Chapter 2
NO_x Regulatory Programs

Editor's Note:

Chapter 4 – NOx Regulatory Programs from the 2000 version of APTI 418 has been replaced. This chapter was written by Chuck Solt.

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Stationary Source Combustion Emission Regulations

This section will cover emission regulations for stationary combustion sources in the United States. It will only address vehicular emission regulation in areas where they are cited in regulations for stationary sources. It will primarily address Federal regulations, but will discuss programs that states develop under Federal regulations.

The intent of this section is to give a general understanding of the federal programs. It will not cover all details. Those responsible for compliance with any of these sections should review the appropriate regulations and/or get consulting assistance to assure compliance.

Before starting on the regulations, we will review some regulatory reference background.

- An Act is a public law passed by Congress. It may include a series of amendments. All US laws are contained in the US Code. Once congress has passed the law, the appropriate agency (in this case, the EPA) will develop regulations to implement the law.
- *Code of Federal Regulations (CFR)* – This publication contains all US regulations. In this section of the study guide we are concerned with the regulations written by EPA to implement the Clean Air Act as amended by subsequent legislation. All environmental regulations are contained in Title 40 of the CFR. When referencing these regulations the convention would be as shown below:
  - 40 CFR Part 60 Subpart GG or
  - 40 CFR 60.4300

  Both of these citations refer to the NSPS emission regulations for Gas Turbines. Both formats are commonly used. 40 means Title 40 of the CFR. Part 60 is the NSPS program. The Subparts refer to the various processes covered in the NSPS program. Subpart D is boilers, Subpart KKKK is gas turbines etc. Subpart KKKK starts in section 60.4300. All regulations supporting the CAA are contained in 40 CFR Parts 50 thru 99. Title 40 EPA regulations for the CAA can be accessed at http://www.ecfr.gov/cgi-bin/text-idx?sid=b62273429a48acc37bfd254dd066683a&c=ecfr&tpl=/ecfrbrowse/Title40/40tab_02.tpl
- *Federal Register* – This is a sort of daily news about official government action. It is published Monday thru Friday and all new proposed or final regulations are published. In many cases, the effective date of a regulation is tied to the date that it appears in the FR. Any issue of the FR from 1994 to the present can be found at http://www.gpo.gov/fdsys/browse/collection.action?collectionCode=FR. It is also easy to subscribe to the air section of the FR at http://listserv.access.gpo.gov/cgi-bin/wa.exe?SUBED1=FEDREGTOC-L&A=1. This will deliver daily any EPA actions related to air pollution.

History

US emission regulations began in 1955 when Congress provided research funding for state programs. In 1963, legislation provided that the Department of Health Education and Welfare (HEW) could provide assistance to states developing programs. It also allowed HEW to initiate multi-state proceedings. In 1967, HEW developed the first National Ambient Air Quality Standards (NAAQS). These standards were to be used by states in developing plans that would then be approved by HEW.

In early 1970 few states had complied with the 1967 Act. There had been little progress in improving air quality or in achieving the NAAQS. The differences between state regulations was being used by industry as a criteria for siting new plants (i.e. there was a tendency for industrial facilities to locate in states with less stringent environmental requirements). In 1970, the original Clean Air Act (CAA) was passed by Congress to provide Federal Authority to develop National programs, Standards etc. This would assure consistent standards from state to state to state. The legislation also created the US Environmental Protection Agency.

The CAA directed the EPA to:

- Identify criteria pollutants.
- Establish NAAQS for each criteria pollutant
- Establish New Source Performance Standards (NSPS) for combustion sources of criteria pollutants
- Determine what areas of the country were achieving the NAAQS and which ones were not.
- Establish dates by which the non-attainment areas were to come into compliance with the NAAQS.
- The EPA was to develop the National Emission Standards for Hazardous Air Pollutants (NESHAPs). In this program, the EPA was to identify toxic air pollutants and develop programs to limit their emissions.

The CAA also ordered each state to develop a State Implementation Plan (SIP) to detail how they would achieve compliance with the NAAQS.

One concept that was not considered in the CAA of 1970 was the problem with areas that were originally determined to be in compliance with the Act, but through growing population and industrialization gradually deteriorated until they also were non-attainment. To address this problem, in 1975, the EPA developed a policy to Prevent Significant Deterioration (PSD). This policy was adopted into the 1977 Amendments of the CAA.

In addition to the PSD program, the 1977 amendments also extended the date for non-attainment areas to achieve compliance until November, 1987, established Class Areas, Increments and the BACT/LAER requirements.

- Air Quality Areas were established and designated as Class I, II or III.

    - Class I – These areas cannot have any degradation from projects within or outside the area. Almost all Class I areas are National Parks, National Forests or Bureau of Land Management properties.
    - Class II – All areas that are not designated Class I or Class III are automatically designated Class II.
    - Class III - Since the 1977 amendments, no areas have been designated Class III.
- Increments – This is a refinement created by the PSD program. Attainment areas are limited in the emission increases for which they can issue permits. They cannot increase emissions by more than 25% of the difference between the original attainment level for the area and the NAAQS.
- BACT/LAER – This program is part of the Non-Attainment New Source Review (NSR) and PSD programs, and is intended to assure that new emission control technologies demonstrated on one project are used on subsequent projects. They will be discussed in a later section.

The situation in 1987 was:

- The compliance date for reaching the NAAQS Attainment was Nov. 1987
- Almost all areas of the country were in compliance with all of the Criteria Pollutants except ozone.
- There had been little progress in achieving the ozone NAAQS
- The NESHAPs program had only established 7 toxic pollutants. Many legislators and environmentalists felt this was a failure.

Two actions were taken to resolve these perceived problems.

- **Post 1987 Ozone Strategy** – The EPA announced a new approach to NAAQS to begin in November 1987. Before 1987, the EPA had targeted emitters of pollutants to achieve NAAQS standards. This worked well with NO_2, SO_2, PM, and CO, but the strategy was a failure for ozone. No one emits ozone. It is manufactured in the atmosphere from NOx and VOC. Before 1987, the EPA was targeting VOC reductions to reduce ozone concentrations in the atmosphere. The problem was that there is an abundance of VOC in most areas, and very little NOx. Accordingly, the photochemical ozone reaction was NOx limited. In some cases, ambient concentration of VOC had been cut in half with no significant reduction in ozone. The 1987 strategy was to reduce NOx along with VOCs.

  In addition, this new approach required that existing sources in ozone non-attainment areas be regulated to reduce NOx and VOC emissions; the existing NSR and NSPS Programs were focused on new sources. As a result of this requirement to reduce NOx and VOC emissions from existing sources, Reasonable Achievable Control Technology (RACT) Programs were established by states with non-attainment areas in the mid-1990s. And later, in 1998, the NOx SIP Call was issued by EPA in order to obtain further NOx reductions from new and existing sources in the eastern U.S that contributed to ozone formation thru interstate transport of NOx, as will be discussed later.

