MARAMA

Mid-Atlantic Regional Air Management Association, Inc.

Allegheny County Health Dept., Air Quality Program, Pittsburgh, PA.
District of Columbia Dept. of the Environment, Air Quality Division
Delaware Dept. of Natural Resources & Environmental Control, Air Quality Mgmt. Section
Maryland Dept. of the Environment, Air & Radiation Management Admin.
New Jersey Dept. of Environmental Protection, Division of Air Quality
North Carolina Dept. of Environment & Natural Resources, Division of Air Quality
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REQUEST FOR PROPOSALS TO UPDATE AND PRESENT APTI 418 – NO_X EMISSIONS CONTROL FROM STATIONARY SOURCES

Who is MARAMA?

The Mid-Atlantic Regional Air Management Association, Inc. (MARAMA) is a Maryland non-profit corporation of ten state and local air pollution control agencies. MARAMA's mission is to strengthen the skills and capabilities of member agencies and to help them work together to prevent and reduce air pollution impacts in the Mid-Atlantic Region. One of our objectives is to provide training to help improve the technical knowledge and skills of the staff and managers of Mid-Atlantic air pollution control agencies.

Funding for this work is from MARAMA's grant from the Region 3 of the U.S. Environmental Protection Agency XA-96334701 (CFDA 66.034 – Surveys, Studies, Investigations, Demonstrations, and Special Purpose Activities relating to the Clean Air Act.

A. Background

APTI 418 *"Control of Nitrogen Oxide Emissions"* presents fundamental information on NOx emissions from combustion sources such as industrial and utility boilers. The goal of this course is to present information that will help environmental professionals address present and future NOx control issues. This target audience is new permit and compliance engineers and scientists, with an engineering or scientific degree, who are responsible for permitting, compliance, and SIP planning activities. The course introduces a broad range of control technology topics and identifies some of the sources for obtaining further information on these topics. Those completing this course will gain an understanding of the mechanisms by which nitrogen oxide (NOx)is formed in the combustion process as well as sources of NOx emissions and the history related to regulating NOx emissions from these sources. Attendees will be able to perform regulatory reviews involving the types, applicability, capability, and limitations of available control techniques to suppress the formation of NOx emissions or to minimize NOx emissions.

Course Materials

Course materials include slide sets and a student manual. The slide sets have been examined by a subject matter expert and require a varying amount of updating as described in **Attachment A** to this RFP.

The student manual that accompanies the course contains a bibliography of technical articles and publications on all control technologies addressed in this manual. This manual also lists web sites that are useful in obtaining additional information related to the control of NOx emissions from combustion sources. This student manual was updated in 2009 and should require a lighter update than the slide sets. However, it too, will need to be reviewed and lightly updated, including new references and information on controls now in use, current trends, and regulations.

To review the existing course materials, please use the following ShareFile link:
https://marama.sharefile.com/d-s35d9ffa480b4bc78

B. Project Tasks

MARAMA is seeking a contractor to:

- Significantly update the APTI 418 *"Control of Nitrogen Oxide Emissions"* slide sets and lightly edit the student manual. The materials have been reviewed by a subject matter expert and will require varying amounts of updating as is described in Attachment A to this RFP.
- In addition to updating the slides in the format that they are currently provided, the slide set materials will also be chunked into 1.5 hour segments (approximately 160 slides +/- 20 slides per chunk) for use in a webinar series.
- For the webinar formatted slides multiple answer poll questions for use in the flow of the webinar presentation should be devised to both encourage participation and gauge student comprehension. There should be 3 poll questions per 1.5 hour segment. It is anticipated that significant time will be required for the update task, and therefore we have divided the chapters into three tasks as follows:

Task 1 – Update Chapters 1-3 slidesets for both in-person training and webinar presentation
Task 2 – Update Chapters 4-6 slidesets for both in-person training and webinar presentation
Task 3 – Update Chaptes 7-10 slidesets for both in-person training and webinar presentation

The updated materials will be used to teach APTI 418 in two formats: In-person and as a series of webinar sessions:

Task 4 - Teach APTI 418 *"Control of Nitrogen Oxide Emissions"* in person Richmond, Virginia in February 2020 for up to 50 students.
Task 5 - Teach APTI 418 *"Control of Nitrogen Oxide Emissions"* as an 8-10 segment webinar series.

MARAMA's webinar system: MARAMA has been presenting educational webinars to air quality staff for 15 years. As part of this project the selected contractor will present technical material via webinars that are managed by MARAMA staff. The contractor will not need to have any specialized knowledge concerning providing webinars or have access to their own webinar presentation system. MARAMA will provide and manage the webinar system. The webinars will only show the slide sets, not the presenter's face. The presenter is never seen on the screen, only the contractor's voice will be heard over the slide sets. MARAMA will record the webinar sessions and lightly edit them to remove verbal fumbles and then post them for asynchronous use by air quality staff.

C. Course Material Requirement

1. Materials used in presentations, including images, will be limited to those in the public

domain. It can be assumed that images in the existing slidesets are in the public domain.
2. Materials developed for use in this training course, under this agreement, are developed with public funds and remain in the public domain.

