United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives

October 1989

AIR POLLUTION

EPA's Efforts to Control Gasoline Vapors From Motor Vehicles

GAO/RCED-90-21

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-236358

October 6, 1989

The Honorable John D. Dingell
Chairman, Subcommittee on
Oversight and Investigations
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

As requested, this report discusses the Environmental Protection Agency's efforts to control gasoline vapors from motor vehicles. Specifically, it describes the progress made and issues remaining in the agency's work to reduce the volatility or evaporation rate of commercial gasoline, the adequacy of the agency's efforts to address and resolve the concerns regarding risks to passenger safety of placing vapor recovery equipment on motor vehicles, and the overall feasibility of installing vapor recovery equipment on service station pumps in lieu of motor vehicles. The report also discusses the President's proposed legislation for revising the Clean Air Act and its impact on these three issues.

Unless you publicly release its contents earlier, we will make this report available to other interested parties 30 days after the issue date. At that time copies of the report will be sent to appropriate congressional committees; the Administrators of the Environmental Protection Agency and the National Highway Traffic Safety Administration; and the Director, Office of Management and Budget.

This work was performed under the direction of Richard L. Hembra, Director, Environmental Protection Issues, who may be contacted at (202) 275-6111 if you or your staff have any questions. Other major contributors are listed in appendix I.

Sincerely yours,

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

Over 100 areas, most of which are major metropolitan areas, had ozone levels in 1988 which exceeded the federal air quality standard for ozone. Ozone, often called "smog," irritates the nose, throat, and lungs, and long-term exposure to ozone may permanently damage the lungs. Gasoline vapors from motor vehicles contribute significantly to ozone, and in 1987 EPA proposed to control these vapors by requiring (1) refiners to lower the volatility (evaporation rate) of gasoline sold during the summer when most high ozone levels occur and (2) motor vehicle manufacturers to install vapor recovery equipment (onboard controls) on motor vehicles.

Concerned with aspects of EPA's proposal, the Chairman, Subcommittee on Oversight and Investigations, House Committee on Energy and Commerce, asked GAO whether EPA (1) could lower gasoline volatility immediately and (2) has adequately addressed concerns regarding the safety of onboard controls and the feasibility of vapor recovery equipment on service station pumps (Stage II controls).

Background

Unlike other air pollutants, ozone is not released directly into the air but is formed when hydrocarbons and nitrogen oxides react in sunlight. Heat stimulates the ozone process and most high levels occur during the summer months. Gasoline vapors, a major source of hydrocarbons, are released from motor vehicles as a result of normal evaporation (evaporative emissions) and vehicle refueling (refueling emissions).

Gasoline-fueled vehicles are equipped with systems to control evaporative emissions. However, the steady rise in gasoline volatility over the years resulted in more evaporative emissions than the systems are designed to handle and the release of excess emissions into the air because of the lack of volatility controls and refiners' increased use of butane. In August 1987 EPA proposed to reduce the maximum volatility of gasoline sold during the summer to 10.5 pounds per square inch beginning in 1989 (Phase I) and 9.0 pounds per square inch—the volatility of the fuel used to certify evaporative emission control systems—beginning in 1992 (Phase II).

Unlike evaporative emissions, refueling emissions are not federally controlled. Since the early 1970s, EPA has studied the feasibility of onboard and Stage II controls to capture refueling emissions. While Stage II controls have been in use in California and the District of Columbia since the 1970s, onboard controls are a new technology. In August 1987 EPA proposed onboard instead of Stage II controls because, among other factors, onboard controls would provide nationwide reductions in ozone- and cancer-causing emissions. However, in June 1989 the President announced his proposal for amending the Clean Air Act that included requiring Stage II controls in areas not in attainment with the ozone standard. Since then, legislation has been introduced in both the House (H.R. 3030) and the Senate (S. 1490) to carry out the President's proposal.

Results in Brief

In March 1989 EPA acted to lower gasoline volatility immediately by issuing regulations that required Phase I volatility reductions beginning in the summer of 1989. EPA has not yet, however, taken action on its Phase II volatility reductions. In the meantime, the President's Clean Air Act amendments propose further volatility reductions which, if implemented, will cap summertime gasoline volatility at the 9.0 pounds per square inch level used to certify current evaporative emission control systems. GAO believes that the Phase I reductions were a step in the right direction and that the President's proposal, if implemented, should result in air quality improvements.

Disagreement continues between EPA and the Department of Transportation over whether the addition of onboard controls will have an adverse affect on vehicle safety, such as an increased risk of vehicle fires. When and if these safety concerns will be resolved remains uncertain since EPA plans no further work on onboard controls in view of the President's proposal to require Stage II controls in nonattainment areas. Also left unclear is how much time motor vehicle manufacturers would require to incorporate onboard controls onto vehicles. In addition, it would be a number of years before onboard controls appear on a sufficient number of vehicles to affect refueling emissions.

The President's proposed Clean Air Act amendments calling for Stage II controls in ozone nonattainment areas reversed EPA's onboard control proposal. In addition, more states have adopted Stage II controls, and advances in Stage II control equipment have improved its efficiency and reduced the inconvenience associated with its use. These factors, along with the unresolved issues regarding the safety and lead time of onboard controls, suggest to GAO that Stage II controls are, in the near term, a practical and feasible option for controlling refueling emissions.

Principal Findings

Further Volatility Reductions

EPA's Phase I gasoline volatility reductions capped volatility at 10.5 pounds per square inch beginning in the summer of 1989 and should reduce total annual hydrocarbon emissions by at least 3 percent or 674,000 tons. Both H.R. 3030 and S. 1490 propose capping gasoline volatility at 9.0 pounds per square inch by the summer of 1992. Phase II volatility reduction issues still facing EPA are (1) whether volatility should be reduced below 9.0 pounds per square inch in certain areas; (2) whether 1992 provides sufficient time for refiners to invest in equipment needed to meet lower volatility levels; and (3) how gasolines blended with alcohol, particularly ethanol blends or gasohol, will be treated under Phase II reductions. EPA estimates that its proposed Phase II reductions could reduce total annual hydrocarbon emissions an additional 8 percent.

Seven northeastern states—Connecticut, Maine, Massachusetts, New Jersey, New York, Rhode Island, and Vermont—adopted regulations requiring gasoline volatility of 9.0 pounds per square inch beginning in 1989. The Clean Air Act prohibits state volatility controls that are inconsistent with federal controls unless approved by EPA. As of early August 1989, EPA had approved the requests from five of the states to enforce their more stringent standard and was continuing to review the requests from the remaining two states.

Safety of Onboard Controls and Feasibility of Stage II Controls

EPA is convinced that onboard controls will not degrade passenger safety based on its development of an onboard control system and other work since proposing such controls. In fact, EPA believes that onboard controls can actually improve motor vehicle safety by simplifying fuel system designs. Department of Transportation agencies involved with motor vehicle and highway safety disagree. They remain concerned that onboard controls can increase the complexity of vehicle fuel systems and the risks of vehicle fires, and based on the National Highway Traffic Safety Administration's experience with a vehicle equipped with onboard controls by the oil industry, cause stalling and other problems that affect driving quality and vehicle safety. Overall, Transportation officials believe that further engineering and testing are needed to assure that onboard controls will not result in safety problems.

While EPA believes that 2 years is generally sufficient to incorporate onboard controls into production, motor vehicle manufacturers contend that a minimum of 4 years is needed. EPA also projects that within 5 years of introduction, onboard-equipped vehicles will consume 50 percent of all gasoline dispensed. The motor vehicle industry, however, contends that it will be well into the next century before onboard controls come close to matching the efficiency of Stage II controls.

Stage II controls are in use in five states—up from two at the time EPA proposed its refueling regulations—and six more could have Stage II controls by 1992. A new Stage II control nozzle, certified for use in California, eliminates the rubber device portion of the current nozzle which causes problems and defects affecting its efficiency. California estimates that the nozzle could reduce hydrocarbon emissions by over 700 tons a year in one of it areas with severe air quality problems while reducing current Stage II control enforcement efforts. Oil company tests show consumers find the nozzle more convenient to use than current Stage II equipment.

Both H.R. 3030 and S. 1490 require Stage II controls in nonattainment areas. As a result of the President's proposal to pursue Stage II controls, EPA plans no further work regarding onboard controls as an option to reduce gasoline vapors.

Matters for Congressional Consideration

GAO believes that Stage II controls are, in the near term, a practical and feasible option for controlling refueling emissions. However, GAO also believes that, despite the current unresolved safety issues, onboard controls should not necessarily be abandoned as an option for reducing gasoline vapors because they may provide advantages above and beyond Stage II controls. Consequently, the Congress, in considering the proposed amendments to the Clean Air Act, may wish to consider directing EPA to continue efforts to resolve the safety concerns associated with onboard controls.