- **Clean Air Act Amendments (CAAA) of 1987** – If you have never heard of the CAAA of 1987, don't be concerned. The act was introduced as the CAAA of 1987, but took 3 years to become the CAAA of 1990. It was a major revision with many new programs. It included:
    - **Severity of Non-attainment** (Title I) – Before 1990, all non-attainment areas fell under the same program with the same compliance dates. This new program introduced 5 categories of non-attainment areas: Marginal, Moderate, Serious, Severe and Extreme. The ranking was based on past exceedences; the more severe the non-attainment condition, the longer the compliance time and the more stringent the mandatory measures that the state had to include in their SIP. This Title also required that, in ozone non-attainment areas, ozone precursors (NOx and VOC) must be treated as non-attainment, even if the area is attainment for the precursor.
    - **Hazardous Air Pollutants** (Title III) – Congress designated 189 substances or categories of substance that they felt warranted regulation. This Title directed the EPA to:
        - Add additional substances that warranted inclusion.
        - Remove substances that they found were not a significant threat
        - Identify the source categories for each substance.
        - Develop a Maximum Achievable Control Technology (MACT) standards for each source category.
        - Enforce compliance with the MACT standards

      The HAP MACT Program combines elements from the NSPS and NSR Programs. As with NSPS, emissions sources are grouped into categories, and emission standards are established for each category based on a control technology (MACT) determination. Following the NSR model, applicability is limited to sources that have potential HAP emissions greater than a specified "major source" threshold".

      For HAPS, the minimum control level corresponding to MACT is very specifically defined: (a) for new sources it corresponds to the best control that has been achieved in practice by a similar emission unit in that source category; and (b) for existing sources it corresponds to the emission limit achieved by the best 12% of the emission units in that source category

      There are several MACT Source Categories concerned with stationary combustion sources, including Industrial and Commercial Boilers, Engines, Combustion Turbines, and Process Heaters. In addition, Title III requires separate consideration of Utility Boilers and Municipal Waste Combustion units. It should be noted that combustion sources are generally small emitters of HAPS, which was reflected in these sources being the last of the MACTs to be promulgated.

- **Acid Deposition (Acid Rain Program)** (Title IV) – There was concern about damage to pine forests in the Northeast and Eastern Canada resulting from Acid Rain. It was believed that this acid deposition resulted from SO_2 and NOx emissions, primarily originating from coal burning power plants. This Title establishes a Cap-and-Trade program to limit total SO_2 emissions from fossil fuel fired utility power plants and, also contains a provision to limit NOx emissions from older coal fired power plants.
- **Federal Operating Permit** (Title V) – This program was not intended to create any new emission requirements. It was only aimed at enforcement of existing regulations. Before Title V, federal air programs were enforced by state or local air agencies. Title V requires that "Major" facilities obtain a *federal* operating permit that includes the requirements of all federal programs. This then gives the EPA enforcement authority over the federal emission programs.

  The Operating Permit serves as a consolidated enumeration of all of a source's federally enforceable permit conditions. The Program also represents a departure from previous federal air programs, with its focus on on-going compliance rather than initial permitting. As a result of this emphasis on continuous compliance, emission monitoring is a significant component of the Operating Permit Program. The importance of monitoring has also been strengthened by the Title VII Enhanced Monitoring provisions applicable to major sources, which resulted in promulgation of the Compliance Assurance Monitoring (CAM) rule.

  The Operating Permit Program was not intended to create any new regulatory requirements for a source. However, the rule does allow the addition of monitoring requirements if the original permit conditions do not include any method of verifying on-going compliance. The extent to which such "gap filling" monitoring may be included in an Operating Permit has been a controversial aspect of program implementation.

Titles II, VI and VII do not generally relate to stationary combustion sources.

The CAAA of 1990 introduced several other items:

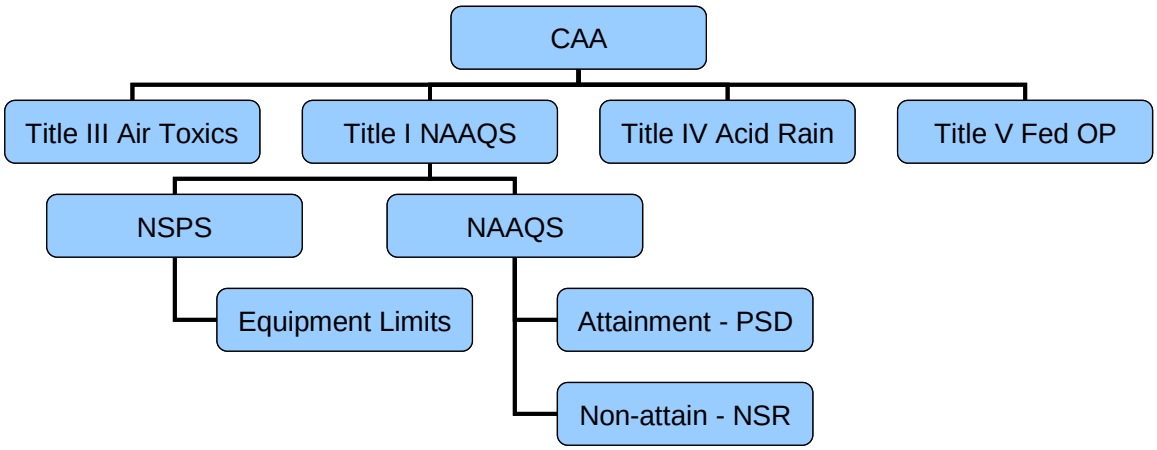
- **Ozone Transport Corridor NOx Budget** – As indicated above, ozone is manufactured in the atmosphere from NOx and VOC. Almost all of the Northeast states were non-attainment for ozone. These states were referred to as the Ozone Transport Corridor. They sued the EPA claiming that precursor emissions from upwind states are contributing to the ozone non-attainment in their states. The CAAA of 1990 directed the EPA to establish a NOx budget to allow these states to achieve ozone attainment. We will say more about this later.
- **Outer Continental Shelf Consistenc**y – The Act stated that:

  "SEC. 328. AIR POLLUTION FROM OUTER CONTINENTAL SHELF ACTIVITIES. § (a)(1)
  (sources must) control air pollution from Outer Continental Shelf sources located offshore to attain and maintain Federal and State ambient air quality standard.

For such sources located within 25 miles of the seaward boundary of such States, such requirements shall be the same as would be applicable if the source were located in the corresponding onshore area. The Administrator shall update such requirements as necessary to maintain consistency with onshore regulations."

When the CAAA of 1990 was passed, it became clear that NOx, SO_2 and Toxic emissions were now the primary targets of stationary source programs.

Clean Air Act



The organization chart above shows the relationship of CAA programs that affect stationary combustion sources. Notice that the NAAQS under Title I create two programs: (1) the PSD program for areas that already meet the NAAQS for a particular pollutant and (2) the Non-attainment NSR program for areas that do not. Each of these programs is applicable on a pollutant specific basis.

The CAA Today

Criteria Pollutants – The CAA of 1970 established the criteria pollutants (those for which an ambient air quality standard was set). The ones that we care about are:

- Nitrogen Dioxide (NO_2) (resulting from the emissions of Oxides of Nitrogen (NOx))
- Carbon Monoxide (CO)
- Sulfur Dioxide (SO_2)
- Particulate (PM) (more recently refined to separately regulate PM-10 and PM ~~2.5~~2.5)

Ozone and lead area also criteria pollutants, but neither are emitted in significant quantities by stationary combustion sources. However, ozone is a very important pollutant as far as combustion sources are concerned since NOx is a critical precursor to ozone.