D. Contractor Tasks for both CLASSROOM and WEBINAR versions

1. Provide to MARAMA for our review and revision, at least six (6) weeks in advance, the agenda and/or outline that will be followed during the course.
2. Provide to MARAMA at least four (4) weeks in advance, an electronic copy of all course materials, including written or electronic materials to be distributed to students as well as PowerPoint presentations that will be used during the course.
3. Communicate with MARAMA as necessary to ensure proper pre-course planning. Identify course support needs including audio-visual equipment the instructor expects MARAMA to provide.
4. Develop a multiple choice pre- and post- test with answers for use in both in-person class and webinar series.
5. Submit a Course Report which will include:
    a. Course number, title, date offered, course instructor(s) (including Company name and/or affiliation), course location, site visit (if applicable);
    b. Narrative of course agenda and objectives/goals;
    c. Outline of materials used for the course - List of material developed, redeveloped, or used as supplements by the instructor. **Note**: Materials developed with MARAMA funding become public domain and must be freely available;
    d. Recommendations, suggestions, and comments from presentation of course: instructor's suggestions for improving the course in addition to the instructor's impression of student attitudes toward the course and comments concerning the facility, materials, EPA support (if applicable) and any other pertinent information;
    e. Summary of course evaluations: MARAMA will complete the summary of Course Evaluations section of the Course Report;
    f. For the classroom presentation of the course, the instructor will provide a grade report including the average, median, mode, lowest, and highest of both the pre-tests as well as post-tests (MARAMA will provide grade report form electronically in Excel to include pre-test results for use in grade analysis).
    g. MARAMA will manage the grade report for the webinar based presentation of the course.
    h. Provide to MARAMA and EPA in a timely manner after conclusion of the course a hard copy and electronic copy of any course materials developed or redeveloped with MARAMA funding.
    i. Provide an accurate invoice for instructional services, consistent with the accepted bid, within thirty (30) days of the end of the course.

E. Contractor Tasks for the CLASSROOM course presentation

1. Administer and score the pre and post-test for all participants.
2. Administer the OMB approved National Air Quality Training Program Course Evaluation Form to all participants in the classroom course.
3. Provide MARAMA with a hard copy of the students'completed pre- and post-tests as well as the students' completed evaluation forms or legible copies of those items.

F. Contractor Tasks for the WEBINAR course presentation

1. Present 8-10 modules of the "live" webinar series. Each part/module will be approximately 1.5-2 hours in length and composed of the following:
   a. 1-1.5 hours of presented material.
   b. 15 minutes of question and answers
   c. MARAMA will provide 10 minutes of initial and final instruction to participants
2. Attend a training webinar hosted by MARAMA where we will test the contractor sound system and explain how the webinar controls will work and train the contractor to use those controls.
3. The contractor will be able to present from their own office using their own computer and desk phone systems. A cell phone will not be adequate quality.

G. MARAMA Responsibilities

In preparing proposals for both in-person classroom and webinar versions of APTI 418, prospective bidders may assume that MARAMA will conduct and manage registration.

1. For the in-person **CLASSROOM** training MARAMA will:
   a. Make course location arrangements and communicate said information in a timely manner to students and instructors.
   b. Make arrangements for basic audio-visual needs including a digital projector, stand, surge protection bar, extension cord, screen, and other similar items of reasonable cost that may be requested by the instructor. MARAMA or the hosting agency shall provide a laptop computer, marker pad and markers, wireless mouse, and lapel microphone.
   c. Make arrangements for appropriate refreshments and snacks.
   d. Provide table tents or name tags.
   e. Ensure adequate paper copies of the course materials are available for distribution at the course location. Paper copies will be double-sided and printed on paper with recycled content unless there are specific reasons for exceptions.
   f. Provide paper copies of sign-in sheets, the OMB evaluation form, an attendance list, and an electronic copy of the student grade report template.
2. For the **WEBINAR** based training, MARAMA will:
   a. Set up the webinar(s) and register participants on the MARAMA GoToWebinar system.
   b. Post and distribute materials, including presentations and handouts for participant download and self-printing prior to the course.
   c. Announce the webinar series and recruit and screen participants.
   d. Administer and grade pre- and post- tests via SurveyMonkey. The contractor will develop the content and answers for the test.
   e. Administer the OMB approved National Air Quality Training Program Course Evaluation Form to all participants in the classroom course.
   f. Identify attendees who are eligible to receive a certificate of completion and then prepare and distribute certificates to those attendees.
   g. Train the contractor to use necessary functions of the webinar system.
   h. Manage the webinar system during presentation of each module, including administration of the poll questions.
3. Make timely payment for instructional services within (30) thirty days of receipt of an accurate invoice and complete Course Report.

H. Nature of Contract(s)

Contract will provide for a fixed fee for services. The contractor will be financially responsible for travel and lodging expenses (including meals), transportation, and any other costs not identified under Section C MARAMA Responsibilities, above.

MARAMA may establish more than one contract under this request for proposals depending on the proposals received and the sources of funding available.

Payment of the total fee will not be made until all agreed products are delivered in acceptable quality.

I. Submission Requirements

If you are interested in updating and presenting one or more courses, please email your proposal to Training@marama.org or mail to:

Jackie Burkhardt and Sue Dilli, Training Coordinators
MARAMA
8600 LaSalle Road, Suite 636
Towson, MD 21286

Proposals must be received by **5:00 PM** on **August 2, 2019**

Your proposal should be brief and must include the following:

1. If incorporated, company name, DUNS number, and confirmation that the company is registered on sam.gov (which has replaced the US government's central contractor registration system).
2. Instructor(s) Name and short resume, including information about when and for whom the instructor has previously taught this and/or related classroom courses and experience with presenting webinars.
3. Dates available in February, 2020
4. Course Description:
    a. Agenda and/or topics covered
    b. Number of hours of instruction
    c. Limits (if any) on class size
    d. Handouts to be provided and date of last update
    e. List of any proprietary equipment or software used in the course and purpose of their use.
5. Student requirements for pre- or post-class homework, and computer and/or equipment needed by students during and after class (e.g. scientific calculator, safety goggles, etc.).
6. Contact information for three references knowledgeable about the instructor's qualifications and performance.
7. Identify percentage of minority owned/woman owned business enterprise (MBE/WBE) participation. MARAMA's applicable "fair share" goals /objectives, as negotiated with EPA by the Maryland Department of the Environment are:

