AIR POLLUTION—1970

Part 1

HEARINGS

BEFORE THE

SUBCOMMITTEE ON AIR AND WATER POLLUTION

OF THE

COMMITTEE ON PUBLIC WORKS UNITED STATES SENATE

NINETY-FIRST CONGRESS

SECOND SESSION

ON

S. 3229, S. 3466, S. 3546

MARCH 16, 17, 18, 1970

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U.S. GOVERNMENT PRINTING OFFICE

43-166 O WASHINGTON : 1970

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AIR POLLUTION—1970

MONDAY, MARCH 16, 1970

U.S. SENATE,
SUBCOMMITTEE ON AIR AND WATER POLLUTION
OF THE COMMITTEE ON PUBLIC WORKS,
Washington, D.C.

The subcommittee met at 9:40 a.m., pursuant to notice, in room 4200, New Senate Office Building, Hon. Edmund S. Muskie (chairman of the subcommittee) presiding.

Present: Senators Muskie, Boggs, and Dole.

Also present: Richard B. Royce, chief clerk and staff director; Bailey Guard, assistant chief clerk, minority; M. Barry Meyer, counsel; Thomas C. Jorling, minority counsel; Leon G. Billings and Richard D. Grundy, professional staff members, and Adrien Waller, staff member.

OPENING STATEMENT OF HON. EDMUND S. MUSKIE, CHAIRMAN, SUBCOMMITTEE ON AIR AND WATER POLLUTION

Senator MUSKIE. The committee will be in order.

At this opening of our hearings on air pollution, I will begin with a brief statement.

Today the Subcommittee on Air and Water Pollution begins 10 days of hearings on pending air quality legislation. These hearings will be held in Washington through Thursday, March 26, and will continue in San Francisco on March 31 and in Los Angeles on April 1. Additional field hearings may be scheduled.*

During the next 10 days the subcommittee hopes to develop a broad public record on the need for additional Federal air quality legislation. The particular bills before the subcommittee represent a major extension of Federal involvement in air pollution control and will require an expanded Federal presence as well as additional manpower and funds.

Today's witnesses will provide the subcommittee with information on the environmental aspects of the air pollution problem, including the pollution ramifications of a proposed new technology.

There is no acceptable justification for a policy that controls only those sources that are easily or conveniently controlled. This pollution control will require a commitment from each of us—a commitment to make sacrifices, to spend money, and to give up some technological comforts and luxuries.

We must not control a source here and a source there and believe that we can survive with half an effort.

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*Subsequent to this announcement the San Francisco hearing was conducted for the purposes of S. 2005 and amendments (Resource Recovery). The Los Angeles hearing was canceled because of urgent business of the Senate. Statements were accepted for the record for that day.

We cannot afford to play a constant catch-up game with the quality of our air.

The bills before the committee today will let us make a whole effort, controlling all sources of pollution and discouraging the introduction into the environment of those sources we cannot control.

Tomorrow the subcommittee will hear Secretary Robert Finch of the Department of Health, Education, and Welfare and his representatives who will discuss the pending legislation as well as the administrative aspects of the program.

The balance of this week will be taken up by industrial, public and other witnesses who will discuss the economic, social and health aspects of the legislation and of the air pollution problem.

Next week the subcommittee will hear representatives of the legal profession on the new enforcement authority proposed in these bills and will sit jointly with the Subcommittee on Energy, Natural Resources, and the Environment of the Senate Commerce Committee, chaired by Senator Hart, on those aspects of the pending bills which relate to moving sources of air pollution.

Before we proceed with the witnesses I will recognize Senator Boggs for his opening remarks.

Senator Boggs?

OPENING REMARKS OF SENATOR BOGGS

Senator BOGGS. Thank you, Mr. Chairman. I join you in your welcome to the witnesses who will open this very important series of hearings.

Each of the three bills before us brings the opportunity for significant advancement in the fight for clean air. I had the honor to cosponsor one of the bills, S. 3466. The two other bills were offered by the distinguished chairman of our subcommittee.

Mr. Chairman, I ask that these bills be included in the record at the start for purposes of reference.

Senator MUSKIE. It is so ordered. And following the bills we will include also the comparison of provisions of the pending legislation.

Senator BOGGS. In the past 7 years since its creation, this subcommittee has acted in a most nonpartisan manner in its consideration of pollution control legislation.

It is my hope that these hearings will provide us with the information we need to blend the very best features from each of these bills and make the 1970 extension of the Clean Air Act an event that will meet to the fullest extent the demand from across our country for clean, healthy air.

(The bills and comparison follow:)

91st CONGRESS
1st Session

S. 3229

IN THE SENATE OF THE UNITED STATES

December 10 (legislative day, December 9), 1969

Mr. Muskie (for himself, Mr. Bayh, Mr. Eagleton, Mr. Montoya, Mr. Randolph, and Mr. Spong) introduced the following bill; which was read twice and referred to the Committee on Public Works

A BILL

To amend the Clean Air Act in order to extend the authorizations for such Act, to extend the provisions of title II relating to emission standards to vessels, aircraft, and certain additional vehicles, and for other purposes, and to provide for a study of noise and its effects.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I

Sec. 101. This title may be cited as the "Air Quality Improvement Act".

Sec. 102. Section 104 (a) (2) of the Clean Air Act is amended by striking out "and (B)" and inserting in lieu thereof "(B) part of the cost of programs to develop low emission alternatives to the internal combustion engine, including steam, electric, and fuel cells; and (C)".

SEC. 103. Section 104(c) of the Clean Air Act is amended by striking out "and for the fiscal year ending June 30, 1970, $45,000,000" and inserting in lieu thereof "for the fiscal year ending June 30, 1970, $45,000,000, for the fiscal year ending June 30, 1971, $125,000,000, for the fiscal year ending June 30, 1972, $150,000,000, and for the fiscal year ending June 30, 1973, $175,000,000".

SEC. 104. Section 108(c) of the Clean Air Act is amended in the first sentence by inserting before "a plan for the implementation" a comma and the following: "after further public hearings at least thirty days following the publishing of such standards and the proposed plan,".

SEC. 105. Title II of the Clean Air Act is amended to read as follows:

"TITLE II—NATIONAL EMISSION STANDARDS ACT

"SHORT TITLE

"SEC. 201. This title may be cited as the 'National Emission Standards Act'.

"ESTABLISHMENT OF STANDARDS

"SEC. 202. (a) The Secretary shall by regulation, giving appropriate consideration to technological feasibility and economic costs, prescribe as soon as practicable standards, applicable to the emission of any kind of substance, from any class or classes of vessels, aircraft, commercial vehicles, new noncommercial vehicles, vessel, commercial vehicle, or aircraft engines, or new non-commercial-vehicle engines, which in his judgment cause or contribute to, or are likely to cause or to contribute to, air pollution which endangers the health or welfare of any persons, and such standards shall apply to such vessels, aircraft, vehicles, or engines whether they are designed as complete systems or incorporate other devices to prevent or control such pollution. Any such standards shall include requirements with respect to the manufacturers' warranty of such systems or devices necessary for the purposes of this Act.

"(b) Any regulations initially prescribed under this section, and amendments thereto, with respect to any class of vessels, aircraft, commercial vehicles, new noncommercial vehicles, vessel, commercial vehicle, or aircraft engines, or new non-commercial-vehicle engines shall become effective on the effective date specified in the order promulgating such regulations, which date shall be determined by the Secretary after consideration of the period reasonably necessary for compliance.

"(c) Any such regulations, or amendments thereto, with respect to aircraft, shall not be made effective until determined by the Secretary of Transportation to not interfere with the safety of such aircraft.

"PROHIBITED ACTS

"SEC. 203. (a) The following acts and the causing thereof are prohibited—

"(1) in the case of a manufacturer of new vessels, new aircraft, new vehicles, new vessel engines, new aircraft engines, or new vehicle engines for distribution in commerce, the manufacture for sale, the sale, or the offering for sale, or the introduction or delivery for introduction into commerce, or the importation into the United States for sale or resale, of any new vessel, new aircraft vehicle, or new vessel aircraft, or vehicle engine, manufactured after the effective date of regulations under this title which are applicable to such vessel, vehicle, or engine unless it is in conformity with regulations prescribed under section 202 (except as provided in subsection (b));

"(2) in the case of an owner of a vessel, aircraft, commercial vehicle, or vessel, commercial vehicle, or aircraft engine, the use in commerce of such vessel, aircraft, vehicle, or engine after the effective date of regulations under this title which are applicable to such vessel, aircraft, or engine unless it is in conformity with regulations prescribed under section 202 (except as provided in subsection (b));

"(3) for any person to fail or refuse to permit access to or copying of records or to fail to make reports or provide information, required under section 207;

"(4) for any person to remove or render inoperative any device or element of design installed on or in a vessel, aircraft, or vehicle, or vessel, aircraft, or vehicle engine in compliance with regulations under this title prior to its sale and delivery to the ultimate purchaser; or

"(5) for any person to remove or render inoperative, other than for purposes of maintenance or repair, any device or element of design installed on or in a vessel, aircraft, or vessel or aircraft engine in compliance with regulations under this title during the term of its use in commerce.