NAAQS – In the early 1970s, National Ambient Air Quality Standards (NAAQS) were established for each criteria pollutant. There are 2 levels of standard set for each pollutant. The first level (primary standard) is to protect human health and the second level (secondary standard) is intended to protect "welfare". The second level would include considerations such as impacts of a pollutant on agriculture etc. The CAA legislation called for periodic review of the standards and adjustments as necessary.

- *NO_2 (which is produced from NOx emissions)* – There are 7 oxides of nitrogen. NOx is the total of the NO and NO_2. Other oxides such as N_2O, which is regulated in some states as a greenhouse gas, but not as a criteria pollutant. Air consists of 79% nitrogen and 21 % oxygen, so the components of NOx are abundant in the atmosphere. The nitrogen in the atmosphere will oxidize into one of the nitrogen oxide compounds at elevated temperature. NOx begins to form at about 1500°C (about 2700°F). The amount of NOx formed is a function of the temperature and residence time at that temperature. Accordingly, almost all combustion devices produce some NOx.

  Most NOx is emitted as NO, but oxidizes further into NO_2 soon after it is emitted into the atmosphere. NO_2 has suspected health risks associated with it. However, most of the concerns associated with NOx relate to the fact that it is the critical precursor for Ozone. This will be discussed more in a later section.

  A number of studies have indicated that the process of NO oxidation into NO_2 can scavenge ozone. This can result in significant near-field reduction of ozone, but when the NO_2 reacts with hydrocarbons and ultra-violet radiation, it will form far more ozone than was originally scavenged.

- *CO* – Carbon Monoxide is the product of incomplete combustion. It has short environmental persistence, and turns into CO_2 quite quickly after it is emitted into the atmosphere. CO is acutely toxic, but has no other environmental consequences.

- *HC* – Hydrocarbon emissions also are the result of incomplete combustion. Regulations address hydrocarbons under a variety of names, each with its own definition.
  - Volatile Hydrocarbons (VOC)
  - Reactive Organic Compounds (ROC)
  - Reactive Organic Gasses (ROG)
  - Precursor Organic Compounds (POC)
  - Non-methane Hydrocarbons (NMHC)
  - Non-~~methane~~méthane, Non-~~ethane~~éthane Hydrocarbons (NMNEHC)

  And, I am sure there must be others. The definitions do vary, and accordingly, the compounds considered may be somewhat different depending on the definition. The definitions mostly include C3 and higher, but not so high that they do not volatilize at standard conditions. In all cases the concern is hydrocarbons that will be gaseous and reactive, but methane and in most

cases, ethane are considered to be non-reactive and are not usually considered in regulations for hydrocarbon emissions.

Title I regulates Non-Methane Hydrocarbons (NMHC), as precursors of ozone, excluding those hydrocarbons such as methane and ethane that do not participate in photochemical ozone reactions. Some components of HC emissions may be toxic, but those are regulated separately under Title III which we will discuss separately.

- *SO_2* – Sulfur is a fuel component. It is burned along with the hydrocarbons. Therefore, the amount of SO_2 emitted is directly proportional to the sulfur content of the fuel. The entire US is now in compliance with the SO_2 NAAQS, but it is now regulated as a precursor to Acid Deposition (Acid Rain) and PM2.5.

- *PM* – There are also multiple designations for Particulate Matter. Originally it included all particulate regardless of size (total suspended particulate). Subsequently the concern shifted to particulate matter smaller than 10 microns, referred to as PM 10, which is slow to settle from the atmosphere. More recent studies have indicated that it is the finer particles, less than 2.5 microns, that are the primary source of respiratory problems, so in 1997, the NAAQS was revised to set standards for PM2.5.

Air Toxic Program (40 CFR 63)

As mentioned above, Title III of the CAAA established a new air toxic program which identified 189 toxic substances or categories of substances. In 1993, the EPA published the list of 72 Source Categories for toxic emissions. Since then, they have been developing the Maximum Achievable Control Technologies (MACT) for each of the source categories. All of the MACTs had been completed.

Implementation of the CAA

The role of the EPA in all of this is to:

- Develop Regulations to implement the CAA
- Develop Standards
- Enforce Program Requirements

There are a number of different regulatory strategies that can be employed in legislation or enabling regulation. These include:

- Establish an Emission Limit (Cap) in the form of:
    - Short Term Absolute Emission Limits (Hourly to 30 Day) or Longer Term (Seasonal or Annual) Absolute mass emission caps, with no trading provisions
    - Cap & Trade programs, consisting of absolute Emission Caps or Budgets established at the Regional or National level, that allow individual

sources the flexibility to cover their emissions thru trading, thereby making compliance more cost effective.

- Restrict the fuel type (i.e. limit the allowed pollutant concentration in a specific fuel type, and/or the amount of usage for a specific fuel type)
- Restrict overall operating usage (hours/year, MMBtu/yr);
- Specify emission Control Equipment for a class of combustion sources
- Specify Operating Practices
- Restrict Combustion Equipment, by not allowing the use of certain combustion technologies.

New Source Performance Standards (NSPS, 40 CFR 60)

In the CAA of 1970, the legislation directed USEPA (which was created in the same legislation) to identify the highest emitting equipment categories. They were then to develop regulations for each equipment category. These standards were to limit the emissions of criteria pollutants from new installations. The list of categories was completed in the early 1970s, but, additional categories have been added over the years. Each category has a subpart designation, for example, Subpart D is the Boiler Standard of Performance, Subpart EE is the Standards of Performance for Surface Coatings of Metal Furniture and so on. The most recent regulation is Subpart OOOO (STANDARDS OF PERFORMANCE FOR CRUDE OIL AND NATURAL GAS PRODUCTION, TRANSMISSION AND DISTRIBUTION)

These standards establish limits on stack concentrations of one or more criteria pollutants. The standards also contain applicability criteria, and testing and reporting requirements. Appendix A of 40 CFR 60 contains all of the test methods.

The NSPS emission standards are typically specified based on the size and type of equipment. It does not make any difference whether the equipment is being installed singly or in large groups; it applies to each equipment unit individually. These standards also apply regardless of whether the installation is in an attainment or non-attainment area. Generally, NSPS standards only apply to new equipment manufactured/constructed after the date of the proposed rule. The owner/operator of a source must also meet any applicable NSR regulations in addition to the NSPS.

New Source Review (NSR)

In contrast to the NSPS Program, which imposes uniform emission standards on a particular source/equipment category, the New Source Review (NSR) Program imposes site specific emission limits on new projects at major source facilities. The stringency of these emission controls will be determined based on the results of a control technology analyses, and by the need for air quality impacts to remain within allowable standards, as discussed below. Emission limits imposed under NSR can be no less stringent than the NSPS standard.

The NSR program actually applies to both attainment and non-attainment areas, but in common usage the term is used to refer to the portion of the program that applies

to non-attainment areas. Prevention of Significant Determination (PSD) is the portion of the NSR program that applies to attainment areas. So in common use, NSR is associated with non-attainment and PSD with attainment. In either case, the source in question must be "Major" for the federal NSR or PSD program to apply.

