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THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

Preliminary Impact Analysis of Proposed Revisions of National Ambient Air Quality Standard for Ozone and Particulate Matter

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

in cooperation with
National Steel and Shipbuilding Company
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NSRP Report # 0485

FINAL REPORT

Preliminary Impact Analysis of Proposed Revisions of National Ambient Air Quality Standard for Ozone and Particulate Matter

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FACILITIES AND ENVIRONMENTAL EFFECTS

Under the
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1.0 Introduction

This report documents a preliminary analysis of the potential long term impacts on shipyards of proposed revisions to the National Ambient Air Quality Standards (NAAQS) for ozone (03) and particulate matter (PM). The analysis was performed to provide information to the U.S. ship building and ship repair industry, so that companies in that industry could determine whether to submit comments on these EPA proposals. Project results were also presented to NSRP SP-1 panel partcipants at *a* quarterly panel meeting in February, 1997.

Revised NAAQS are the first step in the air regulatory process. In some cases, new regulations based on revised NAAQS may be in place in as little at four or five years. However, EPA has estimated that it may take 10 to 15 years before programs based on revised NAAQS are "fully implemented." This project addresses the potential impacts of these downstream implementation measures.

The U.S. EPA has reviewed existing NAAQS for 03 and PM as required by sections 108 and 109 of the Clean Air Act (Act). Based on these reviews, the EPA proposes to change the standards for both classes of pollutants. 1' With respect to O_3, EPA proposes to change the current primary standard (last modified in 1979) in the following manner.

1. Since longer exposure periods are of greater concern at lower O_3 concentrations, attainment of the standard would no longer be based upon l-hour averages, but instead on 8-hour averages.

2. The level of the standard would be lowered from the present 0.12 parts per million (ppm). Based upon its review, the EPA has proposed an .08 ppm standard and state that this would provide increased protection for children and asthmatics. The EPA also solicits comment on retaining the current primary standard and on an alternative 8-hour standard at a level of 0.07 ppm.

3. In addition, EPA proposes to change the test for attainment (i.e., the form) of the new standard. Currently, the test of attainment is whether a region

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1/ As of February 12,1997, these proposals were open for comment until March 12, 1997. Comments on the PM standard proposal are in Docket No. A-95-54; the O_3 standard is Docket No. A-95-58. Comments (in duplicate) may be submitted to these Dockets at Air and Radiation Docket and Information Center (6102), EPA 401 M. St. S.W., Washington D.C. 20460.

exceeds the 1-hour standard on average no more than once per year, averaged over three years. Given the natural variation in hourly O_3 levels, this "one expected exceedance" test can result in relatively unstable attainrnent/nonattainment designations. Therefore, the EPA proposes a new form with attainment status based on a 3-year average of the annual third-highest daily maximum 8-hour ozone concentration.

With respect to particulate matter, EPA proposes to revise the current 150 micrograms/meter^3 (µg/m^3) primary 24 hour standard for PM_{10} (i.e., particles <10 micrometers effective aerodynamic diameter) by changing the form of that standard. The current form allows l-expected-exceedance per year, this would be replaced by referencing instead the 98th percentile concentration, averaged over 3 years at each monitor within an area. EPA solicits comment on an alternative proposal to revoke the 24-hour PM10 standard. The EPA also proposes to retain the current annual primary PM10 standard of 50 µg/m^3.

In addition, the proposed new NAAQS adds two new primary $PM_{2.5}$ standards (particles less than 2.5 micrometers) set at 15 µg/m3, annual mean, and 50 µg m^3, 24-hour average. The EPA believes the new standard would provide increased protection against a wide range of PM-related health effects.

1. The proposed annual $PM_{2.5}$ standard would be based on the 3-year average of the annual arithmetic mean of $PM_{2.5}$ concentrations, spatially averaged across an area.

2. The proposed 24-hour PM_{25} standards would be based on the 3-year average of the 98th percentile of 24-hour PM_{2-5} concentrations at each monitor within an area.

To assess the impact of these proposed changes to the ambient air quality standard, a stepwise process was followed. The first step was to assess the current attainment status of those areas in the US where the majority of the new ship construction and ship repair is conducted and evaluate the emission limits in place for those facilitiesin areas currently not in attainment with these standards. Next, the projected attainment status for each of these facilities under the proposed standard was evaluated. EPA's projections were used in this analysis; some industry projections show more areas will be out of attainment with proposed new standards.

At a fundamental level, the general nature of the impacts of more stringent NAAQS is clear: More areas will become "non-attainment" areas, and both these new non-attainment areas and existing non-attainment area will need to take more pollution out of the air to achieve federal air quality standards. Stationary sources will be required to provide some of the emissions reductions that will be needed to achieve more stringent NAAQS.

At an industry-specific level, impacts are more difficult to predict. A change in NAAQS does not directly and mechanically result in specific changes in control requirements for particular facilities or categories of equipment. Some changes in requirements will flow from changes in attainment status, under long-standing Clean Air programs; these changes can be predicted fairly confidently. Examples include requirements to install retrofit control technology, and the application of "new source review" requirements to additional facilities. Other changes in control requirements will be matters for state discretion. Shipyards may also be affected as employers and vehicle fleet operators. The most significant long term impacts of revised NAAQS, however, may result from new legislation and new regulatory institutions, as discussed below.

This analysis briefly addresses all of these potential impacts, but it should be recognized that varying amounts of informed speculation are necessary to this process.

2.0 NAAQS ATTAINMENT STATUS

An understanding of the current NAAQS status for ozone and particulate matter for those areas of the US with major shipbuilding and repair facilities is necessary to establish the baseline attainment levels and current control requirements in each location. The current attainment status for an area drives the local regulations. Typically, areas which are in nonattainment will have more stringent emission limits for sources than attainment areas. Also, nonattainment areas may require control of the emissions from a wider variety of sources. Changes to the NAAQS may change the attainment status of the county or parish in which the facility is located. As the attainment status drives the level of required controls on sources of non-attainment pollutants and precursors, a change in the attainment status may affect both equipment and operational controls required in shipyards. Therefore, this section contains the current ozone and PM_{10} attainment status for the major shipyard facilities in the US.