Agency Comments

GAO discussed the matters in this report with EPA officials and have incorporated their comments where appropriate. However, as requested, GAO did not obtain official agency comments on a draft of this report.

Contents

Abbreviations

API	American Petroleum Institute
ASTM	American Society for Testing and Materials
CAS	Center for Auto Safety
DOT	Department of Transportation
EPA	Environmental Protection Agency
GAO	General Accounting Office
IIHS	Insurance Institute for Highway Safety
NESCAUM	Northeast States for Coordinated Air Use Management
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
OAQPS	Office of Air Quality Planning and Standards
OMB	Office of Management and Budget
OMS	Office of Mobile Sources
psi	pounds per square inch
RVP	Reid Vapor Pressure

Introduction

Reducing ozone in the air we breathe to safe levels continues to be the nation's most pressing air quality problems. The Environmental Protection Agency (EPA) reported in July 1989 that 101 areas, most of which are major metropolitan areas, experienced ozone levels during 1988 that exceeded the federal air quality standard[1] for ozone. Ozone causes nose, throat, and lung irritation, and concern is growing that repeated exposure to ozone over a lifetime may cause permanent lung damage.

Ozone, unlike other air pollutants, is not emitted directly into the air by a particular source. Rather, it is formed when hydrocarbons chemically react with nitrogen oxides in the presence of sunlight. Because heat stimulates the ozone process, most high levels occur during the summer months.

Literally thousands of sources emit pollutants that contribute to the ozone problem, with motor vehicles being a dominant source. In 1987 EPA estimated that during 1988, motor vehicles would account for about 7 million of the approximate 21 million tons in hydrocarbon emissions, with gasoline vapors from motor vehicles contributing about 3.5 million tons.

Because of continuing concern over motor vehicles' role in the ozone problem, EPA, in 1987, acted to control gasoline vapor emissions from motor vehicles. Specifically, EPA proposed regulations that would require (1) motor vehicle manufacturers to install vapor recovery equipment, commonly referred to as onboard controls, on automobiles and trucks to control gasoline vapors emitted during vehicle refueling and (2) refiners to reduce the volatility (evaporation rate) of gasoline sold during the summer months to reduce other vapors emitted from the vehicle fuel tank and fuel system.

Gasoline Vapor Emissions and EPA's Control Actions

Gasoline vapors are emitted from motor vehicles during routine operations through the normal evaporative process (evaporative emissions) and during vehicle refueling (refueling emissions). Evaporative emissions occur as gasoline in the vehicle fuel tank and other parts of the fuel system is heated by (1) the engine and exhaust system while the vehicle is being driven, (2) the engine after it is shut off, and (3) the outside air while the vehicle is parked. Evaporative emissions make up

[1] Under the Clean Air Act, EPA established a national ambient air quality standard for ozone of .12 parts per million parts of air. The act required all areas to comply with the standard by December 31, 1987.

the bulk of gasoline vapors emitted by motor vehicles. Refueling emissions occur during vehicle refueling as vapors in the fuel tank are displaced by the incoming fuel and forced up the fill pipe and into the outside air.

Evaporative Emissions

Currently, each gasoline-fueled vehicle is equipped with an evaporative emission control system. The system collects and stores gasoline vapors in a canister filled with charcoal and later, when the engine is running, purges the vapors from the canister and sends them to the engine where they are burned.

Evaporative emission control systems are certified to meet federal evaporative emission standards[2] using a fuel with a volatility of 9.0 pounds per square inch (psi) Reid Vapor Pressure (RVP).[3] The 9.0 psi RVP represents the average volatility of summertime gasoline in use in the early 1970s when federal evaporative emission standards were first established. Over the years, while the volatility of the fuel used to certify evaporative emission control systems has remained at 9.0 psi RVP, the volatility of gasolines used in motor vehicles has steadily increased. In 1987 EPA reported that the volatility of summertime gasolines nationwide averaged 10.5 psi RVP, with the average in many areas at 11.6 psi RVP. Two major factors contributing to this rise in volatility were the lack of controls on the volatility of commercial gasoline and the increased use of butane by refiners to reduce production costs and to replace octane lost in the phaseout of lead—another pollutant regulated by EPA. The high volatility of commercial gasoline resulted in more vapors than the evaporative emission control systems are designed to control and the release of excess emissions into the air. EPA's testing of nearly 500 in-use passenger vehicles between 1983 and 1986 on gasoline with volatility levels from 11.4 to 12.0 psi RVP showed actual evaporative emissions 5 to 7 times the 2-gram standard.

In its 1985 study of gasoline volatility and hydrocarbon emissions from motor vehicles, EPA basically considered two alternatives for dealing

[2] EPA's test procedures for certifying evaporative emission control systems limit the amount of hydrocarbon emissions per test to (1) 2 grams for passenger vehicles and trucks with a gross vehicle weight up to 8,500 pounds, (2) 3 grams for trucks between 8,500 pounds and 14,000 pounds, and (3) 4 grams for trucks over 14,000 pounds.

[3] RVP is the most common measure of gasoline volatility and represents a fuel's vapor pressure when tested at 100 degrees Fahrenheit, which is in the usual range of temperatures found in vehicle fuel tanks during the summer.

with excess evaporative emissions. One involved increasing the volatility of the fuel used to certify evaporative emission control systems to that of commercial gasoline and improving evaporative emission control systems to handle the higher volatile commercial gasoline. The other involved lowering the volatility of commercial gasoline to or near the volatility level of the certification fuel.

In August 1987 EPA proposed regulations that would, in two phases, reduce the volatility of commercial gasoline sold during the period May 16 through September 15 of each year. Under Phase I, the volatility of gasoline sold during the 5-month period in areas designated by the American Society for Testing and Materials (ASTM) as Class C, B, and A areas[4] would be reduced beginning in 1989 from the ASTM-recommended levels of 11.5, 10.0 and 9.0 psi RVP, respectively, to 10.5, 9.1, and 8.2 psi RVP. Under Phase II, gasoline volatility would be further reduced beginning in 1992 to 9.0, 7.8, and 7.0 psi RVP, respectively, in Class C, B, and A areas. According to EPA, reducing gasoline volatility would (1) produce immediate reductions in hydrocarbon emissions; (2) reduce emissions throughout the entire gasoline distribution chain and not just from motor vehicles; and (3) reduce emissions from all motor vehicles, including those without evaporative emission control systems or with malfunctioning systems.

In March 1989 EPA issued regulations finalizing its Phase I reductions in gasoline volatility beginning in the summer of 1989. Chapter 2 discusses in detail the Phase I reductions and other related gasoline volatility issues.

Refueling Emissions

Although EPA has been studying ways of controlling refueling emissions since the early 1970s, no federally mandated standards or controls exist for refueling emissions.

Refueling emissions can be controlled by vapor recovery equipment on motor vehicles (onboard controls) or on service station pumps (Stage II controls). Although identical in purpose, onboard and Stage II controls function differently. Onboard controls use a mechanical or liquid seal in

[4]ASTM, in conjunction with the oil refining and motor vehicle industries, recommends volatility levels for each state for each month of the year to ensure proper engine starting and vehicle operation in the summer and winter. There are five ASTM volatility classes, A through E, with Class A being the lowest (9.0 psi RVP) and Class E the highest (15.0 psi RVP). States in warmer climates are assigned lower ASTM volatility classes, especially in the summer, and those in colder climates are assigned higher volatility classes, especially in the winter.

the vehicle fill pipe to prevent vapors from escaping out the fill pipe and into the outside air. The onboard control system, like the evaporative emission control system, captures and stores the vapors in a canister filled with charcoal. The system periodically purges the vapors from the canister and sends them to the engine where they are burned. Stage II controls, on the other hand, use a specially designed gasoline dispensing nozzle to collect the vapors at the opening of the vehicle fill pipe. A separate or specially designed hose recirculates the vapors to the underground gasoline storage tank. Unlike Stage II controls, which have been in use in California and the District of Columbia since the 1970s and more recently in St. Louis, Missouri, the New York City metropolitan area, and New Jersey, onboard controls have been tested but have yet to be used on production vehicles.

In its August 1987 rulemaking, EPA proposed that passenger vehicles and gasoline-fueled trucks be equipped with onboard controls within at least 2 years after issuance of final regulations. According to EPA, various reasons existed for choosing onboard over Stage II controls, both as a nationwide strategy and as a control strategy for helping areas not in attainment with the ozone standard to ultimately attain compliance. EPA noted that compared to requiring Stage II controls only in nonattainment areas, onboard controls included the following advantages: (1) greater long-term emission reduction potential; (2) consumers not having to handle new and inconvenient refueling equipment; (3) ozone reduction benefits in areas in attainment with the ozone standard, which helps these areas to maintain compliance as well as reduce the transport of ozone-causing pollutants to nearby nonattainment areas; and (4) nationwide health benefits from reduced exposure to benzene and other probable carcinogens in gasoline vapors.

