west virginia department of environmental protection

SIGN-IN SHEET

Public Hearing on proposed 2017 Division of Air Quality Rules 45CSR1, 45CSR8, 45CSR13, 45CSR14, 45CSR16, 45CSR18, 45CSR25, and 45CSR34.

August 1, 2016, 6:00 p.m.

The Department of Environmental Protection asks for the information below so that agency staff may provide responses and information about decisions to you. The information you voluntarily provide on this sheet becomes part of the public record related to this topic and may be released if requested under the Freedom of Information Act.

Visitor Tag #	Name (please print)	Address	Organization	Phone	E-mail	Comment Y/N
47	Missy L. Young		Court Reporter			
48	Julie Archer	1500 Dixie Street Charleston, WV 25311	WV Citizen Action INVSORO	346-5891	julie@wvsoro.org	N
49	Don Smith	3404 Pennsylvania Ave, Charleston	WVPA	304-550-0451	donsmith@wvpress.org	Y
50	Ken Ward JR	Gazette-Mail 1001 Virginia St E Charleston WV 25301	Gazette-Mail	304-~~343~~ 348-1702	kward@wvgazette.com	N
	Laura Crowder		DEP/DAQ		Laura.M.Crowder@wv.gov	N

Name (please print)	Address	Organization	Phone	E-mail	Comment Y/N
Wendy Radcliff		WVDEP	1328		N
Robert Keatley		WVDAQ	1695		N
Jake Glance		WVDEP			N
Laura Jennings		WVDAQ			

BEFORE THE WEST VIRGINIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION
DIVISION OF AIR QUALITY

In re: 45CSR1 - *Alternative Emission Limitations During Start-up, Shut-down and Maintenance Operations*

Transcript of proceedings had at a public hearing in the above-styled matter taken at the West Virginia Department of Environmental Protection, Division of Air Quality, Conference Room, 601 57th Street, S. E., Charleston, West Virginia, commencing at 6:01 p.m., on the 1st day of August, 2016, pursuant to notice.

MISSY L. YOUNG, C.C.R.
POST OFFICE BOX 13622
SISSONVILLE, WEST VIRGINIA 25360
304-539-6192

P R O C E E D I N G S

MS. JENNINGS: Good evening and thank-you for coming tonight. My name is Laura Jennings and I work for the West Virginia DEP, Division of Air Quality (DAQ). I would also like to introduce Stephanie Hammonds, also with the Division of Air Quality who was out in the hall giving out the tags. This is Missy Young who is the court reporter this evening.

This evening there will be individual public hearings for each of the seven DAQ proposed rules. The purpose of the public hearing is to receive public comments on the record regarding the proposed DAQ rules. Unlike a public meeting, I will not be responding to questions regarding the rule this evening. However, all public comments received, both orally and written, will be addressed in a response to comment document that will be part of the rulemaking record.

For those wishing to speak, when I state that the floor is open for comments, please raise your hand. When called upon, if you could come forward to this desk, we have a microphone so that the court reporter can hear you. Clearly state your name and indicate for the record if you are representing any group or organization. Please keep

the comments on topic.

If you haven't already done so, please make sure that you sign the sign-in sheet before leaving. If you have any written comments to submit, make sure that you get them to Stephanie Hammonds before the end of the evening.

This public hearing will now come to order on this 1st day of August, 2016, at the West Virginia Department of Environmental Protection Headquarters. Comments and testimony will be accepted until the close of this hearing and will be made part of the rulemaking record. Any relevant questions regarding revisions to the rules will be included with your comments, and any such question will be addressed as part of the response to comments in the rulemaking record.

The purpose of this public hearing is to accept comments on proposed rule 45CSR1 - Alternative Emission Limitations During Start-up, Shut-down and Maintenance Operations.

The rule sets forth the criteria for establishing an alternative emission limitation during periods of start-ups, shut-down, or maintenance. The rule adopts the alternative emission limitation provisions contained in State Implementation Plans: Response to Petition for

Rulemaking; Restatement and Update of EPA's SSM Policy Applicable to SIPs; Finding of Substantial Inadequacy; and SIP Calls to Amend Provisions Applying to Excess Emissions During Periods of Startup, Shutdown and Malfunctions," as published June 12, 2015, in Volume 80 of the Federal Register starting on Page 33,840. This is also referred to as The Federal SSM SIP Policy.

The EPA found 17 provisions in 8 West Virginia rules to be substantially inadequate to meet Clean Air Act requires and issued a SIP call to West Virginia to correct this SIP. This rule is established to provide a mechanism for a source or sources subject to State rules 2, 3, 5, 6, 7, 10, 21 or 40 to request, at their option, alternative emission limitations based on a set of criteria established in EPA's SSM policy.

Upon authorization and promulgation of 45CSR1, the rule will submitted to the EPA as a revision to the State Implementation Plan.

The floor is now open for comments. Does anyone want to comments. Any one have a comment on Rule 1?

There being nothing further, this public hearing for proposed rule 45CSR1 is concluded.

(WHEREUPON, the hearing was

concluded at 6:36 p.m.)

STATE OF WEST VIRGINIA,

COUNTY OF KANAWHA, to-wit:

I, the undersigned, Missy L. Young, a Certified Court Reporter and Notary Public within and for the State of West Virginia, duly commissioned and qualified, do hereby certify that the foregoing, was taken to the best of my skill and ability, a true and accurate transcript of all the proceedings had in the aforementioned matter.

Given under my hand and official seal this 2nd day of August, 2016.

Missy L. Young, CCR

Certified Court Reporter
Notary Public for the State of West Virginia

My commission expires April 15, 2018.

OFFICIAL SEAL
Notary Public, State Of West Virginia
MISSY L YOUNG CCR
PO Box 13622
Sissonville, WV 25360
My Commission Expires April 15, 2018

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

JUL 2 8 2016

Mr. William F. Durham, Director
West Virginia Department of Environmental Protection
Division of Air Quality
601 57th Street SE
Charleston, West Virginia 25304

Dear Mr. Durham:

Thank you for your June 29, 2016 letter requesting comment on the following seven West Virginia Department of Environmental Protection proposed air quality rules: 45 C.S.R. 1, 45 C.S.R. 8, 45 C.S.R. 13, 45 C.S.R. 14, 45C.S.R. 16, 45 C.S.R. 25, and 45 C.S.R. 34.

The U.S. Environmental Protection Agency's comments are enclosed.

If you have any questions, please do not hesitate to contact me or have your staff contact Ms. Irene Shandruk, for 45 C.S.R. 1, at 215-814-2166, or shandruk.irene@epa.gov or Ms. Amy Johansen, for the remaining rules, at 215-814-2156, or johansen.amy@epa.gov.

Sincerely,

David L. Arnold,
Acting Division Director

Enclosure

Enclosure

EPA's Comments on West Virginia's Proposed Air Quality Rules for 2017 Legislative Session

45 C.S.R. 1 - Alternative Emission Limitations during Startup, Shutdown, and Maintenance Operations

1. Please explain provision 45-1-3.3. The wording is vague and it is unclear why only RACT is mentioned. Perhaps it should say that the alternative emission limitation (AEL) shall otherwise meet applicable West Virginia and Clean Air Act requirements.

2. Please clarify the meaning and intent of provision 45-1-7. It is unclear how the AEL could be more stringent than an otherwise applicable limitation. If the AEL is less stringent, based on this provision, the AEL would not apply to sources during startup/shutdown/malfunction when the sources cannot meet the otherwise applicable emission limitations.

3. To the extent that West Virginia intends to establish AELs for periods of startup/shutdown/malfunction, such limitations must be submitted to EPA for approval into West Virginia's state implementation plan (SIP) for SIP compliance purposes. That is, if the AEL is done via permit or enforcement order, the permit or order must be approved by EPA into West Virginia's SIP to ensure that the limitations are enforceable by EPA.

4. Please define "zero process weight rate" to make the definition of "maintenance operation" clearer.

45 C.S.R. 13 – Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, Permission to Commence Construction, and Procedures for Evaluation

1. Please explain why 45-13-5.8 is being removed. By removing this provision there appears to be no limit on the timeframe in which the Secretary shall complete review of any application for an existing stationary source operating permit.

2. It should be noted that on December 29, 2015 (80 FR 81234), EPA proposed "Revisions to the Public Notice Provisions in Clean Air Act Permitting Programs," which will remove mandatory requirements to provide public notice of a draft air permit, as well as certain other program actions, through publication in a newspaper and would instead allow for electronic noticing (e-notice) of these actions. EPA suggests West Virginia

review that proposed rule as well as the final rule, once published, noting that the proposal is subject to change upon going final.

3. West Virginia is making changes to Public Review Procedures in 45-13-8 and is to be commended for moving to electronic public noticing; however, please explain why West Virginia is removing requirements to public notice applications for operating permits in provision 45-13-8.3.

45 C.S.R. 14 – Permits for Construction and Major Modification of Major Stationary Sources for the Prevention of Significant Deterioration of Air Quality

1. Please explain the changes made to provision 45-14-2.45. It is unclear why "under the CAA" is being removed.

2. Please explain your changes to the definition of "PAL permit" in provision 45-14-2.54.

3. The edits made to 45-14-11.5 are confusing and unclear. It appears the same thing is being said twice. Please clarify.

4. In the provisions under 45-14-17 for Public Review Procedures, it appears West Virginia will continue to use legal advertisement in a newspaper of general circulation, but are moving to electronic notice under 45-13. Once EPA finalizes "Revisions to the Public Notice Provisions in Clean Air Act Permitting Programs," EPA would recommend one consistent public noticing method, unless there are specific instances where the public would be better served using a CAA approved alternative (i.e., newspaper).

Jennings, Laura M

From: DEP Comments
Sent: Monday, August 01, 2016 4:25 PM
To: Jennings, Laura M
Subject: FW: AEP Comments on 2017 Proposed Legislative Rules

Jake Glance

Please consider the environment before printing this email.

From: Jeffrey P Novotny [mailto:jpnovotny@aep.com]
Sent: Monday, August 01, 2016 3:58 PM
To: DEP Comments <DEP.Comments@wv.gov>
Cc: Gregory J Wooten <gjwooten@aep.com>; Janet J Henry <jjhenry@aep.com>; John C Hendricks <jchendricks@aep.com>
Subject: AEP Comments on 2017 Proposed Legislative Rules

Enclosed please find comments on the recently proposed revisions to West Virginia Regulations that were public noticed on the West Virginia DEP website. The comment period begins July 1, 2016 and ends at the conclusion of the public hearing on August 1, 2016. American Electric Power, Appalachian Power Company and Kentucky Power Company (AEP) appreciate this opportunity to provide comment on these important regulations that directly impact facilities operated by our companies in West Virginia. Please consider these comments on the proposed regulations.

45 CSR 1 – Alternative Emission Limitations During Start-up, Shutdown and Maintenance Operations

AEP supports the agency's effort to develop this rule allowing sources flexibility to develop an alternative emission limitation other than numerical limits, such as using work practices. The US EPA has utilized alternatives to numerical limits by defining the start-up/shutdown period and acceptable work practices in several new regulations, specifically the MATS and ICI Boiler MACT. We agree that the state should provide sources with the opportunity to develop similar alternatives, providing they are specific and able to be monitored, is advantageous to the source. Where the source has existing requirements based upon other federal or state requirements for start-up and shutdown, those existing requirements should not also fall under this regulation nor should this regulation impart additional burden on those

sources. Those requirements defined under the NSPS or HAP/MACT federal regulations should take precedence over and negate the applicability of this rule to those sources.

We support the concept that work practices can be based on, but not limited to equipment manufacturer's recommendations or procedures and industry standards. We request that site-specific practices utilized for older equipment be acceptable taking into consideration the age and condition of the source.

The proposed rule infers that the implementation of this regulation will typically occur during the permitting process. The agency did not provide a timeline for implementing this rule. The agency also requires a summary of strategies considered and reasoning for not using those strategies. This is an excessive burden to document the process of arriving at the proposed alternative control strategy for no apparent use. The criteria requirements do not refer to evaluation of alternatives. The section 4.2.c. is requested to be removed since it is not considered within the criteria for agency approval of the alternative emission limit.

The proposed rule does not provide instructions or clarity on the level of the evaluation of the worst-case emissions that could occur during periods when using the alternative emission limit. The agency should define their expectations regarding this emissions estimate.

45 CSR 13 – Minor New Source Permitting

The existing rule includes a maximum 180-day permit development time limitation for the agency (Section 5.8 of Regulation 13) after the permit application is considered complete (as defined in Section 5.7 of Regulation 13). This section of the rule has been proposed to be removed. We request that the agency return this or enter a similar timeline into the regulation to allow facilities opportunity to obtain a permit on a timely basis and utilize this development time in any project schedule. As proposed, the agency does not have any requirements to evaluate and return a permit on a timely basis.

45 CSR 14 – Major Source Permitting for PSD

The revision proposed for Section 11.5 is very confusing! As written, the changes appear to repeat sections already included in the condition. We suggest this condition be rewritten as follows:

> *The owner or operator shall gather, over a period of one year, all required ambient air quality monitoring data which shall represent the year preceding receipt of the application. However, if the Secretary determines that a complete and adequate analysis can be accomplished with monitoring data gathered over a period shorter than one year, but not less than four months, the owner or operator may use the data that is gathered over that shorter period.*

Jeffrey P. Novotny
Air Quality Services
American Electric Power
Bus. Phone (614) 716-1294
Bus. FAX (614) 716-2255

Jennings, Laura M

From: DEP Comments
Sent: Monday, August 01, 2016 5:04 PM
To: Jennings, Laura M
Subject: FW: Sierra Club Comments on West Virginia's Proposed SSM Rule
Attachments: 2016.08.01_Sierra Club Comments on WV Proposed SSM Rule.pdf; Sahu SSM SIP Call Report Excerpt.pdf; Attachment A - SCR MOT.pdf; Attachment B - DSI.pdf; Sahu Resume.pdf

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Jake Glance

From: Bridget Lee [mailto:bridget.lee@sierraclub.org]
Sent: Monday, August 01, 2016 4:56 PM
To: DEP Comments <DEP.Comments@wv.gov>
Subject: Sierra Club Comments on West Virginia's Proposed SSM Rule

Good afternoon,

Please find attached Sierra Club's comments on West Virginia's Proposed Rule for Alternative Emission Limitations during Startup, Shutdown and Maintenance Operations along with a supporting report excerpt.

Best regards,

--
Bridget Lee
Staff Attorney
Sierra Club
50 F Street, NW, 8th Floor
Washington, DC 20001
202-675-6275
202-547-6009 (fax)

bridget.lee@sierraclub.org

SIERRA CLUB

August 1, 2016

Via E-mail to dep.comments@wv.gov

West Virginia Department of Environmental Protection
Division of Air Quality
ATTN: Public Information Office
601 57th Street SE
Charleston, WV 25304

Re: Comments on West Virginia's Proposed Rule for Alternative Emission Limitations during Startup, Shutdown and Maintenance Operations

To Whom It May Concern:

On behalf of our West Virginia members and supporters, the Sierra Club respectfully submits these comments regarding the proposed rule for alternative emission limitations during startup, shutdown and maintenance operations ("Proposed Rule"), developed by the West Virginia Division of Air Quality ("DAQ") in response to a request by the U.S. Environmental Protection Agency ("EPA") that West Virginia amend those provisions of its Clean Air Act state implementation plan ("SIP") applying to excess emissions during startup, shutdown and malfunction ("SSM").

Despite EPA's request (hereinafter referred to as the "SSM SIP Call"), the regulatory amendments that West Virginia has proposed retains SIP provisions that allow for automatic and discretionary exemptions from otherwise applicable emission limitations during SSM. Given this and the other defects identified below, the Proposed Rule fails to satisfy the requirements of the Clean Air Act or EPA's final policy from the SSM SIP Call. Significant changes to the Proposed Rule must be made in order for EPA approval to be appropriate.

I. BACKGROUND

Power plants and other facilities can emit massive amounts of particulate matter and other pollutants during SSM periods. For example, ten permits issued by the Texas Commission on Environmental Quality in 2011 authorize particulate matter emissions from power plants during SSM periods up to 7,616 pounds per hour—far higher than allowable emission rates during "normal" operations. These permits do not restrict the number of SSM events or hours during which the higher limits apply. But if the allowable limits are reached for just 80 hours per year (about 1% of operating time), emissions of

particulates during SSM periods would account for between 15% and 66% of total annual emissions, based on our review of 2012 emission inventory data.

EPA has found that SSM events historically have caused disproportionate, and enormous, pollution. As part of the SSM SIP Call rulemaking, EPA stated: "[I]n connection with the EPA's issuance of a SIP call to address an exemption for excess emissions during malfunctions in Utah, the EPA illustrated the practical consequences of such exemptions by noting the large amount of additional emissions during malfunctions at individual sources, *e.g.*, one malfunction that was estimated to emit 11,000 pounds of SO_2 over a 9-hour period when the applicable limit was 3,200 pounds per day."[1] Furthermore, EPA has found that power plants are likely to emit these large amounts of SSM pollution on multiple occasions during a year: the "average EGU [electric generating unit] had between 9 and 10 startup events per year during 2011-2012, but data from a small number of EGUs indicated significantly more startup events (e.g., the EGUs with the most startup events had o*ver 100 startup events* in 2011 and *over 80* in 2012)."[2]

Because facilities subject to the Clean Air Act can emit massive amounts of particulate matter, sulfur dioxide and other harmful air pollution during SSM periods, strong SIP provisions governing emissions during these periods are needed to protect downwind communities. Accordingly, EPA has directed thirty-six states to correct specific provisions in their SIPs that are inconsistent with governing law. EPA expects that revisions made in response to its SSM SIP Call could "decrease emissions significantly in comparison to existing provisions, . . . encourage sources to reduce emissions during startup and shutdown and to take steps to avoid malfunctions, . . . provide increased incentive for sources to be properly designed, operated and maintained in order to reduce emissions at all times, . . . [and] result in significant emission control and air quality improvements."[3] Importantly, beyond the legal deficiencies in the existing provisions, "the results of automatic and discretionary exemptions in SIP provisions, and of other provisions that interfere with effective enforcement of SIPs, are real-world consequences that adversely affect public health."[4]

The best approach to the SSM SIP Call is for affected states, such as West Virginia, to remove the illegal exemptions from their respective SIPs. Removing the exemptions would restore the effectiveness of emission limits that are designed to protect air quality and satisfy the Clean Air Act's requirements would apply at all times. Removing the exemption would make the regulations of affected states comparable to regulations in those states that were not subject to the SSM SIP Call.

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[1] Memorandum dated February 4, 2013 to Docket EPA-HQ-OAR-2012-0322 at 23, *available at* www3.epa.gov/airquality/urbanair/sipstatus/docs/ssm_memo_021213.pdf.

[2] EPA Office of Air and Radiation, "Assessment of startup period at coal-fired electric generating units – Revised," at p. 4 (Nov. 2014) (emphasis added), *available at* www3.epa.gov/airtoxics/utility/matsssfinalruletsd110414.pdf.

[3] EPA, State Implementation Plans; Response to Petition for Rulemaking; Restatement and Update of EPA's SSM Policy Applicable to SIPs; Findings of Substantial Inadequacy; and SIP Calls to Amend Provisions Applying to Excess Emissions During Periods of Startup, Shutdown and Malfunction; Final Rule, 80 Fed. Reg. 33,840, 33,955–56 (June 12, 2015) (codified at 40 C.F.R. Part 52).

[4] *Id.* at 33,850.

Alternatively, for those source categories that truly cannot meet SIP emission limits during startup and shutdown, states can establish alternative numerical limits that satisfy the other requirements of the Clean Air Act. In these instances, states must establish clear, narrow definitions of "startup" and "shutdown" to ensure these periods are as short as possible. Any alternative limits must be adopted through the SIP revision process, with the accompanying requirements for public notice and comment. Such limits must not interfere with maintenance of any National Ambient Air Quality Standards ("NAAQS") or Prevention of Significant Deterioration ("PSD") increments.

II. THE PROPOSED RULE VIOLATES THE CLEAN AIR ACT AND EPA'S SSM SIP CALL AND POLICY.

A. DAQ Has Failed to Eliminate or Correct Provisions of its SIP Identified by EPA as Substantially Inadequate to Meet Clean Air Act Requirements.

As part of its June 2015 final action on SSM SIPs, EPA found that certain provisions of West Virginia's SIP are substantially inadequate to meet the requirements of the Clean Air Act and called for West Virginia to submit corrective SIP revisions by November 22, 2016. Specifically, EPA found inadequate the provisions in the West Virginia SIP that allowed for automatic exemptions from emission limitations, standards, and monitoring and recordkeeping requirements for excess emission during SSM events—W. Va. Code R. §§ 45-2-9.1; 45-7-10.3; 45-40-100.8—and those that that provide exemptions from the otherwise applicable SIP emission limitations on account of an "unavoidable shortage of fuel," "any emergency situation or condition creating a threat to public safety or welfare," "unavoidable malfunctions of equipment," or "routine maintenance"—W. Va. Code R. §§ 45-2-10.1; 45-3-7.1; 45-5-13.1; 45-6-8.2; 45-7-9.1; 45-10-9.1; 45-21-9.3.[5]

However, in response to EPA's SSM SIP Call, West Virginia has proposed to revise its SIP to include a new rule governing the establishment of alternative emission limitations during period of startup, shutdown, and maintenance (not malfunction), but to leave unchanged the provisions identified above. Those SIP provisions providing for automatic or discretionary exemptions from emission limitations must be amended to eliminate such exemptions.

B. The Proposed Rule Would Allow for Source-Specific Alternative Emission Limitations, in Violation of the Requirements of the Clean Air Act and EPA's SSM SIP Call.

Any alternative emission limitations must be incorporated through the SIP amendment process, allowing for public notice and comment and EPA approval. Thus, source-specific alternative emission limitations, generally, are not proper. As EPA states in the SSM SIP Call: a "SIP needs to reflect the control obligations of sources, and any revision or modification of those obligations should not be occurring through a separate

[5] *Id.* at 33,961.

process, such as a permit process, which would not ensure that 'alternative' compliance options do not weaken the SIP."[6] Moreover, EPA reasoned that:

> [E]ven where a specific type of operation may not during startup and/or shutdown be able to meet an emission limitation that applies during full operation, the state should be able to develop appropriate limitations that would apply to those types of operations at all similar types of facilities. The EPA believes that there will be limited, if any, cases where it may be necessary to develop source-specific emission requirements for startup and/or shutdown.[7]

Here, the Proposed Rule would allow only for alternative emission limitations in the form of source-specific permit conditions. Because EPA cannot yet evaluate such to-be-determined permit conditions, there is no way to know whether the source-specific compliance option weakens West Virginia's SIP.[8]

If DAQ maintains this option, any permit condition for a particular source regarding alternative emission limitations should be incorporated into the West Virginia SIP, with public notice and comment and EPA approval. In addition, DAQ should include specific language explaining that source-specific work practice standards could only be available as a very last resort upon a sufficient showing that the listed criteria are met and that such requirements are continuous and enforceable.

C. DAQ Has Failed to Demonstrate that the Proposed Reliance on SSM Work Practices Is Appropriate Under These Circumstances

Work practices compliance options (in lieu of having to meet normal SIP limits during startup and shutdown) such as those included in the Proposed Rule are only appropriate for those limited source categories that truly cannot meet "normal" numerical limits for particular pollutants during startup and shutdown and, even then, only for those limited periods of time when specific source categories cannot accurately measure emissions of particular pollutants.

In the final SSM SIP Call rule, EPA confirmed that "[s]tartup and shutdown are part of the normal operation of a source and should be accounted for in the design and operation of the source. It should be possible to determine an appropriate form and degree of emission control during startup and shutdown and to achieve that control on a regular basis."[9] Likewise, EPA also made clear that, for most sources, "it should be feasible to meet the same emission limitation" during both "steady-state" and startup/shutdown periods.[10] EPA's final policy from the SSM SIP Call provides that a

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[6] *Id.* at 33,915.

[7] *Id.*

[8] *See id.*

[9] *Id.* at 33,979.

[10] *Id.*

"state can develop special, alternative emission limitations that apply during startup or shutdown *if the source cannot meet the otherwise applicable emission limitation in the SIP*."[11] (The attached report excerpt, prepared by Dr. Ranajit Sahu on behalf of the Sierra Club, details various air pollution controls and discusses the operational range and startup/shutdown characteristics of the respective controls.)