The determination whether a source is major is made on a pollutant specific basis, and is determined separately for the PSD and Non-Attainment NSR Programs. Under PSD, if the potential emissions of any criteria pollutant exceeds major source thresholds (of 100 or 250 tons/year depending on the source category), then the source is designated as major. Once a source is designated as major for PSD, based on the emissions of one pollutant, other criteria pollutants may also be subject to the PSD program if their annual potential emissions exceed specified DeMinimus (Significance) levels. Under (Non-Attainment) NSR, only pollutants that are in non-attainment and whose potential emissions exceed major source thresholds are subject to the Program. However major source thresholds may be significantly lower under Non-Attainment NSR than for PSD; these thresholds depend on the classification of the Non-Attainment area.

If the source is not major for any pollutant, it will only be regulated by any applicable local or state regulations.

Caution: There are differing definitions for a "Major" source in the NSR program, the Title V federal operating permit program, and Title III toxic emission program. They read very similar, but *they are not the same*! Be sure to check the definition for the applicable program. Definitions of Major Sources can be found in the CFR at:

- Title V Definitions, Major Source – 40 CFR 71.2
- PSD Definitions, Major Source – 40 CFR 51.165 (1)(iv)(A)
- NSR – may be the same as PSD, but in non-attainment areas, local/state agencies can set lower limits in their SIP
- Air Toxics Program Definitions. Major Source – 40 CFR 63.2
- Compliance Assurance Monitoring – 40 CR 64.1

Except for CAM, the determination of whether a source is major is based on the level of emissions after the application of any emission control equipment required in the permit, and accounting for any federally enforceable operating (hours of usage, fuel usage, etc.) restrictions.

The NSR/PSD Program also applies to a new source installed at an existing major facility or to alteration of an existing emission unit at a major facility, if the change (new unit or alteration) results in an increase of potential emissions that exceeds a "major modification" threshold.

Determining Applicability of NSR or PSD

The first step is to determine if the facility is in a non-attainment area for each pollutant to be considered. This parameter should be absolute and project independent. Check with the local/state air agency.
For most combustion applications, the major pollutant of concern is NOx. The other pollutants need to be checked, but will usually not require as much consideration as NOx.

If the project is located in an attainment area, the project must be reviewed to determine if PSD is applicable.

- If the facility is new, and the source is *major*, it will apply.
- If the new source adds sufficient net potential emissions to make an existing non-major facility *major*, it will apply.
- If it is an existing *major* facility, and the new source has potential emissions that exceed the *major modification* threshold, the rule will apply.
- If the potential emissions for any other criteria pollutant is "significant" (aside from the pollutant that resulted in major source status), those pollutants are subject to PSD/BACT review as well as the pollutant that triggered PSD/BACT.

If the project is in a non-attainment area, for any criteria non-attainment pollutant, the determination can be a bit more complex. The determination is the same as for the PSD program above, but the thresholds for *major* and *major modification* may be lower than the PSD thresholds. If any other criteria pollutant is "significant", the source will have to use PSD/BACT for that pollutant if the area is attainment for the "significant" pollutant or LAER if it is non-attainment.

In practice, determination of PSD/NSR Applicability is most problematic for modifications performed on an existing unit at an existing major source. For these projects, it must be first determined if the project may be exempted as "routine maintenance, repair and replacement (RMRR)". If the project does not qualify as RMRR, then the net potential emission increase due to the project must be determined. For an existing unit at a major source, this analysis can be complicated by: (a) the occurrence of separate contemporaneous emission changes in other units at the facility, and (b) on the manner in which future emissions are projected to occur after the modification is implemented (this issue is discussed later). As a result, the evaluation of major modification status for an alteration project on an emission unit at an existing major source can be a difficult and confusing process.

PSD Program (40 CFR 51.165)

The purpose of this program is to prevent attainment areas from gradually deteriorating until they become non-attainment. If it is determined that the PSD program applies to a facility or project, there are 2 basic types of federal requirements that must be satisfied:

(1) BACT – Best Available Control Technology requires that a new emitting unit use the technology which:

- Is technologically feasible,
- Is economically feasible,
- Does not have overriding adverse environmental consequences, and
- Has been demonstrated in practice, or
- Achieves the best emissions of any technology meeting the above criteria or, achieve the same emissions using another control technology.

Economic Feasibility – The US EPA Office of Air Quality Planning & Standards has prepared a Manual for doing economic feasibility analysis (www.epa.gov/ttn/catc/dir1/cs1ch2.pdf). The applicant determines the incremental cost for the control technology and the incremental emission reduction. They then calculate the cost effectiveness of controls per ton of pollutant removed on an annualized basis. If this cost effectiveness is below a threshold, it is determined that the applicant should use the technology. If it is above the threshold, the applicant can claim the technology is not cost effective. Unfortunately, the EPA will not tell anyone what the threshold is. It is possible, by diligently reviewing EPA determinations concerning the feasibility of certain technologies, to infer the value assigned to this moving cost/effectiveness threshold at any time. At the present time, the threshold for NOx appears to be about $10,000 per ton.

Environmental Impact – This is a criterion that should be seriously considered, but, in practice, local/state permitting agencies have problems dealing with it. For example, how do they evaluate a tradeoff of NOx vs. ammonia? This particular issue has been raised because SCR used to control NOx emissions from combustion sources will emit ammonia. Some gas turbines are guaranteed as low as 5 ppm without SCR. Most permits based on using SCR are for 2.5 ppm. The ammonia emissions on such a unit are often 10 ppm. This means that the environment is getting 4 times as much ammonia as the resulting NOx emission reduction. The EPA reviewed the question and prepared a guidance that indicated ammonia emission should be considered in making a BACT determination involving SCR, but they did not provide criteria for making the determination. Another common consideration in combustion projects is the tradeoff between NOx and CO. Most combustion control technologies that reduce NOx will increase CO, but there is no EPA guidance on how to make a tradeoff determination.

Energy Impact – This is actually a 4th criteria for determining BACT. Applications should address the subject, but don't expect this item to have any impact on the determination.

Demonstrated in Practice – The term "demonstrated in practice" (or achieved in practice) has several definitions. The first came from a NSR revision proposed in 1996 (40 CFR 51.165 (a)xxviii(B)(1) which read:

(1) Has operated at a minimum of 50 percent of design capacity for 6 months; and

(2) The pollution control efficiency performance has been verified with either:

(i) A performance test; or

(ii) Performance data collected at the maximum design capacity of the emissions unit (or units) being controlled, or 90 percent or more of the control technology's designed specifications.

Unfortunately, this NSR Reform was never adopted, and the CFR still has no definition. The South Coast Air Quality Management District (which serves the LA basin) later developed their own definition which requires 12 months of typical operation. It is still subject to district-by-district and case-by-case evaluation.

BACT Review: BACT is determined on a case-by-case basis, considering all of the above criteria. The owner/operator of a proposed new source will prepare a BACT analysis as part of the application. The analysis will:

- Review clearinghouses, literature, permitting summaries etc. to determine the best technologies that have been permitted.
- Starting with the technology that produces the lowest emission, the applicant will determine whether it meets all of the above criteria. If it does, the application will conclude that the project will use that technology.
- If it does not, the applicant will move to the next technology, and repeat the process until he reaches one that is technologically feasible, economically feasible, demonstrated in practice and has no overriding environmental impacts.