As of mid-June 1989, EPA's refueling regulations were still in the proposal stage primarily because of the continuing concern over the potential impact of onboard controls on passenger safety. In June 1989 the President announced his proposal to amend the Clean Air Act that included requiring Stage II controls in ozone nonattainment areas. Since then legislation has been introduced in both the House and Senate to carry out the President's proposal. H.R. 3030, known as the Clean Air Act Amendments of 1989, was introduced in the House on July 27, 1989, and S. 1490, also known as the Clean Air Act Amendments of 1989, was introduced in the Senate on August 3, 1989. Chapter 3 discusses the onboard control safety issue and presents data on the feasibility of Stage II controls.

Objectives, Scope, and Methodology

Since September 1987 the Chairman, Subcommittee on Oversight and Investigations, House Committee on Energy and Commerce, has written EPA a series of letters regarding its proposals to control evaporative and refueling emissions. The Chairman's initial inquiry was prompted by our August 7, 1987, report[5] concerning the cost, benefits, and tradeoffs of each alternative that EPA considered in its decision to control evaporative and refueling emissions. The Chairman, while generally agreeing with EPA's proposal to reduce gasoline volatility levels, questioned the feasibility of onboard controls. He cited a number of concerns regarding the onboard control system, particularly its overall safety in crash and noncrash situations, and pointed out that Stage II controls focus squarely on ozone where it is a problem (i.e., in nonattainment areas). EPA, in responding to the Chairman's letters, defended its position that onboard controls are safe and the best alternative to control refueling emissions. As a result, in subsequent discussions with the Chairman's office, we agreed to answer the following questions.

- Could EPA uncouple its proposal to reduce gasoline volatility from its proposal to require onboard controls and act immediately to lower gasoline volatility? (See ch. 2.)
- Has EPA adequately addressed the concerns raised regarding the safety of onboard controls?
- Are Stage II controls more viable for controlling refueling emissions than EPA depicts?

The onboard safety and Stage II control issues are discussed in chapter 3.

With regard to the gasoline volatility issue, we reviewed EPA's August 1987 regulations proposing gasoline volatility reductions, its March 1989 regulations finalizing the Phase I volatility reductions, and the regulatory impact analyses accompanying each rulemaking for information on the policy, economic, and technical factors that EPA considered in arriving at its decision. EPA's Office of Mobile Sources (OMS) has overall responsibility for developing programs to control emissions from mobile sources and related fuels. We discussed with OMS officials each rulemaking as well as the issues still facing EPA with regard to further reductions in gasoline volatility. We also discussed the volatility issue with states that have or are considering state regulations to reduce gasoline volatility. Specifically, we contacted representatives of the Northeast States

[5] Air Pollution: EPA's Efforts to Control Vehicle Refueling and Evaporative Emissions (GAO/RCED 87-151).

for Coordinated Air Use Management (NESCAUM)—an association of state air pollution control agencies—and its eight member states (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) for information on the states' efforts to reduce gasoline volatility. Similar discussions were held with officials in California, Delaware, and Pennsylvania. We interviewed oil industry representatives and reviewed industry documents for insight into the industry's views on this issue.

For information on the safety of onboard controls, we reviewed various studies, reports, and other documents from EPA and the Department of Transportation's (DOT) National Highway Traffic Safety Administration (NHTSA), and other groups including the National Transportation Safety Board (NTSB), the Motor Vehicle Manufacturers Association, and the Insurance Institute for Highway Safety (IIHS)—a nonprofit research group that identifies and develops ways to reduce motor vehicle crash losses. The principal documents reviewed were (1) EPA's June 1987 and August 1988 analyses of onboard safety, (2) NHTSA's October 1988 comments on EPA's August 1988 safety analysis, and (3) NHTSA's December 1988 report to the House and Senate Appropriation Committees on the safety of onboard control. We discussed the onboard control safety issue with representatives of EPA, NHTSA, NTSB, IIHS, the American Petroleum Institute (API), and the Ford Motor Company. We observed an onboard control system that the OMS staff developed and the two vehicles that API equipped with onboard controls. While we established the views of these major parties regarding the safety of onboard controls, we did not independently assess the safety of such controls.

With regard to Stage II control feasibility, we determined those factors that have changed since EPA's August 1987 proposal and their impact, if any, on the feasibility of Stage II controls. We interviewed state officials in California, Missouri, New Jersey, and New York and reviewed state documents for information on Stage II control programs ongoing or underway in the states. We reviewed the drafts of the supplemental notice of proposed rulemaking that EPA provided to the Office of Management and Budget (OMB) in September 1988 and January 1989 to determine EPA's views regarding the impact of the state Stage II control programs on its decision to require onboard controls. We also contacted a major oil company for information on a new Stage II control nozzle that the company developed.

Using computer files and records obtained from EPA's Office of Air Quality Planning and Standards (OAQPS), we replicated and verified the onboard and Stage II control cost-effectiveness estimates that EPA reported in its August 1987 refueling proposal. We discussed how the estimates were calculated with OAQPS officials and representatives of the EPA contractor that performed much of the analysis. The results of this work are being reported to the Chairman in separate correspondence.

We reviewed the President's proposed amendments to the Clean Air Act and discussed with OMS their impact on EPA's efforts to reduce gasoline volatility and require onboard controls.

We conducted our work between May 1988 and March 1989 in accordance with generally accepted government auditing standards. We discussed with EPA officials the factual information in the report. However, as requested by the Chairman, Subcommittee on Oversight and Investigations, House Committee on Energy and Commerce, we did not obtain written agency comments on a draft of this report.

EPA's Efforts to Reduce Gasoline Volatility Levels

Nearly 2 years have passed since EPA proposed its two-phased approach for reducing gasoline volatility. In March 1989 EPA uncoupled its refueling and gasoline volatility proposals and moved ahead with its Phase I volatility reductions. The Phase I reductions—which went into effect in the summer of 1989 and cap gasoline volatility nationwide at 10.5 psi RVP—should reduce total hydrocarbon emissions by at least 674,000 tons a year, or 3 percent. EPA has not yet, however, acted on Phase II reductions proposed to take effect in the summer of 1992 that would further reduce the volatility of gasoline to a maximum of 9.0 psi RVP and total hydrocarbon emissions an additional 8 percent. At the same time, legislation proposed by the President to amend the Clean Air Act provides for further reductions in gasoline volatility below EPA's Phase I volatility cap. In addition, individual states subject to the Phase I volatility cap have received EPA's approval to begin enforcing the 9.0 psi RVP volatility standard in 1989 in order to make progress toward attaining the ozone standard.

EPA Adopts Phase I Gasoline Volatility Reductions

On March 22, 1989, EPA published regulations in the Federal Register finalizing its Phase I gasoline volatility reductions. The regulations require that beginning in 1989, the volatility of gasoline sold nationwide (except in Alaska and Hawaii where no ozone problems exist and each state has its own gasoline supply system) be reduced to 10.5, 9.5, or 9.0 psi RVP, depending on the area of the country and month of the year.[1] The 10.5 psi RVP level generally applies to the ASTM Class C areas while the 9.5 and 9.0 psi RVP levels generally apply to the ASTM Class B and A areas, respectively.[2]

The Phase I reductions, except for 1989, take effect on May 1 of each year for refineries, importers, pipelines, and terminals and on June 1 of each year for retail service stations and other end-users of gasoline. In 1989 the reductions took effect on June 30 for retail service stations and other end-users and on June 1 for all others in the gasoline distribution chain in order to provide sufficient lead time during the first year to

[1]The Phase I volatility levels differ from the 10.5, 9.1, and 8.2 psi RVP levels EPA originally proposed in August 1987. EPA found that not all refiners could meet the August 1987 levels without sufficient lead time for capital investment.

[2]EPA, in setting its Phase I volatility reductions, found that the location and temperatures of nonattainment areas and the pattern of fuel distribution systems made it possible to deviate from the ASTM-recommended designations and better focus emission reductions where and when they are needed. As a result, EPA relaxed the volatility levels from Class B to C for all or portions of 23 states and from Class A to B for 5 states.

comply with the reductions. The volatility requirements end for all parties on September 16 of each year.

According to EPA, the Phase I reductions in gasoline volatility will not require any capital investments. Rather, refiners can meet the reductions primarily by reducing the amount of butane added to the gasoline and by varying refining processes. According to EPA, no refiner expressed any serious concern about the feasibility of producing fuel meeting the Phase I volatility levels or demonstrated the need for capital investment. Also, EPA noted that while the refining industry preferred capping volatility at the current ASTM levels, API specifically recommended reducing volatility to 10.5, 9.5, and 9.0 psi RVP levels in lieu of the Phase I reductions EPA originally proposed. EPA estimates that the Phase I reductions in gasoline volatility will reduce total hydrocarbon emissions from all sources by at least 674,000 tons annually, or 3 percent.