Here, DAQ's Proposed Rule would allow for work practice requirements in lieu of allowable emission limit during periods of startup, shutdown, and maintenance. In order to satisfy the requirements the Clean Air Act and EPA's SSM SIP Call, DAQ should establish alternative *numerical* limits for source *categories* instead of allowing for the inclusion of work practices as source-specific permit conditions. Even if a category of sources cannot meet allowable emission limits, work practices should only be available for periods where emissions are not measurable. In the SSM SIP Call, EPA specifically stated that "*[i]n cases in which measurement of emissions during startup and/or shutdown is not reasonably feasible*, it may be appropriate for an emission limitation to include as a component a control for startup and/or shutdown periods other than a numerically expressed emission limitation."[12] Where at all possible, establishing numerical limits in lieu of work practices is required by Clean Air Act § 110(a)(2), which provides that SIPs are to include "*enforceable* emission limitations . . . as may be necessary or appropriate to meet the applicable requirements" of the Act.[13] In the SSM SIP Call, EPA echoed that numerical limits are preferable to work practices in terms of enforceability: "In practice, it may be that numerical emission limitations are the most appropriate from a regulatory perspective (*e.g.*, to be legally and practically enforceable) and thus the emission limitation would need to be established in this form to meet [Clean Air Act] requirements."[14]

DAQ's Proposed Rule does not limit the use of work practice requirements to where emissions are not measurable. At least for power plants, emissions are measurable during startup and shutdown, as shown by the fact that, as part of the Acid Rain program, EPA has required power plants to monitor sulfur dioxide and nitrogen oxide emissions continuously from the moment combustion begins and throughout generation, and has relied upon this data for decades to determine compliance with the requirements of the program.

The work practice compliance options proposed by DAQ appear to apply to virtually all (if not all) sources covered by West Virginia's SIP, despite the fact that many of those sources could in fact comply with normal SIP limits during startup and shutdown. Even assuming sources are unable to meet normal SIP limits during startup and shutdown, absent a showing that emissions are not measureable during that time, DAQ should establish alternative numerical limits rather than relying on work practices.

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[11] *Id.* at 33,980 (emphasis added).

[12] *Id.* (emphasis added).

[13] 42 U.S.C. § 7410(a)(2) (emphasis added).

[14] *See* 80 Fed. Reg. at 33,979; *see also id.* at 33,974–75 ("There are many sources for which a numerically expressed emission limitation will be the most appropriate and will result in the most legally and practically enforceable SIP requirements.").

D. The Work Practices Compliance Option in DAQ's Proposed Rule Is Not Enforceable.

Apart from the fact that work practices generally are not enforceable, the Proposed Rule does not meet the enforceability requirement of Section 110 of the Clean Air Act for other reasons. First, the Proposed Rule does not require sources to report to DAQ any information to assure that sources are complying with the requirements of the rule. All that is required is the maintenance of records and provision of data upon request. Because there is no way for DAQ to know—without requesting documentation from sources—whether sources are complying with the work practice requirements, there is no way for citizens or EPA to obtain information regarding compliance. Thus, the alternative emission limitation requirements are not practically enforceable by DAQ in enforcement suits. Nor are they enforceable by EPA or citizens in federal court. If DAQ insists on including work practices as a compliance option (which we maintain is not consistent with the requirements of the Clean Air Act or the SSM SIP Call and, therefore, not approvable by EPA or a reviewing court), DAQ should require the work practice compliance information from the Proposed Rule to be reported by sources through, at the least, their quarterly Title V compliance reports.

Second, the Proposed Rule proposal does not establish any time limitations for periods of "startup" or "shutdown." This is extremely problematic. For example, coal-fired power plants could conceivably claim they are in startup or shutdown mode (and thus exempt from the SIP's numerical emissions limits applicable to "normal" operations) all the way up to full load—and for hours and hours. DAQ should establish clear, limited definitions of startup and shutdown. If alternative emission limitations are established for power plants, startup under the West Virginia SIP should end (and thus the normal numerical SIP limits should begin to apply) at the point these plants begin to generate electricity—either for sale over the grid or for any other purpose (including internal use). Similarly, shutdown should only begin when no electricity is generated for sale over the grid or for any other purpose—or when no fuel is being fired in the boiler.

E. DAQ Cannot Demonstrate that the Proposed Rule Will Not Violate the NAAQS or PSD Increments.

Under Section 110(l) of the Clean Air Act, EPA cannot approve SIP revisions that would interfere with attainment of the NAAQS or PSD increments: "The Administrator shall not approve a revision of a plan if the revision would interfere with any applicable requirement concerning attainment and reasonable further progress (as defined in section 7501 of this title), or any other applicable requirement of this chapter."[15] In keeping with this requirement, EPA stated in the SSM SIP Call that: "[a]s part of its justification of the SIP revision, the state [should] analyze[] the potential worst-case emissions that could occur during startup and shutdown based on the applicable alternative emission limitation."[16]

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[15] 42 U.S.C. § 7410(l).

[16] 80 Fed. Reg. at 33,980.

Excess emissions from startup, shutdown and malfunction events have far-reaching impacts on other requirements of the Act.[17] States must rely on assumed continuous compliance with emissions limitations in their modeling exercises to demonstrate attainment and maintenance of ambient air quality standards.[18] In areas that are meeting air quality standards, state plans must include emission limitations designed to ensure that air quality does not worsen.[19] Similarly, in nonattainment areas, nonattainment SIPs must include emission inventories which are comprehensive, accurate, and current of actual emissions and must also include emission statements from stationary sources.[20] Also, in nonattainment areas, state plans must include a program that assures reasonable progress toward attainment of ambient air quality standards.[21] Nonattainment NSR permitting requires offsetting of emissions based on permitted emission limits.[22] There is no way to adjust the required offsets should a source exceed its permitted emission limits during periods of SSM because nonattainment NSR permitting occurs prior to construction and the permits do not ever expire. Plans must also protect scenic views in many of America's most treasured public lands.[23]

Where a state establishes SSM limits through permits, assessing the collective impact on the NAAQS or PSD increments becomes difficult if not impossible. Here, DAQ appears not to have considered the potential effect of its proposed alternative emission limitations compliance option on these required demonstrations and planning under the Act.

III. CONCLUSION

For the foregoing reasons, West Virginia's proposed SIP revision must be further revised to ensure that it is consistent with the requirements of the SSM SIP Call and Clean Air Act, protects air quality and public health, and is approvable by EPA.

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[17] 78 Fed. Reg at 12,485.

[18] *See* EPA Memorandum to Docket EPA-HQ-OAR-2012-0322, at 14, n. 41 (Feb. 4, 2013) (*citing*, *inter alia*, Clean Air Act Section 110(a)(2)(A) and (C)).

[19] 42 U.S.C. § 7475(a)(3), 40 C.F.R. § 51.166(k)(1); *see* 78 Fed. Reg. at 12,485.

[20] *See, e.g.*, 42 U.S.C. §§ 7511(a)(1), (3).

[21] 42 U.S.C. § 7501 *et seq*.

[22] *See, e.g.*, 42 U.S.C. § 7511(a)(4).

[23] 42 U.S.C. § 7491(a)(1).

Thank you, and please do not hesitate to contact the undersigned with any questions or to discuss the matters raised either here.

Sincerely,

/s/ Bridget Lee

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Attachment A

On the Minimum Operating Temperature (MOT) for Selective Catalytic Reduction (SCR) Systems for NOx Reduction at Coal-Fired Plants

1.0 Introduction

Coal-fired power plant operators or consultants hired by them have often claimed that Selective Catalytic Reduction (SCR) units, which use catalysts for NOx reduction, are ineffective at temperatures below 620 F (or similar), which they claim is a "fundamental limitation" of the SCR technology.

For example, the company operating the Somerset plant, which consists of one unit equipped with SCR, submitted a Reasonably Achievable Control Technology application[1] seeking to carve out the low load and startup conditions from meeting the presumptive RACT limit, on the grounds that the "SCR catalyst temperature is not at sufficient operating temperature to control NO_x emissions...."[2] It is impossible to evaluate this claim because the "sufficient" catalyst operating temperature (which would depend on the choice of catalyst and other factors) is simply noted as 620 F,[3] with no basis or connection to details on the catalyst.

In another example, at the Cayuga plant, consisting of two roughly 150 MW units, one of which (Unit 1) has an existing SCR, the draft Title V permit contains the following conditions:

> "1. The owner or operator shall comply with the following NOx limits for Boiler 1:
> i. At loads equal to and greater than 58 MW (gross) but less than or equal to 85 MW (gross), provided that flue gas temperature at the inlet to the SCR temperature does not exceed 620 degrees F, emissions shall not exceed 0.42 pounds NOx per million Btu.

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[1] NO_x Reasonably Available Control Technology (RACT) Analysis for the Somerset Generating Station in Barker, New York, December 2011.

[2] Somerset RACT Analysis, p. ES-2. In some places the document further confuses this issue by stating that a "...minimum" sustained operating temperature is necessary for SCR operation without specifying it (also at p. ES-2).

[3] Somerset RACT Analysis, p. 12

> ii. At operating loads greater than 85 MW, and whenever the flue gas temperature at the inlet to the SCR temperature exceeds 620 degrees F, emissions shall not exceed 0.12 pounds per million Btu."[4]

A somewhat similar example is from the permit from Apache units 2 or 3, which states that:

> "[B]ased on manufacturers requirements, the SCR system shall be placed in service as soon as practicable after exhaust gas temperature reaches 570 degrees Fahrenheit...."[5]

Although the temperature limit specified in the Apache permit is 570 F as opposed to 620 F, the basis for the 570 F specified in the permit is still not clear.

The focus of this Attachment is to critique conditions such as the above which allow SCR to not operate, unless the gas temperature at the inlet to the SCR exceeds 620 F, 570 F (or something similar). Further, like the example of the Somerset RACT, the technical discussion associated with the draft Title V permits often contain no support or discussion justifying the gas temperature cut off for SCR operation.

For this discussion, we will assume that SCRs are located after the economizer and before the air preheater or any particulate controls, and, as such, are considered to be in the "high dust" configuration. The SCR inlet temperature that is relevant is the economizer exit gas temperature.

It is not surprising that SCR catalysts, like all catalysts designed to promote specific chemical reactions, might not have sufficient activity at low temperatures.[6] In that sense, we do not dispute the general idea that there may be inherent "minimum operating temperatures" (MOT) associated with SCR catalysts.

However, as we will demonstrate below:

> (a) there is not a single such MOT that is universal to all SCR catalysts;

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[4] Draft Title V Air Permit, Permit ID: 7-5032-00019/00016, Facility ID: 7503200019, Condition 94.2.
[5] Air Quality Control Permit No. 35043, dated July 9, 2007, p. 50 of 84.
[6] SCR catalysts also have upper temperature limits above which they should not be operated. That is generally not an issue and we therefore do not comment on that any further.

(b) the MOT for all SCR catalysts is not specifically 620 F as noted in the examples of the two NY plants discussed above;

(c) SCR catalysts are not irreversibly damaged should the inlet flue gas temperature entering the SCR fall below the MOT;

and

(d) there are methods available to maintain the SCR inlet temperatures higher than the MOT (whatever temperature that may be for the specific SCR in question) for wide ranges of boiler loads using other techniques such as economizer bypass and additional approaches.

2.0 SCR Catalyst Suppliers

As a general matter, I note that there are numerous original equipment manufacturer vendors that supply SCR catalysts, specifically formulated and designed for NOx reduction from coal-fired units. These original equipment manufacturers of catalysts include, among others, Halder Topsoe,[7] Johnson Matthey-Argillon,[8] Hitachi,[9] Cormetech,[10] etc. SCRs, themselves, are designed and constructed by engineering and construction firms, to which the SCR catalyst vendors provide the catalyst and related equipment. In addition to original equipment manufacturer catalyst vendors, there are also vendors who can refurbish used catalysts in order to regain their activity levels.

Each of these catalyst manufacturers have various catalyst designs or formulations, tailored for specific applications and depending on factors such as coal type, the range of NOx concentrations at the inlet to the SCR, the operating load range for the boiler, the sulfur content of the coal, the desired NOx reduction needed, ammonia slip

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[7] http://www.topsoe.com/business_areas/air_pollution_control/processes/nox_removal.aspx
[8] See, for example, http://wenku.baidu.com/view/1b3dce896529647d2728523c.html
[9] See, for example, http://www.marketwatch.com/story/hitachi-power-systems-america-reaches-agreement-to-supply-plate-type-catalyst-for-american-electric-powers-scr-fleet-2013-12-16
[10] http://www.cormetech.com/catalystoverview.htm

limitations, pressure drop limitations, the expected catalyst life, and others.[11] Thus, the terms "SCR catalyst" include a variety of vendors/catalysts/formulations. There is no theoretical reason or basis to expect that all of these different SCR catalysts from various vendors would have a single MOT.

3.0 SCR Catalyst Minimum Operating Temperature (MOT)

Ammonia is by far the most common reducing agent used in SCRs. As a practical matter, the MOT in SCRs using ammonia is governed by the potential formation of several ammonium salts. The goal is to maintain gas temperatures in the SCR above the level where these salts, if formed, might condense in the catalyst, thereby blocking portions of its pore structure available for NOx reduction reactions.

Ammonia can react with other chemical species present in the exhaust gases from coal combustion to potentially form a number of different salts such as ammonium chloride, NH_4Cl, ammonium bisulfate (ABS), NH_4HSO_4, and ammonium nitrate, $(NH_4)_2NO_3$.[12] Of these, typically, in coal combustion exhaust gases, the MOT is driven by avoiding ABS condensation, which forms when ammonia and sulfuric acid (which, in turn is formed by the reaction of sulfur trioxide and water vapor) might condense as liquid ABS in the catalyst pores. Thus, determining MOT, of necessity, requires some understanding of the conditions that can or might lead to ABS condensation in specific situations.

The chart below[13] shows the conditions for formation of ABS as a function of ammonia concentration and SO3 concentration in the exhaust gases. As expected, the lower the ammonia and SO3 concentrations, the lower the temperature above which ABS formation becomes an issue – i.e., lower the MOT. The operator has control over the given ammonia concentration, including the excess ammonia concentration (i.e., ammonia concentration above and beyond that needed for the NOx reduction reactions) since it is an input material for the SCR, with economic value to the operator.

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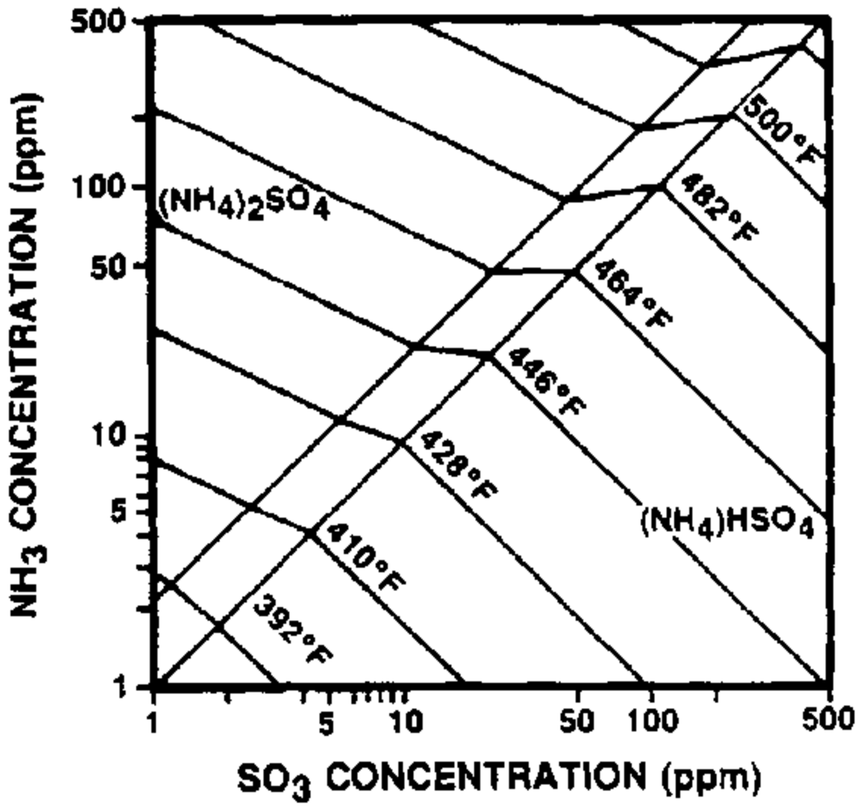
[11] See id notes 6-9.
[12] See, for example, Thogersen, J.R., et. al., Ammonium Bisulphate Inhibition of SCR Catalysts.
[13] Ratafia-Brown, J., "Advanced NOx Control Assessment," DoE, March 1989.

For a given ammonia concentration, the lower the SO3 concentration, the lower the MOT. It is worth noting that even at very high levels of ammonia and SO3, the potential conditions for ABS formation are well below 620 F.

FIGURE 2-3

CONDITIONS FOR THE FORMATION OF AMMONIUM SULFATE/BISULFATE



I also note that in actual SCRs, which typically have two or more catalyst layers in the direction of gas flow (the "gas path"), the MOT in the second and subsequent layers is lower since there is less free ammonia available as the gases progressively pass through the SCR.[14]

While the MOT for particular formulations is a closely guarded trade secret by catalyst vendors, there are examples of typical MOT in the open literature.

The graph below is by Argillon, a SCR vendor.[15]

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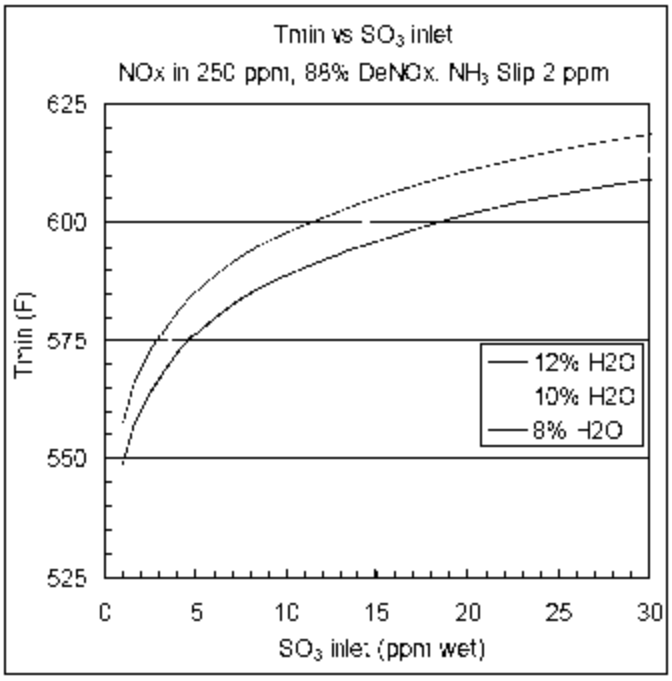
[14] Thogersen, J.R., et. al., Ammonium Bisulphate Inhibition of SCR Catalysts.

[15] From a paper presented at the Reinhold Environmental Ltd. 2008 NOx-Combustion Round Table & Expo, February 4-5, 2008 in Richmond, VA.



The graph shows that at relatively high levels of SO3 concentration, for example 15 ppm, the MOT (on the y-axis) is significantly below 620 F. The dependence of the MOT on water vapor, always present in combustion systems, is also shown.

The next graph below shows a composite envelope of the MOT from various SCR vendors.[16] Like the curve from Argillon, the composite curve below also shows the dramatic impact of SO3 concentration on the MOT. It also shows that the MOT can be significantly below 620 F.

[16] Lockert, C. A., et. al., Dynamic Control of SCR Minimum Operating Temperature, CoalGen 2009.

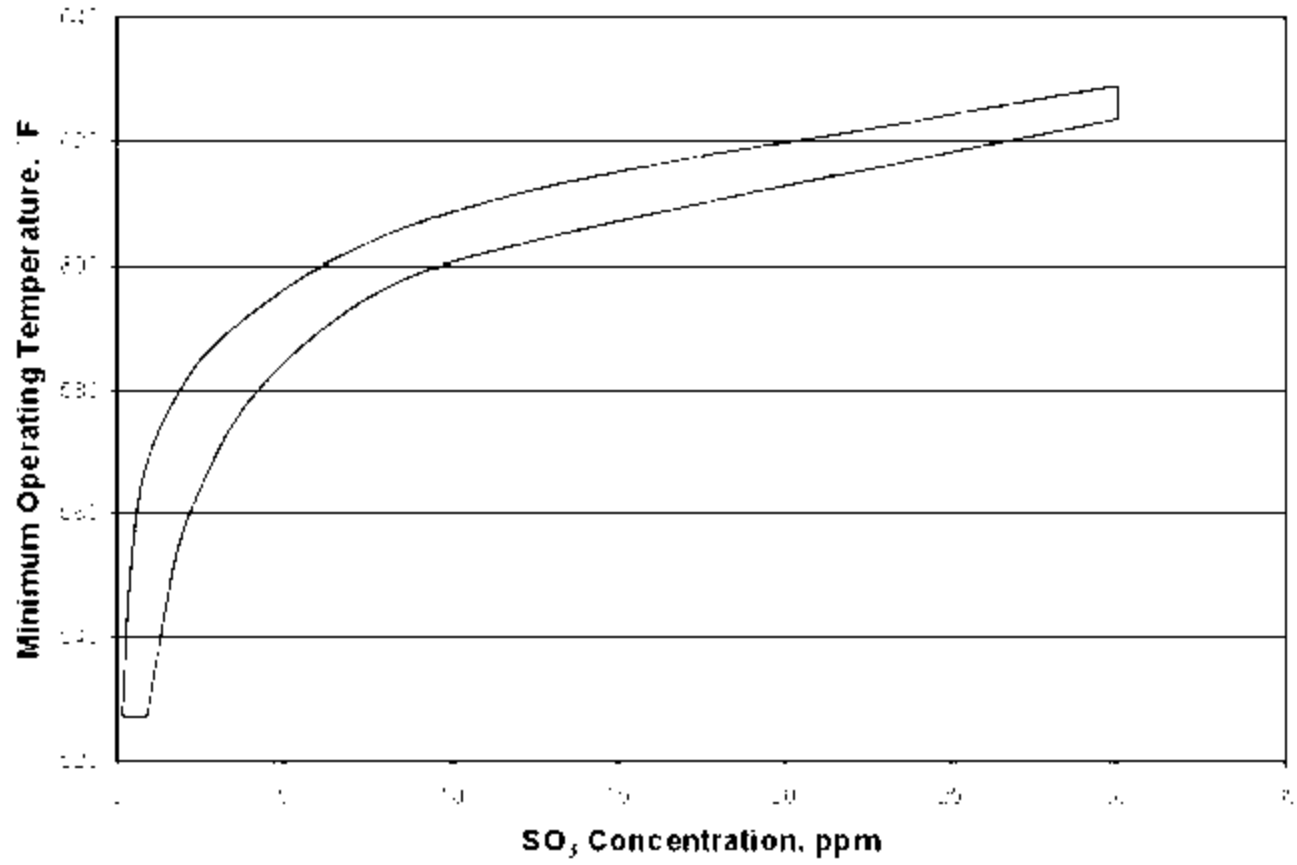


Figure 1 - Composite Catalyst MOT vs SO3 curve

There are other specific examples. An SCR at the Edgewater Unit 5 can operate at temperatures of 550 F.[17] Even this relatively lower temperature, however, should not be misconstrued as a lower temperature limit for SCR catalyst performance as shown in the MOT curves above.

As another example, in a recent analysis of SCR performance for a coal-fired unit in Arizona, EPA notes that "[T]he normal maximum allowable temperature for a baghouse is 400 degrees F, which is at the low end of the temperature range required for

[17] Knier, J., et. al., History and Challenges of a Successful NOx Reduction Project, Power Engineering, March 2014, p. 38.

operation of an SCR system (approx 400-800 degrees F)."[18] Thus, in EPA's analysis, SCR can operate at temperatures as low as 400 F. This is consistent with the ABC condensation temperatures that I have discussed earlier, especially at low ammonia and SO3 concentrations.

Based on the above, the representation of 620 F (or similar) as some sort of a "fundamental" limiting temperature below which SCR catalysts do not work is untrue.

Further, from the discussion above, it should be obvious that SO3 concentration plays a significant role in ABS formation, and therefore the establishment of the MOT. Understanding SO3 formation in the boiler (i.e., before the flue gases reach the SCR) is important since it will provide additional options to potentially reducing SO3 concentrations, and therefore MOT.