	MBE	**WBE**
Construction	17.0	16.0

Supplies	13.0	13.0
Services	12.0	14.0
Equipment	13.0	13.0

8. Proposals must comply with Subpart C of 2 CFR Part 180 entitled, "Responsibilities of Participants Regarding Transactions Doing Business with Other Persons," as implemented and supplemented by 2 CFR Part 1532 and certify that the contractor is not presently debarred, suspended, proposed debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.
9. Insurance: Proposal must describe the company's insurance coverage and indicate the company will provide a copy of their insurance certificate as a part of entering into an agreement with MARAMA.
10. Tax Liabilities: Proposal must affirm that contractor (1) is not subject to any unpaid federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, and (2) has not been convicted (or had an officer or agency acting on its behalf convicted) of a felony criminal conviction under any federal law within 24 months preceding the award, unless EPA has considered suspension or debarment of the corporation, or such officer or agent, based on these tax liabilities or convictions and determined that such action is not necessary to protect the US Government's interests.
11. Civil Rights: Proposal must affirm that in carrying out this project the contractor will comply with laws and regulations prohibiting discrimination based on race, color, or national origin (including limited English proficiency), and prohibiting discrimination against persons with disabilities, and prohibiting discrimination on the basis of age or sex.
12. Indicate in your proposal if MARAMA will have the right to post publicly and re-use instructional materials, including handouts and presentations used in this class. Specify any limitations on free use and the rationale for the limitations. Note that MARAMA requires information and materials developed with MARAMA support must be made available to the public.
13. Cost Proposal:
    a. Instructional service charges - fixed fee cost for administration and presentation including any course updates, preparation, reports, and course delivery for each of the two instructional delivery methods (classroom and webinar).
    b. When estimating your costs, be advised that we expect instructors to arrive the day before the course begins and leaving the evening the course ends except in special circumstances that should be specified in the proposal. **Note:** The contractor will be financially responsible for travel and lodging expenses (including meals);
    c. Other relevant itemized expenses, if any. Pre-approval by MARAMA of these costs will be required.

J. <u>Criteria for Evaluation of Proposals</u>

MARAMA will only select experienced contractor(s). Selection criteria will include:

- Responsiveness of the written proposal to the requirements outlined in this RFP
- Course content and instructional method, including use of appropriate equipment and materials
- Instructor qualifications and experience in presenting the course material, describe expertise in NOx formation and control.

- Availability of course outline and handout materials for posting to the MARAMA website and for future use by MARAMA
- References
- Dates available to present the course
- Proposed costs for completing the tasks specified
- Percentage MBE/WBE participation

MARAMA is not required to select the lowest cost bid, but will consider cost among the other factors listed above.

It may be necessary to utilize more than one contractor to obtain needed expertise. MARAMA may request follow-up bids from selected contractors if necessary to obtain further information before making final selections.

Funds available for this contract are federal funds from the U.S. Environmental Protection Agency, and contractors must meet requirements associated with the use of federal funds.

All information and data developed and/or updated under this contract will be in the public domain. This includes handouts and presentations. If the proposed course will include the use of any materials considered to be proprietary and not in the public domain this must be noted in the proposal.

Any questions about this RFP should be sent in writing via e-mail to Jackie Burkhardt and Sue Dilli, MARAMA Training Coordinators, training@marama.org. Questions and answers will be posted on MARAMA's web site www.marama.org under "Request for Proposals." No further questions or answers will be posted after **August 2, 2019.**

Attachment A - NOx Emissions Control from Stationary Sources
APTI Course 418
REVIEWER COMMENTS
FOR 2019 COURSE UPDATE

These notes describe what, at a minimum, should be updated/changed/supplemented, not exactly how it should be changed. Having citations and dates for the data is a general comment. The numbers are the slide numbers.

CHAPTER 1 INTRODUCTION TO NITROGEN OXIDE CONTROLS

1-2 conflicts with 1-6. Does NOx = just NO + NO2? or does it include other NOx compounds?

1-5 Seasonal limits bullet should be "Seasonal, daily, hourly limits?" Also, there should be a slide presenting the NO2 and ozone NAAQS and their averaging times. The averaging times for key NSPS NOx limits are also relevant. The presumption of seasonal limits in a course on NOx control is wrong.

1-6 The parentheticals are confusing. For example "Nitrogen oxide (NO - NOx)" should be "Nitrogen oxide (NO)"

1-7 Delete "very". Update. Date. Cite.

1-8 Check and update. Relevance of NO and NO2 emission proportions? How fast does NO convert to NO2 in air? If fast, than assuming all NOx is NO2 is a good first approximation for modelling potential downwind NO2 concentrations in ambient air. If the rate of conversion is the difference between NO2 NAAQS violation and no violation, then this is very important concept and needs further information. The modelling professionals in the states may be helpful here.

1-9 Cite and date.

1-10 Conflict with 1-8? Assumes that all NOx is NO2. See discussion of 1-8.

1-12 What is the relevance of "prompt NOx"? Is it a subset of thermal NOx?

1-13 Clarify "very high temp" . I generally think of over 2500 F as high. Slide 1-19 talks about 1300 F (about 2400F) as being a low NOx temp. Clarify that "clean fuels" include natural gas and ultra-low sulfur diesel and home heating oil. At some point discus the NOx benefit of 15 ppm home heating oil now required by most OTC states.