EPA Faces Decisions Regarding Phase II Volatility Reductions

Having finalized its Phase I reductions, EPA must now decide on the Phase II or final reductions in gasoline volatility proposed to take effect in the summer of 1992. According to the OMS Assistant Director, EPA did not act on Phase II reductions at the time that it adopted the Phase I levels because EPA had not completed its analysis of all the comments pertaining to the final reductions.

According to the assistant director, EPA faces three issues regarding Phase II volatility reductions. One is the actual levels of the reductions. In August 1987 EPA proposed that beginning in 1992, the volatility of gasoline sold from May 16 through September 15 would be reduced to 9.0 psi RVP in ASTM Class C areas, with proportionate reductions to 7.8 and 7.0 psi RVP, respectively, in Class B and A areas. In April 1989 the assistant director told us that there appeared to be little disagreement with reducing volatility to 9.0 psi RVP and that EPA would probably go ahead with this reduction. The assistant director also told us, however, that the bulk of the comments that EPA received on its proposal dealt with the feasibility of reducing gasoline volatility below this level. This official told us that the oil industry is especially concerned that reductions in gasoline volatility below 9.0 psi RVP will be very costly and not worth the benefit. In its February 1988 comments to EPA, API estimated that the annual cost of complying with the Phase II reductions that EPA proposed would be about $1.5 billion, or about 3 times more than the $405 million EPA estimated.

The second issue is whether the Phase II reductions will take effect in the summer of 1992 or at a later date. Originally, EPA proposed 1992 because it believed that 3 to 4 years would be sufficient time for refiners to complete the design work and the permitting, installation, and testing of the new equipment needed to produce the lower volatile gasoline. The OMS Assistant Director told us in March 1989 that the 1992 date may still be realistic if EPA can issue final volatility regulations by late summer 1989.

The third issue is how gasolines blended with alcohol—methanol blends and ethanol blends (gasohol)—will be treated under Phase II reductions that EPA may adopt. At the time EPA proposed its volatility reductions, methanol blends were required to comply with volatility levels specified in the waiver documents issued by EPA. EPA continued this by requiring that methanol blends meet the Phase I volatility levels. The volatility of gasohol, however, was uncontrolled and was about 1.0 psi RVP higher than the volatility of gasoline used in the blending process. EPA's Phase I volatility regulations allow gasohol to meet a standard 1.0 psi RVP higher than the Phase I levels required for gasoline.

According to the OMS Assistant Director, the real issue facing EPA is whether gasohol should continue to be exempt from volatility controls. Gasohol poses several unique problems. Gasohol comprises about 7 percent of the gasoline market, with individual state sales ranging from zero to more than 30 percent. About 80 percent of all gasohol is sold in the Midwest states. Unlike methanol blends, which use a specially formulated low volatility gasoline as base stock, gasohol uses the final, in-use gasoline as its base, and blending occurs after the gasoline leaves the refinery. This method of blending gasohol, referred to as splash blending, increases the volatility of the gasoline by about 1.0 psi RVP and has, according to EPA, created an entire splash-blending industry. In addition, the federal government and a number of states provide a tax credit for gasohol. The federal gasoline tax credit was enacted in the late 1970s to encourage production of gasohol as an alternative fuel and, at the same time, make use of the nation's excess production of corn. The OMS Assistant Director said that EPA must ultimately weigh these and other factors in deciding whether the economic impact of requiring gasohol to meet Phase II volatility requirements is worth the benefit in terms of emission reductions.

Lowering Volatility Provides Emission Reduction and Safety Benefits

The major benefit of reducing gasoline volatility during the summer months is the substantial reduction in hydrocarbon emissions that can be achieved throughout the gasoline distribution chain. At the same time, the actual benefits in terms of hydrocarbon emission reductions to be gained from controls on gasoline volatility levels may be greater than EPA had anticipated.

At the time EPA proposed reducing gasoline volatility levels in 1987, it described the control measure as one of the single largest hydrocarbon emission reduction strategies available, estimating that it would reduce hydrocarbon emissions nationwide by 8 percent or about 1.8 million tons annually. Since then, EPA has developed new data on running losses—evaporative emissions that occur as the vehicle is being driven.[3] EPA estimates that emission reductions from its Phase I volatility reductions will total at least 674,000 tons annually and could be as much as 2 million tons per year based on its new running loss data. EPA also estimates that its proposed Phase II reductions in gasoline volatility could produce an additional 8-percent reduction each year in total hydrocarbon emissions.

Reducing Gasoline Volatility Levels Could Also Improve Vehicle Safety

In addition to reducing hydrocarbon emissions, lowering gasoline volatility could also improve vehicle safety by reducing the risks of fires. A March 1988 Center for Auto Safety (CAS) study of (1) 4,276 safety recalls issued since 1966 and (2) 146,000 vehicle safety reports on file with NHTSA since 1977 showed that as gasoline volatility increased in recent years, the incidence of vehicle fires and gasoline spurting and leaking from over pressurized vehicle fuel tanks increased dramatically. The study reported that from 1979 to 1986 the average summer volatility of gasoline rose from 9.2 to 10.4 psi RVP and that during the same period vehicle fires and fuel safety problems worsened. CAS noted, for example, that from 1978 through 1980, NHTSA received less than 10 complaints per year related to gasoline volatility. However, CAS reported that as the volatility of gasoline increased, the number of complaints increased steadily to over 100 a year in 1983 and each year thereafter. CAS also reported that since 1979, high gasoline volatility levels and fuel-system pressures resulted in 12 NHTSA safety recalls that were linked to 71 fires, 25 injuries, and 2 deaths. CAS concluded that the results of its study showed that EPA should move immediately to impose stringent gasoline volatility standards.

[3]In addition to the reduced evaporative emissions resulting from lowering gasoline volatility, EPA is preparing regulations that will revise the procedures for certifying evaporative emission control systems to ensure that the systems are designed to work effectively and provide adequate control of remaining running losses and other evaporative emissions.

Other proponents of gasoline volatility reductions also cite improved vehicle safety as one of the benefits of reducing gasoline volatility levels. IIHS, in testifying before EPA in October 1987 on the agency's proposal to reduce gasoline volatility levels, noted that there has been a number of highly publicized cases of vehicle fires erupting when overpressurized fuel spurted out of the vehicle fuel tank. IIHS stated that limiting the volatility of gasoline should reduce this problem. Both the NTSB and NHTSA, in their comments supporting reducing gasoline volatility levels, pointed out that the higher volatility levels of gasoline lead to more vapors and a greater risk of vehicle fires. Both agencies stated that lowering the volatility of gasoline would reduce this problem and provide immediate safety as well as emission reduction benefits.

States Adopting More Stringent Gasoline Volatility Levels

Individual states, recognizing the emission reduction benefits from reducing gasoline volatility, are adopting gasoline volatility levels below their Phase I volatility levels. Seven northeastern states adopted regulations lowering the volatility of gasoline sold in the states beginning in the summer of 1989 to 9.0 psi RVP. As of early August 1989, EPA, as provided under the Clean Air Act, had approved the regulations of five of the states on the basis that the 9.0 psi RVP gasoline volatility is needed in order for the states to make further progress toward compliance with the ozone standard.

In November 1987 the eight states making up NESCAUM—Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont—entered into an agreement to reduce the volatility of gasoline sold during the ozone season. The states decided to act together because of the regional nature of the ozone problem in the northeast, the large emission reduction benefits available, and the slowness of the federal effort to reduce volatility levels. Since then, each state (with the exception of New Hampshire which plans to require the 9.0 psi RVP standard beginning in 1990) has adopted regulations requiring that gasoline sold between May 1 and September 15 of each year, beginning in 1989, have a volatility of 9.0 psi RVP. NESCAUM estimates that the 9.0 psi RVP level will reduce regionwide hydrocarbon emissions from 150,000 to 200,000 tons a year.

Under section 211(c)(4)(A) of the Clean Air Act, EPA's Phase I reductions in gasoline volatility preempt any state volatility controls, with the exception of California's, that are inconsistent with EPA's unless EPA approves the state controls as necessary to achieve air quality standards. The seven NESCAUM states that adopted regulations submitted

State Implementation Plan revisions to EPA requesting that it exempt them from the federal volatility standard and allow them to enforce the more stringent state volatility level. As of early August 1989, EPA had approved the requests from Massachusetts, Connecticut, New Jersey, New York, and Rhode Island, giving the states authority to enforce the 9.0 psi RVP gasoline volatility level between June 30 and September 15 in 1989, and between May 1 and September 15 in each succeeding year. EPA was continuing to review the requests from Maine and Vermont. EPA, in approving the states' requests, stated specifically that the more stringent volatility level is needed to enable the states to make further progress toward compliance with the ozone standard.