In simple terms, SO3 is formed in the boiler via the oxidation of SO2, which, in turn, is produced via the oxidation of sulfur in the coal itself. While some of the sulfur in the coal exits via the bottom ash (typically between 5-15% of the inlet sulfur in the coal), the majority of the coal sulfur compounds oxidize to SO2 in the overall oxidizing environment in the boiler. A portion of this SO2 can then oxidize to SO3 via iron catalytic reactions.[19]

The graph below shows the important factors that affect SO3 formation.[20]

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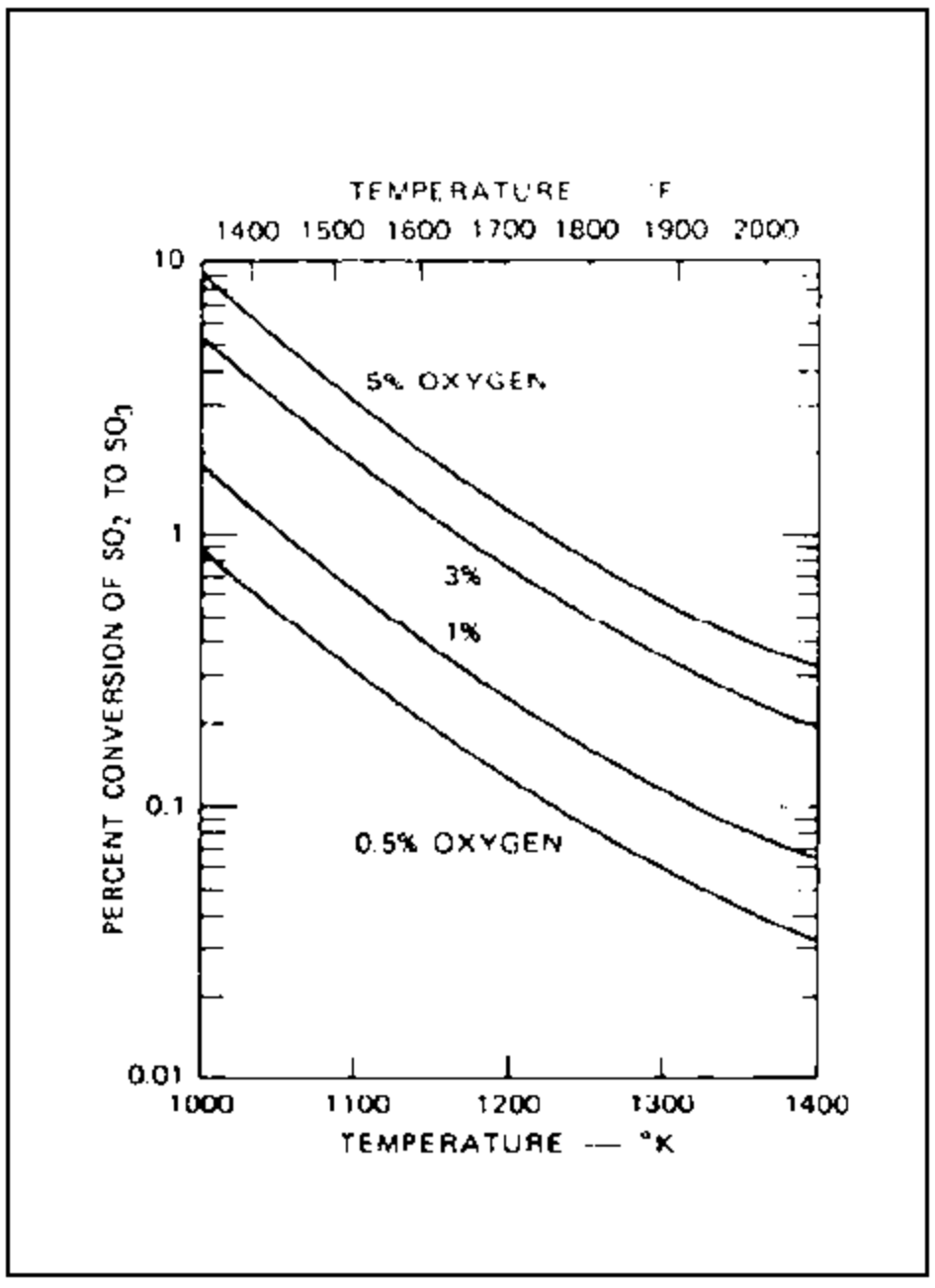
[18] Technical Support Document for the Proposed Phase 3 Action on the Federal Implementation Plan for the Regional Haze Program in the State of Arizona, EPA Docket No. EPA-R09-OAR-2013-0588, available at www.regulations.gov

[19] Lockert, C. A., et. al., Dynamic Control of SCR Minimum Operating Temperature, CoalGen 2009.

[20] *Id.*



As Lockert et. al., note, "What is clear is that: the higher the level of excess O2, the higher the formation rate of SO3; the lower the temperature at which the SO2 meets the iron catalyst, the higher the formation rate of SO3"[21]

Based on the above, and based on typical gas temperature profiles in the boiler back pass, the bulk of the conversion of SO2 to SO3 typically occurs in the region between the reheat pendants and the economizer inlet.

Breen, a consulting company additionally notes that "[S]ince the goal of the plant is to burn the most economical opportunity coal available, it is not possible to control either the iron content in the fuel or the alkalinity of the resultant fly ash. However there are three specific actions that plant operations can take:

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[21] *Id* at p. 3.

1. Strive to maintain the lowest possible excess oxygen level that can reasonably be delivered by the secondary air control process. To achieve this it is more important than ever to:

2. Understand and balance fuel distribution through the pipe from each mill. This will allow a more balanced fuel profile to the boiler and allow a more balanced fuel/air ratio. This, in turn, will allow the plant to operate at lower O2 levels without the negative side effects.

3. If a high iron content fuel is being burned, pay close attention to ash deposits in the region from the primary reheat to the economizer inlet. Keep this area as clean as possible to reduce the catalytic impacts of iron oxides."[22]

Lockert et. al., also notes that, since as boiler loads change excess oxygen levels can change, and as loads change the temperature profile, particularly in the critical SO2 to SO3 conversion region, can also change, "...the conversion rate of SO2 to SO3 ahead of the SCR is rarely a constant number and application of a fixed MOT curve based on a fixed level of SO3 input is generally over conservative. What is required is a real-time measurement of the actual SO3 entering the SCR and subsequent closed loop control of the ammonia injection curve based on the dynamic number."[23]

Instruments to do just that are now available to power plant operators.[24]

4.0 Operating SCR Below MOT

One of the major considerations with regards to MOT (as not limiting SCR performance) is that even if a SCR is occasionally operated at temperatures below the MOT, as long as these durations are relatively short (say, 12 hours or less, as would be the case for startup, shutdown, low-load unit cycling during the nighttime, etc.), followed by unit

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[22] Breen Energy Solutions, Comprehensive Acid Gas Management, March 2012.
[23] Lockert, C. A., et. al., Dynamic Control of SCR Minimum Operating Temperature, CoalGen 2009.
[24] See, for example, ammonia analyzers as discussed in http://www.teledyne-ai.com/products/app_ammonia_slip_monitoring.asp; see also technical paper at https://www.industry.usa.siemens.com/automation/us/en/process-instrumentation-and-analytics/process-analytics/pa-case-studies/Documents/P019DeanFinal.pdf. See information on SO3 measurements at https://www.sick.com/media/pdf/0/30/830/IM0058830.PDF; See additional information on SO3 measurements at https://tools.thermofisher.com/content/sfs/brochures/D20831~.pdf

operation at normal loads with economizer exit gas temperature above the MOT, then any condensed ABS will simply and reversibly vaporize, leaving catalyst pore structures and activity unchanged.

This is well established and has long been known. We provide several examples.

First, we quote extensively below from a major SCR catalyst vendor, Cormetech, with regards to this issue from a discussion in 2007.[25]

Cormetech Catalyst Can Be Used at Lower Temperatures for Limited Periods

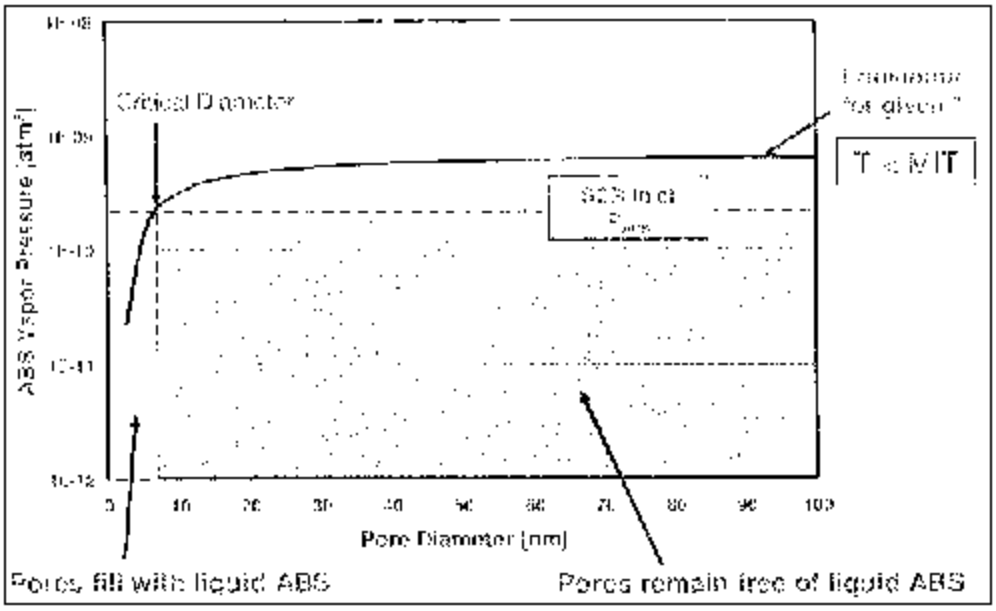
Cormetech's design strategy for setting minimum operating temperature guidelines for SCR operation involves two distinct approaches: the Basic Approach, in which ammonium bisulfate (ABS) deposition on the catalyst is avoided, and the Enhanced Approach, which allows a controlled amount of ABS deposition and catalyst deactivation, before the ABS is driven off by heating above a recovery temperature. The Enhanced Approach provides significant opportunity to expand the SCR operating range below the temperature at which ABS first condenses in the catalyst, while maintaining the required NO_x removal efficiency. Benefits to the utility include higher overall NO_x removal, improved flexibility for load cycling and maintenance, and the potential for eliminating the need for an economizer bypass or alternate methods of temperature control for the SCR system in new designs and retrofits.

The Enhanced Approach requires a substantial understanding of the unit's operation (at full and part loads) and the catalyst's response, including temperature (average and spatial distribution), gas composition: SO_3, H_2O, NH_3 (DeNOx, inlet NO_x, NH_3 slip), gas flow rate, the expected ranges for these parameters (expected fuels), boiler transient information (temperature/flow versus time) and the routinely achievable temperature for recovery. Each plant must also consider the desired operating strategy (i.e., target load, temperature, hours, performance targets and frequency) that best enhances operability.

Figure 4 below presents a case where the temperature is now below the Minimum Injection Temperature (MIT) for NH_3 for the SCR. ABS will form in pores smaller than critical diameter, while larger pores remain free of ABS and capable of performing the $DeNO_x$ reaction. (Note: Cormetech SCR

[25] FGD and DeNOx Newsletter, January 2007, available at http://www.mcilvainecompany.com/brochures/newsletters/fgdnl345OLD/Cormetech%20Catalyst%20Can%20Be%20Used%20at%20Lower%20Temperatures%20for%20Limited%20Periods.htm

Catalyst™ has a tri-modal pore distribution with micro, meso, and macro power; the micro pores are most susceptible to capillary condensation effects).



Implementation of this strategy at TVA plants with Cormetech SCR catalyst provided significant cost savings due to lower permissible operating temperatures (net savings of about $2.4 million for the 2005 ozone season), without adverse effect on the catalyst, air preheater (APH) or stack opacity. See Figure 5. In addition to the cost savings, an additional 974 tons of NO_x were reduced. Both benefits were accomplished with an implementation cost of $200,000. In addition, the new operating guidelines avoided the need to install an economizer by-pass on these units.

Second, the Electric Power Research Institute, a utility industry research organization has been investigating exactly this issue since 2010 or thereabouts. We provide excerpts from their work below.

"Operators can also take advantage of the fact that the ABS formation reaction is reversible. When the flue gas temperature moves back above the minimum operating temperature at full load conditions, the liquid ABS will evaporate from the catalyst pores. Some catalyst suppliers have worked with operators to develop procedures for operating below the minimum operating temperature. The procedures generally involve dropping below the minimum operating temperature for a limited amount of time, allowing a controlled amount of ABS deposition and catalyst deactivation, and then recovering the catalyst activity by increasing load and reheating the catalyst above a specified recovery temperature where the ABS will evaporate. Using procedures defined by the catalyst

vendor, results show that high NO_x removal rates can be maintained during extended low load operation; and catalyst activity can be completely recovered (without a significant time lag) when flue gas temperatures are increased back to full load conditions. These low load cycles do not appear to accelerate catalyst deactivation."[26]

In a follow-up to the study above, EPRI noted the following:

"Researchers investigated SCR catalyst deactivation due to temperature and ABS deposition using both new and used homogeneous honeycomb, plate, and corrugated catalysts. Effects on the first and second catalyst layers were studied by collecting gaseous samples at the inlet and outlet of each SCR layer. Honeycomb catalyst samples were analyzed for pore size and distribution. The experimental data were used to develop performance predictions for several low-load scenarios.

The experimental data showed the new honeycomb, corrugated, and plate type catalysts have different ABS deactivation characteristics in the first and second layers. For the new catalyst, an SCR process model showed that overnight (8–12 hours) operation at low load below the ABS dew point does not appear to jeopardize SCR performance."[27]

That operators are actually using these approaches is also well known. For example, TVA, a large operator of numerous coal-fired power plants, many using high sulfur coals (i.e., with relatively high SO3 concentrations in the exhaust gases) stated recently that

"TVA used the EPRI load cycling technology guides to develop and implement a strategic approach to increase the turndown capability of its fossil-fueled fleet. After reviewing the EPRI O&M guidelines for SCR systems, TVA engineering determined that the units with SCR equipment could operate at lower inlet temperatures than the existing operational procedure limits. The new lower operating temperatures were designed to still allow appropriate recovery times to evaporate ABS at higher operating temperatures, and to avoid permanent deposition and catalyst damage."[28]

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[26] Summary of Selective Catalytic Reduction System Operational Issues at Low Load, Product ID 1021208, November 12, 2010 (taken from abstract).

[27] EPRI, Investigation of Catalyst Deactivation from Operation Below the Minimum Operating Temperature, Product ID:1023928, September 11, 2012 (taken from abstract).

[28] *See* EPRI Success Story, TVA Uses Information on Cycling Operation to Improve Unit Turndown Capability, February 2013, available at http://www.tva.com/environment/technology/pdf/improve_unit_turndown_capability.pdf.

5.0 Measures That Can Maintain Gas Temperatures Greater Than MOT at Low Loads

In addition to the discussion above which clearly shows that SCRs can run without adverse impact even if the economizer exit gas temperature is below the MOT for short durations (as long as they are then run at temperatures above the MOT subsequently – which is consistent with the normal mode of how coal units operate), in this section we will note that there are several approaches that can be used to effectively operate the boiler/SCR system at temperatures above its MOT even at low loads.

The conventional approach to maintaining economizer exit gas temperature (EEGT) above the MOT is to allow for a gas path that can bypass the economizer. Depending on the degree of bypass, which is controlled via a damper, a portion of the flue gases bypasses the economizer thereby retaining its heat or enthalpy while the majority of the flue gases pass over the economizer, as designed. They are then combined at the exit to the economizer before proceeding to the SCR inlet. In this manner, the hotter by-passed gases combine with the cooler non by-passed gases, thereby keeping the overall temperature above the MOT. The obvious drawback to this approach is the loss of unit efficiency due to the heat that could not be extracted by the economizer from the by-passed gases. However, this is not the only possible approach.

The 2010 EPRI document provides several additional possible options.

> "To avoid problems during low load operation, conventional design practice calls for a flue gas or water-side economizer bypass to elevate the flue gas temperature at low load to a level high enough to allow reagent injection. However, many units are not equipped with economizer bypass capabilities. In these cases, operators have a number of options to comply with the minimum operating temperature (emphasis added):
> - Evaluate actual SCR inlet operating conditions (NH_3 and SO_3 concentrations, temperature distribution) and compare to the SCR design conditions
> - Modify current operational practices (fuel sulfur content, NO_x reduction levels at low load)
> - Improve the SCR inlet temperature distribution by installing a static mixer

- Reduce SO_3 levels upstream of the SCR by injecting a sodium sulfite solution, or a dry sorbent such as trona or hydrated lime…"[29]

In particular, the last option is very viable to diminish the SO3 concentrations at the inlet to the SCR. As discussed previously, ABS formation depends strongly on the SO3 concentration and lowering the SO3 concentration can provide a direct pathway to a lower MOT.

In addition, boiler vendors such as Babcock and Wilcox have also developed specific and proprietary approaches to allow for unit operations at low loads while allowing for SCR operation.

> "[T]he solutions currently available to resolve the EEGT issue do not provide the turndown required by most power plants for loads of 40% and below….Babcock & Wilcox Power Generation Group, Inc. (B&W PGG) has patented the V-Temp system to control the flue gas temperature leaving the boiler and entering the SCR, within the SCR's desired operating load range. This system controls the distribution and flow of the economizer fluid so that the EEGT can be increased at reduced loads. The V-Temp system maintains an application-specific minimum EEGT at reduced loads, permitting the SCR to remain in service and to control NOx emissions, while minimizing the risk of ammonium bisulfate formation in the downstream flue, at the SCR inlet, or in the SCR catalyst…..This paper will include results from successful installations of the V-Temp system on both supercritical and subcritical boilers. Optimization of this system is currently being developed **to allow for operation of the boiler down to 25% load with the SCR in service while maintaining unit efficiency at full load**." (emphasis added)[30]

6.0 Summary

This discussion shows that the MOT for SCRs depends on several variables, in particular the inlet SO3 concentration, along with that of ammonia, which excess levels can be better controlled dynamically using online ammonia analyzers to provide lower MOT, and thus SCR operations over wider loads. In particular, there is no basis for the MOT to be 620 F or similar as claimed by the examples discussed earlier (i.e., the Cayuga and

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[29] Summary of Selective Catalytic Reduction System Operational Issues at Low Load, Product ID 1021208, November 12, 2010 (taken from abstract).

[30] Albrecht, M.J., et. al., "The V-Temp Economizer System and Method for SCR Temperature Control, Babcock & Wilcox Power Generation Group, BR-1861, presented at: Power-Gen International, December 13-15, 2011, Las Vegas, Nevada, U.S.A.

Somerset plants). The discussion also shows that operating the SCR temporarily below the MOT will not cause irreversible adverse impacts to the SCR and that there are several approaches that can be used to maintain economizer exit gas temperature above the MOT even during low load operations at a unit, including during startup and shutdown.

Attachment B

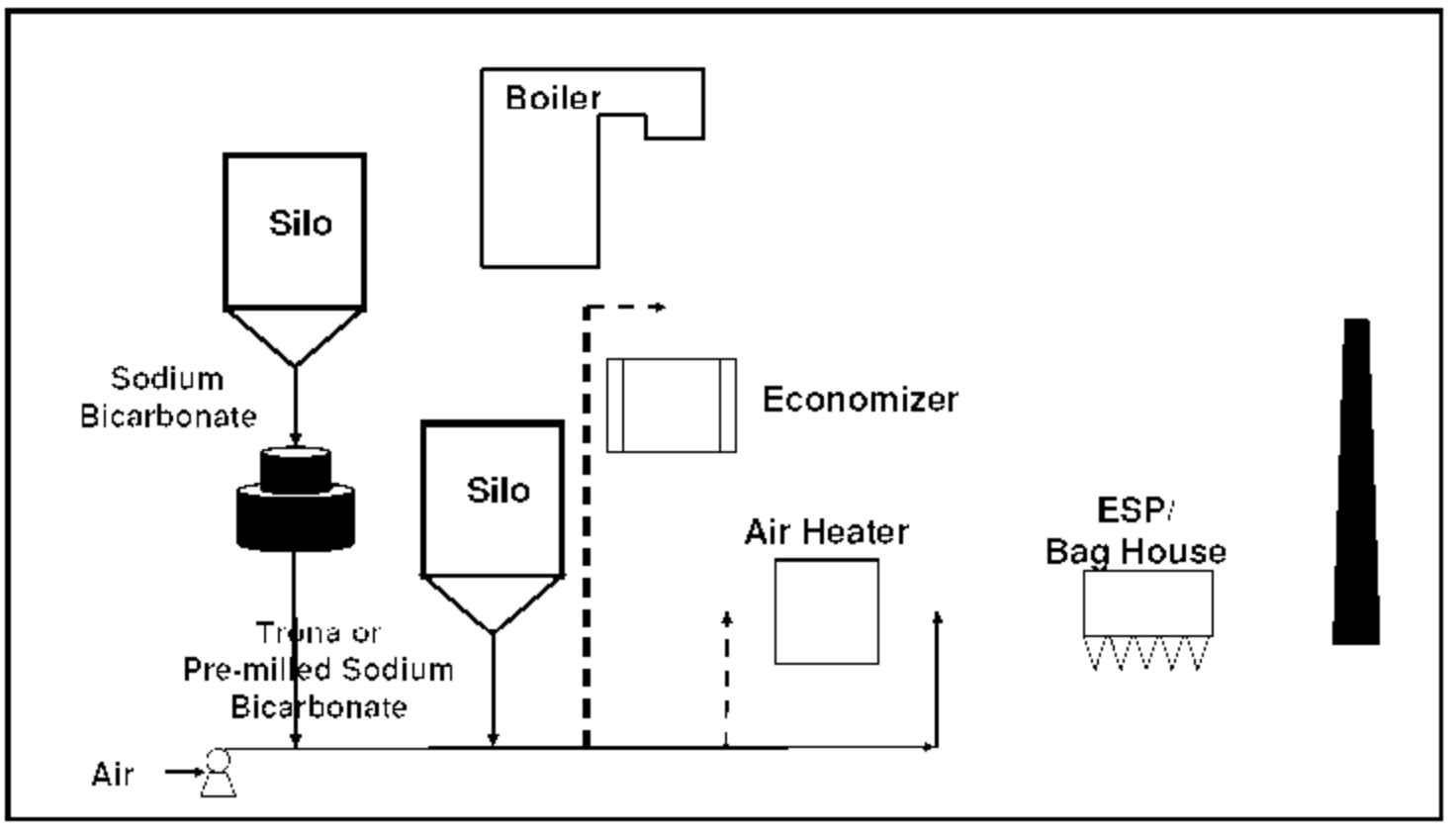
Dry Sorbent Injection

1.0 Basics and Elements of a DSI System

A Dry Sorbent Injection (DSI) system is, as the name implies, a dry process in which a sorbent is pneumatically injected either directly into a coal-fired boiler or into ducting downstream of where the coal is combusted and exhaust (flue) gas is produced. This discussion will focus on the latter, more common, implementation of DSI. The goal of the sorbent injection is to interact the sorbent with various pollutants in the flue gases (such as sulfur trioxide (SO3), various acid gases including hydrochloric acid (HCl), and sulfur dioxide (SO2), such that some fractions of these pollutants are removed from the gas stream.

Figure A,[1] below shows a simple schematic of the DSI process. We will discuss the sorbents that are used in more detail below. For now, Figure A shows that the sorbents can be injected at a number of locations, all prior to the particulate control device.

Figure A – Simple DSI Schematic



[1] Comparison of Sodium Bicarbonate and Trona for Multi-Pollutant Control, Yougen Kong and Stan Carpenter, Solvay Chemicals, Electric Power 2010.

After the appropriate chemical interactions between the pollutants in the flue gas and the sorbent, the dry waste product of reaction is removed at the (typically) existing particulate control device downstream of the injection point – which is usually either an electrostatic precipitator (ESP) or a fabric filter baghouse.

Traditionally, DSI was used to remove SO3 and acid gases – and these pollutants are usually present in far lower concentrations in the flue gases as compared to SO2. However, some SO2 was also invariably and unavoidably removed as well. As regulatory pressures have focused increasingly on SO2 removal, DSI vendors haveincreasing targeted their systems at this pollutant. SO2 removal via DSI is the focus of this technical report.

Historically, SO2 removal was effected using various types of scrubbers, whether wet or dry. These technologies have roughly 40 years of field implementation and can routinely achieve SO2 reductions ranging from 90%+ to 99%, depending on various factors. However, they have significant capital costs.

In contrast, DSI systems have two distinct advantages that have recently propelled their acceptance as a suitable SO2 control technology. First, the capital cost of DSI systems is much lower compared to wet or dry scrubbers. Second, DSI systems take up much less physical space, which is especially important when considering retrofit or upgrades to existing units.

The expected SO2 control efficiency of DSI (and at what overall cost) is a matter of some controversy. We will explore that in more detail later in this section. However, it is rare that DSI SO2 efficiency is 90% or greater – vendor claims notwithstanding. Thus, if the SO2 efficiency requirement is 90% or greater, DSI is not likely to be an appropriate technology. But, for lower efficiencies, it is possible to remove SO2 via DSI but various factors including capital cost, operating costs (of which sorbent costs are not insignificant), waste handling issues, etc. need to be considered before a proper decision can be made.

2.0 Sorbents

Two primary sorbents are utilized in DSI systems: sodium sesquicarbonate, or trona, and sodium bicarbonate. Both of these, as their names suggest, are sodium based sorbents. Less frequently, a calcium based sorbent, hydrated lime, can also be used although rarely so if the goal is SO2 removal.

I focus mainly on trona since it is by far the most widely used sorbent in DSI. Most trona, a naturally occurring mineral, is mined from a vast formation in the Green River, WY area[2] and certain areas of California. Sodium bicarbonate, on the other hand, is a chemical compound primarily manufactured using the Solvay Process. This salt is obtained from a reaction of calcium carbonate, sodium chloride, ammonia, and carbon dioxide in water.

There are several notable differences between these materials. First, sodium bicarbonate is more effective in removing sulfur dioxide emissions than trona. Hence, less sodium bicarbonate is required for an equivalent amount of removal. But, sodium bicarbonate is much more expensive than trona in the United States. Hydrated lime is not as effective as either of the sodium based sorbents so greater quantities of hydrated lime are required, making operational costs significantly greater. However, not all operational costs are properly accounted for in many situations. Examples includes costs for grinding, material handling, power usage, and the like. Thus, in actual site-specific implementation, the final economics may favor any one of these three sorbents.