1-14 Cite. The very high flame temps in this graph seem academic. I think flame temps of most combustion sources are much lower; perhaps as high as the low end of this graph. This graph starts at 1600 C (about 2900 F) which is now low. Slide 1-19 talks about less than 1300 C as being a goal. It's been a long time since I did adiabatic flame temps, so a younger combustion professional would be useful here.

1-17 Another academic slide. What is the relevance of NOx formation in pure air at high temperatures? NOx emissions are from combustion, not indirectly heating up air. Here again the highest temperature cited is about 2900 F, at the low end of the also academic 1-14 slide.

1-18 Good.

1-19 See discussion of 1-14. I believe 1300 C is in the range of flame temp of importance for NOx from common combustion sources.   Having a graph of NOx formation below and above 1300 C would be useful.

1-19 Clarify "furnace release rate".   Is it heat input rate divided by the volume of the combustion chamber? If so, I agree that is relevant.

1-20 Might indicate which chapters the listed combustion control measures will be addressed.

1-21 Coal and residual oil combustion processes not clear in this graph. Is this clarified in another chapter? If so, cite.   If not, add further explanation here or in another chapter.

1-22 OK as an illustration of the general CO/NOx relationship, but NOx does not increase linearly with higher excess air, except in narrow regions.   At some point NOx decreases and CO increases as excess air increases.   Clarify the PIC = products of incomplete combustion, of which CO is used as a surrogate for all PICs.

1-23 Good referencing chapters where NOx control approaches will be addressed.

1-24 "Non utility sources" should be "Non utility major stationary sources" to distinguish from mobile sources and area sources.

1-25 Update. Show how utility and mobile source NOx has decreased and off road proportion has increased.   Might use slide 1-24 source categories if possible.

1-26 1998 mobile source values not consistent with 1-25 slide.

1-27 and 28 Update, date, and cite.

1-29 Cite date of AP42. Update if later version. Probably still good for uncontrolled emission rates for old sources prior to combustion modification and add on control. Need to clarify what is meant by uncontrolled, as pre low NOx combustion. I note that a modern turbine emits less than 0.1 lb./million Btu without add on control (just low NOx combustion) and less than 0.01 lb./million btu with SCR and low NOx combustion.

1-30 Cite. USA? Update to 75 year trend if possible. Have some additional graphs showing progress since 1990, after which NOx was focused on as the primary cause of high ozone.

1-31 Update.

1-32 Important. Says ozone emission data is generated from the annual emission inventory. That was the case, but the use of the annual inventory did not capture peakers and other high NOx emitters on high ozone days. Should highlight efforts to generate high ozone day inventories today and what additional work is needed to generate relevant ozone day inventories.   There must be a good high ozone day emission inventory to inform additional NOx control measures to attain the 8 hour ozone NAAQS, and possibly the new 1 hour NO2 NAAQS.

1-32 Update. Says EPA inventory last done in 2002 with projections to 2010. Also, need to add high ozone day NOx inventory information.

1- 34 Update.

CHAPTER 2 – COMBUSTION EMISSION REGULATION AND CONTROL

This material is very outdated so significant updating is required to be useful for training.

2-2 Add NO2 separately or in place of NOx. NO2 is the NAAQS. NOx is precursors for ozone NAAQS. Identify NOx and VOC as precursors to ozone.

2-9 need separate slide on OTC NOx budget rule. At some point should have slide comparing NOx caps for title 4 acid rain, OTC, CAIR, CSAPR1 and CSAPR2.

2-12 Clarify NSR applies to new and modified sources

2-16 Add project applicability criteria adopted about 10 years ago.

2-17 Last bullet is confusing.

2-18 Update for new applicability tests

2-20 Correct spelling in title. Clarify NO2 is the NAAQS and NOx is ozone precursor.

2-21 Might identify NO2, PM25 and ozone as NAAQS.

2-22 Update. Delete acid rain program since no longer a driver in 2009, or include the timeframes when it was a driver. Add PM2.5 as a driver for NOx reductions in 2009. Add visibility plans as a driver.

2-23 clarify what is a temporary generator. Is it a portable generator? Check cited website to see if still relevant.

2-24 Important. Raising CO to lower NOx is no longer a common practice. Adverse consequences are increases in other PICs and adverse effects of the reducing gases on the boiler. Newer low NOx burners achieve both low NOx and low CO.

2-25 Fix title. Use VOC, rather than HC.

2-26 Correct title and visibility spelling.

2-27 Add 1 hour SO2 NAAQS and rules to monitor/model and control. Need separate slides. Is IAQR a reference to CAIR?

2-29 Add "direct PM emissions"

2-30 Update for MAT. Delete last bullet. Add slides on MAT.

2-31 Revise title to read "GHG (cause global warming)". Add methane as an important GHG. Delete bullet on expected major actions soon. Add slide on CPP and ACE legal and regulatory status, along with comparison of some key provisions.

2-32 Revise last bullet to read "Establish regulations on a regional basis, to address transport of air pollution and good neighbor CAA requirements." Add slide on good neighbor concepts.

2-33 Delete last bullet on bubble. Might have a slide on PALs (plant applicability limits) regulatory provisions and pros/ cons.

2-34 and 35 Update NSR reform slides to show most were overturned by courts. Good historical perspective with the current AA for Air the author of some of those reforms.

2-36 and 37 Delete since these bills were not enacted.

2-38 Add slide (s) for CSAPR1 and CSAPR2. Add table to compare caps with CAIR.

