicly committed to retrofitting 15 units with SCR, affecting over 4,600 MW of capacity.

As a result, the NO_X SIP call region's total SCR commitment is at least 115 units, representing over 66,000 MWs of capacity.

NESCAUM will continue to track the industry's compliance progress in the coming months on our web site at "www.NESCAUM.org".

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In recent months, commitments to install selective catalytic reduction (SCR) control technology have been announced for some 100 major generating units (representing over 61,000 MW of capacity) throughout the eastern United States. These commitments will result in substantial reductions in power plant emissions of oxides of nitrogen (NO_X), a key ingredient in the formation of ozone smog. In fact, already announced SCR commitments should achieve from 75 percent to over 90 percent of the total reductions needed from SCR retrofits to comply with summertime NO_X budgets under EPA's Section 110 NO_X SIP call and the Northeastern states' Section 126 petitions. Two to three years ahead of applicable compliance dates, the power industry appears well positioned to achieve the successful and timely implementation of new NO_X control requirements, demonstrating yet again the power of effective regulation to yield results.

Overview

High levels of ozone smog are common across large areas of the eastern United States during the summer months, creating unhealthy breathing conditions for millions of citizens – especially children, exercising adults, the elderly and those with respiratory ailments. In September 1998, the federal Environmental Protection Agency (EPA) took an important step toward addressing this pervasive public health problem by proposing major cuts in one of the key pollutants responsible for ground-level ozone: oxides of nitrogen or NO_X. Specifically, EPA issued a new rule, widely known as the "NO_X SIP call," that required large power plants across a 22-state region to substantially reduce their summertime NOx emissions starting in 2003. As a backstop to the NO_X SIP call, EPA subsequently approved petitions brought by several individual northeastern states under a separate section of the Clean Air Act. Like the NO_X SIP call, these so-called "Section 126" petitions sought NOx reductions at a large number of major upwind sources to remedy their contribution to downwind violations of ambient ozone standards.[1]

Since it was issued, the NO_X SIP call has been aggressively opposed by many in the electric power industry. Legal challenges, decided in two D.C. Circuit Court decisions (in March and August of 2000) that largely upheld EPA's action, have already had the effect of delaying its implementation by one year (to 2004) and of exempting some areas (including Wisconsin, and parts of Alabama and Michigan)[2] from its requirements. Nevertheless, legislative proposals to further delay or otherwise weaken the NO_X SIP call have continued to circulate in Congress, many of them under the banner of avoiding California-type power shortages in the rest of the country. In addition, some in industry and Congress have urged EPA to similarly delay the implementation date for NO_X emissions reductions required under individual state "126 petitions" from the current

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[1] Whereas EPA's NO_X SIP call is authorized by Section 110 of the Clean Air Act, individual state petitions for relief from the impacts of upwind air pollution are authorized under Section 126. Both sections provide a mechanism for addressing interstate transport of pollution. In this case, the proposed remedy – broad-based NO_X reductions at major sources throughout a large eastern states region – was essentially the same.

[2] The applicability of the NO_X SIP call to Wisconsin and to portions of Georgia, Missouri, Alabama and Michigan was originally remanded back to EPA by the courts as a result of lawsuits arguing that the contribution of these areas to downwind violations of ozone standards had not been adequately demonstrated. EPA will address Georgia and Missouri in subsequent rulemaking and will accept partial state SIPs for Alabama and Michigan.

deadline of 2003 to 2004. In the debate over implementing regional NO_X reductions and possible impacts on electric supply and reliability, opponents have focused on the challenge of retrofitting large numbers of units with a particular type of control technology – "selective catalytic reduction" or SCR – at large numbers of existing power plants. Though commercially available and widely used overseas, only a handful of these systems had been installed at U.S. power plants at the time the NO_X SIP call was issued.

The good news as of May 2001 – a full two years before the compliance deadline for 126 petitions and three years before the compliance deadline for the NO_X SIP call – is that power plant owners have been making investments and signing contracts for SCR installations, even as some in the industry continue to voice doubts about the feasibility of adopting this technology. In fact, based on already announced SCR commitments, the primary technological hurdle for timely implementation of the NO_X SIP call has already been surmounted. Put another way, SCR commitments *already in the pipeline* can be expected to produce from 75 percent to over 90 percent of the total NO_X emissions reductions needed from SCR retrofits to achieve overall NO_X SIP call emissions budgets. Given that additional SCR commitments are likely to be announced in coming months, and taking into account the fact that extra allowances will be available from a "compliance supplement pool" in the early years of program implementation, the power industry is well-positioned to meet current regulatory deadlines without further delay.

The remainder of this analysis documents the evidence for concluding that recent federal actions to dramatically reduce power sector NO_X emissions in the eastern U.S. are well on their way to creating another regulatory success story: one in which industry demonstrates yet again that it can successfully rise to new technological challenges when faced with clear environmental performance goals.