In addition, current emissions control requirements were compiled for shipyard processes in existing non-attainment areas, to provide insight into the level of control that may be required elsewhere if attainment status is changed based on the new NAAQS for ozone and particulate matter.

2.1 Major Shipyard and Repair Locations

The impact of the proposed NAAQS will be geographically biased. At the level of the individual shipyard, those facilities which are located in areas designated non-attainment for ozone or particulate matter will be impacted the greatest. For this reaso~ the study was limited to those areas in the U.S. where the majority of the shipbuilding and repair capacity resides. For new ship construction, these areas include

San Diego, California
Groton, Connecticut
New Orleans, Louisiana

Bath, Marine
Pascagoula, Mississippi
Newport News, Virginia

The shipyards in these locations typically account for 95 to 98 percent of gross value of the new ship order book.

The majorty of the ship repair industry, in addition to those locations given above for new ship construction, is found in the following locations:

Bayou La Batre, Alabama
Mobile, Alabama
San Francisco, California
Terminal Island California
Jacksonville, Florida
Tampa, Florida
Savannah, Georgia
Amerila, Louisiana
Lockport, Louisiana
Morgan City, Louisiana
Sparrows Point, Maryland
Gulfport, Mississippi
Portland, Oregon
Galveston, Texas
Houston,~ Texas
Port Author, Texas
Norfolk Virginia
Seattle, Washington
Tacoma, Washington
Surgeon Bay, Wisconsin

Although the U.S. shipyard repair industry is geographically more dispersed than the new construction industry, we believe the above two lists capture over **50** percent of the annual gross revenues of the U.S. ship repair industry.

2.2 Ozone Attainment Status

The current NAAQS for ozone is 0.12 parts per million. The standard is attained when the expected number of days per calendar year with maximum hourly average concentration above 0.12 parts per million is equal to or less than 1. For each shipyard area identified, the current attainment status with the NAAQS for ozone was investigated. The results of this investigation are shown in Table 1. The areas of interest which are in nonattainment status for ozone include:

Shipyard Location	Area Classification
San Diego, CA	Serious
Terminal Island, CA	Extreme
Groton, CT	Serious
Bath, ME	Moderate
Sparrows Point, MD	Severe
Galveston, TX	Severe
Houston, TX	Severe
Port Arthur, TX	Moderate

Local rules and regulations for these areas focus on reaching attainment status by requiring additional controls for pollutants that are precursors to ozone (i.e. oxides of nitrogen (NOx) and volatile organic compounds (VOC)).

2.3 PM Attainment Status

The current federal ambient air quality standard for particulate matter, measured as PM_{10}, is 150 micrograms per cubic meter, 24-hour average concentration. The standard is achieved when the estimated number of days per calendar year with a 24-hour average concentration above the standard is equal to or less than 1. The attainment of the current particulate matter standard has been achieved at all but three of the areas listed in Table 2; San Diego, San Francisco, and Terminal Island which are all located in California. Each of these areas have regulations in place to limit the emission of particulate emissions from fuel burning equipment, and general processes found in operation at shipyards.

2.4 Current Source Specific Emission Limits

The main sources/activities that are conducted at a shipyard which have emissions that contribute to the particulate matter and ozone attainment status of an area include boilers, internal combustion engines, abrasive blasting, and marine vessel coating. A more detailed description of shipyard sources of particulate matter is provided in Appendix A. For those locations identified to be in nonattainment status with either the ozone or particulate matter NAAQS, the current source specific emission limits were investigated for each of these activities. For boilers and engines, particulate and NO_x emissions limits are established based on fuel usage or exhaust concentration (i.e. pound of NOx per MMBTU heat input). For the abrasive blasting operation, particulate emission limits are based on process weight usage per hour. For the marine vessel coating operations, the VOC emissions are limited by controlling the VOC content in the coating. For areas in nonattainment with the NAAQS, more stringent standards have been put in place and may serve as examples of measures which may be required for areas projected not to be in attainment with the new standards. A summary of the emission limits for these activities for the locations identified as being in nonattainment with the current NAAQS for ozone and PM_{10} is contained in Appendix B.

3.0 IMPACT OF PROPOSED STANDARDS

The impact of the proposed ozone and partictiate matter NAAQSs for shipyards will depend in part on the projected attainment status of the areas in which these facilities are located, and in part on how processes at these facilities are already regulated. Therefore, this section begins by discussing the projected attainment status of the major shipyard locations with and without a change in NAAQS.

Change in retrofit control requirements and in the application of new source review requirements are discussed next. These changes are related to attainment status in predictable ways that are likely to be fairly stable even if NAAQS revisions are followed by legislative adjustments. Because these changes are reasonably predictable, this analysis includes an evaluation of the "most stringent" control requirements currentIy being imposed on shipyard processes in areas that are already designated as non-attainment areas.

Finally, this assessment discusses other potential effects that new NAAQS could have, directly or indirectly. Discretionary state regulatory decisions, impacts on shipyards as employers and fleet operators, and potential institutional change are discussed.

3.1 Projected Attainment Status

The projected attainment status with the proposed NAAQS for the ship construction and repair facilities considered (Table 1 and Table 2) is based on the findings from EPA's draft regulatory impact analyses (RIAs) for the proposed particulate matter and ozone standards. These RIAs were based on EPA predictions of air quality in different regions in the year 2007. According to these documents, the year 2007 was chosen because most of the mandatory CAAA requirements will have taken full effect and most areas currently in violation are expected to achieve attainment of the current NAAQS standard by this year. The air quality predictions were based on particulate matter inventories and ozone precursor inventories. Ozone concentrations are a function of meteorology, precursor emission, and the air chemistry that transforms them into ozone.