"(b) (1) The Secretary may exempt any new vessel, new aircraft, new vehicle, or new vessel, aircraft, or vehicle engine, or class thereof, from subsection (a), upon such terms and conditions as he may find necessary to protect the public health or welfare, for the purpose of research, investigations, studies, demonstrations, or training, or for reasons of national security.

"(2) A new vessel, new aircraft, new vehicle, or new vessel, aircraft, or vehicle engine offered for importation by a manufacturer in violation of subsection (a) shall be refused admission into the United States, but the Secretary of the Treasury and the Secretary may, by joint regulation, provide for deferring final determination as to admission and authorizing the delivery of such a vessel, aircraft, vehicle, or engine offered for import to the owner or consignee thereof upon such terms and conditions (including the furnishing of a bond) as may appear to them appropriate to insure that any such vessel, aircraft, vehicle, or engine will be brought into conformity with the standards, requirements, and limitations applicable to it under this title. The Secretary of the Treasury shall, if a vessel, aircraft, vehicle, or engine is finally refused admission under this paragraph, cause disposition thereof in accordance with the customs laws unless it is exported, under regulations prescribed by such Secretary, within ninety days of the date of notice of such refusal or such additional time as may be permitted pursuant to such regulations, except that disposition in accordance with the customs laws may not be made in such manner as may result, directly or indirectly, in the sale, to the ultimate consumer, of a new vessel, aircraft, vehicle, or engine that fails to comply with applicable standards of the Secretary of Health, Education, and Welfare under this title.

"(3) A new vessel, aircraft, vehicle, or engine intended solely for export, and so labeled or tagged on the outside of the container and on the vessel, aircraft, vehicle, or engine itself, shall not be subject to the provisions of subsection (a).

"INJUNCTION PROCEEDINGS

"SEC. 204. (a) The district courts of the United States shall have jurisdiction to restrain violations of paragraph (1), (2), or (3) of section 203 (a).

"(b) Actions to restrain such violations shall be brought by and in the name of the United States. In any such action, subpenas for witnesses who are required to attend a district court in any district may run into any other district.

"PENALTIES

"SEC. 205. Any person who violates paragraph (1), (2), (3), (4), or (5) of section 203 (a) shall be subject to a fine of not more than $1,000. Such violation with respect to sections 203 (a) (1). 203 (a) (2). 203 (a) (4), and 203 (a) (5) shall constitute a separate offense with respect to each vessel, aircraft, vehicle, or engine.

"CERTIFICATION

"SEC. 206. (a) Upon application of the manufacturer, the Secretary shall test, or require to be tested, in such manner as he deems appropriate, any new vessel, aircraft, vehicle, or engine submitted by such manufacturer to determine whether such vessel, aircraft, vehicle, or engine conforms with the regulations prescribed under section 202 of this title. If such vessel, aircraft, vehicle, or engine conforms to such regulations the Secretary shall issue a certificate of conformity, upon such terms, and for such period not less than one year, as he may prescribe.

"(b) Any new vessel, aircraft, vehicle, or engine sold by such manufacturer which is in all material respects substantially the same construction as the test vessel, aircraft, vehicle, or engine for which a certificate has been issued under subsection (a), shall for the purposes of this Act be deemed to be in conformity with the regulations issued under section 202 of this title.

"(c) Vessels and aircraft and vessel and aircraft engines used in commerce and subject to standards promulgated under section 202 of this title shall be periodically certified under such procedures as the Secretary may by regulation prescribe.

"RECORDS AND REPORTS

"SEC. 207. (a) Every manufacturer or owner of a vessel or aircraft shall establish and maintain such records, make such reports, and provide such information as the Secretary may reasonably require to enable him to determine whether such manufacturer or owner has acted or is acting in compliance with this title and regulations thereunder and shall, upon request of an officer or employee duly designated by the

Secretary, permit such officer or employee at reasonable times to have access to and copy such records.

"(b) All information reported or otherwise obtained by the Secretary or his representative pursuant to subsection (a), which information contains or relates to a trade secret or other matter referred to in section 1905 of title 18 of the United States Code, shall be considered confidential for the purpose of such section 1905, except that such information may be disclosed to other officers or employees concerned with carrying out this Act or when relevant in any proceeding under this Act. Nothing in this section shall authorize the withholding of information by the Secretary or any officer or employee under his control, from duly authorized committees of the Congress.

"STATE STANDARDS

"SEC. 208. (a) No State or any political subdivision thereof shall adopt or attempt to enforce any standard relating to the control of emissions from new motor vehicles or new motor vehicle engines subject to this title. No State shall require certification, inspection, or any other approval relating to the control of emissions from any new motor vehicle or new motor vehicle engine as condition precedent to the initial retail sale, titling (if any), or registration of such motor vehicle, motor vehicle engine, or equipment.

"(b) The Secretary shall, after notice and opportunity for public hearing, waive application of this section to any State which has adopted standards (other than crankcase emission standards) for the control of emissions from new motor vehicles or new motor vehicle engines prior to March 30, 1966, unless he finds that such State does not require standards more stringent than applicable Federal standards to meet compelling and extraordinary conditions or that such State standards and accompanying enforcement procedures are not consistent with section 202(a) of this title.

"(c) Nothing in this title shall preclude or deny to any State or political subdivision thereof the right otherwise to control, regulate, or restrict the use, operation, or movement of registered or licensed motor vehicles.

"FEDERAL ASSISTANCE IN DEVELOPING VEHICLE INSPECTION PROGRAMS

"SEC. 209. The Secretary is authorized to make grants to appropriate State air pollution control agencies in an amount up to two-thirds of the cost of developing meaningful uniform motor vehicle emission device inspection and emission testing programs except that (1) no grant shall be made for any part of any State vehicle inspection program which does not directly relate to the cost of the air pollution control aspects of such a program; and (2) no such grant shall be made unless the Secretary of Transportation has certified to the Secretary that such program is consistent with any highway safety program developed pursuant to section 402 of title 23 of the United States Code.

"REGISTRATION OF FUEL ADDITIVES

"SEC. 210. (a) The Secretary may by regulation designate any fuel or fuels (including fuels used for purposes other than motor vehicles), and after such date or dates as may be prescribed by him, no manufacturer or processor of any such fuel may deliver any such fuel for introduction into interstate commerce or to another person who, it can reasonably be expected, will deliver such fuel for such introduction unless the manufacturer of such fuel has provided the Secretary with the information required under subsection (b) (1) of this section and unless any additive contained in such fuel has been registered with the Secretary in accordance with subsection (b) (2) of this section.

"(b) For the purposes of this section the Secretary shall require (1) the manufacturer of such fuel to notify him as to the commercial identifying name and manufacturer of any additive contained in such fuel; the range of concentration of such additive or additives in the fuel; and the purpose in the use of such additive; and (2) the manufacturer of any such additive to notify him as to the chemical composition of such additive or additives as indicated by compliance with clause (1) above, the recommended range of concentration of such additive, if any, the recommended purpose in the use of such additive, and to the extent such information is available or becomes available, the chemical structure of such additive or additives. Upon compliance with clauses (1) and (2), including assurances that any change in the above information will be provided to the Secretary, the Secretary shall register such fuel additive.

"(c) All information reported or otherwise obtained by the Secretary or his representative pursuant to subsection (b), which information contains or relates to a trade secret or other matter referred to in section 1905 of title 18 of the United States Code, shall be considered confidential for the purpose of such section 1905, except that such information may be disclosed to other officers or employees of the United States concerned with carrying out this Act or when relevant in any proceeding under this title. Nothing in this section shall authorize the withholding of information by the Secretary or any officer or employee under his control, from the duly authorized committees of the Congress.

"(d) Any person who violates subsection (a) shall forfeit and pay to the United States a civil penalty of $1,000 for each and every day of the continuance of such violation, which shall accrue to the United States and be recovered in a civil suit in the name of the United States, brought in the district where such person has his principal office or in any district in which he does business. The Secretary may, upon application therefor, remit or mitigate any forfeiture provided for in this subsection and he shall have authority to determine the facts upon all such applications.

"(e) It shall be the duty of the various United States attorneys, under the direction of the Attorney General of the United States, to prosecute for the recovery of such forfeitures.