Other states are also considering regulations that would require reductions in gasoline volatility that are more stringent than EPA's. The Director, Division of Air and Waste Management, Delaware Department of Environmental Controls, told us in March 1989 that the state was drafting regulations that would require 9.0 psi RVP gasoline volatility beginning in 1990. As of April 1989 efforts were also underway in Pennsylvania to require gasoline with a volatility of 9.0 psi RVP beginning in the summer of 1990. An Air Quality Program Supervisory Specialist in Pennsylvania's Department of Environmental Quality, who is involved with the state effort, told us that the department was working on getting the state's Regulation Review Board to approve the regulations. According to this individual, the 9.0 psi RVP gasoline volatility level would reduce hydrocarbon emissions statewide by about 87,000 tons a year. He said that 56 of the 60 counties in the state are either in nonattainment or border areas in nonattainment with the ozone standard and that this reduction in emissions would be sufficient to bring all the areas into attainment, with the exception of the Philadelphia and Allentown/ Bethlehem areas. Both the Delaware and Pennsylvania officials told us that Maryland and Virginia are also considering adopting the 9.0 psi RVP volatility standard.

In addition, California, which for over 15 years has limited the volatility of gasoline sold in the state during the warmer months to 9.0 psi RVP, plans further reductions to 8.0 psi RVP. The Chief, Compliance Division, California Air Resources Board, told us that the 8.0 psi RVP volatility level would reduce statewide hydrocarbon emissions an additional 66,000 tons a year. He told us that the regulations proposing the 8.0 psi RVP volatility level should be ready for review by the Air Resources Board in late 1989 or early 1990.

Administration Plans Further Reductions in Gasoline Volatility

One of the specific proposals made by the President in June 1989 to amend the Clean Air Act was a further reduction in the volatility of gasoline sold during the ozone season below the 10.5 psi RVP cap set by EPA's Phase I volatility reductions. Both H.R. 3030 and S. 1490 require that the maximum volatility of summertime gasoline be reduced to 9.0 psi RVP—the maximum volatility proposed under EPA's Phase II reductions—no later than the summer of 1992. Both bills also provide EPA with the discretion to require volatility levels below 9.0 psi RVP and to allow gasolines blended with ethanol to exceed volatility requirements by 1.0 psi RVP. The OMS Director told us in August 1989 that EPA plans to issue its final Phase II volatility regulations by late fall of 1989.

Conclusions

EPA's March 1989 action to uncouple its refueling and gasoline volatility reduction proposals and to finalize its Phase I reductions in gasoline volatility represents a step in the right direction. The Phase I reductions will, according to EPA, result in annual reductions in nationwide hydrocarbon emissions of at least 674,000 tons without any major capital cost to industry. EPA has not yet, however, acted on its Phase II proposal that would further reduce the volatility of gasoline sold during the summer to 9.0 psi RVP and possibly lower in some areas. At the same time, on the basis of the President's proposed Clean Air Act amendments, it appears to us that EPA remains committed to reducing gasoline volatility nationwide to at least 9.0 psi RVP.

We believe that capping gasoline volatility nationwide at 9.0 psi RVP is feasible and desirable for several reasons. First, it would equate the volatility levels of in-use gasolines and of the fuel used to certify evaporative emissions control systems. This would, in turn, eliminate the discrepancy that has existed in the volatility levels of the two fuels and the primary cause of the current problem with excess evaporative emissions. Second, it would provide additional emission reduction benefits. EPA estimates that adopting its Phase II volatility levels would result in an additional 8-percent reduction in hydrocarbon emissions above and beyond those to be achieved under Phase I reductions. Third, further reducing gasoline volatility could also improve vehicle safety by reducing the risks of vehicle fires. According to CAS, as the volatility of gasoline increased since 1979 so has the incidence of vehicle fires and complaints associated with gasoline volatility. Finally, and perhaps most importantly, reducing gasoline volatility beyond the Phase I levels is needed if states are to attain the ozone standard. Already, seven northeastern states, recognizing the potential emission reduction benefits available from lower gasoline volatility levels, have adopted regulations requiring 9.0 psi RVP volatility in 1989. Furthermore, EPA is approving the states' actions as a measure the states must take in order to comply with the ozone standard.

Safety of Onboard Controls and Feasibility of Stage II Controls

The President's proposed Clean Air Act amendments calling for Stage II controls in nonattainment areas reversed EPA's long-standing policy advocating onboard controls to reduce gasoline vapor emissions. The safety of onboard controls continues to be a major concern, with EPA and DOT disagreeing over the impact onboard controls could have on the design and operation of motor vehicles and on passenger safety. Also left unclear is how long it would take for motor vehicle manufacturers to place onboard controls into production. In addition, it would be a number of years before onboard controls appear on a sufficient number of vehicles to make a substantial impact on refueling emissions.

In the meantime, states have continued their efforts to install Stage II controls, and improvements have been made in Stage II equipment that makes it more user-friendly and efficient. These efforts, coupled with the debate over the safety of onboard controls, suggest that Stage II controls are a feasible and practical near-term solution for controlling refueling emissions.

EPA and DOT Continue to Disagree Over Safety of Onboard Controls

EPA, based on its continuing analysis of onboard control safety that included developing an onboard control system, remains convinced that onboard controls can be simple in design and will not degrade passenger safety. In fact, EPA maintains that onboard controls have the potential to improve vehicle safety. On the other hand, NHTSA and other agencies involved with transportation safety remain concerned that onboard controls will increase fuel system complexity and the risks of vehicle fires in crash and noncrash situations. They are also concerned, based on NHTSA's experience refueling and test driving an automobile equipped with onboard controls by the oil industry, that onboard controls could affect the safe operation of a motor vehicle.

History of the Onboard Safety Debate

Concern over the safety of onboard controls existed well before EPA formally proposed the control alternative in 1987. As early as mid-1986, NHTSA and others expressed concern that the larger charcoal canisters, larger vapor lines, and other components associated with onboard controls could increase the complexity of vehicle fuel systems and the chances of fuel system failures and fires in motor vehicle crashes.

To address these early safety concerns, EPA in June 1987 released its initial evaluation of the safety implications of onboard controls. The report examined the integrity of onboard controls in crash situations and the effects that system defects, tampering, faulty repairs, and vehicle refueling could have on the in-use safety of onboard controls. Overall, EPA concluded that straightforward, reliable, and relatively inexpensive engineering solutions existed for each of the potential problems identified and that onboard control systems could be designed to achieve the same or better level of in-use integrity as the fuel systems on vehicles at that time.

EPA's June 1987 analysis did not, however, resolve the safety issue. In their comments on EPA's August 1987 refueling proposal, auto–industry related groups expressed concern that onboard controls would be more complex than current evaporative emission controls and lead to an increase in the risks of vehicle fires in crash and noncrash situations. Others such as the IIHS, NTSB, and the Department of Commerce expressed concerns similar to or supported the auto-industry related groups' concerns regarding the safety of onboard controls.

EPA Continues Efforts to Address Onboard Safety Issues

In an effort to address the continuing concerns raised by the auto industry and others regarding the safety and complexity of onboard controls, EPA, since proposing its onboard control regulations, designed and built an onboard control system, investigated the in-use safety record of current evaporative emission control systems, and compared the risks posed by onboard controls with those present in current fuel system designs.

EPA has always anticipated that onboard controls would be simple in design. Consequently, in 1988, EPA designed and built what it termed as a simple onboard control system. EPA's goal was to modify its earlier onboard control system design and develop a single system that would control both refueling and evaporative emissions, be no more complex than current evaporative emission control systems, and use as many current production components as possible. EPA took what it considered to be a typical, current, and relatively simple evaporative emission control system and modified it by enlarging and relocating the charcoal canister, adding a valve to control fuel spurting from the tank during refueling, and making other changes.

In addition, EPA has continued to maintain that onboard controls would be a mere extension of current evaporative emission controls. Consequently, to determine the overall in-use safety of evaporative emission controls and to establish a baseline from which to quantify any increase in the risks posed by onboard controls, EPA investigated the safety record associated with current evaporative emission control systems. Specifically, EPA reviewed (1) data in three national data systems for information on crash and noncrash fires associated with evaporative emission control systems and (2) motor vehicle manufacturer service bulletins, NHTSA safety recalls, and owner complaints for information on problems and overall in-use performance of evaporative emission controls.