It should be noted that, in addition to SO2 removal, each of these sorbents is more or less effective on other pollutants that may be of interest.

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[2] The largest deposit of trona in the world is in the Green River Basin in Wyoming, where seams of trona vary in depth from 600 to 3500 ft and are spread over approximately 2500 square miles. Known deposits of trona in the Green River Basin exceed 100 billion tons. Four companies currently mine trona in the Green River Basin, but only two, Solvay Chemicals and FMC market trona for SO2 control.

For example, trona is effective for SO2, SO3, condensable particulate matter (mostly sulfuric acid mist) and HCl. Sodium bicarbonate is effective for SO2 and HCl. Hydrated lime for is most effective for SO3, condensable PM and HCl.

3.0 Sorbent Particle Size

The effectiveness of SO2 reduction is based on many factors, including, in no particular order: sorbent mass injection rate, sorbent residence time in flue gas stream (which depends or dictates the injection location), sorbent penetration and mixing with flue gases, the type of particulate control device, flue gas temperature profile, and, finally, the sorbent particle size. Typically, the finer the sorbent particle size, the greater the sorbent surface area available for reactions – and all of the other factors remaining constant – the greater the SO2 removal efficiency for a given quantity of sorbent injected or less sorbent mass required for a specified SO2 removal efficiency.

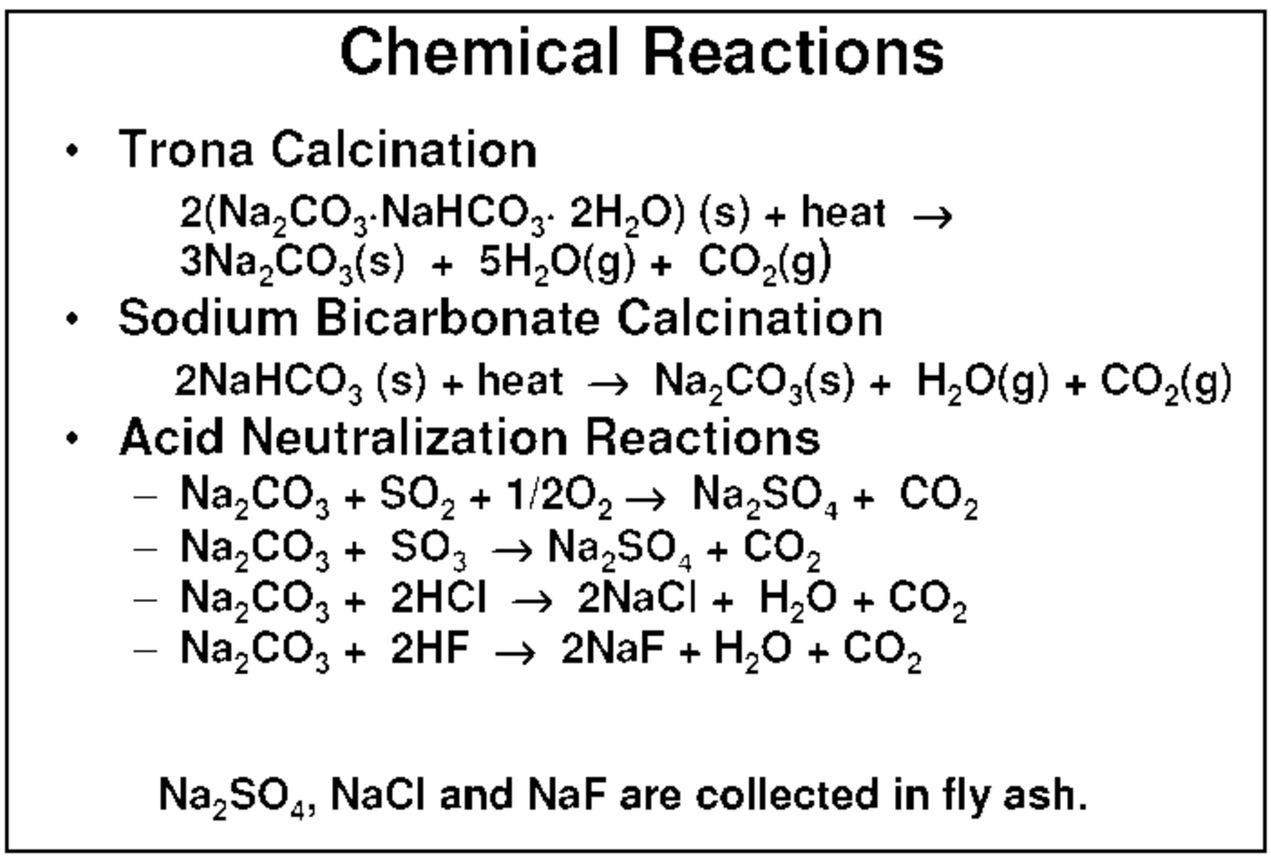
However, creating finer sorbent particles usually involves additional milling equipment, which adds to initial capital cost, with the promise of reasonably quick payback, in terms of avoided increased operating costs.

4.0 Reactions

The various reactions that can occur between the DSI sorbent and the pollutants in the flue gases are summarized below in Figure B.[3]

[3] Comparison of Sodium Bicarbonate and Trona for Multi-Pollutant Control, Yougen Kong and Stan Carpenter, Solvay Chemicals, Electric Power 2010.

Figure B – DSI Reactions



It is important to note that CO2, a greenhouse gas, is a by-product of many of these reactions when sodium-based sorbents are used in DSI. While use of hydrated lime will not create CO2 emissions, the manufacture of hydrated lime elsewhere can create CO2 emissions as well.

Of course, it should also be noted that the reaction products are collected in the fly-ash, which is, along with the unreacted sorbent, collected in the particulate control device downstream. Thus, the chemical and physical properties of the collected particulates from either the baghouse or the ESP change when DSI is added. Since these particulates must be disposed off, typically in existing landfills, understanding the nature of these changes is important. We will discuss this in a little more detail later.

5.0 SO2 Removal Efficiency and Factors

As noted above, SO2 removal efficiency depends on numerous factors. Briefly, these include:[4]

- sorbent injection rate or Normalized Stoichiometric Ratio (NSR);

- sorbent particle size;

- residence time of the sorbent in the flue gas stream (before capture in the PM control device);

- extent of dispersion and mixing of the sorbent and the flue gas;

- the type of PM controls device (ESP versus baghouse). A baghouse allows for longer contact time of the sorbent and the pollutant gases, given the filter cake present in the baghouse. With and ESP, particle size is thus more important;

- flue gas temperature;

- presence of other competing pollutants in the flue gases;

In this subsection we will present some of the more important factors and their impact of the expected SO2 removal efficiency.

In one recent study,[5] the authors evaluated the sensitivity of SO2 removal to trona injection rate, particle size, and injection location. The predicted SO2 reduction ranged from 45-80% and was highly dependent on a parameter called the Normalized Stoichiometric Ratio (in simple terms the multiple by which sorbent must be injected as compared to the theoretical or stoichiometric amount required based on the amount of SO2 present), and trona distribution.

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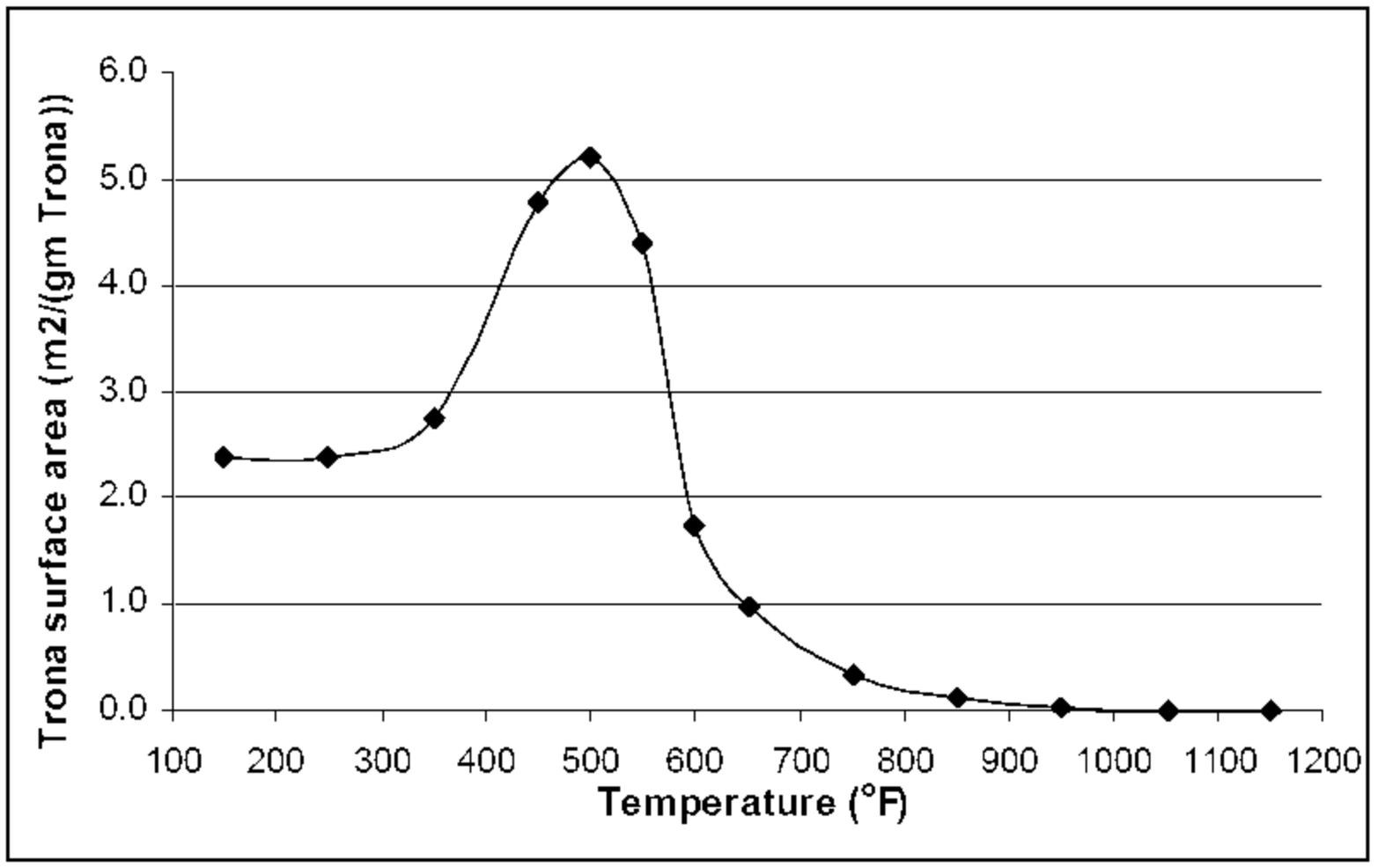
[4] Dry Sorbent Injection of Sodium Sorbents for Acid Gas Mitigation, Heidi E. Davidson, Solvay Chemicals, Inc., International Biomass Expo and Conference, 2010.

[5] Cremer, M. A., et. al., Testing and Model Based Optimization of SO2 Removal With Trona in Coal Fired Utility Boilers, Paper #137.

When a trona particle is introduced into the hot flue gas stream, upon decomposition to sodium carbonate, the surface area of the particle increases significantly. This behavior is commonly referred as the "popcorn effect". Figure C below shows the particle surface area as a function of temperature. As seen in the figure, the surface area begins to increase at approximately 300F, peaks at approximately 500F, and then decreases for increasing temperature above 500F where the particles begin to sinter. Clearly adding trona at temperatures greater than 800F is not advisable.

Figure C – Trona Particle Surface Area versus Temperature

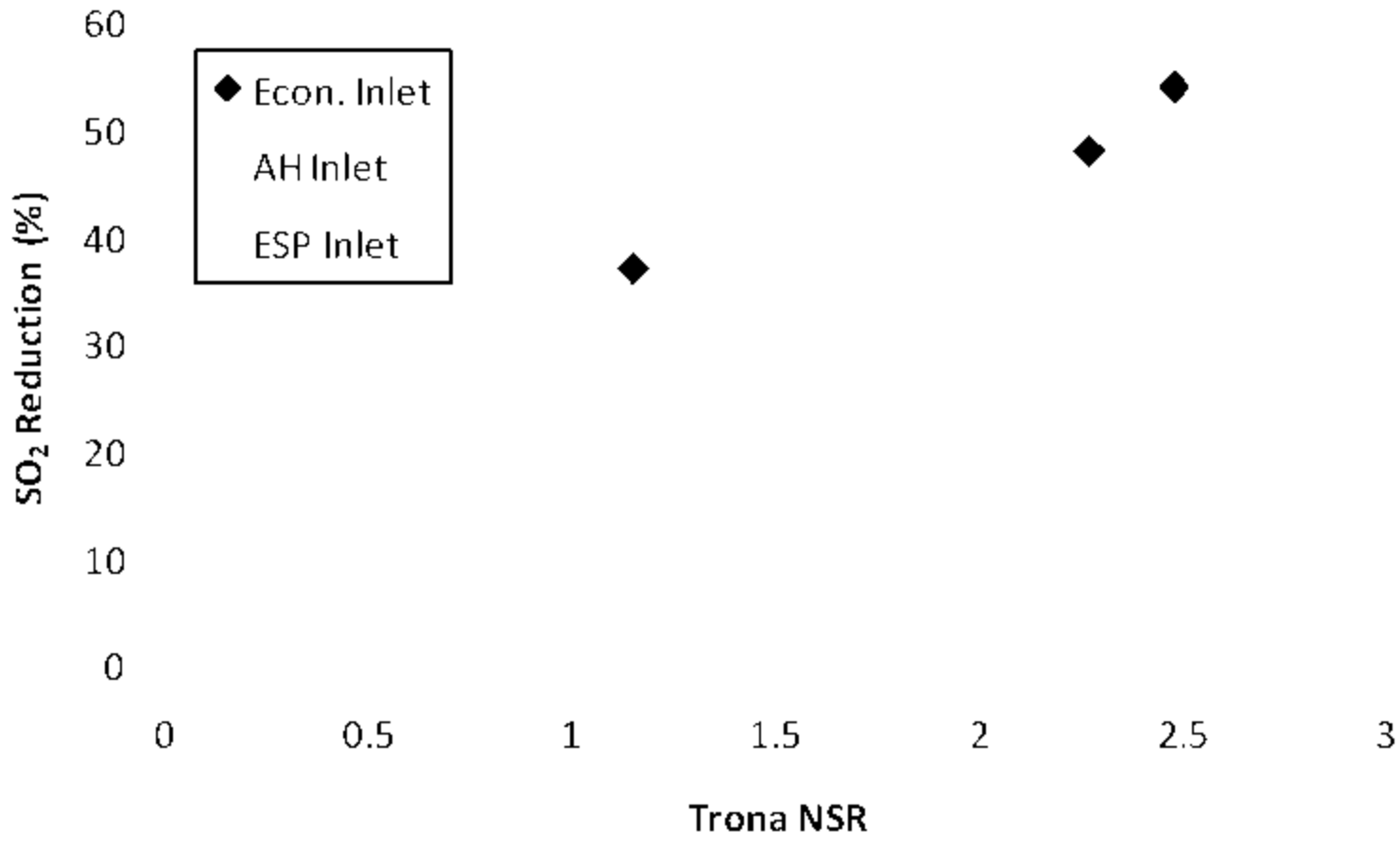


Field tests have been carried out by various vendors and researchers in order to evaluate trona performance for SO2 reduction. In one set of studies the impacts of injection location were evaluated. In particular, trona was injected at the economizer inlet, the air heater inlet, and the ESP inlet. Average gas temperatures at these locations under full load conditions were reported to be 705F, 550F, and 230F. These tests were primarily carried out using the as-received, unmilled Solvay T200 material (D50 = 30 μm). Figure D shows the measured SO2 reductions for these tests. The data show the best performance was achieved for trona injection at the economizer inlet and the worst performance was seen for injection at the ESP inlet. Most of these tests

were carried out for a trona NSR of approximately 2.5 (i.e., 2.5 times more trona than would be needed based on theoretical calculations).

Figure D – Effect of Injection Location on SO2 Removal Efficiency

Figure 5. Measured SO_2 reduction with unmilled trona as a function of NSR and injection location



Another set of tests focused on particle size and the effect of milling the trona. Two pin mills were used either in series or in parallel to supply trona to lances at the economizer inlet. When used in series, the trona was milled to D50 of approximately 11.6 µm. When used in parallel, the D50 was approximately 13.7 µm. Tests were carried out for NSRs ranging from approximately 1 to 3.5. These results were compared against earlier results using unmilled trona and are shown in Figure E.

Although the data are limited, the results indicate, as expected, improved SO2 reduction using the milled trona compared to the unmilled trona. As seen in the figure, measured SO2 reduction up to 74% was observed, but at a high trona injection rate (NSR of 3.5).

Figure E – Effect of Trona Particle Size and NSR on SO2 Removal Efficiency

Figure 6. Measured SO_2 reductions as a function of NSR and milling configuration.

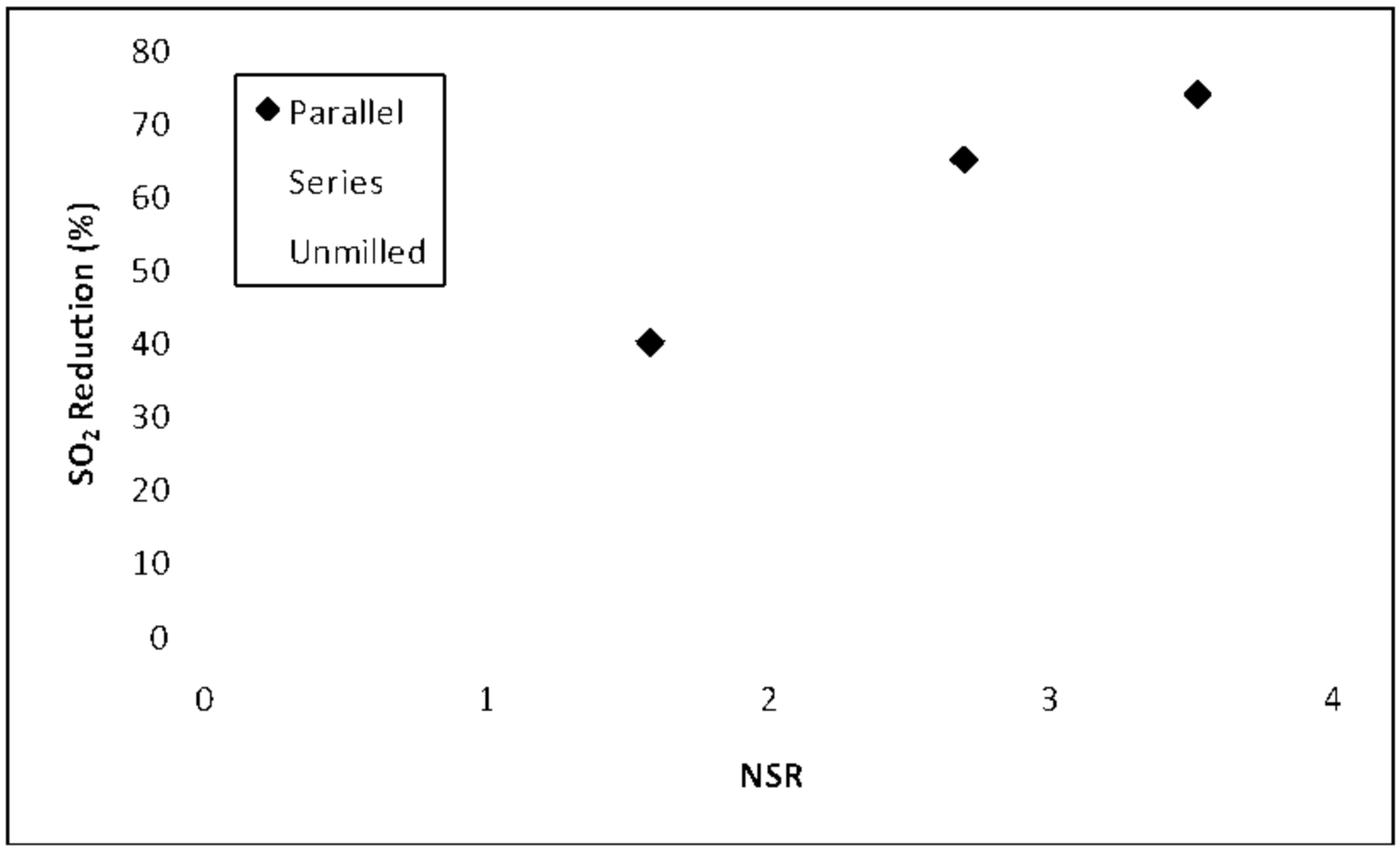
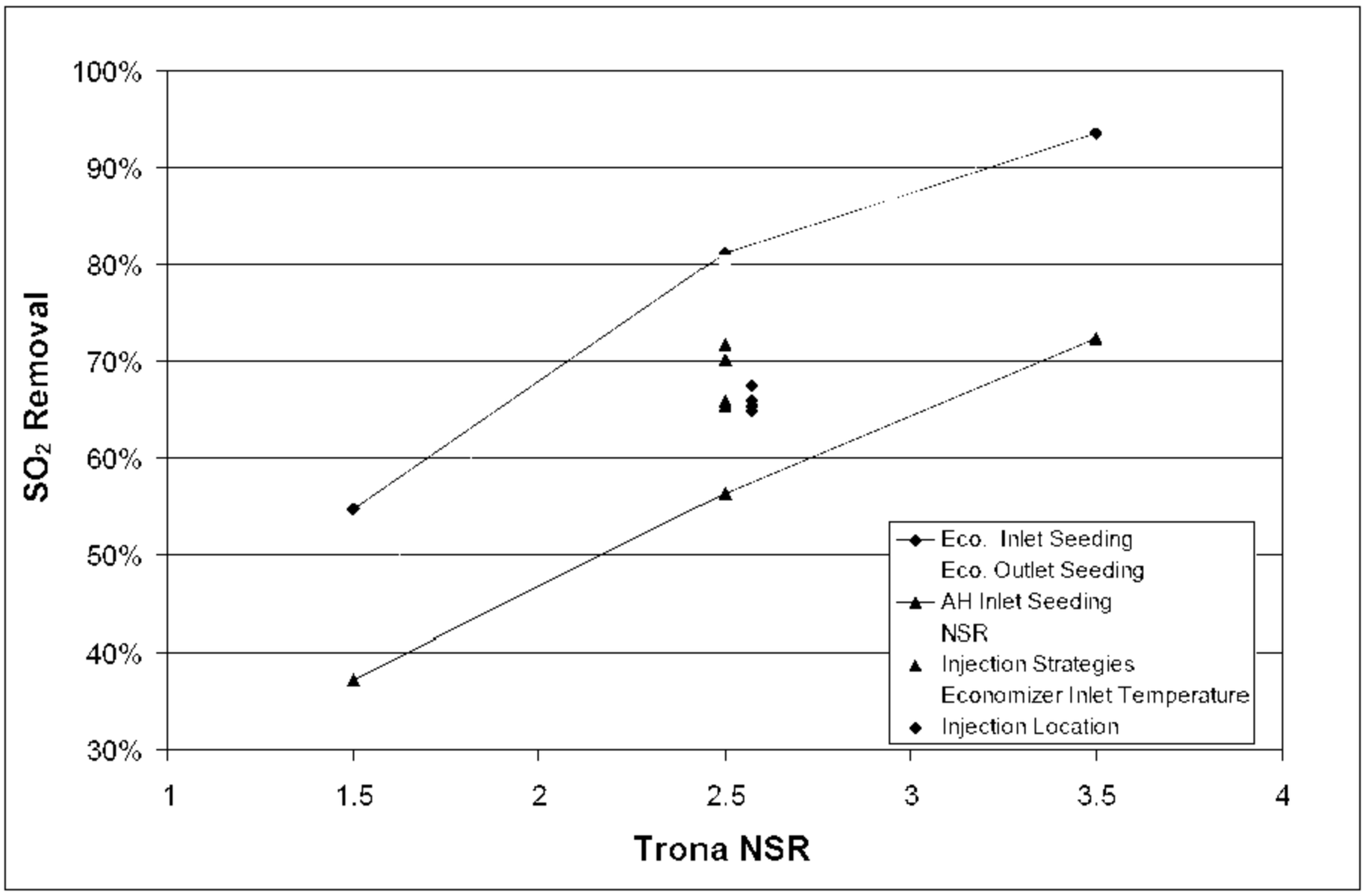


Figure F below combined the effects of various factors into one chart, showing how SO2 removal efficiency is affected by these factors. As can be seen in the figure, achieving 90% or greater SO2 removal efficiency is not generally feasible. Second, it should also be noted that even achieving SO2 removal efficiencies of 70% or greater requires significantly greater quantities of trona injection (high NSR values). This increases the operating cost of DSI since it requires greater quantities of trona purchase, increased milling costs, and also higher costs of waste disposal. The implication of greater quantities of unreacted sorbents in the ash on ash properties will be discussed later.