"DEVELOPMENT OF LOW-EMISSION VEHICLES

"SEC. 211. In order to encourage research and promote the development of low-emission vehicles the Secretary is authorized to—

"(1) prescribe special low-emission standards for any class or classes of vehicles or engines and such standards shall permit an emission of not more than 50 per centum of the amount of pollutants permitted by standards established pursuant to section 202 for the same class of vehicle or engine;

"(2) provide testing procedures to determine if vehicles and engines meet such standards; and

"(3) certify vehicles or engines meeting such standards as low-emission vehicles or engines for the purpose of this section.

"SOLVENTS

"SEC. 212. (a) The Secretary by regulation may designate solvents, coating materials, organic or inorganic materials, and products containing any such substance as a constituent thereof, either singly or by classes or in combinations, which when used in uncontrolled situations, in his judgment, may cause or contribute to air pollution adversely affecting health or welfare; and after such date or dates as may be prescribed by him, no manufacturer of any such product or substance may deliver any such product or substance into interstate commerce unless such substance has been registered with the Secretary in accordance with this section.

"(b) For the purposes of this subsection the Secretary shall require (1) the manufacturer of any product which contains any such substance to notify him as to the commercial identifying name and the manufacturer of the solvent, coating material, organic or inorganic material, or other such substance contained in the product; the range of concentration of such substance; the purpose of such substance; and (2) the manufacturer of any such substance to notify him as to the chemical structure and composition of such substance as indicated by compliance with clause (1) above, the recommended range of concentration of such substance, if any, and the recommended purpose of such substance. Upon compliance with clauses (1) and (2), including assurances that any change in the above information will be provided to the Secretary, the Secretary shall register such product.

"(c) The Secretary may develop and publish proposed standards, either singly or by classes, for the use of those substances and products that are registered in compliance with subsections (a) and (b) above. The Secretary may from time to time review such proposed standards and make changes therein, taking into consideration increased knowledge regarding technology or effects on health or welfare.

"(d) If the Secretary determines that any such substance or class thereof constitutes a substantial and imminent danger to the health or welfare of any person, he may promulgate any of the proposed standards for such substance which have been developed and published pursuant to subsection (c) and he may prohibit the introduction of such substance into interstate commerce unless it complies with such regulations as he shall promulgate under this subsection.

"(e) If two or more manufacturers, vendors, or distributors of any such substance or product notify the Secretary that two or more State, interstate, or local agencies or authorities have established standards, rules, or regulations applicable to such substance or product and varying from each other in their terms or effects upon the manufacturer, vendor, or distributor, the Secretary may promulgate any of the proposed standards he has developed, and published for such substance or product under subsection (c) and they shall become effective after a date established by him.

"(f) At any time he shall deem it necessary, the Secretary may add additional substances or products to the designations made under subsection (a), add additional substances or products to those to which proposed standards existing under subsection (c) already apply, or promulgate under subsection (d) or (e) additional standards which have been proposed under subsection (c).

"(g) All information reported or otherwise obtained by the Secretary or his representative pursuant to this section, which information contains or relates to a trade secret or other matter referred to in section 1905 of title 18 of the United States Code shall be considered confidential for the purpose of such section 1905, except that such information may be disclosed to other officers or employees concerned with carrying out this Act or when relevant in any proceeding under this Act. Nothing in this subsection shall authorize the withholding of information by the Secretary or any officer or employee under his control from the duly authorized committees of Congress.

"(h) (1) Any person who violates after the effective date the provisions of subsection (a), (d), or (e) or regulations promulgated pursuant thereto shall forfeit and pay to the United States a civil penalty of $1,000 for each and every day of the continuance of such violation, which shall accrue to the United States and be recovered in a civil suit in the name of the United States brought in the district where such person has his principal office or in any district in which he does business. The Secretary may, upon application therefor, remit or mitigate any forfeiture provided for in this section and he shall have authority to determine the facts upon all such applications.

"(2) It shall be the duty of the various United States attorneys, under the direction of the Attorney General of the United States, to prosecute for the recovery of such forfeitures.

"DEFINITIONS FOR TITLE II

"SEC. 213. As used in this title—

"(1) The term 'manufacturer' as used in sections 203, 206, and 207 means any person engaged in the manufacturing or assembling of new vessels, aircraft, or vehicles, or new vessel, aircraft, or vehicle engines, or importing such vessels, aircraft, vehicles, or engines for resale, or who acts for and is under the control of any such person in connection with the distribution of such vessels, aircraft, vehicles, or engines, but shall not include any dealer with respect to new vehicles or new vehicle engines received by him in commerce.

"(2) The term 'vessel' means any self-propelled water-craft designed for transporting persons or property on or in water.

"(3) The term 'new vessel' means a vessel the equitable or legal title to which has never been transferred to an ultimate purchaser; and the term 'new vessel engine' means an engine in a new vessel or a vessel engine the equitable or legal title to which has never been transferred to the ultimate purchaser.

"(4) The term 'aircraft' means any self-propelled contrivance designed for transporting persons or property in the air.

"(5) The term 'new aircraft' means an aircraft the equitable or legal title to which has never been transferred to an ultimate purchaser; and the term 'new aircraft engine' means an engine in a new aircraft or an aircraft engine the equitable or legal title to which has never been transferred to the ultimate purchaser.

"(6) The term 'vehicle' means any self-propelled vehicle designed for transporting persons or property on a street or highway or on rails, or any vehicle for agricultural use, and the term 'motor vehicle' means only such a vehicle designed for transporting persons or property on a street or highway.

"(7) The term 'commercial' means used with profit as the primary aim.

"(8) The term 'new' as used with respect to a vehicle, motor vehicle or vehicle or motor vehicle engine means a vehicle, motor vehicle, or engine the equitable or legal title to which has never been transferred to an ultimate purchaser.

"(9) The term 'dealer' means any person who is engaged in the sale or the distribution of new vehicles or new vehicle engines to the ultimate purchaser.

"(10) The term 'ultimate purchaser' means, with respect to any new vessel, aircraft, vehicle, or new vessel, aircraft or vehicle engine, the first person who in good faith purchases such new vessel, aircraft, vehicle, or engine for purposes other than resale.

"(11) The term 'commerce' means (A) commerce between any place in any State and any place outside thereof; and (B) commerce wholly within the District of Columbia."

Sec. 106. Section 309 of the Clean Air Act is amended by striking out "and $134,300,000 for the fiscal year ending June 30, 1970" and inserting in lieu thereof "$134,300,000 for the fiscal year ending June 30, 1970, $150,000,000 for the fiscal year ending June 30, 1971, $175,000,000 for the fiscal year ending June 30, 1972, and $200,000,000 for the fiscal year ending June 30, 1973".

TITLE II

Sec. 201. This title may be cited as the "Noise Pollution and Abatement Act".

SEC. 202. (a) The Secretary of Health, Education, and Welfare shall establish within the Department of Health, Education, and Welfare an Office of Noise Abatement and Control, and shall carry out through such office a full and complete investigation and study of noise and its effect in order to determine—

(1) effects at various levels;

(2) projected growth of noise levels in urban areas through the year 2000;

(3) the psychological effect on humans;

(4) effects of sporadic extreme noise (such as jet noise near airports) as compared with constant noise;

(5) effect on wildlife and property (including values);

(6) effect of sonic booms on property (including values); and

(7) such other matters as may be of interest in the public welfare.

(b) The Secretary shall report the results of such investigation and study, together with his recommendations for legislation or other action, to the President and the Congress not later than one year after the date of enactment of this Act.

(c) In any case where a department or agency of the Government is carrying out any activity resulting in noise which amounts to a public nuisance or is otherwise objectionable, such department or agency shall consult with the Secretary of Health, Education, and Welfare to determine possible means of abating such noise.

(d) There is authorized to be appropriated such amount, not to exceed $30,000,000, as may be necessary for the purposes of this section.

91st CONGRESS
2d Session

S. 3229

IN THE SENATE OF THE UNITED STATES

February 18, 1970

Referred to the Committee on Public Works and ordered to be printed

AMENDMENTS

Intended to be proposed by Mr. Montoya to S. 3229, a bill to amend the Clean Air Act in order to extend the authorizations for such Act, to extend the provisions of title II relating to emission standards to vessels, aircraft, and certain additional vehicles, and for other purposes, and to provide for a study of noise and its effects, viz:

On page 13 between lines 7 and 8 insert the following:

"ESTABLISHMENT OF STANDARDS FOR FUELS

"Sec. 211. (a) The Secretary shall, as soon as practicable, prescribe (1) such standards with respect to the composition of fuels of all types as are necessary to protect the public health and welfare and carry out the policy of this Act, (2) such rules and regulations as are necessary to pre-

Amdt. No. 501

vent the manufacture or processing for use in the United States of fuels not meeting such standards, and (3) after consultation with the Secretary of the Treasury, such rules and regulations as are necessary to prevent the importation into the United States of fuels not meeting such standards. Included with such standards shall be specific methods by which fuels shall be tested by the Secretary to determine if they conform to such standards.