2-39 CAMR - Update to indicate courts overturned emission trading for HAPs and MATs performance standards replaced CAMR.   Include MAT slides here or elsewhere.

2-40 Update for 75 and 70 ppb NAAQS.

2-41 Delete or revise. There are no guidance documents applicable for major source NSR (BACT or LAER). Some states do have emission limit guidance for minor source NSR. .Could highlight some of those with a minor NSR slide.   For major NSR, there should be a slide on the RACT/BACT/LAER clearinghouse and how it works with case by case BACT/LAER.

2-42 Update to show latest BACT/LAER for NGCC, which is the most common PSD and NSR permit activity for the last 20 years, and remains so today.

2-43 and 44 Update and include actual examples of output based limits in state rules (NJ NOx RACT for example) and federal rules (MAT).

2-45 Other - RACT is a good topic to expand on, including issues with cost benefit analysis as it may apply the short averaging time NAAQS like ozone. Offset availability and opportunities to create and document ERCs could also be a focus topic.

CHAPTER 3 PRIMER ON COMBUSTION SOURCES

This chapter on basic combustion is still relevant and seems to be generally correct. Good diagrams. Needs some more focus on combustion in turbines and how the modern low NOx combustors in boilers and turbines work. Also, the reciprocating engine slides are few. If another chapter does not further explore engines, then more should be explained in this chapter.

CHAPTER 4 – NOX CONTROL BY REDUCING FLAME TEMEPERATURE

This chapter is in pretty good shape, but could be enhanced and updated to give more information on the design and success of low NOx combustors; especially on gas fired boilers and turbines

4-4 Bullet 2 states most NOx from oil and coal combustion is from fuel bound nitrogen. While fuel bound nitrogen is an important source of NOx for heavy oil and coal, thermal NOx is also important, perhaps half of the NOx in an old oil or coal burner without low NOx combustion design. Once an effective low NOx burner is installed it is probably correct that most of the remaining NOx is related to the N in the fuel. Some data on the amount of thermal vs fuel NOx would be useful.

4-9 Add bullet on how much NOx reduction is achieved in practice with water injection. My understanding is about 50%, not the 80% upper end in slide 8. Also, need a bullet that water injection will increase CO. That is one reason water injection is not pushed beyond about 50%. Also, need a bullet that water injection used on older turbines, but not on new turbines which rely on low NOx combustion and SCR.

4-11 Explain last bullet on passive FGR not being appropriate for high sulfur fuels. May be related to corrosion of burner from sulfuric acid formed in the flue gas being recirculated.

New slide - Could also add a slide on how reduction of sulfur in home heating oil to less than 15 ppm enabled high efficiency condensing furnaces to be used when combusting home heating oil. Prior to the northeast states requiring home heating oil be less than 15 ppm, primarily gas furnaces could be condensing. Expensive metals or premature corrosion were the experience with home heating oil furnaces before ULS home heating oil. Also, the higher efficiency condensing furnaces are a way to lower NOx emissions because of the higher efficiency and lower fuel use. Should also include information on the NOx concentrations from modern home heating condensing burners, and contrast with old heating systems. Updating old oil and gas fired heating systems is a good way to lower NOx, and other pollutants, and at the same time save $ on fuel over the life of the new furnace.

4-14,15,16,18, 19 would benefit from diagrams to illustrate the points being made.

4-19 Update catalytic combustion advances. I'm not aware of much use of catalytic combustion, except in afterburners for VOC control of industrial processes. But that makes more information on catalytic combustion important.

CHAPTER 5 – OXYGEN BASED CONTROLS

This chapter is disjointed, poorly addresses the topic of O2 based controls, and needs significant updating to describe and compare modern low NOx burner technology. Not very useful for evaluating permit applications or conducting inspections today. I offer the following comments, but just doing these things will not make this chapter acceptable. A combustion expert is needed to re-write this chapter.

Page 3 third bullet and page 28 2nd bullet are the only mention of stokers. I don't think stokers are used any longer. If so, rarely. Either explain stokers better or cut these bullets.

Page 4 has the only mention of "thermal NOx control". Unless a later chapter covers this, thermal NOx control should be explained and expanded. I think oxygen control (air to fuel ratios and ways to mix) apply equally to thermal NOx control.

Page 7 - Source of graph? Explain %. Could be a useful graph.

Page 8 - relevance today? Why did the nitrogen content increase over the 25 year period? What is the nitrogen content of fuels used today? I believe oil refined in the USA today (Dakota crudes) are relatively low in N content. Compare N content of gas, ULSD, ULS home heating oil, No 6 oil, No 4 oil, coals.

Page 10 Explain that PIC is products of incomplete combustion, including CO

Page 11 Doesn't explain diffusion and premix combustion. These were mentioned in previous chapter. I expected a more in depth explanation in this chapter. There was even less explanation in this chapter.

Page 12 Explain how excess air is controlled. A better slide would be: Measure excess air. Control air flow. Minimize excess air; without creating excessive PICs (CO, smoke, etc.).

Need to make clear that just controlling excess air is insufficient air pollution control today. Careful control of excess air is necessary, and LNB are also needed to minimize both PICs and NOx.

Page 13 - useful graph. More graphs of actual NOx and CO data would be useful. Mining EPA emission data base for CSAPR and acid rain programs could be informative. Use of the BACT/LAER clearinghouse could focus on the newest units and how they achieved low NOx (combination of LNB and SCR usually) would be useful. How much of the NOx reduction is attributed to the LNB and the SCR?

Page 15 - Replace "means" with "includes"

Page 21 - Need more LNB diagrams.