This process is called the Top-Down approach.

(2) Air Quality Modeling: four (4) types of air quality modeling must be conducted under PSD to evaluate project conformance with allowed impact levels

- ***NAAQS Impact Analysis***: no pollutant emissions can result in impacts, when combined with background pollutant concentrations, that exceed an NAAQS

- ***Increment Consumption –*** Congress was concerned that an attainment area may issue permits for new sources until eventually the area becomes non-attainment. So, the CAA of 1977 included the increment provision. It limits permits in attainment areas to a total of 25% of the difference between their ambient concentration in 1977 and the NAAQS. When permitting a new source, either the applicant or the agency must determine if the project causes the air basin to exceed its increment.

- ***Insignificant Impact on Class I Areas*** – A PSD project cannot be permitted if it will result in an air quality impact on a downwind Class I

area. As mentioned above, Class I areas are under the jurisdiction of the Federal Land Management program. When starting a PSD permitting process, it is wise to involve the applicable federal agency, which may be the National Forest Service, National Parks Department and/or Bureau of Land Management, as early as possible in the process. This analysis is only required if the proposed project is within a specified distance of a Class I area.

- ***Soils, Vegetation, Visibility Impact Analysis***: this analysis evaluates whether the project would impair visibility or adversely affect soils or vegetation.

(Non-Attainment) NSR Program

The purpose of the New Source Review program is to gradually decrease emissions in a non-attainment area, so that the area comes into attainment. If it is determined that a project is subject to the NSR program, there are three (3) federal requirements:

LAER – Lowest Achievable Emission Rate is similar to BACT, with the exception that cost is not considered.

Offsets – When a new emitting source is installed, the applicant must provide offsets such that new project results in a net reduction of emissions. ERCs (see below) are used to meet the offset requirement.

Netting out – The applicant can credit the emissions from the new source with any contemporaneous reductions made at the same facility. If the net change is a reduction, there are no offsets required. If an increase exceeds the major modification threshold, the applicant must offset the increase with reductions at another facility at a ratio greater than 1 to 1.

Offset Ratio – Title I of the CAAA (1990) specified minimum offset ratios based on the attainment status of the air basin. These run from 1.2 for marginal non-attainment areas to 1.5 for extreme non-attainment. Local/state agencies may increase these ratios in their SIP. Also, some local/state agencies apply higher ratios based on the distance between the reductions and the new source, whether the reductions are up wind or downwind from the source and whether the reductions are in the same air agency territory as the new source.

ERCs – Emission Reduction Credits are the currency used to pay an offset obligation. To be claimed as an ERC, emission reductions must be real, quantifiable, and permanent. They must also be reductions that are not required by regulations, or if a certain reduction is required by regulation, an ERC may be generated by extending this reduction beyond the required level, with the ERC corresponding to the excess amount of reduction. The baseline for determining ERCs reductions typically consists of the emissions occurring during a two year (or 2 of the last 3 years) period just prior to the implementation of the emission reduction (ERC) project. Baseline emissions

may be determined based on source tests, or using emission factors from a US EPA catalog of emission factors called AP 42. ERCs can be credited to a new source at a different location or banked for future use or sale.

The cost of ERCs is very dependent on location. In a district where many industrial facilities have been closed in recent years and the owners have captured and banked the ERCs, the cost may be quite low. In an area where industry is expanding, and there has been little industrial base, the cost can be quite high. Today, NOx ERCs are trading as low as $1500 per ton and as high as $150,000 in the same state. For example, in some areas, such as San Diego, it is almost impossible to construct new sources of NOx because of the unavailability of ERCs.

Potential vs. Actual – In performing Netting and/or in generating ERCs, the allowed credit (netting) or emission baseline (ERCs) corresponds to actual historic emission levels, while the offset requirement is based on the *Potential to Emit* (PTE) for the new source. If the applicant requests a permit with no limitations on fuel use, hours of operation etc. his PTE will be based on full load operation, 7/24/52. As a result, an applicant wanting to replace an existing unit with a new one having the same emission rate may find that the PTE for the new unit is several times the actual historical emission level (tons/year) for the unit being replaced (assuming the unit being shut down has not been operating continuously at full load)

NOx Drivers

The reasons that the control of NOx emissions is a primary focus of the EPA and Congress included:

- NO_x is a pollutant in itself, although it is attainment in all areas at this time.
- Ozone – NOx is the precursor that is usually limiting in ozone formation. In most cases, if you reduce NOx you get a proportional reduction in Ozone.
- PM2.5 – NOx can form nitrates that contribute to PM 2.5
- Acid Deposition – NOx is a precursor to Acid Deposition.
- Visibility – because of the particulate formation mentioned above and the fact that NO_2 is visible, NOx also contributes to visibility degradation.

Current NOx Programs

As mentioned above, NOx is a major target of the NSPS and NSR programs. In addition, there are other programs aimed at reducing NOx and in some cases other pollutants. These include:

- Ozone Non-attainment Status (NSR)
- Acid Rain Program
- NOx SIP Call

Stationary diesel engines are usually used for emergency or temporary generation and accordingly are usually exempt for the federal programs. Many state/local agencies have their own regulations. Also, some other government agencies that have authority over some sources such as the Bureau of Land Management, Department of Interior for offshore activities, etc. have their own regulations. There has been a recent trend to impose vehicular regulations on stationary diesels because almost all of the engines used in these applications are manufactured primarily for vehicle service. The best resource for regulatory information for vehicle programs is www.dieselnet.com.

Ozone Non-attainment Status – As mentioned above, since NOx is a precursor to ozone, the CAAA of 1990 indicates that NOx must be treated as a non-attainment pollutant in ozone non-attainment areas. In 1997, the Administration signed an order changing the ozone NAAQS. The old standard (pre 1997) is referred to as the *One Hour Ozone Standard*, and the new standard is called the *Eight Hour Ozone Standard*. There are 3 differences between the 2 standards:

	One Hour Std.	**8 Hour Std.**
Allowable level	0.12 ppm	0.08 ppm
Allowable exceedances	1 every 3 years	1 every year
Averaging Time	one hour	8 hours

The increase in allowable exceedences (one per year instead of one in 3 years) and the increased averaging time both act to make made the new standard slightly less stringent, however the reduction in the allowable ozone level had far more impact than the other 2 changes combined.

Under the old 1 Hour standard, compliance had gotten to the point where 40% of the population lived in non-attainment areas. The first action under the new 8 Hour standard was for the EPA to determine if any existing ozone attainment designations were affected by the revised standard. When the determinations were complete, almost 85% of the population was found to live in areas that are non-attainment under the new ozone standard. There are some areas that had been non-attainment under the 1 Hour standard that were attainment under the 8 Hour standard, but, far more areas that were attainment were now non-attainment.

And, since NOx is the primary target to control ozone, this has required many states to revise their SIPs to reduce NOx emissions.