Background

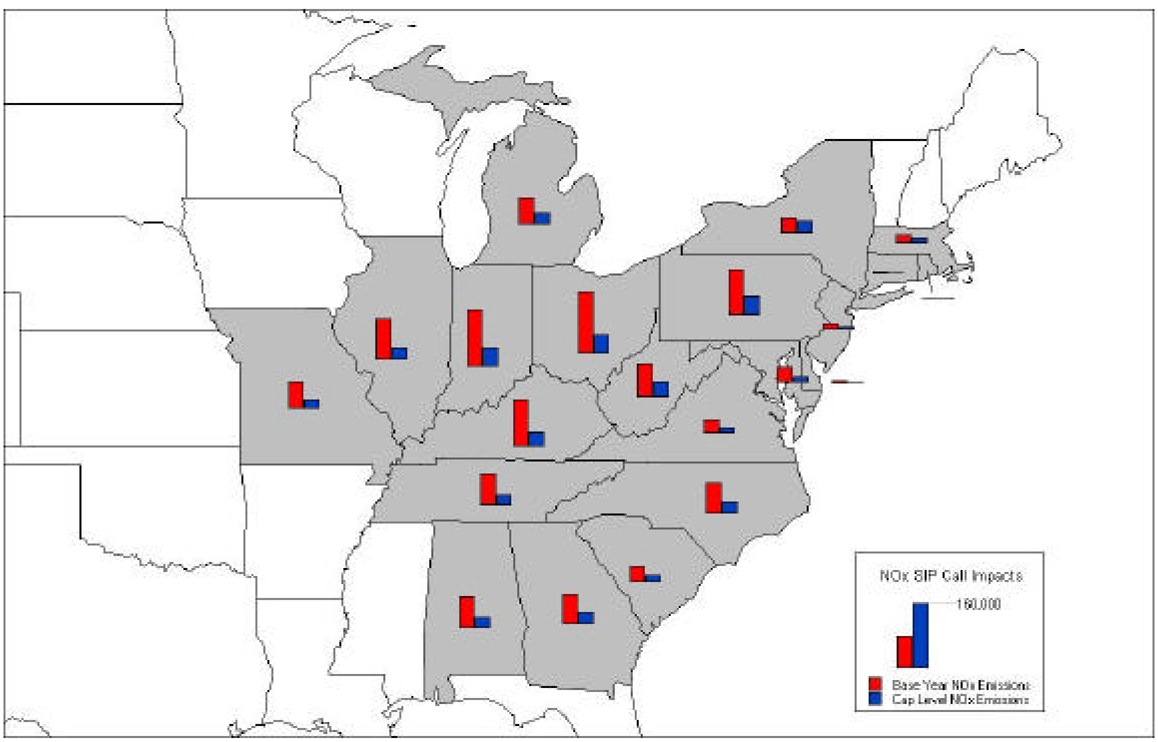
The 1998 NO_X SIP call was the product of many years of debate about the contribution of transported ozone and ozone-precursors to downwind smog levels, especially along the densely populated eastern seaboard. Mid-Atlantic and northeastern states had for years pointed to the role played by major upwind NOx sources – primarily coal-fired power plants in the industrial Midwest – in exacerbating their chronic ozone non-attainment problems and had called for the expansion of regional control strategies beyond the borders of the existing Ozone Transport Region. [3] Growing recognition that ozone in the eastern U.S. was indeed a regional, rather than local or even state problem led in 1995 to the formation of the 37-state Ozone Transport Assessment Group (OTAG). Over the course of two years, OTAG conducted modeling, synthesized the best available atmospheric science, and sought consensus about appropriate control measures to address transported ozone throughout the eastern U.S. When OTAG ended in 1997, EPA – citing its obligation to remedy interstate pollution transport under Section 110 of

[3] The Ozone Transport Region includes: Maine, New Hampshire, Vermont, Massachusetts, New York, Rhode Island, Connecticut, New Jersey, Pennsylvania, Maryland, Delaware, northern Virginia and the District of Columbia.

the federal Clean Air Act – relied on the group's findings to develop a rule requiring major ozone season NO_X reductions across a broad, 22-state region.[4]

Specifically, the NO_X SIP call required affected states to submit implementation plans for achieving a specified NO_X emissions budget during the ozone season (May 1 through September 30) starting in 2003. Each state's budget was based on achieving NO_X reductions from all major NO_X-emitting sectors. State NO_X emission budgets for large power plants were based on limiting emissions rates to an average of 0.15 pounds per million Btu (lb/mmBtu) of fuel input and took into account anticipated growth in electricity demand and generation between 1998 and 2007. Importantly, however, the NO_X SIP call did not dictate a command and control approach. Rather, states were free to devise their own strategies for obtaining required reductions and were encouraged to use flexible, market-based approaches. Moreover, EPA encouraged affected states to establish a multi-state allowance trading program to further enhance compliance flexibility and reduce overall control costs. Figure 1 below shows NO_X SIP call baseline emissions for large power plants by state as compared to their respective state NO_X SIP call budgets.