3.1.1 Ozone

For the prediction of attainment with the ozone standard, a projected inventory of the VOC and NO_x emissions was developed by the EPA assuming the implementation of the control measures projected to exist in the US in 2007, based on existing laws and regulations. For VOC, these control measures include reduction in VOC content of consumer and producer products, AIM Coatings, Stage II Vapor Recovery for gasoline dispensing stations, Reasonable Available Control Technology (RACT) applied to major sources in nonattainment areas and the Northeast ozone transport region (OTR), implementation of MACT for applicable sources, Title II VOC reductions, onboard vapor recovery, and RCRA VOC reductions. The NO_x emission inventory was developed based on RACT controls, NO_x offsets, mandatory maintenance plans, reformulated gasoline, California low emission vehicle standards, and regional NO_x management.

Using these emission inventories, air quality models were used to predict the air quality values on a county by county basis for the year 2007. The air quality analysis projected the attainment status for each county based on "regional" and "local" control strategies. The "regional" control strategy includes the full implementation of the current CAAA requirements, implementation techniques mandated in the CAAA and implementation of the regional NOX strategy in the East (Ozone Transport Assessment Group (OTAG) and Clean Air Power Initiative (CAPI)). The "local" control strategy does not include the regional efforts in the East Under each of these control strategies, three forms of the proposed standard were evaluated

1. Alternative 8H5EX-80

   This form is the same as the current one hour expected exceedance standard except five exceedances of the standard are allowed per year on average.

2. Alternative 8H4AX-80

   Attainment is achieved when the three year average of the annual fifth highest daily maximum eight hour ozone concentration is less than or equal to 0.08 ppm.

3. Alternative 8H1AX-80

   Attainment is achieved when the average annual second-highest daily maximum eight hour ozone concentration is less than or equal to 08 ppm.

EPA’s attainment projections for the locations of the shipyard facilities for each of the control strategies and standard form are shown in Table 1.

3.1.2 Particulate Matter

A review of the projected attainment status for the major shipyard and repair facility locations was completed for the proposed PM_{10} and $PM_{2.5}$ standards and is presented in this section. This information is also based on EPA’s regulatory impact analysis.

Projected attainment status for the new form for the 24-hour PM_{10} standard was based on a database of 1993-1995 data. Compliance with the 24-hour PM_{10} standard of 150 µg/m^3 is determined based on the 3-year average of the 98th percentile, spatially averaged across the area. As shown in Table 2, all the selected shipyard locations would be in attainment with this new PM_{10} standard.

The projected attainment of the 24-hour $PM_{2.5}$ standard was developed for the RIA based on EPA's so-called "National Particulate Inventory." This inventory contains county-level emissions of primary PM_{10} and $PM_{2.5}$ (Los Angeles area only), and precursors to secondary particulate formation S02, NO_x, VOC, and ammonia. Because actual data on $PM_{2.5}$ are scarce, EPA estimated $PM_{2.5}$ emissions and ambient concentrations; these estimation processes are controversial.

To project the emission inventory for the base year 2007, the 1990 emissions were increased based upon national estimates of growth in industry earnings and other categoy-specific growth sectors. The major source categories used in this process were electric utilities, non-utility point sources, figitive dust and agricultural production-this is obviously a higldy aggregated and not very precise process. After the growth of emissions were projected, CAAA-nmndated control programs were expressed as control efficiencies, which were applied to develop the 2007 emission inventory. The emission inventory was then used as input to the ambient air quality modeling effort which developed the projected PM concentrations on a county-by-county basis.

Based on the EPA RIA, six shipyard facility locations are projected to be in $PM_{2.5}$ non-attainment counties in the year 2007. These location are:

Bayou La Batre, AL	Sparrows Point, MD
Mobile, AL	Houston, TX
San Diego, CA	
Terminal Island, CA	

3.2 "Federal" Retrofit Control Requirements

Under the Act state regulators in non-attainment areas (but not other areas) are obliged to impose retrofit control requirements on some processes at "major" sources. "Major' source is defined by statute, based on total emissions of pollutants of concern from a facility. All the new construction yards identified for this study, and many of the repair yards, are "major" sources of air pollution. With a few exceptions (e.g., marine coatings, and certain large sources of NO_x), the types and sizes of processes that must be subjected to a retrofit requirement as well as acceptable levels of emissions for those processes, are defined in EPA "guidance" rather than by statute. Only a few "newer" and "larger" categories of equipment used in shipyards have so far been identified by EPA as mandatory retrofit targets, but this is a discretionary and iterative process. If NAAQS standards become more stringent, EPA's guidance concerning mandatory retrofit programs could become more aggressive.

States are required to develop specific regulations to implement EPA's retrofit guidance. These state regdations must be included in a State Implementation Plan (SIP) that EPA reviews and approves. Once a retrofit rule is approved as part of a SIP, it an be enforced by EPA and by the state.

The most common level of federally mandated retrofit control is "Reasonably Available Control Technology" (RACT). RACT is defined as a control technology or strategy that has a proven track record, is relatively easy to procure and operate and is affordable. In practice, EPA's guidance has occasionally been more aggressive than these principles would suggest. For example, some shipyards are experiencing difficulty in actually achieving the emission petiormance that RACT requires for diesel engines.

An alternative to RACT controls is "best available control technology" (BACT) controls. BACT is defined as the maximum "achievable" level of control for a source. The current Act does not directly mandate that BACT be imposed as a retrofit level of control. The Act does include some incentives to encourage severe and extreme non-attainment areas to impose this more stringent level of retrofit control requirements, on more sources. For example, in "severe" ozone non-attainment areas, required offset ratios for emissions from new and modified sources are reduced if&l major sources (not merely those operating units for which RACT guidance exists) are required to install BACT. In "serious" ozone non-attainment area, imposition of BACT requirements on all major sources is an alternative to an otherwise-mandatory demonstration that a specific "rate of progress" is being achieved in reducing total emission in the area. Substitution of BACT levels of retrofit control for RACT levels of control, and the imposition of BACT retrofit requirements on "all" major sources, is likely to become more common if NAAQS become more stringent.

RACT for affected shipyard processes is fairly well defined. A discussion of RACT and BACT "standards" is provided below for common shipyard activities, including boilers, internal combustion engines, abrasive blasting and surface coating.