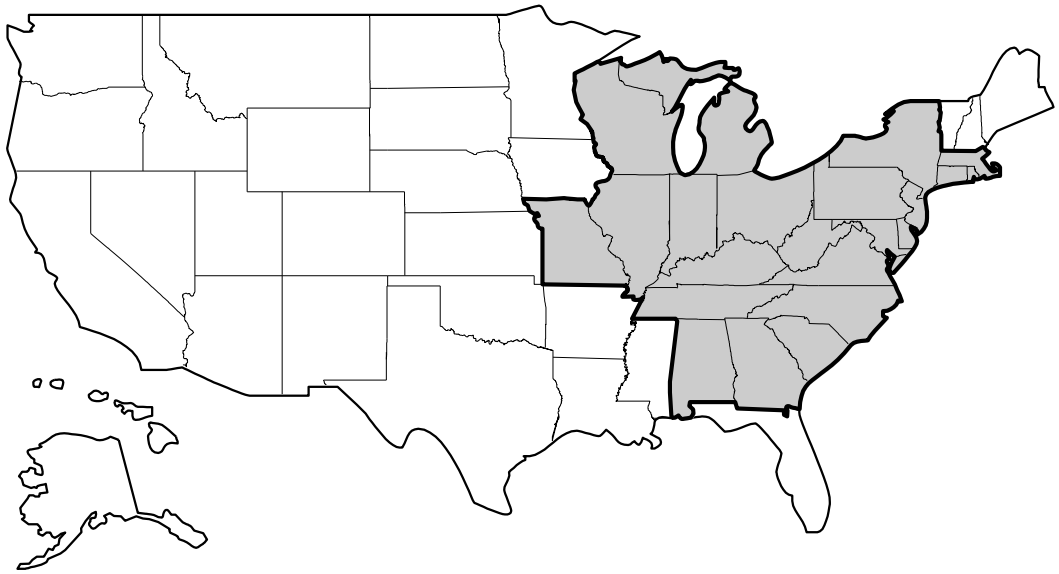
Acid Rain Program (Title IV) – Title IV of the CAAA of 1990 was based on the determination that both SO_2 and NOx contribute to acid deposition (acid rain). The major focus of the Title IV Program is the reduction of SO_2 using a Cap and Trade approach (see below). But the Act also contained provisions for reducing NOx emissions. It set a goal of reducing NOx by 2 million tons from 1980 levels. The Acid Rain program focuses on one set of sources that emit NOx: older coal-fired electric utility boilers. As with the SO_2 emission reduction requirements, the NOx program was implemented in two phases: for NOx the phases began in 1996 and 2000.

The NOx program embodies many of the same principles of the SO_2 trading program, in that it also has a results-oriented approach, flexibility in the method to achieve emission reductions, and program integrity through measurement of the emissions. However, it does not "cap" NOx emissions as the SO_2 program does, nor does it use an allowance trading system. Instead it sets NOx emission limits for the boilers.

NOx SIP Call – As mentioned above, a number of states in the Northeast were non-attainment for ozone. These states were referred to as the Ozone Transport Corridor (OCT). They sued the EPA, claiming that their ambient ozone was, in part, caused by emissions of NOx in up-wind states. They were trying to force the EPA to initiate programs to reduce NOx emissions in those upwind areas.

The Lake Michigan States (IL, IN, MI and WI) countersued the EPA, claiming that tighter NOx limits would create ozone compliance problems for them, due to the loss of the ozone scavenging effect of the NO emissions.

In an attempt to resolve the dispute, a group of 35 states formed the Ozone Transport Assessment Group (OTAG). OTAG did considerable atmospheric modeling and developed 3 alternative programs based on the best case, most probable and worst case. They recommended the most probable, but the EPA adopted a program based on the worst case analysis. They implemented the program by issuing the NOx SIP Call (requiring each state to revise their SIP to meet the new NOx limitations) for the states that were believed to be contributing significantly to the OTC problem. That included approximately 22 states including most of the OTC states. The SIP call set a summertime (May – September) NOx Budget for each state. The state program allocations can be found in 40 CFR 96. The SIP Call was implemented as a Cap and Trade Program based on the Acid Rain model – see below.



States and territories originally subject to the NO_x SIP Call

Cap and Trade

Until 1990, all federal regulations were "command and control" in that they set limits that must be met individually by each emission unit or facility. The 1990 CAAA, Title IV (the Acid Rain Program) introduced a Cap and Trade compliance approach. The EPA set a nationwide annual cap for the emissions of SO_2 from fossil fuel fired utility boilers. An amount of SO_2 emissions equal to the Cap was then allocated among the existing Acid Rain utilities based on their historical usage in 1985 in the form of allowances (an SO_2 Allowance is a credit to emit 1 ton of SO_2). This annual allowance allocation is basically fixed (i.e. new sources receive no allocation).

At the end of the calendar year, each utility must hold sufficient allowances to cover all of their actual SO_2 emissions. If their annual SO_2 emissions exceed the number of allowances they hold, then additional allowances must be purchased to cover the extra emissions. Any unused allowances from one year can be carried over into future years. Allowances can be bought and sold.

A utility can keep its SO_2 emissions within its allowances by using low sulfur coal, installing stack gas scrubbing equipment, or purchasing allowances from a utility whose emissions are less than the allowances they hold.

Allocation of the allowances was based on the SO_2 emissions totals in 1985 before the Title IV program went into effect. The goal of the Acid Rain Program was to achieve a 60% reduction in nationwide SO_2 emissions relative to these pre-program levels, consequently the allowances totaled only 40% of the emissions before the program went into effect.

Other federal and state/local programs, such as the NOx SIP Call, have adopted this Cap and Trade type of compliance approach. It allows industry to achieve the required reductions by the most cost effective means.

Title V

As mentioned above, Title V is a federal operating permit which is intended to bring all federal requirements for a facility under a single federally enforceable permit. With its introduction, the EPA now has a mandatory permit that they can revoke "for any reason, at any time". Before Title V, since all permits were issued by the state/local agencies, only the issuing agency had the authority to revoke a permit.

Also, as mentioned above, it was intended that the Title V permit would not add any new requirements, just put all federal requirements under a federally enforceable permit. In fact, Title V did add a few new requirements. One was the designation of a Responsible Individual. This individual must annually sign a document that they are responsible for compliance with the Title V permit and that the facility is in compliance. Title V also addresses the issue of stationary sources that pass their initial compliance test, but may, through deterioration or lack of maintenance, eventually go out of compliance, and never be detected.

A primary goal of the Title V Program, then, is to ensure on-going compliance with permit requirements. To support this goal, a key focus of the Title V Operating Permit program is monitoring. However, older air quality permits do not always contain sufficient monitoring to properly verify whether a source is in compliance. The Compliance Assurance Monitoring (CAM) rule, which implements the Enhanced Monitoring Provisions of Title VII, helps to improve monitoring for larger emitting units. In addition, the Operating Permit rule allows for a limited amount of new gap filling monitoring to be required for older permit conditions that do include monitoring provisions.