Figure 1: Power Plant Baseline NOx Emissions and Budgets, by State (in tons)



As is evident from Figure 1, implementation of the NO_X SIP call will substantially reduce NO_X emissions across most of the NO_X SIP call region. It will also

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[4] As noted earlier, EPA's NO_X SIP call was reinforced by individual state petitions under Section 126 of the Clean Air Act. The remedy proposed to address these petitions was essentially the same as that proposed by the NO_X SIP call. (See Footnote 1).

reduce the disparity in NO_X emissions rates that now exists among states within the region. High NO_X emissions, especially in the Ohio River Valley, are the result of a large concentration of coal-fired power plants, many of which were effectively grandfathered from meeting New Source Performance Standards (NSPS) under the Clean Air Act. By contrast, power plants in the Northeast and Mid-Atlantic states, because of their proximity to ozone non-attainment areas, have generally been subject to at least "Reasonably Available Control Technology" (RACT) requirements. In addition, under a more recent Memorandum of Understanding, states in the Ozone Transport Region implemented further NO_X reductions in 1999, with another phase of power plant reductions (at NO_X SIP call levels of stringency) due to be implemented by 2003.

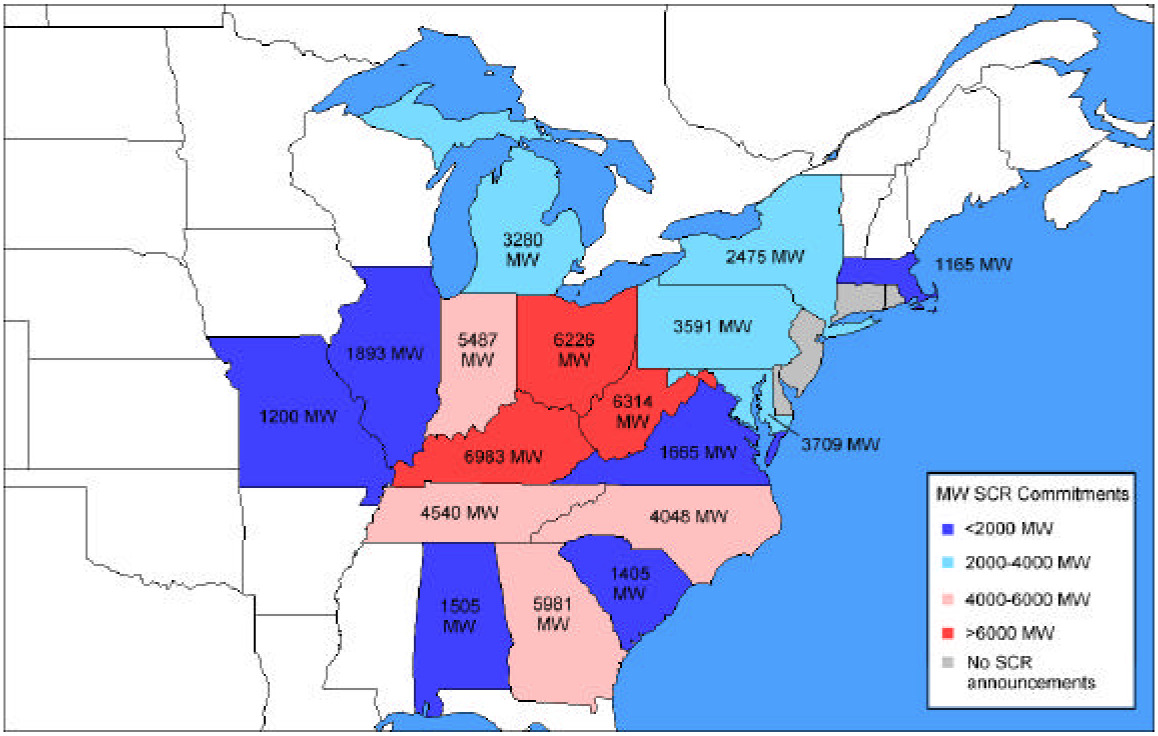
Recent NO_X Control Commitments

The NO_X emissions limit used by EPA to calculate NO_X SIP call budgets – 0.15 lb/mmBtu – represents an approximately 85 percent reduction from uncontrolled NOx emissions for most large coal-fired power plants. Hence, it has generally been assumed that advanced control technologies, notably SCR, would need to be installed at a significant number of facilities to achieve NO_X SIP call budgets. As noted in the Overview, much of the opposition to NO_X SIP call implementation has focused on this presumption, with particular concerns raised about the cost, technology and logistical challenges of retrofitting large numbers of power plants with SCR.