To determine the risks associated with onboard controls, EPA in May 1988 contracted with Battelle to quantify and compare the risks, that is, the likelihood of fire from the leakage of gasoline liquid or vapor, associated with the addition of onboard controls to those resulting from recent changes in vehicle fuel systems, such as the addition of fuel injection. Battelle examined 10 fuel system configurations—6 systems with evaporative emission controls but without onboard controls and 4 systems that incorporated onboard control designs. For each of the 10 systems, Battelle determined the likelihood of a system component failing and fire occurring from leaking fuel or vapors under three conditions—while the vehicle is being refueled, driven, and parked. Battelle relied primarily on engineering judgment supported by data from safety recalls, manufacturer service bulletins, owner complaints, and national fire statistics to make a qualitative assessment of risk. Battelle officials told us that they were unable to make a quantitative comparison of the risks because the data needed to do so; that is, the number of times a particular fuel system component failed was not available. Overall, Battelle reported that the level of risk did not differ greatly among the 10 systems and that in most cases the likelihood of a fire occurring from a fuel or vapor leak when a system component failed was remote or improbable. At the same time, Battelle reported that the systems with onboard controls posed less overall risk than the other systems primarily because they control refueling emissions, utilize a valve to inhibit the spitback of liquid fuel, and/or locate the vapor collection canister in the rear of the vehicle away from ignition sources.

EPA Remains Convinced That Onboard Controls Are Simple and Safe

In August 1988 EPA published a draft of its revised analysis of the safety issues related to onboard controls. EPA reported that its onboard control system design work showed that much of the added complexity suggested by the auto manufacturers in their comments is not necessary to successfully control refueling emissions. EPA noted that its simplified onboard control system, when tested on the 9.0 psi RVP certification fuel, consistently met the proposed refueling emission standard by a substantial margin. EPA also noted that a modification it made to the system used to build its onboard control system completely eliminated the problem the stock system had of fuel spurting from the fuel tank. EPA concluded that onboard controls can be simple extensions or modifications of present evaporative emissions control systems and that some of these modifications can enhance safety by reducing the complexity of current fuel tank and evaporative emission system designs and by controlling evaporative emissions in addition to refueling emissions. In addition to trapping refueling vapors, EPA also concluded that onboard controls would likely decrease the amount of gasoline spilled during refueling and thereby reduce the number of service station fires resulting from refueling vapors and fuel spills.

EPA also reported that its examination of the fire data, safety recall, and other information showed that current evaporative emission controls have not compromised vehicle safety. It noted, for example, that only 20 safety recalls (less than 0.5 percent of the more than 4,200 recalls issued over the past 20 years) involving 415,000 vehicles (less than 0.3 percent of the 130.8 million vehicles recalled since 1966) involved evaporative emission control systems. Furthermore, although EPA's review showed that the level of complexity varied from one evaporative emission control system to another, it found no evidence that any one design or design approach was more or less safe than another. EPA also noted that some of the evaporative emission control system designs that it reviewed incorporated some of the same features, for example, plastic components, that some auto manufacturers characterized as posing an unacceptable risk on onboard control systems. EPA concluded that because of the similarity between evaporative and onboard control systems and the safety record of evaporative emission controls, onboard controls could also be implemented safely.

Overall, EPA concluded that after analyzing the safety comments received on its proposal, it remained convinced that onboard controls can be placed on passenger vehicles without degrading passenger safety and, in fact, can enhance vehicle safety.

Section 202(a)(6) of the Clean Air Act requires that EPA consult with DOT on the safety of onboard controls. In August 1988 EPA provided its revised analysis of the safety of onboard controls to DOT for review and comment.

Department of Transportation Disagrees With EPA on Safety Issue

In October 1988 NHTSA provided DOT's response to EPA's revised safety analysis. NHTSA stated that after reviewing the information in EPA's revised safety analysis, it (along with the Federal Highway Administration which concurred with NHTSA's comments) still believed that not all the safety concerns associated with onboard controls had been satisfactorily resolved.[1] It noted that its previous concerns that onboard controls will add complexity to vehicle fuel systems and increase the opportunity for fuel system fires in crash and noncrash situations remained. NHTSA also stated that fuel filling, fuel leakage, stalling, and other driving problems its staff encountered in test driving a vehicle equipped with onboard controls by API left it with significant concerns about the impact that onboard controls could have on safe vehicle performance that overshadowed its concerns regarding fuel system complexity.[2] NHTSA noted that no organization, to its knowledge, had demonstrated a safe, simple onboard control system that works properly and consistently in real-world operating conditions and, as a result, no practical data existed to review concerning the safety of the simple onboard control system. Overall, NHTSA concluded that further engineering, demonstration, and/or testing must be conducted to assure that onboard controls will not result in safety problems. At the same time, NHTSA noted that EPA must ultimately determine whether the magnitude of the safety risks of onboard controls, which can never be precisely known, is commensurate with the anticipated reductions in pollutants or the other benefits EPA estimates.

NHTSA disagreed with EPA's position that onboard controls are an extension of evaporative emission controls. NHTSA noted that although the two systems are similar physically and structurally, they function differently in terms of the amount of vapors each must recover in a certain time interval, how often the vapors must be collected, and the requirements for purging the vapor from the canister. According to NHTSA, EPA's simple onboard control system did not reduce the functional complexity of the onboard control system because EPA designed it to also control evaporative emissions. Because onboard and evaporative emission control systems function differently, NHTSA stated that the operating, driving, and other safety concerns for these two systems are very different

[1] In a November 21, 1988, letter NTSB's Bureau of Technology stated that after reviewing EPA's revised safety analysis it basically agreed with NHTSA's conclusions regarding the safety of onboard controls.

[2] In August 1989 the OMS Director and other OMS officials told us that EPA had equipped a Ford Taurus with its onboard control system and that NHTSA, during its test drive of the vehicle, experienced none of the problems it had experienced with the API vehicle.

and that it would be premature for EPA to conclude that onboard controls do not pose any safety risks because of its physical similarity to evaporative emission control systems. NHTSA noted that the complexity that EPA found in its evaluation of current evaporative emission control system designs is the result of making a simple concept work under real world conditions.

NHTSA also disagreed with EPA's conclusion that evaporative emission controls have had no detrimental effect on vehicle fires. According to NHTSA, the incidence of vehicle crash fires is small and that the national data bases that EPA reviewed are not designed to detect changes in the incidence of such infrequent events. Consequently, NHTSA would only conclude that any change in the incidence of fires due to evaporative emission controls is small and not nonexistent as EPA contends. Similarly, NHTSA also stated that the recall data show that the incidence of non-crash fires is real, even if few in numbers.

NHTSA also had concerns regarding the results of the Battelle study. In December 1988 NHTSA's Associate Administrator for Rulemaking told us that the study limited itself to only hardware failures and did not look at the safety risks posed by the actual operation of the onboard control system. He told us that completely missing from Battelle's analysis was an assessment of the ability of the motor vehicle to safely purge the additional vapors generated by the onboard control system. NHTSA also had problems with Battelle's position that onboard controls would improve vehicle safety by moving the canister from the engine compartment to the rear of the vehicle and away from ignition sources. First, the associate administrator said that not all current vehicles have their evaporative emission control canisters in the engine compartment, as Battelle infers. Second, he said that moving the canister to the rear of the vehicle may not be that easy because sufficient space may not exist to do so.

In January 1989 NHTSA in a special report to the House and Senate Appropriations Committees on the safety of onboard controls repeated its concerns that the potential added complexity of some onboard control systems could lead to an increased safety risk and its view that the simplified onboard control system designs it had reviewed do not resolve these concerns satisfactorily.

In March 1989 NHTSA's Associate Administrator for Enforcement told us that NHTSA, at the request of the Secretary of Transportation, contracted with Arthur D. Little for a study to reevaluate its position on the safety of onboard controls. He told us that NHTSA based much of its comments regarding the potential safety problems with onboard controls on its analysis of safety recall notices and manufacturer service bulletins and that the contractor would review this information to find out if it supports NHTSA's position.

In June 1989 Arthur D. Little issued its final draft report to NHTSA. Overall, the contractor concluded that adequate evidence exists that there are potential safety risks associated with onboard controls based on its (1) review of research reports, safety recalls, and service bulletins; (2) discussion with EPA and an EPA contractor; and (3) test drive of a vehicle equipped with a prototype onboard control system developed by EPA. The contractor also reported that the Battelle risk assessment used by EPA to claim that onboard controls would not degrade vehicle safety is severely limited in scope and used faulty methodology and assumptions. In addition, the Arthur D. Little report stated that there is considerable evidence from the safety recalls and service bulletins that existing evaporative emission control systems pose safety risks to the motoring public. It noted that despite 18 years of experience with evaporative emission controls, problems and related safety recalls and service bulletins continue. Overall, the report recommended that much more developmental work and in-use testing of proposed onboard control systems are needed.

In July 1989 the Associate Administrator for Enforcement told us that NHTSA planned to make the report available to EPA, the motor vehicle industry, and others for comment.

Motor Vehicle Manufacturers Also Disagree With EPA

In an effort to evaluate EPA's onboard control system design, two motor vehicle manufacturers—Ford and General Motors—each built and equipped two of their vehicles with versions of EPA's onboard control system. In September 1988 both companies reported that based on the results of their tests, the onboard control design concept that EPA developed was unsafe and not readily adaptable or unacceptable for production vehicles. Despite additional work by EPA, both companies continue to express concerns regarding the safety and operation of onboard controls.