"(b) Any person who violates any provision of rules and regulations prescribed pursuant to this section shall be subject to a fine of not more than $1,000. Each day on which any such violation occurs shall constitute a separate offense.

"(c) All action taken under this section in prescribing standards, rules, and regulations shall be taken in conformity with the provisions of title 5, United States Code, relating to administrative procedure."

On pages 13 through 17, redesignate sections 211 through 213 as sections 212 through 214, respectively.

91st CONGRESS
2d Session

S. 3466

IN THE SENATE OF THE UNITED STATES

February 18, 1970

Mr. Scott (for himself, Mr. Cooper, Mr. Randolph, Mr. Baker, Mr. Bellmon, Mr. Bennett, Mr. Boggs, Mr. Brooke, Mr. Cotton, Mr. Dole, Mr. Ervin, Mr. Fannin, Mr. Fong, Mr. Goldwater, Mr. Goodell, Mr. Griffin, Mr. Gurney, Mr. Javits, Mr. Jordan of Idaho, Mr. McIntyre, Mr. Mansfield, Mr. Miller, Mr. Mundt, Mr. Murphy, Mr. Nelson, Mr. Packwood, Mr. Pearson, Mr. Percy, Mr. Prouty, Mr. Saxbe, Mr. Schweiker, Mr. Smith of Illinois, Mr. Stevens, and Mr. Tower) introduced the following bill; which was read twice and referred to the Committee on Public Works

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A BILL

To amend the Clean Air Act so as to extend its duration, provide for national standards of ambient air quality, expedite enforcement of air pollution control standards, authorize regulation of fuels and fuel additives, provide for improved controls over motor vehicle emissions, establish standards applicable to dangerous emissions from stationary sources, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Clean Air Act Amendments of 1970".

II

EXTENSION OF DURATION

SEC. 2. (a) The first sentence of section 104 (c) of the Clean Air Act (42 U.S.C. 1857b–1 (c)) is amended by striking out "and" before "for the fiscal year ending June 30, 1970," and by inserting before the period at the end thereof ", and such sums as may be necessary for the fiscal year ending June 30, 1971, and for each of the next two fiscal years".

(b) Section 309 of the Clean Air Act (42 U.S.C. 1857l) is amended by striking out "and", and inserting before the period at the end thereof ", and such sums as may be necessary for the fiscal year ending June 30, 1971, and for each of the next two fiscal years".

TESTING OF MOTOR VEHICLES AND ENGINES

SEC. 3. (a) Subsection (a) of section 206 of such Act (42 U.S.C. 1857f–5) is amended by striking out in the first sentence thereof "Upon application of the manufacturer, the" and inserting in lieu thereof "The"; by striking out "such manufacturer" and inserting in lieu thereof "the manufacturer"; and by inserting after "not less than one year" in the second sentence thereof "(except as provided under subsection (c))".

(b) Subsection (b) of such section is amended by inserting before the period at the end of the sentence ", except as provided in subsection (c)".

(c) Such section 206 is further amended by adding after subsection (b) the following new subsections:

"(c) (1) In order to determine whether new motor vehicles or new motor vehicle engines being manufactured by a manufacturer are in fact constructed in all material respects substantially the same as the test vehicle or engine, the Secretary is authorized to test such vehicles or engines. Such tests may be conducted by the Secretary directly or, in accordance with conditions specified by the Secretary, by the manufacturer.

"(2) If, based on such tests conducted on a representative sample of such vehicles or engines, the Secretary determines that such vehicles or engines do not conform with the regulations in effect on the date the certificate of conformity was issued, he may revoke such certificate and so notify the manufacturer. Such revocation shall apply in the case of any new motor vehicles or new motor vehicle engines manufactured after the date of such notification and until such time as the Secretary finds that vehicles and engines being manufactured by the manufacturer do conform to such regulations.

"(d) For purposes of enforcement of this section, officers or employees duly designated by the Secretary, upon presenting appropriate credentials and a written notice to the manufacturer, are authorized (A) to enter, at reasonable times, any factory, or other business or establishment, for the purpose of conducting tests of vehicles or engines coming off the production line, or (B) to inspect, at reasonable times, records, files, papers, and processes, controls, and facilities used by such manufacturer in conducting tests under regulations of the Secretary. A separate notice shall be given for each such inspection, but a notice shall not be required for each entry made during the period covered by the inspection. Each such inspection shall be commenced and completed with reasonable promptness."

(d) The heading of such section 206 is amended to read:

"COMPLIANCE TESTING AND CERTIFICATION"

(e) Paragraph (1) of subsection (a) of section 203 of such Act (42 U.S.C. 1857f–2) is amended by striking out "it is in conformity with" and inserting in lieu thereof "such manufacture is covered by a certificate of conformity issued (and in effect) under".

(f) The amendments made by this section shall apply in the case of motor vehicles and motor vehicle engines manufactured after the month in which this Act is enacted.

IMPORTATION OF VEHICLES AND ENGINES

SEC. 4. (a) Paragraph (1) of subsection (a) of section 203 of such Act (42 U.S.C. 1857f–2) is amended by inserting "(in the case of any person, except as provided by regulation of the Secretary)," after "commerce, or"; and by striking out "United States for sale or resale" and inserting in lieu thereof "United States".

(b) The first sentence of paragraph (2) of subsection (b) of such section is amended by striking out "by a manufacturer" and inserting in lieu thereof "of imported by any person".

(c) Paragraph (3) of section 212 of such Act (42 U.S.C. 1857f–7) is amended by striking out "The" and inserting in lieu thereof "Except with respect to vehicles or engines imported or offered for importation, the"; and by adding before the period at the end thereof "; and with respect to imported vehicles or engines, such terms mean a motor vehicle and engine, respectively, manufactured after the effective date of the regulations issued under section 202".

(d) The amendments made by this section shall apply in the case of motor vehicles and motor vehicle engines imported into the United States on or after the sixtieth day following the date of enactment of this Act.

REGISTRATION AND REGULATION OF FUELS AND FUEL ADDITIVES

SEC. 5. (a) Subsection (a) of section 210 of such Act (42 U.S.C. 1857f–6c) is amended to read as follows:

"(a) The Secretary may by regulation designate any fuel (which, for purposes of this section, means only fuel intended for use in the transportation of any person or thing) or fuel additive, and after such date or dates as may be prescribed by him, no manufacturer or processor of any such fuel or fuel additive may sell or deliver it unless the manufacturer of such fuel or fuel additive has provided the Secretary with the information required under subsection (c) of this section and unless such fuel or fuel additive has been registered with the Secretary in accordance with subsection (c) of this section."

(b) Section 210 of such Act is amended by redesignating subsections (b), (c), (d), and (e) as subsections (c), (d), (e), and (f), respectively, and by adding after subsection (a) the following new subsection:

"(b) The Secretary may, on the basis of information obtained under subsection (c) of this section or any other information available to him, establish standards respecting the composition or the chemical or physical properties of any fuel or fuel additive to assure that such fuel or fuel additive will not cause or contribute to emissions which would endanger the public health or welfare, or impair the performance of any emission control device or system which is in general use or likely to be in general use (on any motor vehicle or motor vehicle engine subject to this title) for the purpose of preventing or controlling motor vehicle emissions from such vehicle or engine. For the purpose of carrying out such standards the Secretary may prescribe regulations—

"(A) prohibiting the manufacture for sale, the sale, the offering for sale, or the delivery of any fuel or fuel additive; or

"(B) limiting the composition or chemical or physical properties, or imposing any conditions applicable to the use of, such fuel or fuel additive (including the maximum quantity of any fuel component or fuel additive that may be used or the manner of such use).