Notwithstanding these concerns, announced SCR commitments as of May 2001 suggest that industry is taking necessary steps to prepare for a smooth and timely implementation of NO_X SIP call and Section 126 petition requirements. Some 27 companies in the NO_X SIP call region have announced commitments to retrofit one or more generating units. Of the 100 units for which retrofit commitments have been announced, at least 61 units (representing 42,899 megawatts (MW)) will have SCR systems in place by the 2003 ozone season. Based on the information contained in trade press accounts, existing retrofit commitments total nearly 62,000 MW; over 20 percent of the total generating capacity in the NO_X SIP call region. Corresponding investment, in terms of committed control expenditures, is estimated to total $5.4 billion. Table 1, at the end of this document, lists publicly announced SCR retrofit commitments as of May 2001; Figure 2 below shows the distribution of SCR commitments by state.

In addition to known SCR commitments, a number of companies are moving ahead to retrofit one or more units with other technologies or to enhance existing control systems in anticipation of future NO_X reduction requirements. Though generally less widely publicized, these commitments will also play an important role in achieving NO_X SIP call targets. For example, a combustion technology called ThermaloNO_X has been applied to a 375 MW unit at American Electric Power's (AEP) Conesville facility. This control option is expected to achieve 80 percent to 90 percent NO_X reductions. Other combustion improvements, such as rotating overfire air at Carolina Power and Light's Cape Fear facility and reburn technology supplied by General Electric to the Southern Company's Scherer plant will achieve between 50 percent and 70 percent NO_X reductions.

Figure 2: Power Plant Capacity (in MWs) with Public SCR Commitments, by State



Compliance Prospects Given Recent SCR Commitments

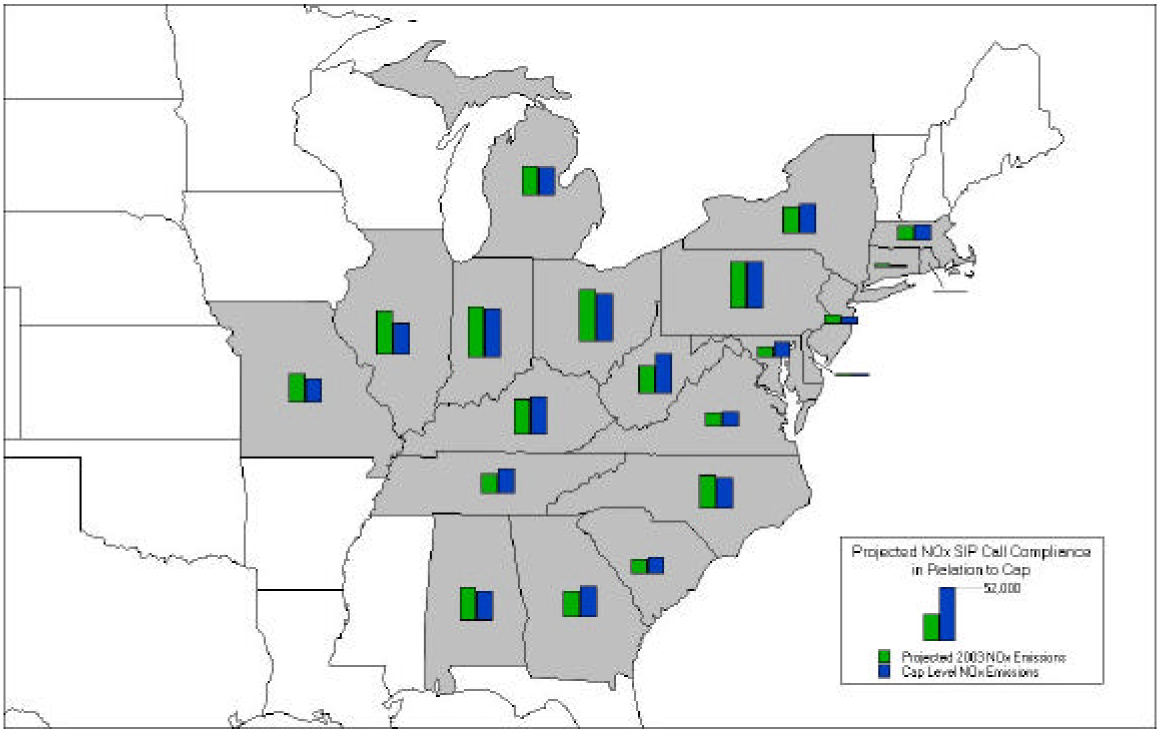
Already announced SCR commitments should produce ozone season NO_X reductions of approximately 354,000 tons (see Figure 3). This estimate is calculated by applying EPA's growth assumptions to the NO_X SIP call's base year activity level for specific units for which retrofits have been announced and assuming average control effectiveness of 90 percent once SCR systems are installed.[5] Based on the proven performance of existing SCR systems (almost all of which are implemented in conjunction with low-NO_X burner and other technologies) and on vendors' claims, NO_X emissions reductions in excess of 90 percent are commonly achieved by today's systems.[6] Importantly, this estimate assumes no change in the utilization of units that have announced SCR commitments, beyond the uniform growth assumptions applied to all units to reflect overall demand growth. However, it is reasonable to expect that SCR-equipped units will operate relatively more in the future given the investment in control technology they represent and given that avoided NO_X emissions are likely to have value in future allowance markets. Assuming that the utilization of SCR-retrofitted units increases from current levels to an average capacity factor of 85 percent during the ozone

[5] For further discussion of the methodology used in this analysis, see Appendix A.