Figure F – SO2 Removal Efficiency and Various Factors

Figure 12. Predicted impacts of injection location, trona distribution, NSR and gas temperature on SO_2 removal



6.0 DSI Challenges

While the DSI process appears relatively straightforward, is easy to understand, and is lower in capital cost as compared to the other SO2 removal options such as scrubbers, it is not without significant challenges.

As noted earlier, this report does not discuss DSI using calcium based sorbents such as hydrated lime, mainly because of its low SO2 removal efficiency (as compared with the sodium based sorbents such as trona or sodium bicarbonate), so it will not discuss myriad issues and challenges associated with calcium based sorbents.

For sodium based sorbents, the following should be noted:

- plugging and caking – historically, sodium sorbent injection systems have been beset by plugging and caking;

- dehydration – sodium sorbents can dehydrate in the conveying system, making water available for agglomeration and caking;

- thus, heat gain should be minimized in the conveying system. It is critical to use high efficiency compressors in the pneumatic systems and to properly manage the temperature of the conveying fluid since higher temperatures will increase fouling in the conveyance systems

- increased SO2 removal with sodium may result in some NOx formation;

- ash sales may be negatively affected by sodium addition since the ash may not be suitable for applications in concrete or structural fill. Of course, loss of ash sales will affect plant economics and operation costs; and

- ash landfilling may be negatively impacted due to solubility of sodium compounds in the fly ash (i.e., Na2SO4 or Na2CO3).[6]

The last impact is significant and as yet generally unrecognized. Yet, it clearly has the potential for significantly increasing the disposal cost and/or creating significant adverse environmental impacts. Thus, some additional discussion is provided in the next subsection.

7.0 Impact on Ash Solubility

The impact of trona-based ash properties has been recently evaluated in industry sponsored studies.[7] Key conclusions include the following:

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[6] Designing and Operating a Reliable DSI System, Greg Filippelli, ADA-ES, 2012

[7] Jianmin Wang, et. al., Leaching Behavior of Coal Combustion Products and the Environmental Implication in Road Construction, A National University Transportation Center at Missouri University of Science and Technology, NUTC R214, April 2011. This work is sponsored by, among others, the Electric Power Research Institute (EPRI).

- trona injection for SO2 emission control significantly changed the fly ash physical characteristics, including reduced specific surface area, and changed particle morphology and microstructure;

- trona injection for SO2 emission control significantly increased the bulk contents of sodium, sulfur, and carbonate in the fly ash, and brought great amount of soluble materials into the fly ash;

- trona injection for SO2 emission control greatly increased the fly ash solubility, pH, and leachability of anionic elements including fluoride, sulfate, chloride, and trace oxyanions of concern especially Arsenic and Selenium. Compared to the conventional fly ash, trona ash leached significantly more Arsenic and Selenium in all conditions, including varying leaching time, pH, storage time conditions. Multiple factors may contribute to the enhanced Arsenic and Selenium leaching from trona ash, including more alkaline pH, greater ash solubility, reduced surface site density, presence of high concentrations of competing anions (such as sulfate and carbonate), increased background Selenium concentration, and a greater Selenium(VI) fraction in trona ash.

The implications are obvious. Since most plants, even including those that are able to sell some of their fly ash, dispose ofthe bulk of their fly ash in local, unlined landfills, increased solubility of this fly ash, with trona injection, will likely increase the leachability of metals such as arsenic and selenium into groundwater below such landfills. Thus, this impact should be carefully evaluated before DSI is considered as a proper or appropriate SO2 reduction technology.

Developing Alternate SSM Limits and Work Practices – Coal Units

[for EPA SSM SIP Call]

Report

By

Dr. Ranajit (Ron) Sahu[1]

Item 2. Control Equipment Characteristics

In this section, we provide brief descriptions of the more important "add-on" air pollution controls used on coal-fired electric generating units[2] in order to reduce pollutant emissions. The purpose of this section is to provide a context for discussing the operational range, and the startup[3]/shutdown characteristics of the respective controls.

The following controls [and the affected pollutant] will be discussed:

- Selective Catalytic Reduction (SCR), [NOx]

- Selective Non-Catalytic Reduction (SNCR), [NOx]

- Wet Flue Gas Desulfurization (WFGD), [SO2]

- Dry Flue Gas Desulfurization, DFGD, [SO2]

- Dry Sorbent Injection, (DSI) [HCl and SO2]

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[1] See Ron Sahu Resume attached.

[2] We focus on that portion of the coal fleet which consists of pulverized coal (PC) units. Thus, we do not focus on circulating or bubbling fluidized bed boilers (CFB/BFB). In general, CFB/BFB units are smaller and often burn waste coal or other fuels. As such, electricity generation from CFB/BFB units is a very small fraction as compared to PC units.

[3] Startups at coal units can generally be classified as cold, warm, or hot depending on the length of time the unit was not burning fuel prior to the startup in question. While exact definitions of these terms vary with practice and operator, a unit is considered to have a hot start if it was offline for 24 hours or less before the start in question. It is considered to have a warm start if the preceding offline period was 24-119 hours and it is considered to undergo a cold start if was offline for 120 hours or more prior to the start. Per citation provided in Kokopeli, P., et. al., Assessment of startup period at coal-fired electric generating units, US EPA. June 17, 2013.

- Activated Carbon Injection (ACI), [Hg]

- Dry Electrostatic Precipitator (ESP) [PM]

- Fabric Filter, (FF) [PM]

Several variants of the controls noted above, are used in the PC coal fleet in the US. Several different types of WFGD are in use, with the most common being the spray absorber type. Similarly, many different types of DFGD are also in use – such as spray dryers and circulating bed dryers etc. Finally, while most ESPs are located on the "cold-side," (i.e., after the air pre-heater), in some units hot-side ESPs are in use. We discuss the most common configurations, as applicable.

2.1 SCR

SCR consists of a catalyst bed over which the exhaust flue gases pass, after being pre-mixed with a reducing agent such as ammonia. Reactions of the NOx present in the flue gases and ammonia in the presence of the catalyst can reduce significant a portion (between 85% to 95%) of the NOx, to harmless nitrogen. However, in order for the catalytic reactions to occur, the catalyst (and, by extension the flue gases) must be present within a proper temperature range. Most of the SCRs in the US coal fleet are located just after the flue gases exit the boiler (i.e., after the economizer section) and prior to the air pre-heater. This is often called the hot-side location.[4] Typically, exhaust flue gases in this location have the proper temperature range to warm up the catalyst, which can then effect the desired NOx reduction reactions.

While SCR catalysts can, when properly designed, provide significant NOx reduction benefits, SCRs only work if: (a) the flue gases pass through the catalyst beds (i.e., the gases do not bypass the SCR – by design or operation); (ii) the gases are pre-mixed with the reducing agent (i.e., by stopping the addition of the reducing agent, the SCR

[4] A very small number of units have SCRs located at the very end of the air pollution train, after the particulate control devices, where the gases are quite low in temperature – often called the "tail-end" configuration. While this has the benefit of lower particulate loads on the SCR catalyst, the flue gases must then be reheated in some fashion to allow the SCR reactions. Such reheating can reduce unit efficiency and increase operating costs.

reactions do not occur); and (iii) the SCR catalyst is in the proper temperature range. As to the last, often the critical temperature of the flue gas that can provide the proper minimum catalyst operating temperature is the so-called Minimum Operating Temperature (MOT).

Clearly, the lower the MOT, the earlier the SCR can be "turned on" during startup (i.e., the earlier the reducing agent can be injected and the desired reducing reactions enabled) and the later the SCR can be "turned off" during shutdown – thus providing the greatest benefits. The MOT of the SCR catalyst is, to a degree, a design and operating parameter. While it is conventionally considered to be around 600 F (+/-), the MOT can be as low as around 400 F. Please see Attachment A for more discussion on this, including the factors that affect the MOT – such as the sulfur content of the coal and the ability of the catalyst to oxidize sulfur dioxide in the flue gas to sulfur trioxide.

In a review of SCR performance of existing units (using operating data from 2011 and 2012), EPA concluded[5] that SCRs, on average, were able to reduce NOx 2-4 hours or so after the generation of electricity at coal units.[6] Best performing units were able to do so less than 2 hours after electricity generation, when unit loads were 25% or less.

Several strategies can be used to obtain flue gas temperatures greater than the MOT (and thereby obtain the benefits of NOx reduction sooner during startup and later during shutdown; and also obtain the NOx reduction benefits during periods of low load, when ordinarily the flue gas temperatures are lower than the MOT).

Two types of bypass in the economizer section of the boiler can be employed that will increase the temperature at the SCR catalyst so that the critical temperature required for reducing agent injection is reached at lower loads. One technology is "hot water" bypass where part of the economizer is not used or feedwater heaters are bypassed to increase the water temperature going to the economizer which in turn increases the flue gas temperature entering the SCR. The second bypass technology uses flue gas

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[5] Kokopeli, P., et. al., Assessment of startup period at coal-fired electric generating units, US EPA. June 17, 2013.

[6] *Ibid.*, EPA noted that the time between fossil fuel combustion and start of generation was less than 9 hours. An examination of the data presented by EPA indicates that best performing units were generating electricity within 1 or 2 hours after start of fossil fuel combustion – certainly for warm or hot starts.

taken from the boiler as it is entering the economizer section, where the gas temperature is greater than 800°F, and mixes it with the flue gas exiting the economizer section to increase the flue gas temperature entering the SCR. While both of these strategies can affect unit efficiency to some degree, the trade-off is more NOx reduction. See Attachment A for more discussion on inlet flue gas temperature and SCR NOx reduction.

Alternatively, boiler combustion modifications can be implemented to minimize NOx production until the SCR can be placed into operation. Overfire air and/or low NOx burners that are present in all coal units can be utilized to minimize NOx emissions during startup and shutdown operation.

Finally, in some cases, to avoid emissions of "blue plumes" associated with the formation and emissions of sulfuric acid mist, units are injecting a sorbent upstream of an SCR (in effect, DSI, as discussed later) to capture sulfur tri-oxide. Reduction of flue gas sulfur trioxide upstream of the SCR allows a lower MOT, as discussed in Attachment A. Such sorbents are either sodium or calcium based. Sodium is an SCR catalyst poison if condensation occurs at the catalyst (water soluble poison). Calcium-based sorbents may contribute to the formation of gypsum on the surface of the catalyst, which masks the active sites responsible for NOx reduction. Effects can be mitigated, however, during shutdown by allowing flue gas to flow through the SCR reactor for some minutes after cessation of sorbent injection so the fly ash that remains on the catalyst after shutdown contains less sodium or calcium. While sorbent injection upstream of catalyst may shorten the catalyst life, such effects may be reversible through catalyst regeneration.

2.2 SNCR

Like SCR, SNCR is also considered to be an "add-on," post-combustion NOx reduction method. However, it is implemented within the boiler itself. Like SCR, SNCR reduces NOx through a controlled injection of a reducing agent (like ammonia or urea) – but directly into the combustion gases themselves. No catalyst is used. In order to be effective, SNCR systems reduce NOx when ammonia is injected at flue gas

temperatures between 1600°F and 1800°F, or urea is injected when temperatures are between 1600°F and 2200°F, with 1800°F to 2000°F being the optimal reaction temperature range. Injection at temperatures below these ranges can result in excessive unreacted reducing agents (i.e., ammonia) to slip through the boiler, and injection at higher temperatures will produce less efficient NOx reduction, or in the extreme, even create more NOx by oxidizing the ammonia or urea into NOx (and other species). Under even good conditions, it is difficult to obtain SNCR NOx reductions greater than 65% or so. More commonly, NOx reductions range from 25 to 40% or so.

SNCR systems typically undergo optimization upon installation so that the appropriate system performance guarantees can be met. This optimization includes the set points for which levels of reducing agent injectors will be in service at given boiler load and furnace temperatures. This control arrangement is customized to specific reagent injection rates and is based on boiler load since those loads have to be correlated to furnace temperatures. The controls are often interlocked for each specific system so that the SNCR system will not be allowed to operate until it reaches the defined minimum boiler load. Many systems are installed with a unit control signal that can use a MOT as measured at the furnace exit to determine when the SNCR system can be put into operation.

When boiler load and temperature ranges change based on different coals, combustion controls or other operating conditions, the needed temperature window at a given boiler load point may change location, and may require re-optimization of the system, or a change to the control logic for system operation. High CO levels in the flue gas in the SNCR temperature range can have a significant effect on SNCR performance and can also impact the effective temperature range. Operation of the SNCR system outside the defined temperature range can lead to unreacted reagent in the flue gas, i.e. ammonia slip, which can be detrimental to downstream components including the air preheater, particulate control devices or FGD systems.

The actual low boiler load at which an SNCR system can operate varies from unit to unit based on furnace type and geometry, flue gas velocities, heat transfer rates and combustion conditions. SNCR operation at 25% load from a cold start condition may be

affected by the economizer outlet temperatures. Low temperatures may affect allowable ammonia slip, which can in turn affect NOx reduction levels. Typically, reagent can be injected when the boiler load is at 30% of full load, although some operators do not often go lower than 40% of full load. Additional injectors can be added to allow operation at 30% of full load or lower.

2.3 WFGD

Modern WFGD systems for coal units are typically designed to achieve SO2 reductions ranging from 98% (with low sulfur coals, such as Power River Basic sub-bituminous coals) to greater than 99% control (with medium or high sulfur coals such as Eastern bituminous coals).

Most WFGD systems use recycle spray systems using headers and nozzles to cool the flue gas and to remove acid gases, including SO2, by contacting a sorbent slurry with the flue gas. Most WFGDs have between three to six independent spray header systems and have either fiberglass or plastic components integral to the system.

The plastic or fiberglass has to be protected against high gas temperatures (typically 220 F for fiberglass reinforced plastic (FRP)). One or two of the lower spray headers needs to be turned on once the FGD system manufacture's maximum temperature guideline is reached regardless if the auxiliary fuel or coal is being burned. Flaked glass-lined systems often require a recycle pump in service prior to the introduction of flue gas. A minimum number of recycle pumps should be placed in service at low load conditions to protect the system against a down draft of slurry. Generally, a recycle pump is placed in service when induced draft (ID) fans are placed in service and reagent addition placed in automatic mode. If the absorber inlet is not properly designed, the downdraft may result in slurry carryover into the inlet ductwork causing buildup.

The above notwithstanding, operating units with WFGD systems are capable of maintaining SO2 emissions during the entire startup and shutdown operating periods – i.e., the WGD can be turned on at the beginning of startup and can be turned off at

the conclusion of shutdown. This is confirmed by EPA's analysis of the US PC coal fleet operating data, previously referenced.[7]

2.4 DFGD

DFGD systems in use in the US coal fleet can be broadly grouped into two general categories; spray dryer absorbers (SDA) and circulating dry scrubbers (SDS). For the purpose of this discussion, a third variant (called the Novel Integrated Desulfurization (NID) system[8]) is grouped with CDS type as the technology and operating conditions are similar.

Modern DFGD systems can be designed to achieve SO2 reduction in the range of 80% (for low sulfur coals) to greater than 95% (for medium to high sulfur coals).

Both SDA and CDS systems have a common design feature – both have an absorber vessel followed by, in most units, a baghouse (for removal of the resulting "dry" products of the SO2 reduction reactions). SDA systems use injected lime slurry into the absorber while CDS systems use a dry hydrated lime sorbent and separate water injection.

This difference results in different startup conditions for these two systems. Neither system can be operated with slurry or water addition at low temperatures because of the potential for corrosion in the ductwork and baghouse.

Generally, these systems are operated at a 30-40 F approach temperature to saturation. In an SDA system since a wet lime slurry is being injected a minimum flue gas flow and temperature has to be maintained – otherwise the lime slurry will build up on the walls of the absorber vessel which can cause structural damage or pluggage in the vessel. Typically, current practice requires that operators not turn on their SDA lime slurry unit they have a minimum of 250 F gas temperature and approximately 50% of design flow. However, during normal startup operators do experience some SO2, SO3, HCl, and Hg removal due to some residual lime coating the bags in the baghouse.

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[7] Kokopeli, P., et. al., Assessment of startup period at coal-fired electric generating units, US EPA. June 17, 2013.

[8] NID was developed by Alstom, an OEM of various pollution control equipment.

Particulate removal can be maintained during startup and shutdown operating periods.

A CDS system is typically operated in a different mode than an SDA. In a CDS lime can be injected during startup as soon as the lime can be suspended in the absorber vessel. This suspended hydrated lime will remove some SO2 even without water injection. Water for cooling and assisting the lime in absorbing additional SO2 is then injected when the flue gas reaches 180°F dependent on flue gas properties. Depending on different OEM designs and specification requirements, flue gas flow normally required to support the circulating a bed in the CDS would be about 50% of the design flow. However, flue gas recirculation can be utilized to reduce the boiler flow to 25% or lower. We recognize that utilizing flue gas recirculation at reduced loads may restrict how much water can be added to the system as the combined flue gas temperature to the CDS decreases when mixed with the cooler recirculation gas.

For an integrated system of a fabric filter with a spray dryer absorber (SDA) upstream, the potential for acid condensation in the fabric filter can be greatly reduced with the startup procedure requiring the spray dryer be in operation at the same time as the fabric filter. However, if the temperature of the flue gas is too low entering the spray dryer, lime slurry may not dry fully in the absorber and will coat the walls of the absorber vessel and allow carryover of moist reagent and ash into the fabric filter with the potential of blinding the filter bags. This is not desirable and should be avoided. Thus, as discussed previously, it is important to develop startup and shutdown procedures for multiple installed APC systems treated as an integrated system with not only the boiler flue gas characteristics in mind but also the effect on APC equipment operation upstream of each APC system. The aforementioned approach temperature is a key parameter that can be monitored to enable optimal operation of both the DFGD and the baghouse.

EPA's analysis of units equipped with DFGDs shows that, for supercritical coal units, they were effective commensurate with electricity generation while at subcritical units, they

were effective within 3-4 hours of electricity generation – with best performing units doing considerably better.[9]

2.5 DSI

DSI involves the injection of a dry fine powder, calcium- or sodium-based reagent directly into the gas path after the exhaust gases exit the boiler. DSI is used primarily to remove acid gases such as HCl and SO3, while also providing some SO2 removal as well. Additional details are provided in Attachment B.

If DSI is the primary method for acid gas removal, it should be started once minimum flow and temperature requirements are met, and then operated on a predetermined load related curve developed by the vendor specific to the unit. The effectiveness of the DSI system to maintain emissions is dependent on flow distribution and operating temperature range.

Depending on different original equipment manufacturer (OEM) designs and specification requirements, minimum flue gas flow normally required to keep the injected sorbent (calcium/sodium or carbon) in suspension and off the duct floor would be about 50% of the design flow. However, flue gas mixing can be utilized to keep sorbent suspended at 25% design flow. Sodium sorbents require a minimum temperature to be effective including trona, which requires flue gas temperature to be greater than 290 F at the point of injection. See Attachment B.

DSI can have significant benefits during startup, shutdown, and cycling load periods. One benefit is that DSI can reduce corrosion that might occur during low load conditions. A second benefit, discussed earlier, is that DSI can be used to reduce the minimum operating temperature when SCRs can begin injecting ammonia and thus begin reducing NOx. Finally, DSI can be used as a tool to reduce maintenance periods, especially with regard to air preheater cleanliness by reducing ammonium bisulfite formation.

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[9] Kokopeli, P., et. al., Assessment of startup period at coal-fired electric generating units, US EPA. June 17, 2013.

2.6 ACI

There are currently two predominant forms of injected sorbent mercury control agents, powdered activated carbon (PAC) which is available in both brominated and non-brominated forms and non-carbon based powdered reagents. By far, the carbon sorbents are most common.

Powdered mercury control sorbents are injected using conveying air into the gas path outside of the boiler. Injection points range from upstream of the air preheater to downstream of a primary particulate collector or upstream of a scrubber. The material is conveyed from its storage point through piping or tubing to a series of lances that distributes the material into the flue gas stream.

Upon startup or shutdown of a unit, before beginning duct injection of a powdered sorbent material or in determining when to cease injection, certain conditions should be met. Suppliers and manufacturers provide recommendations on procedures, and may need to be consulted for the final configuration and process operation related to their materials.

A brief list of relevant parameters includes:

- carrying velocity - determines whether there is sufficient carrying velocity to convey the material in the duct without significant fallout. In turn, this will depend on the sorbent characteristics, including particle size range, of the material itself as well as in-duct flue gas conditions. For carbon sorbents, typically the minimum conveying velocity for dilute phase flow is 2000-2400 ft/min.

- condensation - depends on the moisture content of the flue gas and creates a potential for condensation in equipment, resulting in pluggage if sorbent is turned on prematurely. The equipment temperatures need to be high enough during injection to avoid condensation.

- particulate collector operation - since the injected sorbents are collected downstream in either the primary particulate collector or a scrubber, these

downstream emission control devices should be operating normally when injecting a powdered material.

2.7 ESP

ESPs are particulate control devices that rely on the mechanism that particulates, once electrically charged, can then be removed from the gas path by subjecting them to an electric field. Typically, an ESP consists of a charging section in which high voltage corona discharges are used to impact electric charge onto particles as the gases pass through the corona. The charged particles are then subsequently removed by passing the gases through an electric field, most commonly present between parallel plates.

In the US coal fleet, ESPs are primarily present in older, smaller units. Most newer units tend to have fabric filters or baghouses for particulate matter control. Given how ESPs and fabric filters operate, the latter are more robust and also more efficient. While either control can achieve very high levels of removal efficiency (greater than 99%), fabric filters can achieve levels greater than 99.9% removal which ESPs can achieve removal levels that are slightly lower.

Flue gas temperature has a major effect on ESP operation and its mechanical and electrical integrity. In the US coal fleet, it is typical that ESPs are not energized (i.e., therefore particles cannot be charged nor can they be removed from the gas stream) until the flue gas temperature reaches a specified minimum – either by the OEM for the ESP or based on operating practices by the operator. The rationale is that if the ESP high voltage power supplies are energized prior to the flue gas being above the acid dew point temperature, there is a high probability that wet ash particles will be collected on the emitting and collecting electrodes and hopper walls which is extremely difficult to remove with electrode rapping. When this material is subsequently dried upon reaching normal operating temperatures, the material can form hard crusty deposit firmly cemented to the ESP electrodes. With the 'fouling' of the electrodes, ESP collection efficiency will be reduced to a degree depending on the amount of ash buildup.

Thus, conventional wisdom in the industry is that boiler startup and shutdown are critical periods for the operation of an ESP that can directly and adversely impact on the ESP achieving its design performance and maintaining this performance. In addition to the aforementioned concern relating to flue gas temperature being below the acid dew point, operators also worry about the potential for spontaneous combustion or explosion with existence of unburned combustibles in the flue gas which could be ignited by sparking in the ESP. During boiler start and warm-up, there is the potential for excessive production of carbonaceous material (i.e., unburned carbon from the coal), CO or unburned fuel (such as startup diesel or fuel oil) caused by incomplete combustion. Operators worry that this can create a hazardous condition that could cause conditions for spontaneous combustion or even explosion particularly if there is sparking in the ESP with the ESP energized. This is also a period when excessive oxygen is passing through the system which could potentially exacerbate this condition.

Based on all of this, typical ESPs in the US coal fleet are not energized below a minimum flue gas temperature of 250 F or so.

We note, however, that in at least one instance, ESPs are operating and have been operated during all time periods at a coal plant, including startup and shutdown – without any of the operational issues or safety issues noted above. The Jim Bridger Plant in Point of Rocks, Wyoming, routinely operates its ESPs during startup and shutdown events. As the plant has noted, "[A]lthough the equipment is not fully effective until proper temperatures and stable conditions are reached, startup emissions are minimized by placing the electrostatic precipitator and flue gas desulfurization scrubber in service prior to the introduction of fuel to the boiler (emphasis added).[10] Placing the electrostatic precipitator in service early in the process provides for a reduction in

[10] The operations cover periods of startup and shutdown.

particulate matter emissions. . . ."[11] Further, PacifiCorp, the operator of the Jim Bridger plant, specifically notes that this procedure expressly deviates from the manufacturers recommendations. "Although the equipment is not fully effective until proper temperatures and stable conditions are reached, startup emissions are minimized by placing the electrostatic precipitator and flue gas desulfurization scrubber in service prior to the introduction of fuel to the boiler. PacifiCorp's commitment to fully energize the precipitator prior to bringing the unit up to operating temperature, which is done by first combusting fuel oil followed by gradual introduction of coal, does not follow the Original Equipment Manufacturer (OEM) recommendation. That OEM recommendation calls for energizing the precipitator after the unit is at full operating temperature and combustion of fuel oil has ceased."[12]

The continued safe operation of the units at the Jim Bridger plant[13] demonstrates the feasibility of ESP operation during startup and shutdown is possible by ensuring that the ESP is kept clean and is properly maintained.