RACT controls are also required for major sources in PM_{10} non-attainment areas, to address both particulate and their precursors-VOCs, NO_x, and SO_x Under this defintion, RACT controls as defined for ozone precursors will be required in PM_{10} non attainment areas as well. In PM_{10} non-attainment areas classified as "serious," the use of more stringent "best available control measures" (BACM), which are analogous to BACT, is required, but only for processes for which EPA issues BACM guidance. While these statutory provision would not directly apply to $PM_{2.5}$ under anew standard, it is highly likely that EPA would impose similar requirements by regulation.

Given this context, more stringent NAAQS may have the following impacts on federally-mandated retrofit requirements:

1. Areas that are in attainment now, and therefore not subject to RACT or BACT requirements, will become subject to those requirements if they are reclassified as non-attainment for ozone <u>or</u> PM_{10}. RACT or BACT is also likely to be required in $PM_{2.5}$ non-attainment areas.

2. EPA may exercise its discretion to create new RACT requirements that all current or new non-attainment areas would be required to implement.

3. As a result of downstream regulatory or legislative changes, federal RACT requirements may be replaced with BACT or BACM requirements in more non-attainment areas.

3.3 New Source Review Requirements

The Act requires "new source review" before "major" new sources of non-attainment pollutants or precursors can be constructed. Major modifications at existing sources are subject to the same requirements. At present, the definition of "major" varies depending on the severity classification of each non-attainment area, for ozone non-attainment areas potential facility emissions of 10 to 50 tons per year will make a source "major."

This mandatory "federal" or "major source" new source review results in the imposition of stringent pollution control requirements on the new source or modification. These BACT or LAER (lowest achievable emission rate) requirements will typically be much more stringent that retrofit BACT requirements for similar sources. In addition, emissions increases after the imposition of these controls will in many cases need to be "offset" by emissions decreases elsewhere. Purchasing credits for such offsetting decreases today typically costs tens of thousands of dollars per ton per year.

In attainment areas, facilities with potential emissions of 100 tons per year of a regulated pollutant will also be subject to new source review. BACT will typically be required, but not LAER. Offsets are rarely required.

Even smaller sources and modifications in non-attainment areas may also be subject to new source review, as part of each state's efforts to achieve applicable NAAQS. The "state" or "minor source" new source review programs typically impose a loose form of BACT requirement, and sometime impose offset requirements as well.

Given this context, more stringent NAAQS could have the following effects on new sources and modifications that are "major" under the Act

1. New source review triggering thresholds (based on potential facility emissions) will be lowered in areas that are classified as non-attainment under the proposed NAAQS standards.

2. In areas where attainment is delayed by the substitution of a new standar& stringent new source review requirements will continue for a longer period of time than would have otherwise been the case.

3. As a result of downstream legislative or regulatory changes, specific triggers for BACT versus LAER, and requirements for offsets, could become more stringent.

3.4 Discretionary State SIP Requirements

Non-attainment areas are required to develop and implement a plan (the SIP) to attain NAAQS. These plans typically include retrofit requirements for types of processes that are not subject to federal RACT requirements. If NAAQS become more stringent, all affected non-attainment areas are likely to find it necessary to "dig deeper" when imposing retrofit control requirements on stationary sources. Smaller units not yet subject to a retrofit requirement are most likely to be affected, but state could also choose to impose BACT-like requirements on sources already-subject to RACT.

Non-attainment areas are also likely to impose more stringent new source review requirements on smaller new sources and modifications. BACT determination may be tightened up, and offset requirements may become more common and more demanding.

3.5 Other Mandatory Requirements For Non-Attainment Areas

Under the Act, "transportation control measures" are required in ozone non-attaimnent areas. In "severe" and "extreme" areas, employer-run trip reduction or "carpooling" programs are required. Shipyards located in areas that are reclassified to non-attainment under new NAAQS may be required to establish such programs.

The Act also imposes requirements on vehicle fleets operated in non-attainment areas. Fleet average emissions limits are set low enough to require the introduction of newer vehicles with lower emissions. With new NAAQS, more shipyards could be subject to these requirements. Requirements for periodic emissions testing and maintenance for private and fleet vehicles may also become applicable.

3.6 Potential Statutory Changes

Congress could play a major role in detemining the impact of any new NAAQS, by setting aside or delaying the impact of those standards, or by defining the manner and schedule for implementing new standards. It is unclear at this point whether Congress will embrace these standards, or push back against them.

The Act currently contains an elaborate set of non-attainment area classification rules that-are based on the current NAAQS. Congress debated at length how to balance vehicle, fuel, and industrial control efforts when the Clean Air Act Amendments (CAAA) were enacted in 1990. This fundamental balancing issue wil1 need to be revisited if NAAQS become more stringent. A strong argument can be made that "most" of the additional emissions reductions that would be needed to achieve more stringent NAAQS standards should come from cleaner and more durable vehicIes and cleaner fuels, and not from stationary sources. If Congress strikes this kind of balance, and protects some stationary sources in some way, then the impacts of the NAAQS wil1 be very different than if implementation is left to EPA and the states.

Even if these "balancing" issues are neglected, however, a change in NAAQS should lead to new legislation. The 1990 CAAA revisions were developed in large part to address the failure of many area to attain the existing ozone NAAQS on time. The Act contains specific non-attainment classifications, requirements and deadlines that are tied to that NAAQS. The development of these specific provisions was a highly political process, and new NAAQS would both render these provisions obsolete, and raise new political issues. Therefore, it is reasonable to assume that Congress would respond to new NAAQS by revisiting these issues.

One potentially major new political issue raised by EPA's NAAQS proposal involves the regulatory institutions needed or best suited to achieve those standards. EPA is currently addressing this question as an "implementation" issue, but Congress could address it in legislation. The issue is discussed futher below.

3.7 Potential Institutional Changes

There are technical connections between ozone, $PM_{2.5}$, and regional haze: emissions of the same precursor pollutants (VOCS, NO_x, and SO_x) can contribute to more than one of these problems. Moreover, controls on these pollutants that are sufficient to attain NAAQS in one area may still ailow emissions that contribute to non-attainment or visibly impacts in down wind areas. Institutions are already in place to study and coordinate efforts to address ozone on a "regional" basis in the eastern U. S.. EPA apparently also believes that regional haze issues in the West will require implementation of multi-state control strategies.