[6] In addition, the allowance trading component of the NO_X SIP call provides an incentive for units to over-control if additional tons can be reduced at less cost than the market price of NO_X allowances. In the past, control technologies were often operated to achieve no more than the level of control required by regulation.

season, future NO_X emissions reductions from announced commitments could total over 425,000 tons.

Figure 3: Projected Power Plant NOx Emissions in 2003 with Current Public SCR Commitments as Compared to Power Plant Budget under the NOx SIP Call (in tons)



At 354,000 to 425,000 tons, anticipated reductions from already announced SIP commitments will go a long way toward meeting overall NO_X SIP call budgets. Specifically, this level of reductions represents from between 40 percent to over 50 percent of the overall gap between projected NO_X emissions without further controls and NO_X SIP call limits. Assuming no further SCR installations, the remaining generating units in the NO_X SIP call region would be required to reduce NO_X emissions by 40 percent to 50 percent. NO_X emissions reductions of up to 50 percent can be achieved by widely available, non-SCR technologies such as selective non-catalytic reduction (SNCR), advanced low-NOx burner technology, and other combustion improvements. Regardless of the control option used, reductions required at a particular site could be considerably lessened if sources avail themselves of a nearly 200,000 ton "compliance supplement pool" created to ease the transition to NO_X SIP call budgets.

Previous regulatory impact analyses conducted by EPA in 1998 and subsequently updated, had indicated that NO_X SIP call implementation would lead to a somewhat higher number of SCR retrofits. Specifically, EPA entered assumptions at different levels of control into the Integrated Planning Model (IPM) – a sophisticated tool that is widely used to model electricity flows and generation at the unit level – to simulate likely compliance responses across the NO_X SIP call region. Originally, EPA predicted that

SCR retrofits would be installed at 123 units, representing a total 63,300 MW of capacity, to achieve approximately 412,100 tons of ozone season NO_X reductions. In response to comments, EPA subsequently modified these assumptions, resulting in the prediction that SCR installations will be needed at approximately 142 units, representing approximately 72,900 MW and providing some 465,600 tons of ozone season reductions. Assuming new SCR systems perform as expected and accounting for the likelihood that retrofitted units are likely to operate more in the future, the emissions reductions anticipated from announced SCR commitments are already very close to the total that will be needed to achieve overall NO_X SIP call/Section 126 compliance.

Moreover, the analysis used to reach this conclusion may prove to be conservative. EPA's recent action to reconsider the applicability of the NO_X SIP call to Georgia and Missouri may further reduce the aggregate NO_X reductions needed for region-wide compliance and/or extend the compliance deadline for units in some portions of these states. In that case, the overall compliance picture, based on already announced SCR commitments, may be even more promising.

Status of NO_X Control Technologies

Recent experience with actual SCR installations and vendor representations concerning expected system performance suggest that future SCR installations – especially when coupled with advanced low-NO_X burner technology – can be expected to consistently deliver reductions in excess of 90 percent. For example, American Electric Service (AES) has stated in the trade press that it will achieve 93 percent reductions from SCR at its 1300 MW New Madrid unit. In addition, NO_X emissions rates as low as 0.05 lb/mmBtu have been achieved at retrofitted units, such as AES's 675 MW Somerset unit.

Of course, control technologies other than SCR will also play an important role in achieving NO_X SIP call budgets. These technologies have also evolved considerably in recent years. Decades of experience with low-NO_X burner technology, for instance, has resulted in refinements that allow for greater than 40 percent NO_X reductions in many cases. New approaches to improving combustion, such as those cited earlier, achieve NO_X control levels as high as 70 percent to 90 percent.

Reliability Impacts of SCR Installations

Since it was issued, opponents of the NO_X SIP call have claimed that the need to retrofit plants with SCR will adversely impact power supply and reliability.[7] At a time when the adequacy of the nation's electric system commands daily media attention, such claims have attracted understandable concern. Fortunately, experience to date provides little basis in reality for frequently voiced reliability concerns. Though specific outage times will vary from installation to installation, past retrofits have generally been

[7] See, for example, "The Impact of EPA's Regional SIP Call on the Reliability of the Electric Power Supply in the Eastern United States. Overview of Comments Previously Submitted by the Utility Air Regulatory Group and Overview Chart Presentation" – presentation prepared by Applied Economic Research Co. August 26, 1998.

accomplished within a roughly four-week timeframe (see Table 2). In many cases, outage times can be minimized by constructing the SCR reactor and necessary ductwork adjacent to the boiler without necessitating a shut down and by installing systems during planned maintenance outages (which are scheduled during periods of low demand). Moreover, once SCR systems are in place they can be expected to operate without compromising overall plant availability. In fact, operational experience with existing SCR systems demonstrates that their reliability is in fact quite high. In the more than 50 boiler years of operation accumulated by SCR installations in the U.S. to date, there have been no reported cases of forced outages due to control equipment failure.