2.8 Fabric Filter or Baghouse

Particulate matter collection in a baghouse is effected by flowing the "dirty" exhaust gases past a filter made of suitable fabric material (there are many candidates, depending on gas chemical and physical characteristics). These filters are configured as long tubes or bags – many of which are grouped into compartments in a typical baghouse. Depending on the type of fabric filter (the older shaker or reverse-air types or the current, standard pulse-jet types), particles are literally collected on the surface

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[11] Jim Bridger Plant Startup and Shutdown Minimization Plan. The startup process at the Jim Bridger units is generally similar to that at many other coal units: "Fuel oil is the initial heat input source used during boiler unit startup, and unit startup begins when fuel oil is introduced into the boiler. As the boiler, turbine equipment and steam temperatures rise to design values, coal mills (pulverizers) are gradually placed into service concurrently with fuel oil firing. (Generally, two pulverizers are operational during the end phase of the boiler startup process.) As steam and equipment temperatures continue to rise while co-firing on fuel oil and coal, the boiler combustion process stabilizes adequately such that fuel oil firing can cease. Startup ends no later than the point in time when flue gas temperatures to the electrostatic precipitator reach a temperature of 220°F and two coal pulverizers have been placed into service. Startup does not extend beyond 20 hours per startup period." *Id.*

[12] Decision, In the Matter of a Permit Application (AP-5157) from PacifiCorp to Modify Operations at the Jim Bridger plant, in Sweetwater County, Wyoming. See page 8.

[13] The plant and its units have operated in this matter since at least 2007, when the referenced startup and shutdown plan went into effect.

of the fabric material (which is generally supported in some fashion), which are then periodically cleaned once the gas flow through the baghouse is impeded by increasing pressure drops across the fabric materials. Once cleaned, bags are ready to receive particles once more.

As noted earlier in the ESP discussion, baghouses are the control of choice for particulate matter removal from current or newer coal units. They are more robust and can typically operate at all times, including startup and shutdown.

To the extent there are concerns with a baghouse operating during low load conditions, low flue gas temperatures might result in moisture and damp ash collecting on the filter bags causing an increase in the pressure drop across the "filter cake" due to lower permeability in the particles previously collected.

If such low temperatures persist for an extended period of time (which is not typical or either startup, shutdown, or cycling load operations), there is the risk of permanently blinding the bags, making them unusable. Acid gas condensation with operation below the acid dew point could also lead to premature filter bag failure.

These conditions can be prevented by pre-coating the bags and/or by using a sacrificial chamber on initial startup. Bags may be pre-coated with sorbent from an upstream DSI or CDS system (which mitigated against acid gas damage) or per supplier's recommendation. For existing bags, the best practice is to not remove all the ash before shutdown so there is a protective layer existing for the following startup.

The baghouse for particulate removal does not have any minimum flow or temperature requirements prior to operation to minimize the number of bags that may weakened by operation below the acid dew point. Specific manufacturers may limit the number of compartments in service at reduced temperatures. The bags have a maximum continuous temperature limit dependent on the filter bag medium (for example 375 F for polyphenyl sulfide, PPS, the material most commonly used).

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CONSULTANT, ENVIRONMENTAL AND ENERGY ISSUES

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EXPERIENCE SUMMARY

Dr. Sahu has over twenty five years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment for a wide range of emissions sources including stationary and mobile sources; soils and groundwater remediation including landfills as remedy; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.), multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over twenty three years of project management experience and has successfully managed and executed numerous projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public.

He has provided consulting services to numerous private sector, public sector and public interest group clients. His major clients over the past twenty five years include various trade associations as well as individual companies such as steel mills, petroleum refineries, cement manufacturers, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, and various entities in the public sector including EPA, the US Dept. of Justice, several states, various agencies such as the California DTSC, various municipalities, etc.). Dr. Sahu has performed projects in all 50 states, numerous local jurisdictions and internationally.

Specific to mobile source as well as non-road engine, equipment, and emissions testing, based on his education (Mechanical Engineer, with B.Tech, M.S. and Ph.D) and over two decades of consulting experience for a wide range of clients including trade associates (consisting of equipment manufacturers of lawn and garden, marine, snow, as well as major US and global on-road vehicle manufacturers), Dr. Sahu is very familiar with engine, fuel systems, and air pollution control technologies: for HC+NOx and CO for spark-ignited; and for NOx and PM for compression ignition (i.e., diesel) engines. Second, he is very familiar with relevant EPA (and CARB) testing and regulatory aspects pertaining to non-road and mobile engines and vehicles, including relevant Federal regulations pertaining to diesel emissions testing and test procedures and standards in non-road as well as on-road applications including heavy duty highway engines (40 CFR Part 1065 and relevant portions of 40 CFR Part 86, Subparts A and N), marine diesel engines (40 CFR Part 1065 and 40 CFR Part 94) and locomotives (40 CFR Part 1065 and 40 CFR Part 92 as well as other non-road engines (40 CFR Part 89). His familiarity extends to various testing and standards regulations in spark-ignited non-road engines including recreational vehicles, marine engines, lawn and garden engines, as well as construction equipment engines (40 CFR Part 1065) and to vehicle testing requirements and test procedures in 40 CFR Part 80, 40 CFR Part 86, 40 CFR Part 87, 40 CFR Part 90, 40 CFR Part 1033, 40 CFR Part 1039, 40 CFR 1042, 40 CR Part 1045, 40 CFR Part 1051, 40 CFR Part

1060, 40 CFR Part 1065 and 40 CFR Part 1066. Lastly he is familiar with a wide variety of Federal, California, European, and Japanese dynamometer driving schedules.

In addition to consulting, Dr. Sahu has taught numerous courses in several Southern California universities including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management) for the past seventeen years. In this time period he has also taught at Caltech, his alma mater (various engineering courses), at the University of Southern California (air pollution controls) and at California State University, Fullerton (transportation and air quality).

Dr. Sahu has and continues to provide expert witness services in a number of environmental areas discussed above in both state and Federal courts as well as before administrative bodies (please see Annex A).

EXPERIENCE RECORD

2000-present **Independent Consultant.** Providing a variety of private sector (industrial companies, land development companies, law firms, etc.) public sector (such as the US Department of Justice) and public interest group clients with project management, air quality consulting, waste remediation and management consulting, as well as regulatory and engineering support consulting services.

1995-2000 Parsons ES, **Associate, Senior Project Manager and Department Manager for** Air Quality/Geosciences/Hazardous Waste Groups, Pasadena. Responsible for the management of a group of approximately 24 air quality and environmental professionals, 15 geoscience, and 10 hazardous waste professionals providing full-service consulting, project management, regulatory compliance and A/E design assistance in all areas.

Parsons ES, **Manager for Air Source Testing Services**. Responsible for the management of 8 individuals in the area of air source testing and air regulatory permitting projects located in Bakersfield, California.

1992-1995 Engineering-Science, Inc. **Principal Engineer and Senior Project Manager** in the air quality department. Responsibilities included multimedia regulatory compliance and permitting (including hazardous and nuclear materials), air pollution engineering (emissions from stationary and mobile sources, control of criteria and air toxics, dispersion modeling, risk assessment, visibility analysis, odor analysis), supervisory functions and project management.

1990-1992 Engineering-Science, Inc. **Principal Engineer and Project Manager** in the air quality department. Responsibilities included permitting, tracking regulatory issues, technical analysis, and supervisory functions on numerous air, water, and hazardous waste projects. Responsibilities also include client and agency interfacing, project cost and schedule control, and reporting to internal and external upper management regarding project status.

1989-1990 Kinetics Technology International, Corp. **Development Engineer.** Involved in thermal engineering R&D and project work related to low-NOx ceramic radiant burners, fired heater NOx reduction, SCR design, and fired heater retrofitting.

1988-1989 Heat Transfer Research, Inc. **Research Engineer**. Involved in the design of fired heaters, heat exchangers, air coolers, and other non-fired equipment. Also did research in the area of heat exchanger tube vibrations.

EDUCATION

1984-1988 Ph.D., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1984	M. S., Mechanical Engineering, Caltech, Pasadena, CA.
1978-1983	B. Tech (Honors), Mechanical Engineering, Indian Institute of Technology (IIT) Kharagpur, India

TEACHING EXPERIENCE

Caltech

"Thermodynamics," Teaching Assistant, California Institute of Technology, 1983, 1987.

"Air Pollution Control," Teaching Assistant, California Institute of Technology, 1985.

"Caltech Secondary and High School Saturday Program," - taught various mathematics (algebra through calculus) and science (physics and chemistry) courses to high school students, 1983-1989.

"Heat Transfer," - taught this course in the Fall and Winter terms of 1994-1995 in the Division of Engineering and Applied Science.

“Thermodynamics and Heat Transfer,” Fall and Winter Terms of 1996-1997.

U.C. Riverside, Extension

"Toxic and Hazardous Air Contaminants," University of California Extension Program, Riverside, California. Various years since 1992.

"Prevention and Management of Accidental Air Emissions," University of California Extension Program, Riverside, California. Various years since 1992.

"Air Pollution Control Systems and Strategies," University of California Extension Program, Riverside, California, Summer 1992-93, Summer 1993-1994.

"Air Pollution Calculations," University of California Extension Program, Riverside, California, Fall 1993-94, Winter 1993-94, Fall 1994-95.

"Process Safety Management," University of California Extension Program, Riverside, California. Various years since 1992-2010.

"Process Safety Management," University of California Extension Program, Riverside, California, at SCAQMD, Spring 1993-94.

"Advanced Hazard Analysis - A Special Course for LEPCs," University of California Extension Program, Riverside, California, taught at San Diego, California, Spring 1993-1994.

“Advanced Hazardous Waste Management” University of California Extension Program, Riverside, California. 2005.

Loyola Marymount University

"Fundamentals of Air Pollution - Regulations, Controls and Engineering," Loyola Marymount University, Dept. of Civil Engineering. Various years since 1993.

"Air Pollution Control," Loyola Marymount University, Dept. of Civil Engineering, Fall 1994.

“Environmental Risk Assessment,” Loyola Marymount University, Dept. of Civil Engineering. Various years since 1998.

“Hazardous Waste Remediation” Loyola Marymount University, Dept. of Civil Engineering. Various years since 2006.

University of Southern California

"Air Pollution Controls," University of Southern California, Dept. of Civil Engineering, Fall 1993, Fall 1994.

"Air Pollution Fundamentals," University of Southern California, Dept. of Civil Engineering, Winter 1994.

University of California, Los Angeles

"Air Pollution Fundamentals," University of California, Los Angeles, Dept. of Civil and Environmental Engineering, Spring 1994, Spring 1999, Spring 2000, Spring 2003, Spring 2006, Spring 2007, Spring 2008, Spring 2009.

International Programs

"Environmental Planning and Management," 5 week program for visiting Chinese delegation, 1994.

"Environmental Planning and Management," 1 day program for visiting Russian delegation, 1995.

"Air Pollution Planning and Management," IEP, UCR, Spring 1996.

"Environmental Issues and Air Pollution," IEP, UCR, October 1996.

PROFESSIONAL AFFILIATIONS AND HONORS

President of India Gold Medal, IIT Kharagpur, India, 1983.

Member of the Alternatives Assessment Committee of the Grand Canyon Visibility Transport Commission, established by the Clean Air Act Amendments of 1990, 1992-present.

American Society of Mechanical Engineers: Los Angeles Section Executive Committee, Heat Transfer Division, and Fuels and Combustion Technology Division, 1987-present.

Air and Waste Management Association, West Coast Section, 1989-present.

PROFESSIONAL CERTIFICATIONS

EIT, California (#XE088305), 1993.

REA I, California (#07438), 2000.

Certified Permitting Professional, South Coast AQMD (#C8320), since 1993.

QEP, Institute of Professional Environmental Practice, since 2000.

CEM, State of Nevada (#EM-1699). Expiration 10/07/2017.

PUBLICATIONS (PARTIAL LIST)

"Physical Properties and Oxidation Rates of Chars from Bituminous Coals," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **67**, 275-283 (1988).

"Char Combustion: Measurement and Analysis of Particle Temperature Histories," with R.C. Flagan, G.R. Gavalas and P.S. Northrop, *Comb. Sci. Tech.* **60**, 215-230 (1988).

"On the Combustion of Bituminous Coal Chars," PhD Thesis, California Institute of Technology (1988).

"Optical Pyrometry: A Powerful Tool for Coal Combustion Diagnostics," *J. Coal Quality*, **8**, 17-22 (1989).

"Post-Ignition Transients in the Combustion of Single Char Particles," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **68**, 849-855 (1989).

"A Model for Single Particle Combustion of Bituminous Coal Char." Proc. ASME National Heat Transfer Conference, Philadelphia, **HTD-Vol. 106**, 505-513 (1989).

"Discrete Simulation of Cenospheric Coal-Char Combustion," with R.C. Flagan and G.R. Gavalas, *Combust. Flame*, **77**, 337-346 (1989).

"Particle Measurements in Coal Combustion," with R.C. Flagan, in "**Combustion Measurements**" (ed. N. Chigier), Hemisphere Publishing Corp. (1991).

"Cross Linking in Pore Structures and Its Effect on Reactivity," with G.R. Gavalas in preparation.

"Natural Frequencies and Mode Shapes of Straight Tubes," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Optimal Tube Layouts for Kamui SL-Series Exchangers," with K. Ishihara, Proprietary Report for Kamui Company Limited, Tokyo, Japan (1990).

"HTRI Process Heater Conceptual Design," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Asymptotic Theory of Transonic Wind Tunnel Wall Interference," with N.D. Malmuth and others, Arnold Engineering Development Center, Air Force Systems Command, USAF (1990).

"Gas Radiation in a Fired Heater Convection Section," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1990).

"Heat Transfer and Pressure Drop in NTIW Heat Exchangers," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1991).

"NOx Control and Thermal Design," Thermal Engineering Tech Briefs, (1994).

"From Purchase of Landmark Environmental Insurance to Remediation: Case Study in Henderson, Nevada," with Robin E. Bain and Jill Quillin, presented at the AQMA Annual Meeting, Florida, 2001.

"The Jones Act Contribution to Global Warming, Acid Rain and Toxic Air Contaminants," with Charles W. Botsford, presented at the AQMA Annual Meeting, Florida, 2001.

PRESENTATIONS (PARTIAL LIST)

"Pore Structure and Combustion Kinetics - Interpretation of Single Particle Temperature-Time Histories," with P.S. Northrop, R.C. Flagan and G.R. Gavalas, presented at the AIChE Annual Meeting, New York (1987).

"Measurement of Temperature-Time Histories of Burning Single Coal Char Particles," with R.C. Flagan, presented at the American Flame Research Committee Fall International Symposium, Pittsburgh, (1988).

"Physical Characterization of a Cenospheric Coal Char Burned at High Temperatures," with R.C. Flagan and G.R. Gavalas, presented at the Fall Meeting of the Western States Section of the Combustion Institute, Laguna Beach, California (1988).

"Control of Nitrogen Oxide Emissions in Gas Fired Heaters - The Retrofit Experience," with G. P. Croce and R. Patel, presented at the International Conference on Environmental Control of Combustion Processes (Jointly sponsored by the American Flame Research Committee and the Japan Flame Research Committee), Honolulu, Hawaii (1991).

"Air Toxics - Past, Present and the Future," presented at the Joint AIChE/AAEE Breakfast Meeting at the AIChE 1991 Annual Meeting, Los Angeles, California, November 17-22 (1991).

"Air Toxics Emissions and Risk Impacts from Automobiles Using Reformulated Gasolines," presented at the Third Annual Current Issues in Air Toxics Conference, Sacramento, California, November 9-10 (1992).

"Air Toxics from Mobile Sources," presented at the Environmental Health Sciences (ESE) Seminar Series, UCLA, Los Angeles, California, November 12, (1992).

"Kilns, Ovens, and Dryers - Present and Future," presented at the Gas Company Air Quality Permit Assistance Seminar, Industry Hills Sheraton, California, November 20, (1992).

"The Design and Implementation of Vehicle Scrapping Programs," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, Colorado, June 12, 1993.

"Air Quality Planning and Control in Beijing, China," presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, Ohio, June 19-24, 1994.

Annex A

Expert Litigation Support

1. Occasions where Dr. Sahu has provided Written or Oral testimony before Congress:

(a) In July 2012, provided expert written and oral testimony to the House Subcommittee on Energy and the Environment, Committee on Science, Space, and Technology at a Hearing entitled "Hitting the Ethanol Blend Wall – Examining the Science on E15."

2. Matters for which Dr. Sahu has provided affidavits and expert reports include:

(b) Affidavit for Rocky Mountain Steel Mills, Inc. located in Pueblo Colorado – dealing with the technical uncertainties associated with night-time opacity measurements in general and at this steel mini-mill.

(c) Expert reports and depositions (2/28/2002 and 3/1/2002; 12/2/2003 and 12/3/2003; 5/24/2004) on behalf of the United States in connection with the Ohio Edison NSR Cases. *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).

(d) Expert reports and depositions (5/23/2002 and 5/24/2002) on behalf of the United States in connection with the Illinois Power NSR Case. *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

(e) Expert reports and depositions (11/25/2002 and 11/26/2002) on behalf of the United States in connection with the Duke Power NSR Case. *United States, et al. v. Duke Energy Corp.*, 1:00-CV-1262 (Middle District of North Carolina).

(f) Expert reports and depositions (10/6/2004 and 10/7/2004; 7/10/2006) on behalf of the United States in connection with the American Electric Power NSR Cases. *United States, et al. v. American Electric Power Service Corp., et al.*, C2-99-1182, C2-99-1250 (Southern District of Ohio).

(g) Affidavit (March 2005) on behalf of the Minnesota Center for Environmental Advocacy and others in the matter of the Application of Heron Lake BioEnergy LLC to construct and operate an ethanol production facility – submitted to the Minnesota Pollution Control Agency.

(h) Expert Report and Deposition (10/31/2005 and 11/1/2005) on behalf of the United States in connection with the East Kentucky Power Cooperative NSR Case. *United States v. East Kentucky Power Cooperative, Inc.*, 5:04-cv-00034-KSF (Eastern District of Kentucky).

(i) Affidavits and deposition on behalf of Basic Management Inc. (BMI) Companies in connection with the BMI vs. USA remediation cost recovery Case.

(j) Expert Report on behalf of Penn Future and others in the Cambria Coke plant permit challenge in Pennsylvania.

(k) Expert Report on behalf of the Appalachian Center for the Economy and the Environment and others in the Western Greenbrier permit challenge in West Virginia.

(l) Expert Report, deposition (via telephone on January 26, 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) in the Thompson River Cogeneration LLC Permit No. 3175-04 challenge.

(m) Expert Report and deposition (2/2/07) on behalf of the Texas Clean Air Cities Coalition at the Texas State Office of Administrative Hearings (SOAH) in the matter of the permit challenges to TXU Project Apollo's eight new proposed PRB-fired PC boilers located at seven TX sites.

(n) Expert Testimony (July 2007) on behalf of the Izaak Walton League of America and others in connection with the acquisition of power by Xcel Energy from the proposed Gascoyne Power Plant – at the State of Minnesota, Office of Administrative Hearings for the Minnesota PUC (MPUC No. E002/CN-06-1518; OAH No. 12-2500-17857-2).

(o) Affidavit (July 2007) Comments on the Big Cajun I Draft Permit on behalf of the Sierra Club – submitted to the Louisiana DEQ.

(p) Expert Report and Deposition (12/13/2007) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

(q) Expert Reports and Pre-filed Testimony before the Utah Air Quality Board on behalf of Sierra Club in the Sevier Power Plant permit challenge.

(r) Expert Report and Deposition (October 2007) on behalf of MTD Products Inc., in connection with *General Power Products, LLC v MTD Products Inc.*, 1:06 CVA 0143 (Southern District of Ohio, Western Division) .

(s) Expert Report and Deposition (June 2008) on behalf of Sierra Club and others in the matter of permit challenges (Title V: 28.0801-29 and PSD: 28.0803-PSD) for the Big Stone II unit, proposed to be located near Milbank, South Dakota.

(t) Expert Reports, Affidavit, and Deposition (August 15, 2008) on behalf of Earthjustice in the matter of air permit challenge (CT-4631) for the Basin Electric Dry Fork station, under construction near Gillette, Wyoming before the Environmental Quality Council of the State of Wyoming.

(u) Affidavits (May 2010/June 2010 in the Office of Administrative Hearings))/Declaration and Expert Report (November 2009 in the Office of Administrative Hearings) on behalf of NRDC and the Southern Environmental Law Center in the matter of the air permit challenge for Duke Cliffside Unit 6. Office of Administrative Hearing Matters 08 EHR 0771, 0835 and 0836 and 09 HER 3102, 3174, and 3176 (consolidated).

(v) Declaration (August 2008), Expert Report (January 2009), and Declaration (May 2009) on behalf of Southern Alliance for Clean Energy in the matter of the air permit challenge for Duke Cliffside Unit 6. *Southern Alliance for Clean Energy et al., v.*

Duke Energy Carolinas, LLC, Case No. 1:08-cv-00318-LHT-DLH (Western District of North Carolina, Asheville Division).

(w) Declaration (August 2008) on behalf of the Sierra Club in the matter of Dominion Wise County plant MACT.us

(x) Expert Report (June 2008) on behalf of Sierra Club for the Green Energy Resource Recovery Project, MACT Analysis.

(y) Expert Report (February 2009) on behalf of Sierra Club and the Environmental Integrity Project in the matter of the air permit challenge for NRG Limestone's proposed Unit 3 in Texas.

(z) Expert Report (June 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*

(aa) Expert Report (August 2009) on behalf of Sierra Club and the Southern Environmental Law Center in the matter of the air permit challenge for Santee Cooper's proposed Pee Dee plant in South Carolina).

(bb) Statements (May 2008 and September 2009) on behalf of the Minnesota Center for Environmental Advocacy to the Minnesota Pollution Control Agency in the matter of the Minnesota Haze State Implementation Plans.

(cc) Expert Report (August 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

(dd) Expert Report and Rebuttal Report (September 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

(ee) Expert Report (December 2009) and Rebuttal reports (May 2010 and June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

(ff) Pre-filed Testimony (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

(gg) Pre-filed Testimony (July 2010) and Written Rebuttal Testimony (August 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

(hh) Expert Report (August 2010) and Rebuttal Expert Report (October 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Liability Phase.

(ii) Declaration (August 2010), Reply Declaration (November 2010), Expert Report (April 2011), Supplemental and Rebuttal Expert Report (July 2011) on behalf of the United States in the matter of DTE Energy Company and Detroit Edison Company

(Monroe Unit 2). *United States of America v. DTE Energy Company and Detroit Edison Company*, Civil Action No. 2:10-cv-13101-BAF-RSW (Eastern District of Michigan).

(jj) Expert Report and Deposition (August 2010) as well as Affidavit (September 2010) on behalf of Kentucky Waterways Alliance, Sierra Club, and Valley Watch in the matter of challenges to the NPDES permit issued for the Trimble County power plant by the Kentucky Energy and Environment Cabinet to Louisville Gas and Electric, File No. DOW-41106-047.

(kk) Expert Report (August 2010), Rebuttal Expert Report (September 2010), Supplemental Expert Report (September 2011), and Declaration (November 2011) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (District of Colorado).

(ll) Written Direct Expert Testimony (August 2010) and Affidavit (February 2012) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

(mm) Deposition (August 2010) on behalf of Environmental Defense, in the matter of the remanded permit challenge to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

(nn) Expert Report, Supplemental/Rebuttal Expert Report, and Declarations (October 2010, November 2010, September 2012) on behalf of New Mexico Environment Department (Plaintiff-Intervenor), Grand Canyon Trust and Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. Public Service Company of New Mexico* (PNM), Civil No. 1:02-CV-0552 BB/ATC (ACE) (District of New Mexico).

(oo) Expert Report (October 2010) and Rebuttal Expert Report (November 2010) (BART Determinations for PSCo Hayden and CSU Martin Drake units) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

(pp) Expert Report (November 2010) (BART Determinations for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

(qq) Declaration (November 2010) on behalf of the Sierra Club in connection with the Martin Lake Station Units 1, 2, and 3. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Case No. 5:10-cv-00156-DF-CMC (Eastern District of Texas, Texarkana Division).

(rr) Pre-Filed Testimony (January 2011) and Declaration (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

(ss) Declaration (February 2011) in the matter of the Draft Title V Permit for RRI Energy MidAtlantic Power Holdings LLC Shawville Generating Station (Pennsylvania), ID No. 17-00001 on behalf of the Sierra Club.

(tt) Expert Report (March 2011), Rebuttal Expert Report (June 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

(uu) Declaration (April 2011) and Expert Report (July 16, 2012) in the matter of the Lower Colorado River Authority (LCRA)'s Fayette (Sam Seymour) Power Plant on behalf of the Texas Campaign for the Environment. *Texas Campaign for the Environment v. Lower Colorado River Authority,* Civil Action No. 4:11-cv-00791 (Southern District of Texas, Houston Division).

(vv) Declaration (June 2011) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

(ww) Expert Report (June 2011) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

(xx) Declaration (August 2011) in the matter of the Sandy Creek Energy Associates L.P. Sandy Creek Power Plant on behalf of Sierra Club and Public Citizen. *Sierra Club, Inc. and Public Citizen, Inc. v. Sandy Creek Energy Associates, L.P.,* Civil Action No. A-08-CA-648-LY (Western District of Texas, Austin Division).