Page 22 last bullet (clever oil nozzles) and page 25 last bullet (gravity effect on oil) are only mention of oil combustion. That is insufficient. Oil remains an important standby fuel for electric generation and an important fuel for small heaters where gas is not available.

Information on modern home heating furnaces would be useful. Also, focus in industry and institutional furnaces necessary.

Page 28 replace "usually combine" with "can combine". Flue gas recirculation is inadequately addressed.

Page 29 - This is the only slide on NSCR. NSCR needs a whole chapter.

CHAPTER 6 – RECIPROCATING INTERNAL COMBUSTION ENGINES

While engines are not the reviewer's area of technical expertise, this chapter seems to have better explanations and graphs of combustion than the stationary source chapters. But it is also incomplete. For example, it does not explain the critical importance of the oxygen analyzer in spark ignition engines. Also, this chapter is over 20 years old and vehicle control technology has advanced significantly, so review and update by a mobile source expert is needed. Use of SCR in on road diesels needs to be included in some detail. Here are my non expert observations.

6-3 Why does 3d bullet mention turbines if this chapter is about recip engines? Contrasting turbines with recip engines best done at beginning of chapter 7 on turbines.

6-7 What is meant by "uncontrolled"? Would it be better to date the engines generating the emission data?

6-10 and 11 nice graphs

6- 12 What is "equivalence ratio"? If a common term in engine design, explain. Appears to be inverse of air to fuel ratio.

6-13 Better explain retarding spark timing. Diagram comparing retarding with no retarding would help.

6-14 good diagram - provide a definition of compression ratio such as "ratio of volume of cylinder at bottom dead center to volume of cylinder at top dead center."

6-17 update if there are later combustion chamber designs; identify most successful designs.

6-18 diagram is unclear as to where the pre combustion chamber is

6-20 1994 emissions are 25 years old. Update and fill in with modern low emission information.

6-22 Good diagram. Check against modern vehicles. Probably still relevant.

6-23 Check against modern catalyst temp profiles

6-25 Check against recent experience

6-26 to 38 are on "emerging technologies". Where are these technologies now? Focus on the successful ones that are in use today. Add a new emerging technologies section to reflect today's emerging technologies.

6-27 to 30 are 4 slides on hydrogen injection. I don't believe that technology is in use today. Does it still hold promise? Or have other technologies surpassed it?

6-29 mentions a stationary engine bio gas demonstration. Bio fuel in engines is an important topic and needs to be covered. Explain and evaluate use of ethanol in gasoline and vegetable oil in diesel fuel.

6-31 to 37 has 7 slides on homogeneous charge compression ignition (HCCI). Is that in use and important today?

6-38 Leaves you hanging. It references chapter 8 which has 5 slides. Not clear what the technology is. Is this technology now in use and important?

CHAPTER 7 – GAS TURBINES

This chapter is pretty good. The reviewer did not note any errors however, some clarification is needed on some of the slides. Also, as usual, some slides need checking and updating for where turbines are today. It does spend considerable pages on low NOx combustion technologies that were under development 20 years ago. Updates on how these fared are appropriate, but less pages spent on those that were not successfully applied and are not in use today. Primary focus should be on the low NOx combustion technology that was successful and is in general use today. Pictures and diagrams of that technology would be a good addition. If there are combustion technologies under development today to get even lower NOx (than achieved with today's low NOx combustion and SCR), that should be included. Also, there should be a section on turbine retrofits which has become common by the major vendors to increase efficiency (and lower NOx?) of existing units. At the end of this e mail, I suggest some focus on the peaker ozone day issue and ammonia slip/fine particle issue for SCR controlled units. It is important that tomorrows leaders in air pollution control understand and help resolve these issues.

7- 14 Explain what is meant by uncontrolled.

7-15 This information on NOx formation from different fuels relative to methane is interesting, but not very relevant. Comparison with 15 ppm Ultra Low Sulfur (ULS) diesel and coal more relevant.

7-16 Update sulfur content of diesel to reflect the 15 ppm (0.0015%) EPA requirement and that this also applies to light oil used in turbines in most mid-atlantic and northeast states

7-18 Correct page number on slide. Update range of SCR NOx which is somewhat better than the 2 to 5 ppm range cited. I believe BACT is 1.5 ppm NOx for large turbines. It may be somewhat higher for small turbines. Reference to the BACT/LAER/RACT clearing house latest permitted levels would be appropriate, both here and in chapter 8. The progression of lower NOx limits over time for turbines would be a good learning tool on how past regulators applied technology advances to reduce NOx emissions from new and then existing sources?

7-19 Needs more descriptive title

7-22 May need updating

7-26 The NOx and CO lines should be different colors.

7-27 Update with most common turbines in use today, with focus on the new turbines.

7- 30 to 34, and 7-55 These pages and others explain catalytic combustion which was under development but in very limited use. Explain the current status of this technology. If not in use, reduce the number of pages. If not in use, why? And what are the lessons learned? If it has application to retrofits and is in use today for that purpose maintain a substantial section on this.

7-35 to 48 focus on "ultra-lean" combustion technology. Status today? Same questions as for catalytic combustion. This technology is billed as an alternative to SCR, but SCR in combination with low NOx combustion is the technology combination of choice and BACT today. Has this technology been applied to the newest turbines constructed to be used along with SCR?

7-53, 57 to 61 focuses in XONON development. Not clear if this is an example of "ultra-lean" or other technology. Same questions as for catalytic combustion.

7-62 This slide on CAM (CEMs and PEMs) is a teaser, perhaps for chapter 9, which should be referenced. In particular, there needs to be explanation of the process emission monitors (PEMs) in use on turbines, especially the simple cycle peaking turbines, which generally do not have CEMs. .