Table 2: Sample SCR Installation Experience

Company/Unit	**Time required to install SCR system while unit is off-line**	**Completion date**	**NO_X reduction**	**Off-line engineering requirements**
AECI *New Madrid Unit 2* (600 MW, cyclone)	6 weeks (normal outage)	Winter '99	93%	• Cutting duct work at the economizer outlet. • Demolish tubular air heater. • Interconnect SCR reactor and new lungstrum air heater.
AES *Kintigh* (650 MW, wallfired)	10 days (normal outage)	Summer '99	90%	• Cut duct work at the economizer outlet. • Tie in inlet of SCR to duct work. • Tie in SCR outlet to air heater inlet.
PSNH (NU) *Merrimack Unit 1* (120 MW, cyclone)	4 weeks (normal outage)	Summer '99	90%	• N/A
Merrimack Unit 2 (320 MW, cyclone)	5 weeks (4 week normal outage plus 1 week extension)	Summer '95	90%	• Tie in of SCR reactor and economizer. • Tie in of SCR reactor and air heater.
TVA *Paradise Unit 2* (700 MW, cyclone)	two 3-4 week installation periods (normal outage)	Fall '99	90%	• Spring '99, install temporary bypass duct to allow SCR work to continue while unit is on-line. • Fall '99, final tie in of the SCR reactor.

AECI: Associated Electric Cooperative, Inc., AES: American Electric Service, PSNH: Public Service Company of New Hampshire, TVA: Tennessee Valley Authority.

Conclusion

A recent NESCAUM report titled *Environmental Regulation and Technology Innovation: Controlling Mercury Emissions from Coal-Fired Boilers*[8] documented the powerful link between regulatory drivers and the adoption and improvement of better control technologies. The three case studies in that report, including one that covered the evolution of NO_X regulations and NO_X control technologies for power plants, described

[8] The executive summary of this report is available at *www.nescaum.org*.

how time and again industry has successfully risen to the challenge of achieving new environmental standards, usually at far lower cost than first anticipated.

There is now compelling evidence that the same pattern of success is repeating itself in the case of the NO_X SIP call and Section 126 petitions. Based on recently announced commitments to new SCR installations, there is every reason to expect that the implementation of substantial NO_X reductions throughout much of the eastern U.S. can be achieved in a timely fashion and with far less disruption to eastern power markets than some had feared. Moreover, it seems likely that the one-year implementation delay for the NOx SIP call caused by industry litigation was unnecessary, given that a majority of recently announced SCR commitments anticipate completing installation by the 2003 ozone season. It is also likely that a great deal of additional SCR retrofit activity may be underway that has not yet been covered in the press. In this context, there can be no justification for further weakening or delay of 126 petition or NO_X SIP call requirements. Such actions would be highly counter-productive, creating investment uncertainty for power companies and NO_X control vendors and unnecessarily undermining a regulatory program that is on the verge of delivering tremendous public health and environmental benefits.