(c) The subsection of section 210 herein redesignated as subsection (c) is amended by striking out "For purposes of this section, the Secretary shall" and inserting in lieu thereof "For the purpose of establishing standards under subsection (b), the Secretary may require the manufacturer of any fuel or fuel additive to furnish such information as is reasonable and necessary to determine the emissions resulting from the use of the fuel or fuel additive or the effect of such use on the performance of any emission control device or system which is in general use or likely to be in general use (on any motor vehicle or motor vehicle engine subject to this Act) for the purpose of preventing or controlling motor vehicle emissions from such vehicle or engine. If the information so submitted establishes that toxic emissions or emissions of unknown or uncertain toxicity result from the use of the fuel or fuel additive, the Secretary may require the submission within a reasonable time of such scientific data as the Secretary may reasonably prescribe to enable him to determine the extent to which such emissions will adversely affect the public health or welfare. To the extent reasonably consistent with the purposes of this section, such requirements for submission of information with respect to any fuel additive shall not be imposed on the manufacturer of any such additive intended solely for use in a fuel only by the manufacturer thereof. Among other types of information, the Secretary shall"; by inserting in clause (2) "the description of any analytical technique that can be used to detect and measure such additive in fuel," after "above,"; by striking out in such clause "to the extent such information is available or becomes available,"; by striking out "clauses (1) and (2)" in the second sentence and inserting in lieu thereof "the provisions of this subsection"; and by striking out "such fuel additive" in such sentence and inserting in lieu thereof "such fuel or fuel additive".

(d) The subsection of section 210 herein redesignated as subsection (d) is amended by inserting between the first and second sentences the following new sentence: "The Secretary may disseminate any information, obtained from reports or otherwise, which is not covered by section 1905 of title 18 of the United States Code and which will contribute to scientific or public understanding of the relationship between the chemical or physical properties of fuels or fuel additives and their contribution to the problem of air pollution." The first sentence of such subsection is amended by striking out "subsection (b)" and inserting in lieu thereof "subsection (c)".

(e) The subsection of section 210 herein redesignated as subsection (e) is amended (1) by adding "or subsection (b)" after "subsection (a)"; and (2) by striking out "$1,000" and inserting in lieu thereof "$10,000".

(f) The amendment made by subsection (e) (2) of this section shall be effective with respect to any fuel or fuel additive to which a regulation issued under subsection (a) of section 210 of such Act or a standard established under subsection (b) of such section, as amended by this Act, applies.

NATIONAL AIR QUALITY STANDARDS

SEC. 6. Section 107 of such Act (42 U.S.C. 1857c–2) is amended to read as follows:

"NATIONAL AIR QUALITY STANDARDS

"SEC. 107. (a) As soon as practicable after enactment of the Clean Air Act Amendments of 1970, but in no event later than the close of the sixth calendar month after the month in which such enactment occurs, the Secretary shall, after consultation with appropriate advisory committees and Federal departments and agencies, publish in the Federal Register proposed regulations establishing nationally applicable standards of ambient air quality for any pollutant or combination of pollutants which he determines endanger or may endanger the public health or welfare, and allow a reasonable time for comment thereon by interested parties. After considering such comments and other relevant information, the Secretary shall promulgate such regulations with such modifications as he deems appropriate. He may from time to time thereafter, by regulation similarly prescribed, extend such standards to other pollutants or otherwise revise such standards.

"(b) As soon as possible after establishing or revising standards under subsection (a), the Secretary shall, after consultation with appropriate advisory committees and Federal departments and agencies, issue to appropriate air pollution control agencies information on those recommended pollution control techniques the application of which is necessary to achieve such standards of air quality at the earliest practicable time. Such information shall include data relating to technology and costs of emission control. The recommendations shall also include such data as are available on the latest available technology and economic feasibility of alternative methods of prevention and control of air pollution. Such issuance shall be announced in the Federal Register and copies shall be made available to the general public."

AIR QUALITY STANDARDS AND ABATEMENT OF AIR POLLUTION

SEC. 7. (a) Paragraphs (1), (2), and (3) of subsection (c) of section 108 of such Act (42 U.S.C. 1857d) are amended to read as follows:

"(c) (1) If, after the date on which the Secretary has, pursuant to section 107, established standards of ambient air quality and issued recommended control techniques therefor—

"(A) any State or any interstate air pollution control agency, within ninety days after such date, files with the Secretary a letter of intent that it will adopt a plan (meeting the requirements of subparagraph (B)) within the time specified, a description of how it will proceed to develop the plan (meeting such requirements) for the various areas within its jurisdiction, and the time within which the plan will be applied to each such area giving due regard, in setting this order of application of the plan, to the relative requirements of each area; and

"(B) such State or interstate agency adopts a plan for the implementation, maintenance, and enforcement of such standards of air quality, which adoption occurs within one hundred and eighty days after the filing of such letter of intent and other material pursuant to subparagraph (A) and after public hearings held not less than thirty days following publication of a proposed plan for implementation, maintenance, and enforcement of such standards; and

"(C) the Secretary determines that such plan—

"(i) includes emission standards, or equivalent measures, and such other measures as may be necessary to assure achieving or preserving such standards of ambient air quality within a reasonable time in all areas within the jurisdiction of such State or interstate agency;

"(ii) contains adequate provisions for intergovernmental cooperation, including, in the case of any area covering part or all of more than one State and designated by the Secretary, appropriate provision for dealing with interstate pollution problems;

"(iii) provides adequate means of enforcement, including authority comparable to that in subsection (k) of this section to prevent or deal with air pollution presenting an imminent and significant endangerment to the public health; and

"(iv) provides for revision from time to time as may be necessary to take account of revisions of such ambient air quality standards or improved on more expeditious methods of achieving such standards;

such plan (except with respect to any area for which an extension is granted pursuant to the last two sentences of this paragraph) shall be approved by the Secretary. Any revisions of such a plan which are similarly adopted and otherwise meet the requirements of the preceding sentence shall also be approved by the Secretary. For good cause shown, the Secretary may extend, for such period as he finds necessary and appropriate, the one hundred and eighty day period referred to in subparagraph (B) with respect to any area or areas under the jurisdiction of the State or interstate agency. No such extension may exceed ninety days unless the request therefor accompanies the material filed pursuant to subparagraph (A) and is in turn accompanied by satisfactory assurances that the portions of the plan relating to the areas most in need of air pollution abatement action will receive priority in the development and submission of the plan.

"(2) If a State or interstate agency does not file a letter of intent and the other material described in paragraph (1) or adopt a plan in accordance with paragraph (1) with respect to any State or portion thereof, the Secretary shall prepare regulations establishing such a plan for such State or portion. Prior to promulgating such regulations, the Secretary shall call a public hearing for the purpose of receiving testimony from State and local pollution control agencies and other interested parties affected by the regulations, to be held in or near one or more of the places where the plan will be applicable. At least thirty days prior to the date of such hearing, notice thereof shall be published in the Federal Register. If, prior to the date the Secretary publishes such regulations, the State or interstate agency has not adopted such a plan, the Secretary shall promulgate such regulations.

(b) Paragraph (4) of such subsection (c) is amended to read as follows:

"(4) (A) Whenever, on the basis of surveys, studies, or reports, the Secretary finds that the ambient air quality in any State or the area under the jurisdiction of any interstate air pollution control agency fails to meet the air quality standards established pursuant to section 107, and he determines, on the basis of facts thus ascertained, that such failure results from the failure of a State or interstate agency to carry out its plan (or the plan provided for it by the Secretary) under section 108 (c), the Secretary shall notify the State or the interstate agency, and the persons contributing to the lowering of the air quality or to the alleged violations, of such findings.

"(B) If such State or interstate agency has not taken appropriate remedial action within ninety days of such notification, the Secretary may request the Attorney General to bring suit on behalf of the United States in the appropriate United States district court to enjoin violation of applicable standards or regulations by any person within that State or the area under the jurisdiction of any interstate air pollution control agency."

(c) (1) Paragraph (1) of subsection (d) of such section is amended by striking out subparagraphs (A), (B), (C), and by striking out "(D)" and inserting in lieu thereof "(d) (1)".

(2) The second sentence of paragraph (1) of subsection (f) of such section is amended by striking out "and each State claiming to be adversely affected by such pollution".

(3) The first sentence of paragraph (2) of such subsection is amended by striking out "pollution referred to in subsection (a)" and inserting in lieu thereof "any pollution".

(d) Subsection (g) of such section is amended to read as follows:

"(g) If action reasonably calculated to secure abatement of the pollution within the time specified in the notice following the public hearing is not taken, the Secretary may request the Attorney General to bring a suit on behalf of the

United States in the appropriate United States district court to secure abatement of the pollution."

(e) The first sentence of subsection (j) (1) of such section is amended by striking out "based on existing data," and inserting before the period at the end thereof ", or any other information which may reasonably be required to assist the Secretary in evaluating the emission of pollutants caused by such person".

(f) Section 108 of such Act is further amended by striking out subsection (b).

(g) The amendments made by subsections (a), (b), and (c) of this section shall become effective on the date on which the Secretary of Health, Education, and Welfare prescribes regulations pursuant to section 107 of the Clean Air Act as amended by this Act. The amendments made by subsections (d) and (f) of this section shall also be effective on such date, except that they shall not apply with respect to any proceeding begun under subsection (d) of section 108 of the Clean Air Act prior to such date on which such regulations are prescribed.