7-64 Update. Explain whether or not these certificates and awards where successful at helping the introduction of technologies in use today.

7-65 Clarify in title or footnote that this summary list of NOx control does not include add on control (which will be addressed in chapter 8)

Add section on NH3 slip issue - there is mention in one slide that low NOx combustion may achieve equally low (or almost as low) NOx as SCR, without NH3 slip associated with SCR. This is an important point. At what point does lower NOx from increased NH3 injection to an SCR result in an unreasonable increase in the emissions of NH3 (and eventual fine particle transformation in the ambient air). A comparison of incremental NOx reduction and incremental NH3 increase from SCR operation is appropriate. Regulators need to understand the NOx/NH3 tradeoff and avoid increasing NH3 more than decreasing NOx. Is a 2 ppm NOx level with an ultra-low NOx combustor without NH3 slip better for air quality than 1 ppm NOx and 5 ppm NH3 slip? What about 4 ppm NOx without NH3 slip? What is the appropriate tradeoff of NOx decreases for fine particle increases?

Add section on Peaker issue - the course should include more information on the use of and emissions from peakers, since these are very common and will continue to be part of the grid even after much of the electric power is provided by wind and solar. SCR can now be applied to most peakers. Should include data on peaker use during high ozone days. Should explain how annualized cost benefit analysis favors base load control, and ozone day cost benefit analysis favors peaker control for ozone NAAQS attainment purposes. Should explain why a 5 month cap and trade rule does not result in ozone day reductions of NOx from peakers. Should include information on BACT performance emission limits for new peakers and RACT performance emission limits for existing peakers.

CHAPTER 8 NOX REMOVAL TECHNOLOGIES

This is a useful chapter with lots of good diagrams and graphs. Most of my comments are pointing out areas in the need of checking against experience over the last 15 or so years and updating accordingly. Comments 17 to 27 suggest areas for expanded focus on today's issues relevant to existing and new NOx control.

8-3 Update. Delete technologies that did not pan out. Update status of technologies that succeeded and are in use today. Add information on any promising new technologies today.

8-6 Update

8-8 Clarify that 1650 F is the optimal temperature of the SNCR and what the range of temperature is to have effective SNCR.

8-15 to 8-18 These Alstom graphs are very useful. Ask Alstom for updates and slides for new developments.

8-19 Update for US coal experience. First USA SCRs on coal were in NJ in the mid-1990s. Still successfully in use today. How many have been installed nationally? What % of the coal capacity has SCR? Oil? Gas?

8-29 Check BACT/LAER clearinghouse and update as appropriate. Need up to date information on NOx from combined cycle gas turbines, which is currently less than 2 ppm.

8-40 I'm not familiar with this configuration where the SCR is after the spray drier and fabric filter. More information on use and performance would be helpful. Provide a comparison of NOx from waste to energy facilities with SNCR and SCR.

8-47 Provide information on SCR catalyst life for different applications. I believe SCR catalyst life has been much longer than expected.

8-49 Provide information on the use of SCR on new diesel vehicles.

8-51 Explain first bullet "virtual lean burn combustion process"

8-53 What has been the performance history since installation about 18 years ago.

8-54 to 56 Performance history?

8-60 RAPER-NOx - Expand or delete (if not in use today).

8-61 Expand to include performance or delete.

8-62 to 74 SCONOX - This was a promising technology but I've lost track. Any operating currently? Relevant for lower NOx and other emissions in the future? Even if not in use today, an explanation of this technology and why it failed to be commercialized is relevant. Was it a lower NOx technology that regulators failed to require? Or did it have a fatal flaw?

8-75 to 8-80 Slides on new technologies about 20 years ago. Expand on any that were proven and are in use. Add any promising new technologies under development or commercialization today.

8-76 points out the problem of biogas control resulting from high H_2S and siloxane which destroy catalysts. Regulators need more information on successful biogas cleanup (California?) so NOx and CO catalysts are not poisoned or coated. Some links to or copies of resources that address this problem would be useful for air and waste regulators.

Mercury - I previously mentioned the issue of using SCRs to oxidize Hg and catch it in an existing scrubber. This is done by reducing NH_3 injection and lowering NOx removal to 50% or less. Regulators need to be aware of this problem and set NOx performance limits to fully use the SCR to catch NOx (80 to 90% efficiency) and control Hg by other means (typically carbon injection).

Ammonia slip - More information on ammonia slip is appropriate. Are their ways to greatly reduce or eliminate NH_3 slip? When are more NOx reductions not worth the adverse effects of NH_3 slip? Is a 1 ppm NH_3 emission increase worth a 1 ppm reduction in NOx, considering $PM_{2.5}$ formation and visibility impairment? How often and under what operating conditions should NH_3 slip be stack tested?

SCR startup - What are appropriate regulatory and permit provisions to account for higher NOx during SCR startup when the catalyst is not hot enough? How can NOx emissions during startup be minimized?

Catalyst layers - Provide more information on effectiveness of depth of SCR catalyst. Can SCR efficiency reasonably be increased to greater than 95%? How effective is more catalyst at reducing NH_3 slip? What is the pressure drop penalty?

SCR maintenance - Expand on catalyst monitoring and replacement.

NH_3 injection control - Expand on boiler and NOx monitoring and feedback to control injection of NH_3.

Heavy duty vehicles - On and off road heavy duty equipment are the major sources of NOx today. More focus on the control of these engines is appropriate. Review of the VW case would be appropriate. What have we learned? What safeguards have been put in place? What is the role of inspection/maintenance programs? There should be separate chapters (or a separate course) dedicated to vehicles.