- *CAM* – Title V permit holders must develop a Compliance Assurance Monitoring (CAM) plan for each emitting unit that has potential emissions that exceed major source thresholds before controls (i.e. emission reductions achieved by add-on controls are ignored in this major source determination). CAM monitoring is primarily designed to verify that emission control equipment is operating properly. The program accommodates a range of monitoring approaches, as discussed below, providing that the approach selected is judged to provide a "reasonable assurance of compliance":
    - *Continuous Monitoring* – Using a continuous emission monitoring system (CEMS) complying with either 40 CFR 60 Appendix B and maintained in compliance with Appendix F, or complying with 40 CFR 75. This approach will detect any exceedence of permit emission limits at any time.
    - *Parametric Emission Monitoring System (PEMS)* – Two different types of PEMS are used. The predictive PEMS is intended to be a substitute for a CEMS, however emissions are not measured directly. Instead process parameters are measured from which estimated emissions are calculated (predicted) in real time. Some predictive PEMS have proven to be very accurate and reliable, but the feasibility of these systems depends on the process to be monitored. A second category of PEMS identifies operational parameters which can be used to indicate that control equipment is operating properly. For each indicator parameter a threshold range is established corresponding to proper operation of the associated control equipment; so long as the indicator parameter values remain within this threshold range, it is assumed that control equipment is operating properly with a reasonable assurance of compliance.
    - *Periodic Measurement* – This approach is often the least expensive, but may be the least comprehensive. If the time between measurements is small in comparison to the rate at which a process deteriorates (e.g. aging of catalyst), and the compliance margin is great enough, this approach may provide high confidence.
- Periodic Monitoring/Gap Filling under Title V - The Title V rule and subsequent guidance specifies that gap filling periodic monitoring may be required by the Operating Permit for permit conditions that do not include any monitoring. The content and extent of such Periodic Monitoring has been a controversial issue that has not been fully resolved. However, it is expected that such periodic monitoring will generally follow the CAM approach.

New Programs

New revisions and programs are continually being introduced and adopted. There are several programs that have recently been adopted, some of which are still under review or challenge. These include:

- NSR Reform
- Clean Air Interstate Rule (CAIR)
- Clean Air Mercury Rule (CAMR)
- Regional Haze Rule

NSR Reform – The effort to reform NSR started in the early 1990's, and drafts were published in the Federal Register for public comment in 1994 and 1996, but these were never adopted. In 2002, the EPA published a new draft with no similarity to the earlier drafts. When it appeared it was published as "direct and final". What that really means is that, if no one objects, it is final. People objected.

Much of this reform package was an attempt to codify existing practice, but there were two significant new policy issues:

- *Actual-to-Projected-Actual Applicability Test (ATPA)* – Under previous NSR regulations, in determining whether an alteration or upgrade project for an existing unit at a major source facility was subject to NSR as a "major modification", post-project emissions were always assumed equal to the units potential to emit, irrespective of its operating history. This "actual past to future potential" methodology was based on the expectation that the planned improvements would make the unit much more cost/effective to operate, and therefore past operating history would not serve as a reliable indicator of future usage (sometimes referred to as the "de-bottlenecking" concept). However, thru the WEPCO decision, EPA revised this policy to allow future emissions to be projected from past emissions for certain types of projects at electrical generating units. This Past Actual to Projected Future Actual methodology was included in the NSR Reforms.
- *Routine Maintenance, Repair and Replacement (RMR&R)* – In determining whether work on an existing emission unit at a major source facility is considered a "major modification", RMR&R activities are exempted. For example, if an engine needs a routine tune-up or new spark plugs or a new air filter, the source does not need to evaluate whether such a project triggers NSR major modification emission thresholds. On the other hand, a large reconstruction project would require a major modification determination. Unfortunately, there are many types of activities for which it is unclear whether they qualify as RMRR (e.g. replacement of boiler tube sections).

  Several landmark cases raised the question of "When does maintenance and repair become reconstruction?" This new section attempted to define the point at which a maintenance project needed a new permit. A new permit not would be required if:

- The project cost is less than 20% of a replacement Unit
- The project results in a *de minimus* Change in Emissions
- There is no exceedence of existing permit

In October 2003, EPA issued a rule providing procedures to allow determination of whether an activity qualifies as RMRR, however this rule was challenged and subsequently rejected by the court and it is now being re-considered by EPA.

Clean Air Interstate Rule (CAIR) – This program essentially places the Clear Skies Initiative (CSI, see below) objectives for NOx and SO_2 in regulation without new legislation. It was published in the FR in March 2005. It establishes regional caps for NOx and SO_2 at the CSI levels and applies to all electric generating units > 25 Mw in 28 eastern states. In July 2008, the courts vacated the rule. The EPA is currently working on the deficiencies identified in the court decision. For updated information, see www.epa.gov/cair/.

Clean Air Mercury Rule (CAMR) – This program places the CSI objectives for mercury in regulation. It was published at the same time as CAIR and caps mercury emissions from coal fired plants nationwide. The courts vacated this rule also in July 2008. The CAMR will not be resurrected. Instead, the EPA is back to work on the Utility Boiler MACT. Progress on the MACT and the draft language can be found at www.epa.gov/ttn/atw/boiler/boilerpg.html

Regional Haze Rule and BART: The purpose of the Regional Haze Rule (7/1/99) is to improve visibility in Class I areas by controlling NOx, SO_2 and PM emissions from nearby sources that have impacts in these areas. The complementary Best Available Retrofit Technology (BART) rule segregates out certain types of units, i.e. those that were constructed between 1962 and 1977, are in one of the 28 special PSD categories [40 CFR 166 (b)(1)(i)(c)(iii)], and have a potential to emit > 250 tpy for SO_2, NOx or PM-10, and requires visibility modeling and an engineering evaluation be conducted for these sources. Emission controls may be required, on a case-by-case basis, if shown by the engineering/modeling evaluation to be a cost effective means of significantly improving visibility in the impacted Class I areas

Regulatory Trends

Multi Pollutant Legislation

Clear Skies Initiative (CSI) – In 2003, the administration introduced legislation to reduce SO_2, NOx and mercury from coal fired power plants. Senator Jeffords introduced the Clean Power Act calling for deeper cuts in SO_2, NOx and mercury plus major reduction in CO_2 emissions. Neither bill passed. The following table is a comparison of the measures.

Comparison of Clear Skies Initiative and Clean power Act

	Actual Emissions	**CSI Caps**		**S.366 (Jeffords)**
Pollutant	2000	Phase I	Phase II	Caps
SO_2 MM Tons	11.2	4.5 by 2010	3 by 2018	2.2 by 2009
NOx MM Tons	5.1	2.1 by 2010	1.7 by 2018	1.5 by 2009
Hg Tons	48	26 by 2010	15 by 2018	5 by 2009
CO_2 B Tons	2.4	N/A	N/A	2.1 by 2009

Regulate Precursors to Reduce Pollutant Formation – Many new regulations are focused on reducing precursor emissions for pollutants that are formed in the atmosphere rather than being emitted from a process. These include:

Ozone
Particulate (2.5)
Acid Deposition
Regional Haze

Global Warming – Global Warming is thought to be caused by Greenhouse Gases (GHG) which reduce radiation of heat from the earth into space, and warm the planet. The most significant GHG is CO_2, the product of combusting any hydrocarbon. There are currently no federal regulations on the emission of GHG, but that is likely to change. Techniques for reducing the net emissions of CO_2 include:

- Reduce energy consumption
- Switch fuels to those that produce less CO_2 (e.g. natural gas)
- Increase the amount of forests on the earth
- Replace fossil fuel sources with renewable energy sources that do not change the net carbon/CO_2
- Stop clearing of rain forests

In 1997, a world gathering in Kyoto developed a plan called the Kyoto Accord which laid out a plan for all participants to reduce emissions over the next 15 years. The target was to reach reduce GHG emission 7% below 1990 levels. The US did not ratify the plan but there are a variety of moves by individual states, cities and corporations to reduce GHG emissions.