SEC. 8. Title I of the Clean Air Act is amended by adding after section 111 the following new sections:

"STATIONARY SOURCE EMISSION STANDARDS

"SEC. 112. (a) The Secretary shall from time to time by regulation, giving appropriate consideration to technological feasibility, establish standards with respect to emissions from classes or types of stationary sources which (1) contribute substantially to endangerment of the public health or welfare, and (2) can be prevented or substantially reduced. Such standards may be established only after reasonable notice and opportunity for interested parties to present their views at a public hearing. Any regulations hereunder, and amendments thereof, shall become effective on a date specified therein, which date shall be determined by the Secretary after consideration of the period reasonably necessary for compliance. The Secretary may exempt any industry or establishment, or any class thereof, from this section, upon such terms and conditions as he may find necessary to protect the public health or welfare, for the purpose of research, investigations, studies, demonstrations, or training, or for reasons of national security.

"(b) Such regulations shall provide that—

"(1) if such emissions are extremely hazardous to health,

"(A) no new source of such emissions shall be constructed or operated, except where (and subject to such conditions as he deems necessary and appropriate) the Secretary makes a specific exemption with respect to such construction or operation;

"(B) any existing source of such emissions shall install and maintain any control measures necessary and appropriate to meet the standards prescribed under this section;

"(2) in other cases to which subsection (a) applies, any new source of such emissions shall be designed and equipped to prevent and control such emissions to the fullest extent compatible with the available technology as determined by the Secretary.

"(c) (1) If, within such period as may be prescribed by the Secretary, any State or interstate air pollution control agency adopts a plan for enforcement of the standards promulgated by the Secretary under this section, such plan shall, if the Secretary determines it provides adequately for the enforcement of such standards, be applicable within such State or other area.

"(2) If a State does not adopt a plan in accordance with paragraph (1) of this subsection, the Secretary shall, after reasonable notice and a conference of representatives of appropriate Federal departments and agencies and State agencies, prepare regulations establishing a plan for such State which shall meet the criteria for enforcement plans required under section 108. If, prior to the date the Secretary publishes such regulations, the State has not adopted such plan, the Secretary shall promulgate such regulations.

"(d) If at any time the Secretary determines that emissions from any stationary sources are in excess of the standards established by him pursuant to this section, and that this results from the failure of a State or interstate agency to carry out its State plan adopted as provided in paragraph (1) or established as provided in paragraph (2) of subsection (c), he shall notify the affected State or the interstate agency, the person contributing to the pollution, and other interested parties and specify a time within which such failure must cease. If such failure does not cease within such time, the Secretary may request the Attorney General to bring suit on behalf of the United States in the appropriate United States district court to secure abatement of the pollution.

"(e) Prior to establishing standards under subsection (a), the Secretary shall consult with appropriate Federal departments and agencies having responsibilities related to any stationary sources to which such standards will be applicable."

"FEDERAL ENFORCEMENT

"SEC. 113. (a) If the Secretary, after reasonable notice and opportunity for a hearing, determines (1) (A) that the ambient air quality of any area fails to meet the air quality standards established pursuant to section 107, or (B) that any person is violating any standards established pursuant to section 112, and (2) that such failure or violation results from the failure of a State or interstate agency to carry out its plan meeting the requirements of section 108 or 112, as the case may be, or the plan of the Secretary established thereunder, he shall so notify the State or interstate agency and the persons contributing to the lowering of the air quality or to the violation of such standards, and shall specify the remedial action to be taken and the time, not less than sixty days, within which such persons must take such action.

"(b) If such action is not taken within such time, the Secretary may request the Attorney General to bring a suit on behalf of the United States in the appropriate United States district court to enjoin continued failure to take the necessary remedial action. In any such suit, the court shall receive into evidence a transcript of the hearing held by the Secretary and a copy of the findings prepared by the Secretary as a result thereof. The court may also receive such additional evidence as it deems necessary. The court, giving due consideration to the practicability and to the physical feasibility of taking the necessary remedial action, shall have jurisdiction to enter such judgment and orders enforcing such judgment as the public interest and the equities of the case may require. The court may also assess a penalty of up to $10,000 for each day after the end of the period specified by the Secretary pursuant to subsection (a) for the taking of the necessary remedial action except that, in determining the amount of such penalty, the court shall take into account the efforts of the defendant to abate the pollution involved."

CONFORMING AMENDMENTS

SEC. 9. Section 106 of such Act (42 U.S.C. 1857c–1) is hereby repealed.

EFFECTIVENESS OF NEW PROVISIONS

SEC. 10. Section 108 (c) of the Clean Air Act as in effect prior to enactment of this Act and ambient air quality standards and implementation and enforcement plans promulgated or approved, prior to enactment of this Act, under such section shall not be considered invalid by reason of such enactment until (1) the Secretary of Health, Education, and Welfare establishes ambient air quality standards pursuant to such section as amended by this Act; and (2) either the State adopts an implementation and enforcement plan which is approved by the Secretary pursuant to such section as so amended or the Secretary provides such a plan pursuant thereto.

91st CONGRESS
2d Session

S. 3546

IN THE SENATE OF THE UNITED STATES

March 4, 1970

Mr. Muskie (for himself, Mr. Bayh, Mr. Eagleton, Mr. Montoya, Mr. Randolph, and Mr. Spong) introduced the following bill; which was read twice and referred to the Committee on Public Works

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A BILL

To amend the Clean Air Act, as amended, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Air Quality Standards Act of 1970."

Sec. 2. In order to accelerate the establishment of ambient air quality standards pursuant to section 108 of the Clean Air Act, as amended, the Secretary of Health, Education, and Welfare shall designate immediately all air quality control regions pursuant to the provisions of section 107 of the Clean Air Act, as amended.

Sec. 3. (a) Section 107 (a) (2) of the Clean Air Act, as amended, is amended by changing "section 108," to "section 108 (c) (1),".

(b) Section 107 (a) of the Clean Air Act, as amended, is further amended by adding a new paragraph at the end thereof to read as follows:

"(3) For the purpose of establishing ambient air quality standards pursuant to section 108 (c) (2), and for administrative and other purposes, each State shall, after public hearings and within six months after the effective date of this paragraph, designate one or more air quality control regions within such State which shall include all areas of the State not included in such regions designated under paragraph (2) of this subsection. Such regions shall be based on jurisdictional boundaries, urban-industrial concentrations, and other factors necessary to provide adequate implementation of air quality standards. The State shall immediately notify the Secretary of such designations. If the State fails to make such designations within the time prescribed, the Secretary shall promptly make such designations and notify the Governor of the State thereof. Such designations may be revised from time to time thereafter as necessary to protect the public health and welfare".

SEC. 4. (a) Paragraph (1) of section 108 (c) of the Clean Air Act, as amended, is amended to read as follows:

"(1) If, within thirty days of receiving any air quality criteria and recommended control techniques issued pursuant to section 107, the Governor of a State files a letter of intent that such State will, after public hearings and within one hundred and eighty days, and from time to time thereafter, adopt ambient air quality standards applicable to any air quality control region or portions thereof designated pursuant to section 107 (a) (2) within such State, and, after public hearings and within one hundred and eighty days thereafter, and from time to time as may be necessary adopts a plan which shall include compliance schedules and emission requirements necessary for the implementation, maintenance, and enforcement of such standards of air quality adopted; and if the Secretary determines that—

"(A) such standards and plan are established in accordance with the letter of intent;

"(B) such State standards are consistent with the air quality criteria and recommended control techniques issued pursuant to section 107;

"(C) such plan assures that such standards of air quality will be achieved within a reasonable time;

"(D) such plan includes emission requirements necessary to implement such standards of air quality;

"(E) such plan includes a procedure to assure that proposed new sources of emissions will not cause violation of such standards;

"(F) a means of enforcement by State action, including authority comparable to that in subsection (k) of this section, is provided; and

"(G) any such State standards and plan are consistent with the purposes of this Act and this subsection; such standards and plan or revisions thereof shall be the air quality standards applicable to such region or portions thereof."

(b) Paragraphs (2) through (6) of ssection 108 (c) of the Clean Air Act, as amended, are amended to read as follows:

"(2) (A) After public hearings and within twelve months of the effective date of this Act, the Governor of a State shall adopt ambient air quality standards applicable to any air quality control region or portions thereof designated pursuant to section 107 (a) (3) of this Act for any pollutants or combinations thereof for which air quality criteria and recommended control techniques have been issued prior to enactment of this Act.

"(B) After receiving any air quality criteria and recommended control techniques issued after the date of enactment of this paragraph and after public hearings, the Governor of a State shall adopt ambient air quality standards applicable to such regions pursuant to the procedures set forth in paragraph (1) of this subsection.