(yy) Expert Report (October 2011) on behalf of the Defendants in the matter of *John Quiles and Jeanette Quiles et al. v. Bradford-White Corporation, MTD Products, Inc., Kohler Co., et al.,* Case No. 3:10-cv-747 (TJM/DEP) (Northern District of New York).

(zz) Declaration (February 2012) and Second Declaration (February 2012) in the matter of *Washington Environmental Council and Sierra Club Washington State Chapter v. Washington State Department of Ecology and Western States Petroleum Association,* Case No. 11-417-MJP (Western District of Washington).

(aaa) Expert Report (March 2012) and Supplemental Expert Report (November 2013) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.,* Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

(bbb) Declaration (March 2012) in the matter of *Center for Biological Diversity, et al. v. United States Environmental Protection Agency,* Case No. 11-1101 (consolidated with 11-1285, 11-1328 and 11-1336) (US Court of Appeals for the District of Columbia Circuit).

(ccc) Declaration (March 2012) in the matter of *Sierra Club v. The Kansas Department of Health and Environment*, Case No. 11-105,493-AS (Holcomb power plant) (Supreme Court of the State of Kansas).

(ddd) Declaration (March 2012) in the matter of the Las Brisas Energy Center *Environmental Defense Fund et al., v. Texas Commission on Environmental Quality,* Cause No. D-1-GN-11-001364 (District Court of Travis County, Texas, 261st Judicial District).

(eee) Expert Report (April 2012), Supplemental and Rebuttal Expert Report (July 2012), and Supplemental Rebuttal Expert Report (August 2012) on behalf of the states of New Jersey and Connecticut in the matter of the Portland Power plant *State of New Jersey and State of Connecticut (Intervenor-Plaintiff) v. RRI Energy Mid-Atlantic Power Holdings et al.,* Civil Action No. 07-CV-5298 (JKG) (Eastern District of Pennsylvania).

(fff) Declaration (April 2012) in the matter of the EPA's EGU MATS Rule, on behalf of the Environmental Integrity Project.

(ggg) Expert Report (August 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Harm Phase.

(hhh) Declaration (September 2012) in the Matter of the Application of *Energy Answers Incinerator, Inc.* for a Certificate of Public Convenience and Necessity to Construct a 120 MW Generating Facility in Baltimore City, Maryland, before the Public Service Commission of Maryland, Case No. 9199.

(iii) Expert Report (October 2012) on behalf of the Appellants (Robert Concilus and Leah Humes) in the matter of Robert Concilus and Leah Humes v. Commonwealth of Pennsylvania Department of Environmental Protection and Crawford Renewable Energy, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2011-167-R.

(jjj) Expert Report (October 2012), Supplemental Expert Report (January 2013), and Affidavit (June 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

(kkk) Pre-filed Testimony (October 2012) on behalf of No-Sag in the matter of the North Springfield Sustainable Energy Project before the State of Vermont, Public Service Board.

(lll) Pre-filed Testimony (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

(mmm) Expert Report (February 2013) on behalf of Petitioners in the matter of Credence Crematory, Cause No. 12-A-J-4538 before the Indiana Office of Environmental Adjudication.

(nnn) Expert Report (April 2013), Rebuttal report (July 2013), and Declarations (October 2013, November 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

(ooo) Declaration (April 2013) on behalf of Petitioners in the matter of *Sierra Club, et al., (Petitioners) v Environmental Protection Agency et al. (Resppondents),* Case No., 13-1112, (Court of Appeals, District of Columbia Circuit).

(ppp) Expert Report (May 2013) and Rebuttal Expert Report (July 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

(qqq) Declaration (August 2013) on behalf of A. J. Acosta Company, Inc., in the matter of *A. J. Acosta Company, Inc., v. County of San Bernardino*, Case No. CIVSS803651.

(rrr) Comments (October 2013) on behalf of the Washington Environmental Council and the Sierra Club in the matter of the Washington State Oil Refinery RACT (for Greenhouse Gases), submitted to the Washington State Department of Ecology, the Northwest Clean Air Agency, and the Puget Sound Clean Air Agency.

(sss) Statement (November 2013) on behalf of various Environmental Organizations in the matter of the Boswell Energy Center (BEC) Unit 4 Environmental Retrofit Project, to the Minnesota Public Utilities Commission, Docket No. E-015/M-12-920.

(ttt) Expert Report (December 2013) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

(uuu) Expert Testimony (December 2013) on behalf of the Sierra Club in the matter of Public Service Company of New Hampshire Merrimack Station Scrubber Project and Cost Recovery, Docket No. DE 11-250, to the State of New Hampshire Public Utilities Commission.

(vvv) Expert Report (January 2014) on behalf of Baja, Inc., in *Baja, Inc., v. Automotive Testing and Development Services, Inc. et. al*, Civil Action No. 8:13-CV-02057-GRA (District of South Carolina, Anderson/Greenwood Division).

(www) Declaration (March 2014) on behalf of the Center for International Environmental Law, Chesapeake Climate Action Network, Friends of the Earth, Pacific Environment, and the Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. the Export-Import Bank (Ex-Im Bank) of the United States*, Civil Action No. 13-1820 RC (District Court for the District of Columbia).

(xxx) Declaration (April 2014) on behalf of Respondent-Intervenors in the matter of *Mexichem Specialty Resins Inc., et al., (Petitioners) v Environmental Protection Agency et al.,* Case No., 12-1260 (and Consolidated Case Nos. 12-1263, 12-1265, 12-1266, and 12-1267), (Court of Appeals, District of Columbia Circuit).

(yyy) Direct Prefiled Testimony (June 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17319 (Michigan Public Service Commission).

(zzz) Expert Report (June 2014) on behalf of ECM Biofilms in the matter of the US Federal Trade Commission (FTC) v. ECM Biofilms (FTC Docket #9358).

(aaaa) Direct Prefiled Testimony (August 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of Consumers Energy Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17317 (Michigan Public Service Commission).

(bbbb) Declaration (July 2014) on behalf of Public Health Intervenors in the matter of *EME Homer City Generation v. US EPA* (Case No. 11-1302 and consolidated cases) relating to the lifting of the stay entered by the Court on December 30, 2011 (US Court of Appeals for the District of Columbia).

(cccc) Expert Report (September 2014), Rebuttal Expert Report (December 2014) and Supplemental Expert Report (March 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

(dddd) Expert Report (November 2014) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

(eeee) Pre-filed Direct Testimony (March 2015) and Supplemental Testimony (May 2015) on behalf of Friends of the Columbia Gorge in the matter of the Application for a Site Certificate for the Troutdale Energy Center before the Oregon Energy Facility Siting Council.

(ffff) Expert Report (March 2015) and Rebuttal Expert Report (January 2016) on behalf of Plaintiffs in the matter of *Conservation Law Foundation v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

(gggg) Direct Prefiled Testimony (May 2015) on behalf of the Michigan Environmental Council, the Natural Resources Defense Council, and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Increase its Rates, Amend its Rate Schedules and Rules Governing the Distribution and Supply of Electric Energy and for Miscellaneous Accounting Authority, Case No. U-17767 (Michigan Public Service Commission).

(hhhh) Expert Report (July 2015) and Rebuttal Expert Report (July 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

(iiii) Declaration (August 2015, Docket No. 1570376) in support of "Opposition of Respondent-Intervenors American Lung Association, et. al., to Tri-State Generation's Emergency Motion;" Declaration (September 2015, Docket No. 1574820) in support of "Joint Motion of the state, Local Government, and Public Health Respondent-Intervenors for Remand Without Vacatur," *White Stallion Energy Center, LLC v. US EPA*, Case No. 12-1100 (US Court of Appeals for the District of Columbia).

(jjjj) Expert Report (December 2015) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., Environmental Law and Policy Center, and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13 CV 01181 (US District Court for the Central District of Illinois, Peoria Division).

(kkkk) Expert Report (November 2015) on behalf of Appellants in the matter of *Sierra Club, et al. v. Craig W. Butler, Director of Ohio Environmental Protection Agency ey al.,* ERAC Case No. 14-256814.

3. Occasions where Dr. Sahu has provided oral testimony <u>in depositions, at trial or in similar proceedings</u> include the following:

(llll) Deposition on behalf of Rocky Mountain Steel Mills, Inc. located in Pueblo, Colorado – dealing with the manufacture of steel in mini-mills including methods of air pollution control and BACT in steel mini-mills and opacity issues at this steel mini-mill.

(mmmm) Trial Testimony (February 2002) on behalf of Rocky Mountain Steel Mills, Inc. in Denver District Court.

(nnnn) Trial Testimony (February 2003) on behalf of the United States in the Ohio Edison NSR Cases, *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).

(oooo) Trial Testimony (June 2003) on behalf of the United States in the Illinois Power NSR Case, *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

(pppp) Deposition (10/20/2005) on behalf of the United States in connection with the Cinergy NSR Case. *United States, et* al. *v. Cinergy Corp., et al.*, IP 99-1693-C-M/S (Southern District of Indiana).

(qqqq) Oral Testimony (August 2006) on behalf of the Appalachian Center for the Economy and the Environment re. the Western Greenbrier plant, WV before the West Virginia DEP.

(rrrr) Oral Testimony (May 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) re. the Thompson River Cogeneration plant before the Montana Board of Environmental Review.

(ssss) Oral Testimony (October 2007) on behalf of the Sierra Club re. the Sevier Power Plant before the Utah Air Quality Board.

(tttt) Oral Testimony (August 2008) on behalf of the Sierra Club and Clean Water re. Big Stone Unit II before the South Dakota Board of Minerals and the Environment.

(uuuu) Oral Testimony (February 2009) on behalf of the Sierra Club and the Southern Environmental Law Center re. Santee Cooper Pee Dee units before the South Carolina Board of Health and Environmental Control.

(vvvv) Oral Testimony (February 2009) on behalf of the Sierra Club and the Environmental Integrity Project re. NRG Limestone Unit 3 before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

(wwww) Deposition (July 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*

(xxxx) Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Coleto Creek coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

(yyyy) Deposition (October 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

(zzzz) Deposition (October 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

(aaaaa) Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Tenaska coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH). (April 2010).

(bbbbb) Oral Testimony (November 2009) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

(ccccc) Deposition (December 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

(ddddd) Oral Testimony (February 2010) on behalf of the Environmental Defense Fund re. the White Stallion Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

(eeeee) Deposition (June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

(fffff) Trial Testimony (September 2010) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, State of Maryland, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case in US District Court in the Western District of Pennsylvania. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

(ggggg) Oral Direct and Rebuttal Testimony (September 2010) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

(hhhhh) Oral Testimony (September 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

(iiiii) Oral Testimony (October 2010) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

(jjjjj) Oral Testimony (November 2010) regarding BART for PSCo Hayden, CSU Martin Drake units before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

(kkkkk) Oral Testimony (December 2010) regarding BART for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

(lllll) Deposition (December 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

(mmmmm) Deposition (February 2011 and January 2012) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (D. Colo.).

(nnnnn) Oral Testimony (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

(ooooo) Deposition (August 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

(ppppp) Deposition (July 2011) and Oral Testimony at Hearing (February 2012) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

(qqqqq) Oral Testimony at Hearing (March 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

(rrrrr) Oral Testimony at Hearing (April 2012) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

(sssss) Oral Testimony at Hearing (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

(ttttt) Deposition (March 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

(uuuuu) Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

(vvvvv) Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

(wwwww) Deposition (February 2014) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

(xxxxx) Trial Testimony (February 2014) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.,* Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

(yyyyy) Trial Testimony (February 2014) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

(zzzzz) Deposition (June 2014) and Trial (August 2014) on behalf of ECM Biofilms in the matter of the *US Federal Trade Commission (FTC) v. ECM Biofilms* (FTC Docket #9358).

(aaaaaa) Deposition (February 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

(bbbbbb) Oral Testimony at Hearing (April 2015) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

(cccccc) Deposition (August 2015) on behalf of Plaintiff in the matter of *Conservation Law Foundation (Plaintiff) v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

(dddddd) Testimony at Hearing (August 2015) on behalf of the Sierra Club in the matter of *Amendments to 35 Illinois Administrative Code Parts 214, 217, and 225* before the Illinois Pollution Control Board, R15-21.

(eeeeee) Deposition (May 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

(ffffff) Trial Testimony (October 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

Jennings, Laura M

From: DEP Comments
Sent: Monday, August 01, 2016 4:25 PM
To: Jennings, Laura M
Subject: FW: Comments on Proposed 45 CSR 1
Attachments: 2016-08-01 let to WVDEP re Response to Proposed 45 CSR 1 (B2699816xAB63C).pdf

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Jake Glance

Please consider the environment before printing this email.

From: Blankenship, Anne [mailto:ABlankenship@babstcalland.com]
Sent: Monday, August 01, 2016 2:58 PM
To: DEP Comments <DEP.Comments@wv.gov>
Cc: Rebecca Randolph (rebecca@wvma.com) (rebecca@wvma.com) <rebecca@wvma.com>; emiller@acandsinc.com; ALTMAN, DAVID F (DAVID.F.ALTMAN@chemours.com) <DAVID.F.ALTMAN@chemours.com>; 'Patty Barnhart' <patty@wvma.com>
Subject: Comments on Proposed 45 CSR 1

Dear Public Information Officer,

Please accept these comments on the DEP's proposed 45 CSR 1 on behalf of the West Virginia Manufacturers Association. A hard copy will be delivered to the DEP today as well. Please let me know if you have any questions.

Thank you,

Anne C. Blankenship
Babst Calland
681.205.8955 office
304.419.1435 cell

WEST VIRGINIA MANUFACTURERS ASSOCIATION

August 1, 2016

VIA HAND DELIVERY AND E-MAIL

West Virginia Department of Environmental Protection
Public Information Officer
601 57th St S.E.
Charleston, WV 25304

RE: West Virginia Department of Environmental Protection's Proposed 45 CSR 1 - - *Alternative Emission Limitations During Startup, Shutdown, and Maintenance Operations*

Dear Public Information Officer,

These comments are being submitted by the West Virginia Manufacturers Association ("WVMA") in response to the West Virginia Department of Environmental Protection's ("DEP") proposed 45 CSR 1, Alternative Emission Limitations During Startup, Shutdown, and Maintenance Operations ("proposed rule"). The WVMA is made up of manufacturing facilities throughout the state, including many which expect to be subject to the proposed rule. It is our understanding that the proposed rule was developed in response to "*State Implementation Plans: Response to Petition for Rulemaking; Restatement and Update of EPA's SSM Policy Applicable to SIPs; Finding of Substantial Inadequacy; and SIP Calls to Amend Provisions Applying to Excess Emissions During Periods of Startup, Shutdown and Malfunction,*" 80 Fed. Reg. 33840 (June 12, 2015) ("SSM SIP Call"). The SSM SIP Call found that West Virginia's and 35 other states' SIP provisions were inadequate to meet the Clean Air Act's requirements for periods of startup, shutdown or malfunction. While we understand the need for creating a new protocol for complying with the SSM SIP Call, the WVMA has a number of concerns with the proposed rule, as set forth below.

I. General Comments

The proposed rule sets forth criteria for establishing an alternative emission limitation during periods of startup, shutdown, or maintenance ("SSM"). The WVMA supports the allowance of emission limits that apply specifically during times of SSM when existing emission limits cannot be met. However, the proposed rule creates a burdensome and time consuming

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permitting, recordkeeping and compliance process for allowing alternative emission for events that occur only a fraction of the time a facility is operating. The WVMA suggests that the DEP consider other options for alternative emissions limits during SSM, including the establishment of a minimum threshold of emissions during such times before triggering a permit.

II. Specific Comments

1. Applicability

The proposed rule applies to persons subject to 45 CSR 2, 45 CSR 3, 45 CSR 5, 45 CSR 6, 45 CSR 7, 45 CSR 10, 45 CSR 21 or 45 CSR 40 that have excess emissions during periods of SSM. The proposed rule does not address sources subject to 45 CSR 16 or 45 CSR 34, which adopt federal NSPS, MACT and HAP requirements. In some instances, there are inconsistencies between those federal rules and the state rules. By excluding those regulations from the proposed rule, those instances may subject otherwise applicable sources to enforcement for non-compliance with emission limits. An example of this is the difference between the definition of "startup" in 45 CSR 2 and the Combustion MACT (40 CFR 63 Subpart DDDDD) for coal fired boilers. Pursuant to DEP guidance for 45 CSR 2 and 2A, startup begins when the purge fans are turned on or the burners are lit. However, the Combustion MACT startup occurs when the first non-clean fuel is fed to the ignited boiler. The difference, although small (usually less than 30 minutes), is a scenario which should allow for an alternative emission limit pursuant to the proposed rule to demonstrate continuous control of emissions from the unit. The WVMA requests that the proposed rule also apply to sources subject to 45 CSR 16 or 45 CSR 34.

2. Duration of Alternative Emission Limits

The proposed rule requires that the permittee set limitations on the amount of time the alternative emission limitations may be used. This essentially requires the permittee to forecast infrequent events and predict the performance of units during transient times of operation. Because of the short time the transient operations are expected to occur it would be difficult, if not impossible, to show compliance with the alternative emission limit. Standard testing methods require more process time to collect a representative sample than the typical duration of SSM events. Further, the agency should clarify how the permittee should specify the amount of time allowed during SSM. We suggest that limits be based on a 12-month rolling total basis rather than per event since startups and shutdowns are transient events that are difficult to predict and maintenance events depend heavily on what comprises the "event".

3. Recordkeeping

Section 6 of the proposed rule requires maintaining records during periods of SSM. Acceptable records include continuous operating logs or other relevant evidence. We request that the agency clarify the definition of "continuous operating logs" and "other relevant evidence".

4. Confidential Business Information

The WVMA is concerned about the confidentiality of certain work practices of information that may be required in the permitting process that would reveal confidential business information. SSM events are transitory events and they often reveal more about the technology associated with a process than at normal operating conditions because the dynamics reveal more about stoichiometry and reaction kinetics than steady state. We request that the DEP clarify how confidential business information will be treated for alternative emission limitations.

5. Unforeseen Circumstances

Although never desired, unforeseen circumstances generated by an unanticipated maintenance event requires different measures to safely decommission equipment. For example, if oxygen infiltration results in polymerization of a material in the normal vent line for a process unit, would the operator be capable of devising an alternative work practice and obtaining approval rapidly or would this constitute a permit change with a full processing period and public notice period? We suggest that a mechanism be included in the proposed rule that will address these situations. One option could be to provide notice to the DEP of the use of an alternative work practice and the reason it was implemented, including a requirement to maintain required records for the event on-site.

6. Maintenance Activities

Section 2.7 in the proposed rule defines maintenance operation as activities that have zero process weight rate and are not defined as a manufacturing process. The WVMA is unclear as to the definition of "process weight rate." A process can include situations where no product is made but still have operational distillation columns (operating on full reflex), or a distillation train may stay functional by re-routing the exit streams back together as a feed stream into the process as a means to maintain an operational profile in the column to allow restarting rapidly once a single maintenance activity is finished. Would such an activity, with the product production rate of the process at zero, still qualify as a maintenance operation since the process is not producing but there are still materials being moved (albeit with minimal emissions)? The WVMA requests clarification on these definitions.

The WVMA appreciates the opportunity to provide comments to the proposed rule. We hope that the DEP considers these points and provides clarity and appropriate revisions accordingly.

Sincerely,

Rebecca McPhail/ACB

Rebecca McPhail
President, West Virginia Manufacturers Association

Jennings, Laura M

From: Leonard Dupuis (Services - 6) <leonard.dupuis@dom.com>
Sent: Monday, August 01, 2016 1:47 PM
To: Jennings, Laura M
Cc: Durham, William F; Mowrer, Tammy L
Subject: Comments on Proposed 45 CSR 1 - Alternative Limitations During Startup, Shutdown, Maintenance Operations
Attachments: Comments on Proposed WV 45 CSR 1_07-27-2016.pdf

Ms. Jennings

Dominion is submitting the attached comments on DEP's "Proposed Regulation and Notice of Public Hearing, Comment Period – 45 CSR 1 – Alternative Limitations During Startup, Shutdown, Maintenance Operations" issued on July 1, 2016.

If you have any questions regarding this submittal or need additional information, please contact Lenny Dupuis at (804) 273-3022 or Leonard.Dupuis@dom.com

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By Electronic Delivery: Laura.M.Jennings@wv.gov

July 27, 2016

Public Information Office
West Virginia Division of Environmental Protection
Division of Air Quality
601 57th Street, SE
Charleston, WV 25304

Re: Comments on WV DEP Proposed Regulation and Notice of Public Hearing, Comment Period – 45 CSR 1 - Alternative Emission Limitations During Startup, Shutdown, Maintenance Operations

Dominion appreciates the opportunity to provide comment on the West Virginia Department of Environmental Protection (DEP) notice of a proposed regulation under 45 CSR 1 setting forth criteria for establishing an alternative emission limitation during periods of startup, shutdown, or maintenance. The proposed rule is in response to the U.S. Environmental Protection Agency (EPA) SIP Call, published on June 12, 2015 (80 *Fed. Reg.* 33,840), concerning treatment of excess emissions in state rules by sources during periods of startup, shutdown or malfunction ("SSM SIP call"). We offer the following comments on this proposal:

We generally support the concept and flexibility provided in the proposed regulation that an alternative emission limitation can take form of a numerical emission limit, a technological control measure or a work practice or operational standard. As a general matter, emissions during startup and shutdown periods will be higher than emissions during normal operations because emissions controls cannot operate optimally until certain temperatures and pressures are achieved, which is always later in the unit startup process. While emissions during startup and shutdown periods can be minimized through appropriate work practice standards, they cannot be reduced to levels that are capable of achieving consistent compliance with an emissions limit based on the optimal operation of control technologies that does not take startup and shutdown conditions into account. Achieving such standards during startup and shutdown periods would not only be technically infeasible, but also would be inconsistent with manufacturers' recommendations and safe operating procedures for control equipment.

We believe there is ample justification for allowing an alternative emission limitation to take the form of a work practice standard. In several recent NESHAPS and MACT rulemakings, EPA has differentiated between startup and shutdown periods and periods of normal operation, providing work practice standards to minimize emissions during startup/shutdown periods. For instance, EPA did this in the final Industrial Boiler MACT rule and in the Utility MATS rule. In

these instances, EPA determined that it is not feasible to establish and/or enforce emission limitations during startup/shutdown periods. In addition, EPA makes clear in the final SSM SIP Call that alternatives to specific emissions limits, including work practice standards, clean fuels and good combustion practices, are appropriate measures to apply to minimize excess emissions during startup/shutdown periods so long as they are properly developed to meet Clean Air Act requirements and are legally and practically enforceable (80 *Fed. Reg.* 33914).

We respectfully request WVDEP to provide additional context and clarification on the following:

- DEP should make clear that this regulation does not alter applicable, unit-specific requirements for startup/shutdown periods set forth in section CAA Section 111 NSPS or 112 MACT regulations.
- The regulation should provide a reasonable sufficient timeline for establishing and implementing the required alternative emission limitations so as to minimize additional administrative burden for both the Department and affected sources. The final regulations should provide more clarity that the compliance timeline is governed by the underlying permit process to which the unit is subject and that required permit applications for alternative emission limits are addressed during the next periodic permit renewal, modification or permit reopening that may occur as a result of other rulemakings or reasons.
- Section 5.1.d of the proposed regulatory text requires evaluation of potential worst-case emissions that could occur during periods of startup, shutdown or maintenance based on the alternative emissions limitation. The regulation should provide more clarity as to what the level and scope of such an evaluation will be required of the applicant.
- Section 5.2 should clarify that, while an alternative emission limitation cannot be established as a generic requirement, such as "general duty to minimize emissions", such generic requirements can be part of a work practice standard.
- In addition, we request that in the development of work practice standards, the regulations allow affected entities the option of using manufacturers' recommendations, industry recommended practices or similar site-specific written maintenance and best operating procedures based on their unique operating requirements and current condition, usage and configuration of the unit. Such alternative options are especially needed where manufacturer's specifications may not be readily available for older boilers, compressors, engines and process heaters.

Thank you for this opportunity to provide comment. If you have any questions, please call Lenny Dupuis at (804)273-3022 or by e-mail at leonard.dupuis@dom.com.

Sincerely,

Pamela F. Faggert

Ebc: Mr. Fred Durham – WV DEP
Ms. Laura Jennings – WV DEP
Ms. Tammy Mowrer - WVDEP

45CSR1

ALTERNATIVE EMISSION LIMITATIONS DURING STARTUP, SHUTDOWN, AND MAINTENANCE OPERATIONS

RESPONSE TO COMMENTS

On July 1, 2016, the Division of Air Quality (DAQ) commenced a thirty day public comment period and subsequently held a public hearing on August 1, 2016 to accept written and oral comments on the proposed legislative rule 45CSR1. Written comments were accepted through the close of hearing on Monday, August 1, 2016. Any comments received after this time are considered ex parte communications and cannot be considered in accordance with WV Code Chapter 29A Article 3. Five commenters submitted written comments regarding revisions to the proposed rule 45CSR1, and no one provided verbal comments. The comments are provided in their entirety prior to this response to comment document. A summary of the written comments are provided and addressed below.