Table 1: Power Plants with Public Commitments to SCR Installation

Count	ST	Plant	Unit	Size (MW)	Information Source	Source Date
1	AL	GORGAS	10	789	3	3-Nov-2000
2	AL	WIDOWS CREEK	2	141	4	25-Aug-1999
3	AL	WIDOWS CREEK	7	575	4	25-Aug-1999
4	GA	BOWEN	1BLR	806	2	13-Mar-2001
5	GA	BOWEN	2BLR	789	2	13-Mar-2001
6	GA	BOWEN	3BLR	952	2	13-Mar-2001
7	GA	BOWEN	4BLR	952	2	13-Mar-2001
8	GA	HAMMOND	4	578	2	13-Mar-2001
9	GA	WANSLEY	1	952	2	13-Mar-2001
10	GA	WANSLEY	2	952	2	13-Mar-2001
11	IL	BALDWIN	1	623	4	25-Aug-1999
12	IL	BALDWIN	2	635	4	25-Aug-1999
13	IL	BALDWIN	3	635	4	25-Aug-1999
14	IN	CAYUGA	1	531	1	25-Sep-2001
15	IN	CAYUGA	2	531	1	25-Sep-2001
16	IN	CLIFTY CREEK	1	217	3	9-Mar-2001
17	IN	CLIFTY CREEK	2	217	3	9-Mar-2001
18	IN	CLIFTY CREEK	3	217	3	9-Mar-2001
19	IN	CLIFTY CREEK	4	217	3	9-Mar-2001
20	IN	CLIFTY CREEK	5	217	3	9-Mar-2001
21	IN	GIBSON	1	668	1	25-Sep-2001
22	IN	GIBSON	2	668	1	25-Sep-2001
23	IN	GIBSON	3	668	1	25-Sep-2001
24	IN	GIBSON	4	668	1	25-Sep-2001
25	IN	GIBSON	5	668	1	25-Sep-2001
26	KY	BIG SANDY	BSU2	816	1	6-Apr-2001
27	KY	COOPER	2	221	3	1-Dec-2000
28	KY	D B WILSON	W1	509	1	18-Sep-2000
29	KY	EAST BEND	2	669	1	25-Sep-2001
30	KY	E W BROWN	3	446	1	18-Sep-2000
31	KY	H L SPURLOCK	1	305	3	1-Dec-2000
32	KY	H L SPURLOCK	2	508	3	1-Dec-2000
33	KY	MILL CREEK	3	463	1	18-Sep-2000
34	KY	MILL CREEK	4	544	1	18-Sep-2000
35	KY	PARADISE	1	704	4	25-Aug-1999
36	KY	PARADISE	2	704	4	25-Aug-1999
37	KY	R D GREEN	G1	264	1	18-Sep-2000
38	KY	R D GREEN	G2	264	1	18-Sep-2000
39	KY	TRIMBLE COUNTY	1	566	1	18-Sep-2000
40	MA	CANAL	1	585	4	25-Aug-1999
41	MA	CANAL	2	580	4	25-Aug-1999
42	MD	BRANDON SHORES	1	685	5	17-Apr-2001
43	MD	BRANDON SHORES	2	685	5	17-Apr-2001
44	MD	CHALK POINT	1	364	5	17-Apr-2001
45	MD	CHALK POINT	2	364	5	17-Apr-2001
46	MD	HERBERT A WAGNER	3	359	5	17-Apr-2001
47	MD	MORGANTOWN	1	626	5	17-Apr-2001
48	MD	MORGANTOWN	2	626	5	17-Apr-2001
49	MI	MONROE	1	817	2	6-Nov-2000
50	MI	MONROE	2	823	2	6-Nov-2000
51	MI	MONROE	3	823	2	6-Nov-2000

Count	ST	Plant	Unit	Size (MW)	Information Source	Source Date
52	MI	MONROE	4	817	2	6-Nov-2000
53	MO	NEW MADRID	1	600	1	23-Feb-2001
54	MO	NEW MADRID	2	600	1	23-Feb-2001
55	NC	ROXBORO	1	411	1	8-May-2001
56	NC	ROXBORO	2	657	1	9-May-2001
57	NC	ROXBORO	3A	745	1	10-May-2001
58	NC	ROXBORO	3B	745	1	11-May-2001
59	NC	ROXBORO	4A	745	1	12-May-2001
60	NC	ROXBORO	4B	745	1	13-May-2001
61	NY	ASTORIA	30	900	1	6-Sep-2000
62	NY	ASTORIA	40	900	1	6-Sep-2000
63	NY	SOMERSET	1	655	4	25-Aug-1999
64	OH	GEN J M GAVIN	1	1,300	1	21-Jun-2000
65	OH	GEN J M GAVIN	2	1,300	1	21-Jun-2000
66	OH	KYGER CREEK	1	217	3	9-Mar-2001
67	OH	KYGER CREEK	2	217	3	9-Mar-2001
68	OH	KYGER CREEK	3	217	3	9-Mar-2001
69	OH	KYGER CREEK	4	217	3	9-Mar-2001
70	OH	KYGER CREEK	5	217	3	9-Mar-2001
71	OH	MIAMI FORT	7	557	1	25-Sep-2001
72	OH	MIAMI FORT	8	558	1	25-Sep-2001
73	OH	W H ZIMMER	1	1,426	1	25-Sep-2001
74	PA	HOMER CITY	1	660	2	1-Nov-2000
75	PA	HOMER CITY	2	660	2	1-Nov-2000
76	PA	HOMER CITY	3	692	2	1-Nov-2000
77	PA	MONTOUR	1	760	4	25-Aug-1999
78	PA	MONTOUR	2	819	4	25-Aug-1999
79	SC	WATEREE	WAT1	386	1	10-Nov-2000
80	SC	WATEREE	WAT2	386	1	10-Nov-2000
81	SC	WILLIAMS	WIL1	633	1	10-Nov-2000
82	TN	ALLEN	1	330	4	25-Aug-1999
83	TN	ALLEN	2	330	4	25-Aug-1999
84	TN	ALLEN	3	330	4	25-Aug-1999
85	TN	BULL RUN	1	950	4	25-Aug-1999
86	TN	CUMBERLAND	1	1,300	4	25-Aug-1999
87	TN	CUMBERLAND	2	1,300	4	25-Aug-1999
88	VA	CHESAPEAKE	3	185	2	17-Nov-2000
89	VA	CHESAPEAKE	4	239	2	17-Nov-2000
90	VA	CHESTERFIELD	4	188	2	17-Nov-2000
91	VA	CHESTERFIELD	5	359	2	17-Nov-2000
92	VA	CHESTERFIELD	6	694	2	17-Nov-2000
93	WV	JOHN E AMOS	3	1,300	1	29-Jan-2001
94	WV	HARRISON	1	684	4	25-Aug-1999
95	WV	HARRISON	2	684	4	25-Aug-1999
96	WV	HARRISON	3	684	4	25-Aug-1999
97	WV	MOUNTAINEER	1	1,300	1	29-Jan-2001
98	WV	MT STORM	1	570	2	17-Nov-2000
99	WV	MT STORM	2	570	2	17-Nov-2000
100	WV	MT STORM	3	522	2	17-Nov-2000