"(C) Such standards and plan or revisions thereof shall be the air quality standards applicable to such region or portions thereof if the Secretary determines that—

"(i) such standards and plan are established in accordance with the letter of intent;

"(ii) such State standards are consistent with the air quality criteria and recommended control techniques issued pursuant to section 107;

"(iii) such plan assures that such standards of air quality will be achieved within a reasonable time;

"(iv) such plan includes emission requirements necessary to implement such standards of air quality;

"(v) such plan includes a procedure to assure that proposed new sources of emissions will not cause violation of such standards;

"(vi) a means of enforcement by State action, including authority comparable to that in subsection (k) of this section, is provided; and

"(vii) such State standards and plan are consistent with the purposes of this Act.

"(3) The Governor of a State shall, from time to time, but at least every five years, hold public hearings for the purpose of reviewing the air quality standards established under this subsection and, as appropriate, revising and adopting improved air quality standards. No revised air quality standards shall reduce the ambient air quality of any designated region or portion thereof to which such standards are applicable below the quality established by the air quality standards for such regions or portions thereof prior to such revision.

"(4) If a State does not (A) file a letter of intent or (B) establish or revise air quality standards in accordance with paragraph (1), (2), or (3) of this subsection with respect to any air quality control region or portion thereof, or if the Secretary finds it necessary to achieve the purpose of this Act, or if the Governor of any State affected by air quality standards established pursuant to this subsection petitions for a revision in such standards, the Secretary shall within one hundred and eighty days develop proposed regulations setting forth such standards or revisions thereof consistent with the air quality criteria and recommended control techniques issued pursuant to section 107 applicable to such regions or portions thereof. When such standards are developed, the Secretary shall, after notice, promptly hold a public conference of interested representatives of Federal, State, and interstate agencies and of municipalities, industries, and other persons to review and comment on such proposed standards. Upon completion of such conference, the Secretary shall publish such proposed standards in the Federal Register with such modifications as he deems appropriate and notify the affected State or States. If, within ninety days from the date the Secretary publishes such standards, the State has not adopted air quality standards found by the Secretary to meet the requirements of this subsection for establishing such standards, or if a petition has not been filed under paragraph (5) of this subsection, the Secretary shall promulgate such standards.

"(5) At any time prior to thirty days after standards have been published under paragraph (4) of this subsection, the Governor of any State affected by such standards may petition the Secretary for a hearing. The Secretary shall promptly issue a notice of such public hearing before a board of five or more persons appointed by the Secretary for the purpose of receiving testimony from State and local pollution control agencies and other interested persons affected by the proposed standards, to be held in or near one or more of the areas where such standards will apply. Each State affected by such standards shall be given an opportunity to select a member of the board. The chairman and not less than a majority of the members shall not be officers or employees of Federal, State, or local governments. Board members, other than officers or employees of Federal, State, or local governments, shall be, for each day (including traveltime) during which they are performing committee business, entitled to receive compensation at the rate fixed by the appropriate Secretary but not in excess of the maximum rate of pay for grade GS–18 as provided in the General Schedule under section 5332 of title 5 of the United States Code, and shall, notwithstanding the limitations of sections 5703 and 5704 of title 5 of the United States Code, be fully reimbursed for travel, subsistence, and related expenses. On the basis of the evidence presented at such hearing, the board shall, within thirty days unless the Secretary determines a longer period is necessary, but in no event longer than sixty days, make findings of fact as to whether the standards comply with the requirements of this subsection for establishing such standards and issue a decision incorporating such findings therein and transmit its findings to the Secretary and make its findings public. If the board finds that such standards so comply, they shall be promulgated immediately. If the board recommends modifications therein, the Secretary shall promulgate revised standards in accordance with such recommendations.

"(6) Any violation of air quality standards established under this subsection, including the implementation plan is prohibited.

"(7) Whenever, on the basis of surveys, studies, investigations, or reports, an authorized representative of the Secretary finds a violation of such standards, he shall promptly issue an order in writing to the person causing or contributing to such violation requiring such person to abate such violation as soon as possible and within a time to be prescribed therein, except that in the case of a violation of emission requirements, such time shall not exceed seventy-two hours. A copy of the order shall be sent to the State pollution control agency of the State or States in which the violation occurred. Subject to the provisions of this subsection, such order shall remain in effect until such representative determines by written notice to such person that such violation no longer exists. All such orders shall contain a detailed description of the conditions or practices which cause or constitute a violation. Nothing in this paragraph shall affect the authority of the Secretary pursuant to subsection (k) of this section.

"(8) (A) Any person issued an order pursuant to paragraph (7) of this subsection other than an order to abate a violation of an emission requirement may file with the Secretary an application within thirty days of receipt thereof for a public hearing to review such order. The applicant shall send a copy of such application to the State pollution control agency in which the violation occurred. Upon receipt of such application, the Secretary shall promptly hold a public hearing to enable such person and other interested persons to present information relating to the issuance and continuance of the order, or the time fixed therein, or both. The filing of an application for review under this paragraph shall not operate as a stay of the order. Any such hearing shall be of record and shall be subject to section 554 of title 5 of the United States Code.

"(B) Immediately upon completion of the hearing, the Secretary shall make findings of fact giving due consideration to the technological feasibility of complying with such standards and he shall issue a written decision, incorporating therein an order vacating, affirming, modifying, or terminating the previous order complained of and his findings.

"(C) In connection with any hearing under this paragraph, the Secretary may sign and issue subpenas for the attendance and testimony of witnesses and the production of relevant papers, books, and documents, and administer oaths. Witnesses summoned shall be paid the same fees and mileage that are paid witnesses in the courts of the United States. In case of contumacy or refusal to obey a subpena served upon any person under this paragraph, the district court of the United States for any district in which such person is found or resides or transacts business, upon application by the United States and after notice to such person, shall have jurisdiction to issue an order requiring such person to appear and give testimony before the Secretary or to appear and produce documents before the Secretary, or both, and any failure to obey such order of the court may be punished by such court as a contempt thereof.

"(9) Any decision issued by the Secretary under paragraph (7) or (8) of this subsection shall be subject to judicial review by the United States court of appeals for the circuit in which the violation occurred, or the United States Court of Appeals for the District of Columbia Circuit, upon the filing in such court within thirty days from the date of such order or decision of a petition by any person aggrieved thereby praying that the order or decision be modified or set aside in whole or in part. Any order issued by the Secretary to abate a violation of an emission requirement shall be final and shall be in force until and unless the court determines that the interests of the public are best served by staying such order. A copy of the petition shall forthwith be sent by registered or certified mail to the Secretary and the State water pollution control agency, and thereupon the Secretary shall certify and file in such court the record upon which the order or decision complained of was issued, as provided in section 2112 of title 28, United States Code. The court shall hear such petition on the record made before the Secretary. The findings of the Secretary, if supported by substantial evidence on the record considered as a whole, shall be conclusive. The court may affirm, vacate, or modify any order or decision of the Secretary and, when appropriate, issue such process as may be necessary to abate such violation, or may remand the proceedings to the Secretary for such further action as it may direct. The judgment of the court shall be subject to review only by the Supreme Court of the United States upon a writ of certorari or certification as provided in section 1254 of title 28, United States Code. The commencement of a proceeding under this paragraph shall not, unless specifically ordered by the court, operate as a stay of the order or decision of the Secretary.

"(10) (A) The Secretary shall institute a civil action for relief, including a permanent or temporary injunction, restraining order, or any other appropriate order in the district court of the United States for the district in which a person subject to air quality standards established under this section is located or resides or is doing business, whenever such person (i) violates or fails or refuses to comply with any final order or decision issued under this subsection to enforce air quality standards established under this subsection or (ii) interferes with, hinders, or delays the Secretary or his authorized representive in carrying out his responsibilities under this section, or (iii) refuses to furnish any information, data or reports requested by the Secretary in furtherance of the provisions of this section, or (iv) refuses to permit access to, and copying of, such records as the Secretary determines necessary in carrying out the provisions of this section. Each court shall have jurisdiction to provide such relief as may be appropriate, except that such court shall have jurisdiction only with regard to the issue of relief being sought pursuant to this paragraph. Temporary restraining orders shall be issued in accordance with rule 65 of the Federal Rules of Civil Procedure, as amended, except that the time limit in such orders, when issued without notice, shall be seven days from the date of entry. In actions under this section, subject to the direction and control of the Attorney General, as provided in section 507 (b) of title 28 of the United States Code, attorneys appointed by the Secretary may appear for and represent him. In any action instituted under this section to enforce an order or decision issued by the Secretary after a public hearing in accordance with section 554 of title 5 of the United States Code, the findings of the Secretary, if supported by substantial evidence on the record considered as a whole, shall be conclusive.