1. COMMENTER: United States Environmental Protection Agency, Region III

COMMENT A
Please explain provision 45-1-3.3. The wording is vague and it is unclear why only RACT is mentioned. Perhaps it should say that the alternative emission limitation (AEL) shall otherwise meet applicable West Virginia and Clean Air Act requirements.

RESPONSE A
The DAQ agrees that this was unclear. The intent was to incorporate the stringency concept of the EPA's SSM SIP Call and update of EPA's SSM Policy from 80 Fed. Reg. 33889-33890, published June 12, 2015.

The DAQ revised subsection 3.3 for clarification as follows:

> *An alternative emission limitation (AEL) may be composed of a combination of numerical limitations, specific technological control requirements or work practice requirements with each component of the emission limitation applicable during a defined mode of source operation. The AEL in conjunction with the permit limitations that apply during normal modes of operation must provide for continuous compliance and must meet the applicable stringency requirements.*

COMMENT B
Please clarify the meaning and intent of provision 45-1-7. It is unclear how the AEL could be more stringent than an otherwise applicable limitation. If the AEL is less stringent, based on this provision, the AEL would not apply to sources during startup/shutdown/malfunction when the sources cannot meet the otherwise applicable emission limitations.

RESPONSE B
This is standard language that is included in West Virginia DAQ Legislative Rules. If the source were to become subject to a more stringent standard, for example, a future MACT standard, the more stringent provision would apply.

COMMENT C
To the extent that West Virginia intends to establish AELs for periods of startup/shutdown/malfunction, such limitations must be submitted to EPA for approval into West Virginia's state implementation plan (SIP) for SIP compliance purposes. That is, if the AEL is done via permit or enforcement order, the permit or order must be approved by EPA into West Virginia's SIP to ensure that the limitations are enforceable by EPA.

RESPONSE C
The DAQ disagrees. 45CSR13, 45CSR14, and 45CSR19 are all part of the SIP approved permitting program. These permitting rules are all SIP approved and are an integral part of the State air program designed to address compliance with the NAAQS. By virtue of their SIP approval, it is immaterial whether an AEL is directly approved into the SIP because it will be embodied in a permit under a SIP approved program and is therefore fully federally enforceable.

COMMENT D
Please define "zero process weight rate" to make the definition of "maintenance operation" clearer.

RESPONSE D
The DAQ added the following definition for "Process Weight Rate" that is consistent with 45CSR7.

2.9. "Process Weight Rate" means a rate established as follows:

2.9.a. For continuous or long-run steady-state source operations, the total process weight for the entire period of continuous operation or for a typical portion thereof, divided by the number of hours of such period or portion thereof.

2.9.b. For cyclical or batch unit operations, or unit processes, the total process weight for a period that covers a complete operation or an integral number of cycles, divided by the hours of actual process operation during such a period.

2.9.c. Where the nature of any process or operation or the design of any equipment is such as to permit more than one interpretation of this definition, the

interpretation that results in the minimum value for allowable emission shall apply.

2. COMMENTER: American Electric Power

COMMENT A

AEP supports the agency's effort to develop this rule allowing sources flexibility to develop an alternative emission limitation other than numerical limits, such as using work practices. The US EPA has utilized alternatives to numerical limits by defining the start-up/shutdown period and acceptable work practices in several new regulations, specifically the MATS and ICI Boiler MACT. We agree that the state should provide sources with the opportunity to develop similar alternatives, providing they are specific and able to be monitored, is advantageous to the source. Where the source has existing requirements based upon other federal or state requirements for start-up and shutdown, those existing requirements should not also fall under this regulation nor should this regulation impart additional burden on those sources. Those requirements defined under the NSPS or HAP/MACT federal regulations should take precedence over and negate the applicability of this rule to those sources.

RESPONSE A

The intention of 45CSR1 is to provide a mechanism for sources that are not subject to specific NSPS or MACT start-up and shutdown regulations to request alternative emission limitations. It is not DAQ's intention to duplicate the federal regulations that the DAQ adopts by reference under 45CSR16 or 45CSR34. The DAQ revised the applicability section of rule to clarify that the federal regulations take precedence and negate the applicability of this rule to those sources.

Subdivisions 1.5.a. and 1.5.b were created. Subdivision 1.5.b states:

> *Person(s) subject to 45CSR16 or 45 CSR34 shall meet the applicable startup and shutdown provisions of the applicable federal rule and are not eligible for an alternative emission limit under this rule for affected sources.*

COMMENT B

We support the concept that work practices can be based on, but not limited to equipment manufacturer's recommendations or procedures and industry standards. We request that site-specific practices utilized for older equipment be acceptable taking into consideration the age and condition of the source.

RESPONSE B *DAQ agrees. Subdivision 4.2.f has been added and states:*

> *4.2.f. If the source is proposing a work practice standard as an alternative emission limitation, it may be based on equipment manufacturer's recommendations or procedures, industry standards, or best management practices based on their unique operating requirements and current condition, usage and configuration of the unit.*

COMMENT C

The proposed rule infers that the implementation of this regulation will typically occur during the permitting process. The agency did not provide a timeline for implementing this rule. The agency also requires a summary of strategies considered and reasoning for not using those strategies. This is an excessive burden to document the process of arriving at the proposed alternative control strategy for no apparent use. The criteria requirements do not refer to evaluation of alternatives. The section 4.2.c. is requested to be removed since it is not considered within the criteria for agency approval of the alternative emission limit.

RESPONSE C

The intent of the rule is to provide an opportunity for sources who may have excess emissions during periods of startup, shutdown, or maintenance and cannot meet an allowable emission limit indicative of normal operations to obtain an alternative emission limitation. In response to the SSM SIP Call, the DAQ intends to remove the provisions identified in the SIP Call after having a mechanism in place for sources to obtain an AEL.

The DAQ does not agree that it is an excessive burden to document the process of arriving at the proposed AEL, whether it is a numeric limit or a work place standard. The DAQ must be able to evaluate the proposed AEL and make a determination that all practical steps are being taken to minimize emissions during periods of startup/shutdown/maintenance, and determine the appropriate AEL. The requested information in subsection 4.2.c is necessary for these evaluations. The DAQ has clarified the wording in Section 4 in response to this comment.

Please refer to Response D below. The information clarified in Response D may be used when the source evaluates the alternatives that were considered to make their recommendation, along with equipment, cost, operations or other pertinent decision making information.

COMMENT D

The proposed rule does not provide instructions or clarity on the level of the evaluation of the worst-case emissions that could occur during periods when using the alternative emission limit. The agency should define their expectations regarding this emissions estimate.

RESPONSE D

The DAQ has added subsection 4.2.e. to clarify the level of the evaluation of worst-case emissions that could occur during periods when using the AEL for SSM events. Subdivision 4.2.e states:

> *4.2 .e. The source shall provide an estimate of the worst-case emissions that may occur during periods of startup, shutdown, or maintenance for which the proposed AEL will apply. For instance, if the proposed AEL is based on a reduced efficiency of the control device during startup, shutdown, or maintenance, then the estimate would be based on the efficiency during those periods.*

3. COMMENTER Dominion Resources Services, Inc.

COMMENT A
We generally support the concept and flexibility provided in the proposed regulation that an alternative emission limitation can take form of a numerical emission limit, a technological control measure or a work practice or operational standard. As a general matter, emissions during startup and shutdown periods will be higher than emissions during normal operations because emissions controls cannot operate optimally until certain temperatures and pressures are achieved, which is always later in the unit startup process. While emissions during startup and shutdown periods can be minimized through appropriate work practice standards, they cannot be reduced to levels that are capable of achieving consistent compliance with an emissions limit based on the optimal operation of control technologies that does not take startup and shutdown conditions into account. Achieving such standards during startup and shutdown periods would not only be technically infeasible, but also would be inconsistent with manufacturers' recommendations and safe operating procedures for control equipment.

RESPONSE A
DAQ agrees with this comment. This is a fundamental reason that DAQ made the decision to propose 45 CSR 1 in response to the SSM SIP Call.

COMMENT B We believe there is ample justification for allowing an alternative emission limitation to take the form of a work practice standard. In several recent NESHAPS and MACT rulemakings, EPA has differentiated between startup and shutdown periods and periods of normal operation, providing work practice standards to minimize emissions during startup/shutdown periods. For instance, EPA did this in the final Industrial Boiler MACT rule and in the Utility MATS rule. In these instances, EPA determined that it is not feasible to establish and/or enforce emission limitations during startup/shutdown periods. In addition, EPA makes clear in the final SSM SIP Call that alternatives to specific emissions limits, including work practice standards, clean fuels and good combustion practices, are appropriate measures to apply to minimize excess emissions during startup/shutdown periods so long as they are properly developed to meet Clean Air Act requirements and are legally and practically enforceable (80 *Fed. Reg.* 33914).

RESPONSE B
DAQ agrees.

COMMENT C We respectfully request WVDEP to provide additional context and clarification on the following:

COMMENT (C)(1):
DEP should make clear that this regulation does not alter applicable, unit-specific requirements for startup/shutdown periods set forth in section CAA Section 111 NSPS or 112 MACT regulations.

RESPONSE (C)(1):
DAQ agrees. Please see Response A to Commenter 2.

COMMENT (C)(2):
The regulation should provide a reasonable sufficient timeline for establishing and implementing the required alternative emission limitations so as to minimize additional administrative burden for both the Department and affected sources. The final regulations should provide more clarity that the compliance timeline is governed by the underlying permit process to which the unit is subject and that required permit applications for alternative emission limits are addressed during the next periodic permit renewal, modification or permit reopening that may occur as a result of other rulemakings or reasons.

RESPONSE (C)(2):
Subsection 4.1 states that the source "may apply for a permit in accordance with 45CSR13, 45CSR14, or 45CSR19 as applicable." DAQ believes that is sufficiently clear. The timelines are provided for in the referenced permitting rules.

DAQ is sensitive to the timelines for establishing and implementing AELs to provide sources a mechanism that allows them to demonstrate continuous compliance. This is a fundamental reason DAQ proposed 45CSR1 in advance of removing the provisions identified in the SSM SIP Call.

The DAQ strongly encourages the sources to apply for a permit as soon as possible if they will anticipate a need for an AEL. West Virginia is subject to a SSM SIP Call. If the state does not adequately address the provision of the SSM SIP Call in a timely manner, then the EPA may impose a federal implementation plan. Therefore it behooves a source to request an AEL by applying for a permit as soon as practicable.

COMMENT (C)(3)
Section 5.1.d of the proposed regulatory text requires evaluation of potential worst-case emissions that could occur during periods of startup, shutdown or maintenance based on the alternative emissions limitation. The regulation should provide more clarity as to what the level and scope of such an evaluation will be required of the applicant.

RESPONSE (C)(3)
Please refer to Response D to Commenter 2.

COMMENT (C)(4):
Section 5.2 should clarify that, while an alternative emission limitation cannot be established as a generic requirement, such as "general duty to minimize emissions", such generic requirements can be part of a work practice standard.

RESPONSE (C)(4)
In the EPA's clarification of its SSM Policy, EPA discusses the general duty requirements and states: "To the extent that such other general-duty requirement is properly established and legally and practically enforceable, the EPA would agree that it may be an appropriate separate requirement to impose upon sources ***in addition to*** *the continuous emission limitation."[emphasis added] [80 Fed. Reg. 33890, June 12, 2015]*

DAQ clarified 5.2 by adding the following sentence to the end of the requirement:

> *A general duty clause may be part of a work practice standard, but may not stand alone as the work practice standard.*

COMMENT (C)(5):
In addition, we request that in the development of work practice standards, the regulations allow affected entities the option of using manufacturers' recommendations, industry recommended practices or similar site-specific written maintenance and best operating procedures based on their unique operating requirements and current condition, usage and configuration of the unit. Such alternative options are especially needed where manufacturer's specifications may not be readily available for older boilers, compressors, engines and process heaters.

RESPONSE (C)(5)
Please see Response B to Commenter 2 for the language added as subsection 4.2.f.

4. COMMENTER Sierra Club, on behalf of their West Virginia members and supporters

COMMENT A
DAQ Has Failed to Eliminate or Correct Provisions of its SIP Identified by EPA as Substantially Inadequate to Meet Clean Air Act Requirements.

RESPONSE A
DAQ proposed 45CSR1 to provide sources a mechanism that allows them to demonstrate continuous compliance. The DAQ intends to propose removal of the provisions identified in the SSM SIP Call after 45CSR1 is effective.

COMMENT B
The Proposed Rule Would Allow for Source-Specific Alternative Emission Limitations, in Violation of the Requirements of the Clean Air Act and EPA's SSM SIP Call.

RESPONSE B
See Response C to Commenter 1.

The proposed 45CSR1 follows the EPA's SSM Policy published in 80 Fed. Reg. 33840 on June 12, 2015.

COMMENT C
DAQ Has Failed to Demonstrate that the Proposed Reliance on SSM Work Practices Is Appropriate Under These Circumstances

RESPONSE C
Nothing in the 45CSR1 automatically guarantees a source will be granted a work practice standard as its AEL. An AEL requires that all practical steps are taken to minimize the impact of emissions on ambient air quality during startup, shutdown, or maintenance events.

Section 3 specifies that an AEL must be practically enforceable and that it may be a numerical limit, a technological control requirement or a work practice requirement as a component of the continuous allowable emission limitation.

DAQ revised subsection 3.3 for clarification as follows:

> *3.3. An AEL may be composed of a combination of numerical limitations, specific technological control requirements or work practice requirements with each component of the emission limitation applicable during a defined mode of source operation. The AEL in conjunction with the permit limitations that apply during normal modes of operation must provide for continuous compliance and must meet the applicable stringency requirements.*

DAQ has clarified 5.1.b as follows:

> *5.1. Verify that the emission limit that applies during normal operation of the emission unit is not achievable during periods of startup, shutdown, or maintenance;*

COMMENT D
The Work Practices Compliance Option in DAQ's Proposed Rule Is Not Enforceable.

RESPONSE D
45CSR1 requires sources to obtain a permit to establish an AEL in accordance with 45CSR13, 45CSR14, or 45CSR19 all of which are SIP approved and federally enforceable.

Section 5.1.f of 45CSR1 requires practically enforceable monitoring parameters and records to ensure compliance with the AEL. The DAQ revised the reference in section 5.1 to include Sections 3 and 4.

45CSR30 requires sources with a Title V permit, to submit an annual compliance certification with all applicable requirements identified and the status of compliance for those requirements, and a deviation report identifying all deviations. As previously noted, if a source is subject to a NSPS or MACT regulation with specific start-up and shutdown provisions, that source is required to meet those regulations and 45CSR1 is not applicable.

Section 4.2.a requires sources to narrowly define their startup, shutdown, or maintenance operations at the emission unit including appropriate parameters that defines the startup, shutdown, or maintenance operations.

Section 4.3 provides that the DAQ may incorporate a reasonable definition of startup, shutdown, or maintenance as a permit condition.

Section 6.4 was added to clarify that submission of reports may be required as a permit condition. Section 6.4 states:

> *6.4. The Secretary may require the submission of reports as a condition of an applicable permit.*

The DAQ believes that 45CSR1 is consistent with the EPA's SSM Policy.

COMMENT E

DAQ Cannot Demonstrate that the Proposed Rule Will Not Violate the NAAQS or PSD Increments.

RESPONSE E

Sources must obtain a permit under 45CSR13, 45CSR14, or 45CSR19 to establish an AEL. These permitting rules are all SIP approved and are an integral part of the State air program designed to address compliance with the NAAQS. Any increases in emissions that trigger the PSD permitting thresholds must obtain a permit pursuant to 45CSR14 which meets all PSD permitting requirements. Similarly, any source located in a nonattainment area that increases emissions that trigger the NNSR permitting thresholds must obtain a permit pursuant to 45CSR19 which meets all NNSR permitting requirements.

45CSR14 addresses the prevention of significant deterioration of air quality Preconstruction permits issued pursuant to this rule shall contain emission limitations and such other measures as may be necessary for the prevention significant deterioration of air quality.

45CSR19 was designed to ensure that major new or modified sources emissions will be controlled to the greatest degree practicable; that more than equivalent offsetting emission reductions will be obtained from existing sources; that there will be progress toward achievement of the National Ambient Air Quality Standards; and that all applicable air pollution regulations adopted by the Secretary will be met.

Absent an emission limit for a specific source, assessing the impact on the NAAQS or PSD increments is difficult if not impossible. This is a fundamental reason DAQ proposed the establishment of source specific AELs in 45CSR1.

COMMENT F

For the foregoing reasons, West Virginia's proposed SIP revision must be further revised to ensure that it is consistent with the requirements of the SSM SIP Call and Clean Air Act, protects air quality and public health, and is approvable by EPA.

RESPONSE F

The DAQ believes 45CSR1, as revised in response to comments is consistent with the requirements of the EPA's SSM Policy as set forth in 80 Fed. Reg. 33840, published June 12, 2015. The DAQ intends to revise 45CSR2, 45CSR3, 45CSR5, 45CSR6, 45CSR7, 45CSR10, and

45CSR21 if 45CSR1 is authorized in order to provide sources a mechanism to demonstrate continuous compliance.

5. COMMENTER West Virginia Manufacturers Association (WVMA)

COMMENT A –
General Comments.
The proposed rule sets forth criteria for establishing an alternative emission limitation during periods of startup, shutdown, or maintenance ("SSM"). The WVMA supports the allowance of emission limits that apply specifically during times of SSM when existing emission limits cannot be met. However, the proposed rule creates a burdensome and time consuming permitting, recordkeeping and compliance process for allowing alternative emission for events that occur only a fraction of the time a facility is operating. The WVMA suggests that the DEP consider other options for alternative emissions limits during SSM, including the establishment of a minimum threshold of emissions during such times before triggering a permit.

RESPONSE A
In accordance with CAA section 302(k), SIPs must contain emission limitations that ''limit the quantity, rate, or concentration of emissions of air pollutants on a continuous basis. Therefore, the DAQ does not agree with establishing a threshold for requiring a permit for an AEL. 45CSR1 provides a mechanism for sources to establish an AEL that applies during startup, shutdown, or maintenance events, allowing sources to demonstrate continuous compliance. It is up to the source to determine when and if an AEL is needed. In the absence of an AEL, the applicable emission limit would apply.

Obtaining an AEL through a permit should be a one-time event. Recordkeeping is an essential element of a practically enforceable permit. The DAQ does not consider these requirements to be unduly burdensome

COMMENT B
Applicability.
The proposed rule applies to persons subject to 45 CSR 2, 45 CSR 3, 45 CSR 5, 45 CSR 6, 45 CSR 7, 45 CSR 10, 45 CSR 21 or 45 CSR 40 that have excess emissions during periods of SSM. The proposed rule does not address sources subject to 45 CSR 16 or 45 CSR 34, which adopt federal NSPS, MACT and HAP requirements. In some instances, there are inconsistencies between those federal rules and the state rules. By excluding those regulations from the proposed rule, those instances may subject otherwise applicable sources to enforcement for noncompliance with emission limits. An example of this is the difference between the definition of "startup" in 45 CSR 2 and the Combustion MACT (40 CFR 63 Subpart DDDDD) for coal fired boilers. Pursuant to DEP guidance for 45 CSR 2 and 2A, startup begins when the purge fans are turned on or the burners are lit. However, the Combustion MACT startup occurs when the first non-clean fuel is fed to the ignited boiler. The difference, although small (usually less than 30 minutes), is a scenario which should allow for an alternative emission limit pursuant to the proposed rule to demonstrate continuous control of emissions from the unit. The WVMA requests that the proposed rule also apply to sources subject to 45 CSR 16 or 45 CSR 34.

RESPONSE B
Section 7 of 45CSR 1 addresses inconsistency between rules and states that the most stringent provision will apply.

Please refer to Response A to Commenter 2.

COMMENT C
Duration of Alternative Emission Limits.
The proposed rule requires that the permittee set limitations on the amount of time the alternative emission limitations may be used. This essentially requires the permittee to forecast infrequent events and predict the performance of units during transient times of operation. Because of the short time the transient operations are expected to occur it would be difficult, if not impossible, to show compliance with the alternative emission limit. Standard testing methods require more process time to collect a representative sample than the typical duration of SSM events. Further, the agency should clarify how the permittee should specify the amount of time allowed during SSM. We suggest that limits be based on a 12-month rolling total basis rather than per event since startups and shutdowns are transient events that are difficult to predict and maintenance events depend heavily on what comprises the "event".

RESPONSE C
The estimation of frequency and duration of startup, shutdown, and maintenance events may be based on historical information. Maintenance events are included as an option for sources that may have emissions beyond the de minimus levels in the permitting rules. Maintenance events are planned events and are not to be confused with malfunction events.

Section 5 of 45CSR1 establishes the criteria that will be used to evaluate proposed alternative emission limitations and develop AELs as permit requirements. The information regarding the frequency of events is required in the application in order for the DAQ to understand the potential emissions at the source. Additionally, the EPA's SSM Policy stipulates that the frequency and duration of operation in startup or shutdown mode are minimized to the greatest extent practicable in the establishment of the AEL. .

DAQ has revised 4.2.a to reflect that the duration and frequency of events are estimated. 4.2.a now states:

> *4.2.a. The source shall narrowly define the startup, shutdown, or maintenance operations at the emissions unit including as appropriate the parameters that define startup, shutdown, or maintenance; the estimated duration of the events; and the estimated frequency of events for each alternative emission limitation.*

DAQ has revised 4.3 to reflect that the definition, duration, and maximum frequency of events may be incorporated as permit requirements. Subsection 4.3 now states"

> *4.3. The Secretary has the authority to approve a reasonable definition of startup, shutdown, or maintenance events, the duration of events, and the maximum frequency of events and may incorporate them as permit requirements.*

The DAQ also observed that the section referenced in 5.1 may be confusing and revised it to state:

> *5.1. The Secretary shall use the following criteria to evaluate proposed alternative emission limitation(s) in accordance with Sections 3 and 4 of this Rule; to develop alternative emission limitation(s) as permit requirements; and to include in the permit the recordkeeping and reporting requirements set forth in Section 6 below.*

COMMENT D

Recordkeeping.

Section 6 of the proposed rule requires maintaining records during periods of SSM. Acceptable records include continuous operating logs or other relevant evidence. We request that the agency clarify the definition of "continuous operating logs" and "other relevant evidence".

RESPONSE D

Subsection 6.1 has been revised to clarify the requirement; it now states:

> *6.1. The owner or operator shall maintain records during periods of startup, shutdown, and maintenance. Acceptable records may include, but are not limited to, operator logs (may be electronic), Continuous Emissions Monitoring System (CEMS) data, or other relevant evidence such as operator notes that document the date, time, duration, and estimated emissions during the event. The records shall demonstrate that the alternative emission limitation requirements were met and document the steps taken to minimize emissions to the extent practicable during the event, including, but not limited to, any monitored parameter established in the permit.*

COMMENT E

Confidential Business Information.

The WVMA is concerned about the confidentiality of certain work practices of information that may be required in the permitting process that would reveal confidential business information. SSM events are transitory events and they often reveal more about the technology associated with a process than at normal operating conditions because the dynamics reveal more about stoichiometry and reaction kinetics than steady state. We request that the DEP clarify how confidential business information will be treated for alternative emission limitations.

RESPONSE E

The requirements surrounding Confidential Business Information (CBI) are provided for in 45CSR31, which has been in effect since 1993.

COMMENT F

Unforeseen Circumstances

Although never desired, unforeseen circumstances generated by an unanticipated maintenance event requires different measures to safely decommission equipment. For example, if oxygen infiltration results in polymerization of a material in the normal vent line for a process unit,

would the operator be capable of devising an alternative work practice and obtaining approval rapidly or would this constitute a permit change with a full processing period and public notice period? We suggest that a mechanism be included in the proposed rule that will address these situations. One option could be to provide notice to the DEP of the use of an alternative work practice and the reason it was implemented, including a requirement to maintain required records for the event on-site.

RESPONSE F
45CSR1 addresses startup, shutdown, and scheduled maintenance procedures only.

The definition in section 2.7 has been clarified as follows:

> *2.7. "Maintenance Operation" means scheduled maintenance activities that have zero process weight rate and are not defined as a manufacturing process.*

COMMENT G
Maintenance Activities.
Section 2. 7 in the proposed rule defines maintenance operation as activities that have zero process weight rate and are not defined as a manufacturing process. The WVMA is unclear as to the definition of "process weight rate." A process can include situations where no product is made but still have operational distillation columns (operating on full reflex), or a distillation train may stay functional by re-routing the exit streams back together as a feed stream into the process as a means to maintain an operational profile in the column to allow restarting rapidly once a single maintenance activity is finished. Would such an activity, with the product production rate of the process at zero, still qualify as a maintenance operation since the process is not producing but there are still materials being moved (albeit with minimal emissions)? The WVMA requests clarification on these definitions.

RESPONSE G
"Maintenance Operation" as defined in 2.7 means maintenance activities that have zero process weight rate AND are not defined as a manufacturing process. The above scenario appears to be an alternative operating scenario and does not meet the agency's interpretation of startup, shutdown, or maintenance.

Please also see Response D to Commenter 1 and Response F to Commenter 5.