EPA is considering implementation plans in connection with the proposed NAAQS that could create new, multi-state institutions in response to EPA's increasingly regional view of air pollution problems. In practice, of course, a distant multi-state institution could not be expected to make detailed decisions about the level of control that was feasible and appropriate for specific emissions units at specific shipyards. Inevitably, this kind of shift in institutions would have two effects: (1) centralized EPA standard-setting or guidance for categories of equipment wouId tend to displace local standard settling, and (2) regulators would rely less on the specific regulation of processes, and more on strategies that limited total emissions from an entire facility. The imposition of facility caps that became tighter overtime could displace the search for feasible and cost effective control opportunities on a unit-specific basis.

Any move in this direction could substantially reduce local and state control over air pollution regulatory decisions. The loss of local decision making authority and local political accountability for discretionary decisions could affect shipyards significantly.

3.8 Potential Additional Requirements For Specific Shipyard Processes

This section briefly summarizes the kinds of control requirement that are currently being imposed or proposed for shipyard units in non-attainment areas. These kinds of requirements could be imposed at additional shipyards if the NAAQS become more stringent.

3.8.1 Boilers

In non-attainment areas, steam generators and other fuel burning units at major sources may be subject to retrofit standards developed by the state or region. Typically these rules will have relatively high thresholds for applicability (e.g., 50 million Btu/hour heat input rating), however in some states, such as Califonia, restrictions apply to boilers as small as 5 million BTU/hour. Numerical limits on NO_x are common, and these rule typically also require periodic cleaning and tuning to ensure efficient combustion, and possibly an initial source test to vefify compliance with NO_x limits.

Where requiredpotential retrofits include combustion modifications, 1ow-NO_x burners, overtire air systems, low excess air systems, flue gas recirculation, turaI gas reburn, burners out-of-service, fuel switching, selective catalytic reduction, and selective non-catalytic reduction.

3.8.2 Internal Combustion Engines

Large older diesel engines (e.g., for cranes, compressors, or generators) in non-attaimnent areas may be subject to RACT. EPA has not established binding guidance defining RACT, but EPA regional offices are providing some guidance to states. Promulgation of RACT requirements for these engines became an issue only with the 1990 Clean Air ACt, and SIP RACT rules are not yet in place in many jurisdiction.

RACT rules may specify a maximum allowable concentration of NO_x in exhaust gases, or require that NO_x emissions be reduced by 25% from "uncontrolled" levels. These standards can be very difficult to meet reliably with some existing engines. Technologies that can be used to reduce emissions from these engines include fuel switching, retarding emissions timing, and installation of fuel-air ratio controllers. Research is also currently underway to investigate fuel additives which may be used to reduce particulate emissions.

3.8.3 Abrasive Blasting

Outdoor abrasive blasting operations in shipyards are typicalIy subject to some combination of limits on opacity, requirements that smaller parts or assemblies be blasted in a contained environment limitations on the fine particle content of blast media, and requirements for the use of curtains or other partial containment devices.

3.8.4 Coatings

Requirements applied to shipyard coating operations focus on painting practices (e.g.,. reducing overspray and containing fumes from gun cleaning), and on paint formulation and thinning.

EPA has issued guidance for "Shipbuilding a nd Ship Repair Operations(Surface Coating)" describing RACT and BACM controls for VOCS from marine coatings (61 FR 44050, August 27, 1996). The guidance is essentially identical to the marine coatings NESHAP, and includes both VOC limits for categories of coatings as applied, and basic standards for storage and transfer of VOC-containing materials. Non-attainment areas must submit SIP rules to implement EPA's guidance by August 27, 1997, and compliance must be required by August 27, 1998.

This guidance is likely to be important only for smaller shipyards in serious or severe non-attainment areas outside of California and Louisiana, such as Houston/Galveston, Philadelphia, Port Arthur TX, Boston, Portsmouth NH, Providence RI, and Milwaukee. The VOHAP content of "compliant" marine coatings may be less than 50% of the total VOC content of such paints, making it possible to exceed major source thresholds for VOC emissions in these areas before the marine coatings NESHAP applicability threshold is reached. In California and Louisiana, potentially affected shipyards are already subject to similar coating rules.

EPA also issued guidance on RACT for miscellaneous metal parts and products coating operations in 1978. Under the 1990 Clean Air Act this guidance has recently been applied in additional areas. Any shipyard that is a major source of VOCs in a non attainment area is Iikely to be subject to a SIP / RACT rule setting VOC limits on metal parts and products coatings, even if miscellaneous parts painting is a small part of the work at the shipyard.

4.0 Conclusions.

4.1 Impact on shipbuilding and repair industry.

The U.S. Shipbuilding and Repair industry will experience significant impacts to both its operational flexibility and cost of operations under the proposed revised NAAQS for ozone and particulate matter. The proposed new standards WN result in a significant portion of the industry being subjected to ozone and particulate matter non-attainment controls, which currently do not exist in these areas. Additionally, those areas in which non-attainment controls currently are in effect will almost certain require more controls for a longer period of time.

Currently eight of twenty six major shipbuilding and repair areas studied in this report are located in non-attainment areas. Based on EPA projections, as many as fifteen of the twenty six areas may be in non-attainment under the revised standards. This includes four of the six largest shipbuilding facilities in the U. S., which currently hold over 50% of all the new ship construction orders.

In non-attainment areas both new construction and repair facilities will be subject to both process and operational constraints. Process constraints include limitations on equipment or process operations, such as limiting the volume of marine coating operations by imposition of an annual VOC cap. Operational constraints could include the restriction of a facility's ability to expand production capacity. For instance the siting of a new diesel crane, when NO_x credits are not available for purchase may prevent the facility from obtaining the necessary permit to construct.