NOx emission limit averaging time - Regulatory and permit limit averaging times vary between 1 hour and 1 year. What is the appropriate averaging times for different types of equipment? What is the peak 8 hour emission rate if the source is operating at a 30 day limit? Should the averaging time for the emission limit match (or be lower than) the averaging time for the adverse health effect? Are Show how different limits with different averaging times can be applied to a source for different purposes. A lb./million btu limit for 24 hours could be set to insure BACT operation every day. Also, a lb/hr or lb/8hr emission limit could be set to ensure emissions do not cause or contribute significantly to a NAAQS exceedance. Also, a ton/yr emission limit could be set to avoid PSD and NNSR applicability.

NOx control of gas turbine peakers - provide an update on capability of new simple cycle turbines with low NOx burners and SCR. Discus when SCR is applicable to retrofit existing simple cycle gas turbines.

NOx control of peaking and cogeneration engines - Same update as for simple cycle turbines.

CHAPTER 9 EMISSION MEASUREMENT, MONITORING AND REPORTING

The comments on this chapter are brief because there is not much to review. The chapter needs a lot more detail. For example, Testing and monitoring are important and take up large portions of an operating permit. The permit engineer Needs information to decide whether CEM, stack test, or parametric monitoring or a combination of these is appropriate for particular size and types of equipment. Examples of permit MRR (monitoring, recordkeeping and reporting) should be included. A section on CAM (compliance assurance monitoring) should be included. It would be helpful to cover different states approach to MRR conditions for typical source categories. Examples of useful parametric monitoring would be particularly helpful.

These slides have some good calculation examples but are weak in many areas. Need information on CEMs and test methods relevant for NOx, NO, NO2. Need more detail throughout, probably doubling the number of slides.

Here are specific comments:

9-3 Explain that DAS is data acquisition system

9-4 3d bullet - "same" should be "sample"

9-6 Delete last bullet. Replace with a slide on the relationship of temperature and moisture content to condensation. Provide example of how to calculate the dew point, i.e. temperature and relative humidity at which the plume condenses water and becomes visible. Provide another example of calculating the temperature at which water in flue gas in a probe condenses.

9-7 Explain each listed system with 1 or more slides each

9-9 Clarify what are "long periods of time"

9-15 Provide 1 or more slide for each bullet

9-15 to 17 - Clarify and expand parameter monitoring. Provide examples relevant to NOx and show how parameter monitoring insures compliance with emission limits. Explain how parameter monitoring must be correlated with relevant test results to calibrate the relationship between the parameter and actual emission levels.

9-18 Slide for each bullet

9-19 Slide for each type of audit

9-20 Add other emissions units commonly used in emission limits, including lb/MWhr and ug/M3 and lb/SCF and lb/dscf. Show how each are determined from stack test data and CEM data.

9-25 What is sf in dsf and wsf? columns 2 and 3. I'm only familiar with scf in column 4.

9-26 Good demonstration on use of emissions equation. Need more of this. Show equation if measuring ppm dry.

9-27 Need equation for determining lb/MMbtu from test data.

9-29 to 31 Good. Provide more problems for the students to solve.

9-32 Relevance?

CHAPTER 10 INSPECTIONS

This chapter is superficial and incomplete. It seems to be designed more for class discussion, rather than lecture. My specific comments follow:

1. 10 - 4 Update and expand types of limits

2. 10-5 Add slide on typical operating limits

3. 10-7 Provide typical questions to ask during an inspection.

4. 10-9 Explain how to check for condensation in CEM umbilical cord. Probably a temperature check. I note that CEM inspections in NJ are preformed by the stack test group which focus on audits of tests and CEMs. This general course for the regular field inspectors should focus on what to look for to decide whether a follow up inspection by the state's testing specialists is appropriate. Is there a separate course on NOx CEMs that can be referenced for the CEM specialists and some inspectors to take?.

5. 10-10 Check and update calibration requirements. What should the field inspector be looking for?

6. 10-11 Check and update zero and span gas bullets. What should the field inspector be looking for? Why does cylinder pressure need to be at least 100 psig?

7. 10-12 Update NSR applicability check. (include key aspects of NSR rule revisions, without getting into the weeds of NSR, which would be a separate course.) Provide example. Do same for NSPS. What are indications that a thorough NSR or NSPS applicability inspection is appropriate? A follow up inspection by NSR/NSPS staff experts may be required.

8. 10-14 Add new question to list. "What are the key permit conditions that should be subject to inspection attention? " Provide examples. Provide examples of enforceable and unenforceable permit conditions? Does every condition need to be enforceable? Is there a benefit of "should do" permit terms, in addition to the "must do" terms?

9. 10 - 15 to 21 provides 6 permit conditions for example 1.

10. 10 - 22 slide on compliance determination needs to be expanded. There should be at least 1 slide on compliance determination for each of the example permit conditions.

11. 10 - 23 and 24 is example 2 which stops with a table of emission limits. Its as if another 30 slides were lost or not done.

More examples and clear information on compliance determination for each example requirement is needed. There needs to be a section on checking air pollution control maintenance. Photos of problems would be appropriate. How does an inspection check for NH3 or urea injection? What about catalyst activity and replacement? How do you check the amount of catalyst in place? How is ammonia slip checked? Are there portable NOx analyzers that can now be used during an inspection? If so, a demonstration on how such an analyzer is used would be helpful. How can inspectors identify situations (high NOx, low stacks, and nearby property line) where there may be exceedances of the NO2 NAAQS to refer to the modelling group for further evaluation. What does a visible orange NOx plume mean for NO, NO2 and NOx concentrations?