Source codes: 1=Company press release or website, 2=Air Daily, 3=Platts Utility Environment Report, 4=Institute of Clean Air Companies, 5=Maryland DEP
Please note that source date given is the most recently checked date (website information changes often)

APPENDIX A: NO_X SIP Call Region SCR Analysis

The following steps explain the process used to model the use of SCR and non-SCR controls by electric generating units in the NO_X SIP call region. The model assigns SCR and non-SCR controls to specific units where the most cost-effective reductions can be achieved. This economic evaluation is then overridden and required to show NO_X SIP call compliance with SCR applied only to those units with current public commitments to SCR. The results included revised values for SCR-affected capacity, total NO_X emissions and economic impacts.

Baseline Data

1. EGU information for each of the NO_X SIP call states was collected from U.S EPA's electric generator database. Data include owner/holding company, size, ORIS number, fuel type, heat rate, and operating information for 1996, including capacity utilization, NO_X emission rate, ozone season fuel use, and resulting ozone season tons.
2. EPA's growth rates were used to calculate activity levels in 2003 from the base year information.
3. NO_X emission rates consistent with the Acid Rain Phase II NO_X requirements for each unit were assigned as follows:
   - dry-bottom, wall-fired units are at 0.46 lb/mmBtu
   - tangential-fired, dry-bottom and wall-fired units are at 0.40 lb/mmBtu
   - dry-bottom and wet-bottom cyclones are at 0.86 lb/mmBtu
   - wet-bottom, wall-fired cyclones are at 0.84 lb/mmBtu
   - dry-bottom and wet-bottom vertical-fired boilers are at 0.80 lb/mmBtu

   However, if a unit's actual rate prior to Phase II is lower than the Phase II requirement, then that lower actual rate was retained. The 25 MW units included in this analysis were also evaluated at their actual (pre-2000) NO_X rate.
4. 2003 baseline NO_X emissions were calculated, reflecting only Acid Rain Phase II NOx compliance and the grown activity level for 2003 (from step 2). This generates the total baseline regional NO_X emissions from electric generators without NO_X SIP call compliance.

Controlled Emission Rate and Tonnage Calculations

5. Each unit's SCR-controlled NO_X emission rate is calculated by multiplying the Acid Rain NOx emission rate by 0.15, yielding an 85% reduction from the Phase II rate. SCR is never applied to units less than 200 MWs. This step is not allowed to result in a value below 0.07 lb/mmBtu. Resulting seasonal NO_X tons are calculated using the 2003 grown activity levels.
6. In addition, each unit's "non-SCR" controlled NO_X emission rate is calculated by multiplying the Acid Rain NO_X rate by 0.50. This step is not allowed to produce a result below 0.20 lb/mmBtu. Resulting seasonal NO_X tons are calculated using the 2003 grown activity levels.

Control Cost Estimates

7. SCR control costs for each unit are calculated using $88/kW capital cost (installation), $7.50/kW fixed operating cost (catalyst replacement), and $0.38/kWh variable operating costs (ammonia). The capital recovery rate is 12% annually. These values are consistent with those used by EPA.

8. Non-SCR control costs for each unit are calculated, also using U.S. EPA values for capital costs. Due to the wide range of non-SCR operating costs this value has been simplified in the analysis to a higher average capital cost of $15 per kW (recovered at 12% annually) with no fixed or variable operating costs. This value is well above most alternative control costs of $1/kW to $4/kW.

9. Cost per ton is calculated for each unit, for each of the two control options by dividing the seasonal cost of the control option by the unit's seasonal tons of NO_X emitted using the NO_X rate resulting from the control option.

10. The units are then ordered by SCR cost from lowest cost per ton to highest until a target cost limit is reached ($3,590/ton). Units with SCR costs above the limit are then ordered by their non-SCR cost per ton values, from lowest to highest, until the same cost limit is reached. The remaining units are not assigned additional controls beyond those needed to meet their Acid Rain NO_X rates.

11. Seasonal NO_X tons for all units are totaled to ensure that the EGU budget for the NO_X SIP call region is not exceeded.

Post-Model

12. The results are modified to reflect SCR only at units with public commitments to install SCR. The model then recalculates non-SCR reductions at other units until the regional cap is achieved.

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