Finally, and possibly most important, implementation of the proposed NAAQS will almost certainly contribute to an erosion of local and state control of air quality programs. Regional and/or multi-state air quality control is seen by many as the inevitable result .of lowering the NAAQS standards to a level where local air districts cannot effectively reduce emissions to reach the standard. A distant regional control office cannot be as responsive to the concerns of a shipyard as a local agency, who is responsible to a locally elected legislative body.

4.2 Effected shipyard process and operations

Processes and operations in shipyards which are the source of ozone and particulate matter precursors will be effected by the reduction in the NAAQS standards. For ozone this will include sources of NQ (internal and extermd combustion) and VOC (marine coating operations). For particulate matter, both the existing (PM_{10}) and proposed ($PM_{2.5}$) standard must be considered. For PM_{10} no significant controls beyond those already in place are anticipated. If fact, by changing the form but not the level of the PM_{10} standard, some areas which are currently non-attainment maybe reclassified as attainment sooner. However, in the case of $PM_{2.5}$ additional controls would be required. Although shipyards in general are not significant sources of directly generated $PM_{2.5}$ they will be significant sources of $PM_{2.5}$ precursors, NO, SO and VOC. These precursors are generated from the same sources that contribute to ozone precursors. It is likely, therefore, that the same type of process and operations controls necessary to control ozone precursors will also be used to reduce the emissions of $PM_{2.5}$ precursors.

By reviewing the types of controls currently placed on shipyard operations and processes in non-attainment areas one can make a fair prediction of the types of controls which would be implement in those areas re-classified as non-attainment under the proposed NAAQS revisions.

Table 1 - Current and Projected Ozone Attainment Status of Shipyard Locations

Location	Coun	Ozone Attainment Based on '93- Current[4] 0.12 ppm	Proposed[5] 0.08	Current	Modeled Nonattainment Areas For: Under Regional Control: 8H5EX-	8H4AX-	8H1AX-	Curre	Under Local Control: 8H5EX-	8H4AX-	8H1AX-
Bayou La Batre, AL	Mobil	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Mobile, AL	Mobil	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
San Diego, CA	San	No	No	No	No	No	No	No	No	No	No
San Francisco, CA	San	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Terminal Island, CA	Los	No	No	No	No	No	No	No	No	No	No
Groton, CT	New	No	No	No	No	No	No	No	No	No	No
Jacksonville, FL	Duv	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tampa, FL	Hillsboro	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Savannah, GA	Chath	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Amelia, LA	St.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lockport, LA	Lafourc	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Morgan City, LA	St.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
New Orleans, LA	Jeffers	Yes	No	Yes	Yes	Yes	No	No	Yes	No	No
Sparrows Point, MD	Baltimo	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes
Bath, ME	Sagada	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gulfport, MS	Harris	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pascagoula, MS	Jacks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portland, OR	Multno	Yes	Yes	No	No	No	No	No	No	No	No
Galveston, TX	Galvest	No	No	No	No	No	No	No	No	No	No
Houston, TX	Harri	No	No	No	No	No	No	No	No	No	No
Port Arthur, TX	Jeffers	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Newport News, VA	James	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Norfolk, VA	Norfolk,	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Seattle, WA	Kin	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
Tacoma, WA	Pierc	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
Sturgeon Bay, WI	Doo	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	No

Table 2 - Current and Projected Particulate Matter Attainment Status of Shipyard Locations

Location	County	PM10 Attainment Status Based on '93-'95 Data: Current Standard	PM10 Attainment Status Based on '93-'95 Data: Proposed (98%)	PM 2.5 Projected Status
Bayou La Batre, AL	Mobile	Yes	Yes	No
Mobile, AL	Mobile	Yes	Yes	No
San Diego, CA	San Diego	No	Yes	No
San Francisco, CA	San Francisco	No	Yes	Yes
Terminal Island, CA	Los Angeles	No	Yes	No
Groton, CT	New London	Yes	Yes	Yes
Jacksonville, FL	Duval	Yes	Yes	Yes
Tampa, FL	Hillsborough	Yes	Yes	Yes
Savannah, GA	Chatham	Yes	Yes	Yes
Amelia, LA	St. Mary	Yes	Yes	Yes
Lockport, LA	Lafourche	Yes	Yes	Yes
Morgan City, LA	St. Mary	Yes	Yes	Yes
New Orleans, LA	Jefferson	Yes	Yes	Yes
Sparrows Point, MD	Baltimore	Yes	Yes	No
Bath, ME	Sagadahoc	Yes	Yes	Yes
Gulfport, MS	Harrison	Yes	Yes	Yes
Pascagoula, MS	Jackson	Yes	Yes	Yes
Portland, OR	Multnomah	Yes	Yes	Yes
Galveston, TX	Galveston	Yes	Yes	Yes
Houston, TX	Harris	Yes	Yes	No
Port Arthur, TX	Jefferson	Yes	Yes	Yes
Newport News, VA	James City	Yes	Yes	Yes
Norfolk, VA	Norfolk, VA	Yes	Yes	Yes
Seattle, WA	King	Yes	Yes	Yes
Tacoma, WA	Pierce	Yes	Yes	Yes
Sturgeon Bay, WI	Door	Yes	Yes	Yes

APPENDIX A
CHARACTERIZATION OF AMBIENT PM AND POTENTIAL SHIPYARD SOURCES

PM represents a broad class of chemically and physically diverse substances. It can be principally characterized as discrete particles that exist in the condensed (liquid or solid) phase spanning several orders of magnitude in size. For regulatory purposes, fine particles can be generally defined as those particles with an aerodynamic diameter of 2.5 m. or less, while coarse fraction particles are those particles with an aerodynamic diameter greater than 2.5 m., but equal to or less than a nominal 10µ m. According to the EPA the health and environmental effects of PM are strongly related to the size of the particles.