Both companies reported that the ability to refuel their vehicles with the onboard control systems was either poor or unacceptable. Ford, for example, found that the system could not be refueled at a rate over 6 gallons per minute without the fuel nozzle prematurely shutting off a large number of times. EPA's proposed refueling regulation requires vapor control at gasoline dispensing rates from 3 gallons up to 10 gallons per minute. Ford also found that the system performed inconsistently in capturing vapors at the lower fill rates. In tests designed to simulate vehicle roll over, Ford reported that the onboard system leaked over 5 times the amount of gasoline allowed under NHTSA standards for fuel system integrity. In addition, Ford expressed concern about being able to develop a system sophisticated enough to purge the large volume of refueling and evaporative emissions collected by the onboard control system.

General Motors found that during normal vehicle maneuvering, liquid fuel can enter the vapor line to the onboard canister. In addition, General Motors found that because the fuel tank on EPA's onboard control system is not pressurized, it can generate 20 times more vapor than a production vehicle using pressure in the fuel tank to suppress vapors. Overall, General Motors concluded that correcting the deficiencies noted with regard to EPA's simplified onboard control system would require adding hardware to restore the functions and features that were deleted by EPA to make a simplified system.

In November 1988 a Senior Project Manager in the OMS Emissions Control Technology Division told us that EPA believed it had addressed all the concerns and problems that Ford and General Motors raised during their tests of the onboard control system. Other information, however, indicates that the problems and concerns of Ford and General Motors regarding onboard controls may not be resolved. In a March 9, 1989, letter to EPA, the Manager, Federal Activities, General Motors' Environmental Activities Staff, wrote that the primary question of whether EPA's onboard control system can be built, operated, and pass all relevant emission and safety tests remained. The letter also stated that the only time EPA's system appears to perform well is when it is built by EPA engineers and tested by EPA technicians in tests not advertised or open to the public.

In May 1989 the Manager of Ford's Advanced Environmental Engineering Department told us that Ford has continued to test EPA's onboard control system design. He said that the concerns that Ford had after its initial test regarding fuel filling, fuel spillage, and vapor purging remain and that the issues of onboard safety and complexity are far from being satisfactorily resolved.

In August 1989 the OMS Director and other OMS officials told us that EPA had visited the Ford Motor Company and solved the problems Ford had experienced with its earliest onboard control system. At the same time, they told us that EPA did not see any subsequent Ford onboard control system designs or any of General Motors' designs and, consequently, were not able to determine why the companies were continuing to experience problems.

Time Needed to Implement Onboard Controls

The continuing debate over the safety of onboard controls has left EPA's onboard control proposal at a virtual standstill and has thwarted EPA's efforts to repropose its refueling regulations. Also unclear is how long it would take motor vehicle manufacturers to place onboard controls into production, with EPA believing that generally 2 years is sufficient and the motor vehicle manufacturers claiming that a minimum of 4 years is needed. Adding to the lead time is the fact that it would be a number of years before onboard controls appear on a sufficient number of vehicles to substantially impact on refueling emissions.

In the cost benefit analysis accompanying its August 1987 refueling proposal, EPA assumed that onboard controls would first appear on 1990 model-year vehicles. However, because of the concerns that existed over the safety of onboard controls at the time EPA proposed its refueling regulations, EPA promised to continue studying the safety issue and to repropose the onboard control regulations for public comment after it received DOT's comments with respect to motor vehicle safety. EPA attempted to repropose its refueling regulations in September 1988, but OMB returned the draft reproposal to EPA because DOT had not completed its review of the revised safety analysis. EPA was also unsuccessful in January 1989 in its attempts to repropose the regulations.

Also unresolved is the length of time motor vehicles manufacturers will need to design, engineer, and incorporate onboard controls onto motor vehicles. At the time it proposed onboard controls, EPA believed that in most cases, a minimum lead time of 2 years from the date a final onboard control requirement was published to its effective date would be sufficient to develop, test, and incorporate the controls onto motor vehicles. However, motor vehicle manufacturers claimed that a minimum of 4 years is needed to incorporate onboard controls into production and that for certain vehicles (i.e., heavy-duty trucks), implementation may never be feasible. Since then, EPA has continually reaffirmed its commitment to provide the auto industry with sufficient lead time to implement safe and effective onboard control systems, including considering the gradual phase-in of onboard controls. EPA, however, has not decided how much lead time is needed because the scope of the onboard safety issues and the range of potential onboard control system designs have not been clearly established. According to EPA, the lead time issue would be fully resolved before any final decision regarding onboard controls.

EPA has estimated that within 5 years after the adoption of onboard controls 50 percent of all gasoline dispensed would be into vehicles equipped with such controls. EPA expects this figure to increase to more than 75 percent within 10 years. The motor vehicle industry, on the other hand, maintains that onboard controls would provide no emission reductions until at least 4 years after a final rule. Furthermore, it contends that since it takes about 20 years for the nation's automotive fleet to turn over, it will be well into the next century before onboard controls come close to matching the emission reduction efficiency of Stage II controls.

Feasibility of Stage II Controls

Since EPA's proposal of its onboard control requirement in 1987, states have continued their efforts to install Stage II controls to deal with refueling emissions. Stage II controls are now in use in five states, including the District of Columbia, and six other states appear committed to Stage II controls by 1992. In addition, a new Stage II control nozzle has been certified by the state of California that is more user-friendly and efficient than current equipment. These advancements in the use and development of Stage II controls, coupled with the unresolved debate over the safety of onboard controls, suggest that Stage II controls are, at least in the near term, a practical and feasible solution for controlling refueling emissions.

States Making Greater Use of Stage II Controls

At the time that EPA proposed its onboard control regulations, Stage II controls were in use in portions of California and the District of Columbia. Efforts were underway to install Stage II controls in the St. Louis, Missouri, area at facilities with gasoline tanks exceeding 1,000 gallons. Since then, installation efforts have been virtually completed in the St. Louis area. In May 1989 an inspector in the Enforcement Section, Missouri Department of Natural Resources, told us that all of the approximate 1,250 facilities in the St. Louis area required to have Stage II controls had installed the equipment. He said the Enforcement Section is now working to determine if there are any facilities that should have, but have not yet installed Stage II controls. Missouri estimates emission reductions of about 4,000 tons per year from Stage II controls.

In addition, installation of Stage II controls are currently underway in both New York and New Jersey. The New York program, which took effect in June 1987 and is limited to the New York City metropolitan area, requires that any facility dispensing 250,000 gallons or more of gasoline per year must install Stage II controls. About 3,060 facilities are affected, and the date of compliance depends on the facility's size. The approximate 2,080 facilities dispensing over 500,000 gallons annually were required to have the equipment installed by July 1, 1988, while the 980 remaining facilities had until July 1, 1989, to install the controls. As of mid-May 1989, 1,300 of the 2,080 facilities had installed the controls and another 222 had signed compliance orders agreeing to do so by a specified future date. According to a Senior Sanitary Engineer in the state's Bureau of Source Control, the bureau had not compiled data on how many of the 980 facilities had installed Stage II controls. Stage II controls are expected to reduce hydrocarbons emissions by about 11,000 tons per year.

The New Jersey program, unlike New York's, applies statewide. The program, adopted in December 1987, requires that any facility dispensing an average of more that 10,000 gallons of gasoline per month must install Stage II controls.[3] An estimated 4,800 facilities are affected. The larger facilities—those dispensing an average of 40,000 gallons or more of gasoline per month—were required to have the controls installed by December 30, 1988. Facilities dispensing between 10,000 and 40,000 gallons per month have until December 30, 1989, to comply. As of June 5, 1989, about 3,400 of the 4,800 facilities either had installed Stage II controls or had submitted applications to the state to do so. New Jersey expects that Stage II controls when fully implemented will reduce gasoline vapor emissions by about 13,500 tons annually and benzene emissions by 270 tons annually.

In addition to New York and New Jersey, directors of air quality agencies in the other six NESCAUM states—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont—signed an agreement in October 1988 recommending that each state adopt Stage II controls by 1992. According to a staff member in the Program Development Branch,

[3]The regulations also exempt from Stage II controls gasoline dispensing devices at marinas used exclusively for refueling marine vehicles.