Guidance Documents (GD) – The CAA calls for BACT/LAER determinations to be made on a case-by-case basis. Many agencies prefer to have a standard that sets a specific emission limit for each type of equipment. Guidance Documents are a means by which agencies can encourage uniformity in BACT/LAER determinations.

An example is the California GD for gas turbines under 50 Megawatts. It suggests new gas turbine generators be permitted at:

NOx – 2.5 ppm with 1-Hour rolling average or
2.0 ppm with 3-Hour rolling average
(the level and averaging period are the Air District's prerogative)

CO – 6 ppm

VOC – 2 ppm

Output Based Standards – In the past, emission limits were on the basis on exhaust stack concentration, typically expressed in parts per million, volumetric (ppmv) corrected to a common oxygen or carbon dioxide base. For example the limit may be expressed as 25 ppmv at 15 % O_2. Since it is on a corrected basis, it can also be expressed as mass of pollutant per unit of fuel consumed, e.g. 0.1 lb/MMBtu. In the last few years, many agencies have been moving to Output Based Standards where the limits are expressed as units of mass per unit of output, e.g. 0.07 lb/MW-Hr.

In principle, this sounds like a good idea. It rewards users who make more efficient use of fuel, or conversely, it encourages the more efficient use of fuel. But in practice, some have serious concerns.

For example, let us consider a distributed generation unit with and without combined heat and power. Without CHP, the efficiency would be 30%, while with CHP it could be as high as 75%. This means that the emission from the CHP unit could be 2.5 times greater than for the unit without CHP. If the engine in question is an IC engine operating at 30% efficiency that can achieve 0.6 g/HP-Hr, and the level for 30% efficiency is set at 0.6 g/HP-Hr, the same engine in a CHP application could be permitted at 1.8 g/HP-Hr. That would be allowing unnecessary pollution. If the limit were based on 75% efficiency at 0.6 g/HP-Hr, the same engine operating without CHP would have to achieve 0.24 g/HP-Hr, - impossible without back end controls. Generally, any applicant will use waste heat from an engine if he has use for it, but if there is no use for the heat, the project becomes impractical.

Some examples of output-based standards for NOx emissions already in use include:

- NSPS Subpart Da for utility boilers, and Subpart KKKK for combustion turbines (optional)
- TNRCC Standard DG Permit
  - East Texas, 0.14 lb/MW-Hr
- California SB 1298
  Reciprocating engines
  - 2003, 0.5 lb/MW-Hr
  - 2007, 0.07 lb/MW-Hr
- RAP Group – 0.07 to 0.15 lb/MW-Hr

Other regulatory trends – Include:

- Establish Regulations on a Regional Basis for Compliance Flexibility
- Tightening of Standards
- Continuous Compliance through monitoring of sources which did not previously require monitoring
- Single Limit for all Sources (Bubble)
- States are developing New and Revised RACT regulations to meet SIP requirements

International

With all of the countries around the world, it may seem an impossible task for manufacturers of combustion equipment to determine what emission limitations must be met by the products they develop. It is not sufficient to say "Make all emissions as low as possible." The cost eventually becomes prohibitive, and as mentioned above, some pollutants present design tradeoffs. Particularly in combustion processes, NOx control technologies often increase VOC and/or CO emissions.

There are some regulations that cover most of the world:

- *European Union* – The EU has developed emission standards for many combustion sources. They are currently working on a comprehensive combustion emission standard. It has been in work for several years, and may still be some time in coming. The EU standards can be found at ec.europa.eu/environment/index_en.htm (no www).
- *World Bank* – Any projects funded by the World Bank must meet their emission standards. Those standards can be found at http://www.epa.gov/air/aqmportal/management/links/goalsetting_resources_pub.htm#4 (no www).
- *US Export Import Bank* – Generally, projects funded by Ex-Im will also be required to meet the World Bank standards.
- *International Network for Environmental Compliance and Enforcement (INECE)* – maintains a site with a listing of Environmental Agencies of the World. It can be found at: www.inece.org/links_pages/onlineresourcesEnvironmentalagencies.html

Review Exercises

1. Which of the following is not a combustion pollutant?
   a. NOx.
   b. CO.
   c. SO2.
   d. Ozone.
   e. Particulate Matter (PM).

2. Which Federal programs relate to stationary combustion sources? (Select all that apply.)
   a. New Source Review (NSR).
   b. Tier 4.
   c. New Source Performance Standards (NSPS).
   d. Prevention of Significant Deviation.
   e. Acid Deposition (Title IV)

3. What is CAM?
   a. Clean Air Management
   b. Carbon Accounting Measures
   c. Critical Assessment Mandate
   d. Compliance Assurance Monitoring
   e. None of the above

4. What pollutants are addressed under the Acid Deposition program (Title IV)?
   a. NOx
   b. PM
   c. Ozone
   d. Sulfur Dioxide
   e. Carbon Dioxide

5. Prevention of Significant Deterioration (PSD) is addressed in 40 CFR 51.166. What is the major source threshold for a gas turbine generating unit?
   a. 8,000 hours per year
   b. 50 Megawatts
   c. 100 tons per year
   d. 250 tons per year
   e. 10 cubic feet per hour

6. What is usually the easiest way to determine the attainment status for NOx for an application?
   a. Check with the US Weather Service.
   b. Look it up in the CFR.
   c. Call the local air agency.
   d. Look it up on the EPA web site.
   e. Ask the Bureau of Land Management.

7. In an attainment area, an air permit applicant must: (Select all that apply)
   a. Determine the applicable LAER technology.
   b. Offset the net increase in emissions.
   c. Determine if the Increment will accommodate the project.
   d. Secure Emission Reduction Credits (ERCs) equal to the projected emissions.
   e. Determine the applicable BACT technology.

8. Why is NOx the primary target of most current air regulations? (Select all that apply).
   a. Most areas are non-attainment for NOx.
   b. It is a precursor for Ozone.
   c. It is a contributor to Acid Deposition.
   d. It contributes to regional haze.
   e. None of the above

9. Some state, local and other air agencies are adopting vehicular standards for stationary liquid fueled engines. If such a standard calls for compliance with the Tier 4 standard, what would be the NOx limit?
   a. 100 ppm at 15% O_2.
   b. 0.4 g/BHp-Hr.
   c. 1 pound per Kilowatt-hour
   d. 30 ppm at 3% O_2.
   e. None of the above.

10. Emission test methods are specified in 40 CFR 60 Appendix A. What of the following is a test method for NOx?
   a. Method 19
   b. Method 10
   c. Method 25
   d. Method 7
   e. None of the above

Answer Key

1. d
2. a, c, d, e
3. d. (At one time it might also have been Clean Air Mercury rule)
4. a and d
5. c
6. c.
7. c and e
8. b
9. xx
10. a and d