The emission sources, formation processes, chemical composition, atmospheric residence times, transport distances and other parameters of fine and coarse particles are distinct. Fine particles are generally formed secondarily from gaseous precursors such as sulfur dioxide (SO) nitrogen oxides (NO), or organic compounds and are composed of sulfate, nitrate, and ammonium compounds; elemental carbon, and metals. Fine particles can also be directly emitted. Combustion of coal, oil, diesel, gasoline, and Wood ,as well as high temperature process sources such as smelters and steel mills, produce emissions that contribute to fine particle formation. In contrast, coarse particles are typically mechanically generated by crushing or grinding and are often dominated by resuspended dusts and crustal material from paved or unpaved roads or from construction, farming, and mining activities. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometers, while coarse particles deposit to the earth within minutes to hours and within tens of kilometers from the emission source. Table 1.1 summarizes the key differences between fine and coarse particles.

Geographic differences (i.e., rural vs. urban locations, East vs. West) also exist between ambient levels of fine and coarse particles and their related characteristics. For instance, total concentrations of coarse fraction particles are generally higher and the crustal material contribution relatively larger in axial areas of the Western and Southwestern U.S. In the Eastern U. S., fine particle sulfate is a significant component of ambient $PM_{2.5}$ concentrations. These geographic differences between ambient level of fine and coarse particles and their related characteristics are summarized in Figure 1-1. The differences in fine and coarse particle characteristics and their geographic variability are significant considerations in the design of control strategies to reduce levels of ambient PM concentrations.

Shipyards produce coarse particulate matter primarily from uncontrolled abrasive blasting activities and internal combustion processes using diesel fuels. These sources have been generally well characterized and have accepted (to a greater or lesser degree) emission factors from which particulate emissions can be calculated.

Sources of fine particulate in the shipyard are not well characterized. It appears however that neither abrasive blasting nor welding operations may be a significant contributor to the overall mass of PM_{Z5} generated by shipyards. (Although the combined welding, burning and cutting operations at large new construction facilities cannot be ruled out as insignificant sources of PM_{25} at this time.) Instead, the same processes and operations that produce ozone precursors, namely marine coating operations, internal combustion and external combustion, are the same sources of $PM_{2.5}$ chemical precursors: NOA , SOX and VOC. Additionally, marine coatings operations may result in the direct generation of $PM_{2.5}$ via fine particle overspray.

TABLE 1-1.

COMPARISON OF AMBIENT FINE AND COARSE MODE PARTICLES

	Fine Mode	Coarse Mode
Formed from:	Gases	Large solids/droplets
Formed by:	Chemical reaction; Nucleation; Condensation; Coagulation; Evaporation of fog and cloud droplets in which gases have dissolved and reacted.	Mechanical disruption (e.g., crushing, grinding, abrasion of surfaces); Evaporation of sprays; Suspension of dusts.
Composed of:	Sulfate, $SO_4^{=}$; Nitrate, NO_3^-; Ammonium, NH_4^+; Hydrogen ion, H^+; Elemental carbon Organic compounds (e.g., PAHs, PNAs); Metals (e.g., Pb, Cd, V, Ni, Cu, Zn, Mn, Fe); Particle-bound water.	Resuspended dusts (e.g., soil dust, street dust); Coal and oil fly ash; Metal oxides of crustal elements (Si, Al, Ti, Fe); $CaCO_3$, NaCl, sea salt; Pollen, mold spores; Plant/animal fragments; Tire wear debris.
Solubility:	Largely soluble, hygroscopic and deliquescent.	Largely insoluble and non-hygroscopic.
Sources:	Combustion of coal, oil, gasoline, diesel, wood; Atmospheric transformation products of NO, SO and organic compounds including biogenic species (e.g., terpenes); High temperature processes, smelters, steel mills, etc.	Resuspension of industrial dust and soil tracked onto roads; Suspension from disturbed soil (e.g., farming, mining, unpaved roads); Biological sources; Construction and demolition; Coal and oil combustion; Ocean spray.
Lifetimes:	Days to weeks	Minutes to hours
Travel Distance:	100s to 1000s of kilometers	< 1 to 10s of kilometers

APPENDIX B
SOURCE SPECIFIC EMISSION LIMITS

Alabama

$PM_{2.5}$ Nonattainment Projected

Boilers and IC Engines between 10-250 MMBTU/hr in Class I Counties
(Rule 335-34.03, Fuel Burning Equipment):

0 PM emissions (lb/MMBTU) = 1.38 $H^{-0.44}$
(where H= Heat Input Btu/hr))

General: Abrasive B1asting
(Rule 335-34.04, Process Industries)

0 PM Emissions (lb/hr) = 3.59 $P^{0.62}$
(where P= Process weight per hour in tons per hour)

Painting

0 Exempt from regulations (335-3-6-.32 (11)(c)(1O))

San Diego, California

$PM_{2.5}$ Nonattainment Projected

Boilers
(SDAPCD Rule 69.2)

0 NOX emission limit 30 ppm with gaseous fuel, 40 ppm with liquid fuel.
(These limits apply only to larger boilers)

Diesel-fired IC Engines
(SDAPCD Rule 69.4)

o 700 ppm NO_x limit in exhaust gas, or 25 percent control of uncontrolled emissions

Abrasive Blasting
(SDAPCD Rule 71; California Code of Regulations Title 17, Part III Chapter 1, Subchapter 6)

- o Abrasives must be certified by the Air Resources Board and contain more than 1 percent of abrasives that can pass through #70 U.S. Standard sieve before blasting. After blasting, the abrasive shall not contain more than 1.8 percent by weight material 5 micron or smaller. The abrasive material shall be labeled as "RB certified for permissible dry outdoor blasting.

Painting
(SDAPCD Rule 67.18)

- o The VOC content of marine coatings shall not exceed 340 grams per liter for military Exterior Topcoat limits are also specified for specialty coatings.