Massachusetts Division of Air Quality Control, Massachusetts in February 1989 proposed regulations that require Stage II controls at existing facilities dispensing 20,000 gallons or more of gasoline per month. In addition, the proposed regulations require that any facility constructed or substantially modified after July 1, 1989, must install Stage II controls at the time of construction or modification. Overall, the regulations, which apply to an estimated 2,500 stations statewide, propose a 3-year phase-in of the controls, with the largest facilities (those dispensing 1 million or more gallons of gasoline annually) required to comply by May 1, 1990, while the smallest (those dispensing between 240,000 and 500,000 gallons annually) have until May 1, 1992, to install Stage II controls. Massachusetts expects that its proposed Stage II control program, once fully operational, will reduce hydrocarbon emissions by 8,950 tons per year and benzene emissions from gasoline by about 145 tons per year. In July 1989 the NESCAUM Executive Director told us that none of the other five NESCAUM states had proposed Stage II control regulations.

Improvements in Stage II Control Equipment

In addition to states expanding their use of Stage II controls, the state of California has certified and is testing a new Stage II control nozzle that California believes will eliminate much of the enforcement and defect problems associated with current Stage II control nozzles. The nozzle, developed by an oil company, does not have the rubber bellows or boot that current Stage II control nozzles rely on to trap and capture refueling emissions. Instead, the nozzle has a series of holes at its end and relies on a pump, which is automatically driven by the flowing gasoline, to collect the vapors through the holes. The company developed the nozzle several years ago as a market research product to find out if gasoline sales would increase or customers would be willing to pay more money at the pumps for the convenience of a Stage II control nozzle that is more user-friendly than current Stage II control equipment. A company spokesman told us that while its customers found the nozzle much more convenient to use than current equipment, its initial marketing data show no increase in the sale of gasoline or willingness on the part of customers to pay more for gasoline to use the nozzle.

According to the Chief, Compliance Division, California Air Resources Board, the nozzle is the way of the future. He told us in May 1989 that the Air Resources Board has tested the nozzle at the station it owns and found it to be 95-percent efficient in actual use. He said that the state's South Coast Air Quality Management District plans to install and further test the nozzle at a commercial station.

The chief also told us that the new nozzle will result in greater emission reductions than achieved by current Stage II nozzles because it does not have the rubber bellows or boot—the source of most defects and problems with current Stage II equipment. According to the chief, an example of the new nozzle's potential is the situation in the South Coast Air Quality Management District. He said that Stage II control equipment in the district has a 6.8 percent defect rate, which translates into about 2 tons of hydrocarbons escaping into the air each day during vehicle refueling. The chief said that the new nozzle would eliminate many of these defects and problems and, in turn, capture emissions of over 700 tons each year. He also told us that eliminating the rubber bellows would reduce the state's current enforcement effort required to ensure that the Stage II control equipment is being properly maintained. According to the compliance division chief, the new nozzle would be $200 to $400 more expensive than current Stage II equipment.

The compliance division chief also told us that under state clean air legislation that went into effect in January 1989, stationary sources in areas of the state with severe air quality problems, such as the South Coast Air Quality Management District, are required to install the best available control technology to control emissions. He said that if the nozzle performs well during testing the way everyone thinks it will (and he said that he has no reason to think that it will not), it will be considered best available control technology and that the South Coast Air Quality Management District plans to require the nozzle on gasoline pumps at all facilities.

Impact of State Actions on EPA's Views Regarding Stage II Controls

The states' actions in adopting statewide Stage II control programs and service station-exemption levels lower than those considered by EPA, coupled with the new Stage II control nozzle's advantages in terms of user convenience and reduced enforcement, indicate that Stage II controls may affect more facilities and produce greater emission reduction benefits than EPA anticipated.

One of EPA's assumptions in comparing onboard and Stage II controls was that Stage II controls would be implemented only in 61 urban areas in nonattainment with the ozone standard. However, the Stage II control program adopted by New Jersey and the one proposed by Massachusetts are both statewide. In addition, in 1988 the state of California, which has required Stage II controls in its nonattainment areas for over 15 years, expanded its Stage II control program statewide to control emissions of benzene, a known carcinogen in gasoline vapors. At the same time, these controls will also reduce hydrocarbon emissions.

In addition, EPA assumed that under a federal Stage II control program, independently- and company-owned stations with monthly gasoline sales of less than 50,000 and 10,000 gallons, respectively, would be exempt from Stage II controls. However, the size of facilities exempted from Stage II controls under the state programs is generally much less. The Missouri Stage II control program in the St. Louis area, for example, exempts facilities with tank capacities of 1,000 gallons or less, or roughly 12,000 to 50,000 gallons of annual gasoline throughput. The New Jersey program exempts only those facilities that dispense an average of less than 10,000 gallons of gasoline per month. According to the Chief, Compliance Division, California Air Resources Board, California's program exempts facilities dispensing less than 25,000 gallons of gasoline per year, but in some areas where severe air quality problems exist, all stations are required to have Stage II controls.

In addition, the new nozzle could impact on two of EPA's major concerns regarding Stage II controls. One involves the inconvenience to consumers of using the Stage II equipment. EPA noted that regardless of their design, all Stage II control systems share a common drawback in that the recovery nozzles and hoses are more awkward than conventional nozzles and that some inconvenience will continue to be associated with the use of Stage II controls. EPA's other concern is that Stage II controls would require a large enforcement effort on the part of the state to assure that the equipment is being properly maintained and operated. The new nozzle, which initial marketing research shows to be more user-friendly and which California believes will reduce the enforcement burden associated with Stage II controls, may lessen the impact of these two concerns.

Administration Plans to Require Stage II Controls in Lieu of Onboard Controls

In June 1989 the President announced his proposal for amending the Clean Air Act that included requiring Stage II controls in ozone nonattainment areas. Under legislation introduced in the House (H.R. 3030) and in the Senate (S. 1490) to carry out the President's proposal, states with areas classified by EPA as having moderate, serious, or severe ozone nonattainment problems[4] must, within 2 years of enactment of the proposed amendments, submit revisions to their state implementation plans requiring Stage II controls. The proposed legislation also requires that the controls must be installed and operating within 2 years after the state adopts the requirement.

The President's proposal to require Stage II controls in nonattainment areas has negated EPA's support of onboard controls. In an August 1989 meeting with the OMS Director and other OMS officials, we were told that the decision has been made to go with Stage II controls and that EPA plans no further research and development work regarding onboard controls, or work to address the concerns raised regarding the safety of onboard controls.

Conclusions

We believe that Stage II controls are the best near-term option for controlling refueling emissions. Stage II controls, unlike onboard controls, represent an existing technology. Five states require Stage II controls statewide or in specific areas to help control ozone and/or reduce toxic emissions of benzene, and as many as six more states could require the controls within the next several years. In addition, legislation introduced in the House and Senate to carry out the President's proposed Clean Air Act amendments mandate Stage II controls in most nonattainment areas. Recent advances in Stage II control equipment have improved its efficiency and reduced the level of enforcement and user inconvenience associated with its use.

While advances have occurred with Stage II controls, questions continue about onboard controls. Disagreement exists between EPA and NHTSA and others over whether onboard controls will impact on vehicle safety. Also unresolved is whether a minimum of 2 years, as EPA contends, or a minimum of 4 years, as the motor vehicle industry maintains, would be needed to engineer, design, and equip vehicles with onboard controls. Adding to the lead time is the fact that it would be a number of years

[4]Title I of H.R. 3030 and S. 1490 defines the three terms as follows: moderate—an area with an ozone level of .14 to .15 parts per million parts of air; serious—ozone level of .16 to .18 parts per million; and severe—ozone level of .19 parts per million and above.

before vehicles equipped with onboard controls begin appearing on the road in significant numbers to make a substantial impact on refueling emissions.

The President's proposal to require Stage II controls in nonattainment areas reversed EPA's support of onboard controls and ended its work regarding the use of onboard controls to reduce gasoline vapors. EPA no longer considers onboard controls to be a viable option and does not plan further work to resolve the safety concerns. Although unresolved issues regarding onboard controls exist, we believe that the concept of onboard controls should not necessarily be abandoned as an option for controlling refueling emissions. Onboard controls, by their very nature, have inherent advantages over a program of Stage II controls in nonattainment areas. While Stage II controls are basically a localized control, onboard controls, by the very fact that they would appear on virtually every motor vehicle, would provide nationwide coverage. Onboard controls would produce across-the-board reductions in benzene and other suspected carcinogens in gasoline vapors and provide health benefits to all individuals, whether or not they are in nonattainment areas. In addition, pollutants from one area can affect air quality in another. Onboard controls would reduce hydrocarbon emissions in areas in attainment with the ozone standard that, in addition to helping to keep the air clean in these areas, would reduce the transport of ozone-causing pollutants into nearby areas not in attainment with the standard.

Matters for Consideration by the Congress

While we believe that Stage II controls are, in the near term, a practical and feasible option for controlling refueling emissions, we also believe that onboard controls, with their nationwide coverage, may offer advantages above and beyond Stage II controls. Consequently, the Congress, in considering proposed amendments to the Clean Air Act, may wish to direct that EPA continue efforts to resolve the safety concerns associated with onboard controls.

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