Terminal Island, CA

$PM_{2.5}$ Nonattainment Projected

Boilers
(SCAQMD Rule 1146)

Input Capacity	Rated Heat Annual Heat Input	Gaseous. Liquid, or Solid Fossil Fuels
Equal to or greater than 5 MMBTU per hour	And, Greater than 9 x 10^9 Btu per year (90000 Therms) fuel use	40 ppm NO_x (0.05 lb NO_x per 10^6 Btu of heat input)
Equal to or greater than 40 MMBTU per hour	And, Greater than 25% annual capacity factor	30 ppm NOx
Equal to or greater than 40 MMBTU per hour	And Equal to or less than 25% annual capacity factor and Greater than 9 x 10^9 Btu per year (90000 Therms) fuel use	40 ppm NOx

(SCAQMD Rule 1146.1)

Applicable to boilers greater than 2 MMBTU/hr and less than 5 MMBTU/hr

- o NOx emission limit= 30 ppm NOx or 0.037 lb NOx/MMBTU

IC Engines-Interim Limits
(SCAQMD Rule 1110.1)

- o Rich Burn Engines >200 bhp or stationary source >2000 max. total bhp: NOx emission limit= 90 ppm NOx @ 15% 02; or, 80% reductions

- o Lean Burn Engines >200 bhp or stationary source >2000 max total bhp: NOx emission limit= 150 ppm NOx @ 15% 02; or, 70'% reduction

<u>IC Engines-Final Limits (December31, 1999)</u>
(SCAQMD Rule 11 10.2)

- o **500** bhp and greatr:e 36 ppm NOx @ 15% 02; or, electrify

  50 to 500 bhp: 45 ppm NOx @ 15% 02; or, electrify

<u>Abrasive B1asting</u>
(SCAQMD Rule 1140)

- o Opacity Limit of Ringelmann No. 1 for unconfined space abrasive blasting

- o Abrasives must be ARB certified for dry unconfined blasting

<u>Marine Coatings</u>
(SCAQMD Rule 1106)

- o VOC Limit are coating specific, and as or more stringent than the NESHAPS, e.g.,

General Coating	340 grams/liter when air dried
Tack Coat	610 grams/liter when air dried

Groton, CT

Ozone Nonattainment Projected

<u>Boilers</u>

- o 0.20 lb NOx/MMBTU (all fuel types except residual oil)

- o 0.25 lb NOx/MMBTU (residual oil)

- o 0.10 lb PM/MMBTU (all fuel types except residual oil)

- o 0.14 lb PM/MBTU (residual oil)

<u>IC Engines</u>

- o 2.5 gm/kp hp-hr NO_x

o 0.10 lb PM/MMBTU (all fuel types except residual oil)

o 0.14 lb PM/MMBTU (residual oil)

<u>Abrasive Blasting</u>

o ≤ 30 tons/hr: 3.59 $P^{0.62}$ (lb/hr) PM
(where P= Process weight per hour in tons per hour)

o > 30 tons/hr: 17.31 $P^{0.16}$ (lb/hr) PM
where P = Process weight per hour in tons per hour)

<u>Painting</u>

o No state VOC limits for marine coatings.

New Orleans, LA

Ozone Nonattainment Projected

<u>Boilers</u>
(Rule 1313.C)
o 0.6 lbs NO_x per MMBTU heat input

<u>IC Engines</u>
(Rule 1311.C)

o < 20% Opacity, with exceedances for not more than one six-minute period in any
60 consecutive minutes

<u>Abrasive Blasting</u>
(Rule 1311.B)

o 4.10 (P)O.67 PM (lbs/hr)
(where P= process weight rate in tons/hr)

<u>Painting: marine coatings</u>
(Rule 2123.C.11)

o 3.5 lbs VOC per gallon of coating

Bath, MA

Ozone Nonattainment Projected

Boilers >3 MMBTU/hr:

- 0.20 lb PMIMMBTU, or
- 0.30 lb PMMMBTU
  (if automatic fuel viscosity controls are integrated into the fuel oil controls and combustion efficiency instrumentation)

IC Engines > 3 MMBTU/hr

- **0.20** lb PM7MIMBTU, or
- 0.30 lb PM/MMBTU
  (if automatic fuel viscosity controls are integrated into the fuel oil controls and combustion efficiency instrumentation)

Abrasive B1asting

- ≤ 30 tons/hr: $3.59 P^{0.62}$ PM (lbs/hr)
  (where P =Process weight per hour in tons per hour)
- > 30 tons/hr: lb/hr) = $17.31 P^{0.16}$ (lbs/hr)
  (where P= Process weight per hour in tons per hour)

painting

- No state VOC limit for marine coatings.

Sparrows Point MD

$PM_{2.5}$ Nonattainment Projected

Boilers and IC Engines

- A complex set of limits on NO_x is specified

Abrasive Blasting

- 55.0 PO. 11 -40PM (lbs/hr)
  (where P= Process weight per hour in tons per hour)

Painting
(Rule 13.C)

- *o* The VOC content of some surface coatings is limited

Houston, TX

$PM_{2.5}$ Nonattainment Projected

Boilers
(Rule 117.205(3))

- *o* Limitations vary. Example: gas-fired boiler, low heat release with preheated air greater than 400F, NOx emission limit= 0.02 lb NOx/MMBtU

IC Engines

- *o* Gas-fired, rich-burn: 2.0 grams of NOx per horsepower hour.

Abrasive Blasting
(Rule 111.151)

- *o* Allowable emissions are related to specific flow rates

painting

- o 3.5 Ibs of VOC per gallon for extreme performance coating.

Portland, OR

Ozone Nonattainment Projected

Boilers

0.2 grains PM per dry standard cubic foot of exhaust gas

IC Engines

0.2 grains PM per dry standard cubic foot of exhaust gas

Abrasive Blasting

- **55.0** PO. 11 -40PM (lbs/hr)
  (where P= Process weight per hour in tons per hour)

Painting

- No state VOC limits

Stnrgeon Bay, WI **

Ozone Nonattainment Projected

Boilers
(NR415.06(3)(a) and NR415.06(3)(c))

- No NO_x limits
- < 100 MMBTU/hr: 0.024 lb PM/MMBTU/hr)(NR415.06(3)(a))

IC Engines

- No NO_x limits
- 100 MMBTU/hr < MMBTU Rating <250 MMBTU/hr: 0.015 lb PM/MMBTU/hr)

Abrasive Blasting
(NR415.05)

- **3.59 (p)0.62** lbs PM/hr
  (where P= process weight rate in tond/hr).

Painting

- No state VOC limit for marine coatings.

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