"(B) Any person who knowingly violates any air quality standards established under this subsection or who knowingly violates any plan for implementation or emission requirements included in such standards or who knowingly violates or fails or refuses to comply with any final order or decision issued under this section shall, upon conviction, be punished by a fine of not more than $25,000 per day of violation, or by imprisonment for not more than one year, or by both, except that, if the conviction is for a violation committed after the first conviction of such person under this section, punishment shall be by a fine of not more than $50,000 per day of violation, or by imprisonment for not more than five years, or by both.

"(C) Any person who knowingly makes any false statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under this title or any order or decision issued under this section shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both.

"(11) For the purpose of making any investigation under this subsection of any building, structure, or other facility subject to air quality standards established under this subsection, the Secretary or his authorized representative shall have a right of entry to, upon, or through such building, structure, or facility. Whenever any person is required by a final order issued under this subsection to abate any violation of air quality standards established under this subsection, the Secretary shall, when appropriate, require such person to sample any emissions subject to abatement by such order in accordance with such methods, at such locations, at such intervals, and in such manner as the Secretary shall prescribe and report such samples to the Secretary as he may prescribe and such report shall be public.

"(12) (A) No person shall discharge or in any other way discriminate against or cause to be discharged or discriminated against any employee or any authorized representative of employees by reason of the fact that such employee or representative of any alleged violator has filed, instituted, or caused to be filed or instituted any proceeding under this Act, or has testified or is about to testify in any proceeding resulting from the administrations or enforcement of the provisions of this Act.

"(B) Any employee or a representative of employees who believes that he has been discharged or otherwise discriminated against by any person in violation of subparagraph (A) of this paragraph may within thirty days after such violation occurs, apply to the Secretary for a review of such alleged discharge or discrimination. A copy of the application shall be sent to such person who shall be the respondent. Upon receipt of such application, the Secretary shall cause such investigation to be made as he deems appropriate. Such investigation shall provide an opportunity for a public hearing at the request of any party to enable the parties to present information relating to such violation. The parties shall be given written notice of the time and place of the hearing at least five days prior to the hearing. Any such hearing shall be of record and shall be subject to section 554 of title 5 of the United States Code. Upon receiving the report of such investigation, the Secretary shall make findings of fact. If he finds that such violation did occur, he shall issue a decision, incorporating an order therein, requiring the person committing such violation to take such affirmative action to abate the violation as the Secretary deems appropriate, including, but not limited to, the rehiring or reinstatement of the employee or representative of employees to his former position with compensation. If he finds that there was no such violation, he shall issue an order denying the application. Such order issued by the Secretary under this subparagraph shall be subject to judicial review in accordance with this subsection. Violations by any person of paragraph (1) of this subsection shall be subject to the provisions of paragraph (10) of this subsection.

"(C) Whenever an order is issued under this paragraph, at the request of the applicant, a sum equal to the aggregate amount of all costs and expenses (including the attorney's fees) as determined by the Secretary to have been reasonably incurred by the applicant for, or in connection with, the institution and prosecution of such proceedings, shall be assessed against the person committing such violation.

"(13) The district courts of the United States shall have original jurisdiction, regardless of the amount in controversy or the citizenship of the parties, of civil actions brought by one or more persons on behalf of themselves or on behalf of any other persons similarly situated within any air quality control region or portion thereof designated under section 107 against any person including a governmental instrumentality or agency, for declaratory and equitable relief or any other appropriate order against any person, where there is an alleged violation of any applicable air quality standards, plan for implementation or emission requirements established pursuant to this section. Nothing in this subsection shall affect the rights of such persons as a class or as individuals under any other law to seek enforcement of such standards."

(c) Section 108 of the Clean Air Act, as amended, is further amended by adding a new subsection at the end thereof to read as follows:

"(i) Within six months after the effective date of this Act, the Secretary shall issue regulations to insure that any person constructing or installing any new building, structure, or other facility subject to any air quality standard established or revised pursuant to this section installs, maintains, and uses the latest available pollution control techniques. Such techniques shall be consistent with information developed pursuant to section 107 (c). No person shall construct or install any such building, structure, or facility without first receiving certification of compliance with such regulations from the Secretary or, as appropriate, the State pollution control agency. In no event shall the Secretary or

State agency certify any technique which does not implement emission requirements established pursuant to this Act."

SEC. 5. Section 111 of the Clean Air Act, as amended, is amended further by adding a new subsection at the end thereof to read as follows:

"(c) Beginning on and after July 1, 1972, no Federal department or agency (1) shall make any loan or grant to, or issue any license or permit to, or enter into any contract for financial assistance with, any person for the construction, installation, or operation of any commercial or industrial building, structure, or other facility from which any matter is discharged into the air within any air quality control region or portions thereof designated under this title, or (2) shall procure goods or products from any person who manufactures such goods or products in a building, structure, or other facility from which matter is discharged into the air within any air quality control region or portions thereof designated under this title, unless it is found that such matter is being discharged in compliance with the air quality standards including emission requirements established under this title for such region or portions thereof by the air pollution control agency of the State in which such building, structure, or other facility is located and such person files a statement with such department or agency of such finding."

SEC. 6. The provisions of this Act amending the Clean

Air Act, as amended, shall, unless otherwise provided in said amendments, be effective on July 1, 1971, except that such amendments shall not, unless otherwise provided therein, affect actions taken under the sections as amended prior to such effective date.

Comparison of Provisions of Pending Legislation

The Administration bill, S. 3466, would amend many of the provisions of the Clean Air Act, as amended, as follows:

(a) Extend authorization of—

(1) Existing section 104(c) (fuel and internal combustion enginge research) by authorizing "such sums as may be necessary" for the next three fiscal years.

S. 3229 before the Committee would similarly extent S. 104 by authorizing: 1970, \$45 million; 1971, \$125 million; 1972, \$150 million; and 1973, \$175 million.

(2) Existing section 309 (general NAPCA appropriation) by authorizing "such sums as may be necessary for the next three fiscal years."

S. 3229 would authorize: 1970, \$134 million; 1971, \$150 million; 1972, \$175 million; and 1973, \$200 million.

(b) (1) To provide authority to spot check assembly line motor vehicles for in fact compliance with emission standards promulgated under existing law and (2) clarifying amendments to the motor vehicle registration provisions.

(c) To amend existing law (section 210) providing authority for fuel additive registration by requiring (1) registration of fuels, (2) compilation of data and research on such fuels and additives, and (3) authority to regulate sale of fuels and fuel additives and increasing to \$10,000 the penalty for violation.

S. 3229 does not contin such an amendment for fuel additives and fuels. However, it does propose to authorize extension of motor vehicle emission standard authority to all moving internal combustion engines—including aircraft. It also provides for Federal preemption for this authority. S. 3229 would also provide for a Federal grant program to assist States in inspection.

An amendment to S. 3229 (#501) introduced by Senator Montoya would authorize the Secretary of HEW to sets standards for fuel composition, to regulate manufacture and processing of fuels, and to regulate their importation. The Amendment further provides a penalty of \$1,000 per day for violation of any such regulations.

S. 3229 would authorize HEW to set emission standards for all sources of "solvents".

(d) To substitute for the present procedure for establishment of regional standards, a new authority for HEW to set national ambient air standards for any pollutant or combination of pollutants. This would eliminate a procedure requiring a 6-month time period required under the present Act. It is not clear from the language whether the States could adopt more stringent standards. Even though Section 109 of the existing law is preserved giving States the authority to set more stringent standards there is no procedure set out in the proposed bill, consequently Section 109 may prove to be impossible to implement. Another problem is that this proposal would avoid public hearings in standard setting which to date have resulted in more stringent standards than recommended by government agencies. The Secretary would continue his responsibility to furnish criteria.

S. 3546, introduced by Senator Muskie, would provide that regional standard setting would be continued but would direct the Secretary of HEW to designate all air quality control regions immediately. It would also accelerate the regional standards setting processes by requiring a letter of intent from the Governor within 30 days of the issuance of criteria rather than the 90 days under present law. S. 3546 preserves the 6-month period for regional standard setting and the 6-month period for establishment of implementation plans in requiring public hearings in both procedures. It will also, as does the Administration bill, require emission requirements (effluent standards) for all sources of air effluence in a given region.

S. 3546 will require consideration of revision of air quality standards every five years. S. 3546 adds a new provision to authorize the establishment of ambient air quality standards for those areas of the States not included in the air quality control regions designated by the Secretary.

(e) In order to conform to the National air standard States would be required to file in 90 days from date of setting the national standard a letter of intent to prepare an implementation plan that would include enforcement, effluent standards and intergovernmental cooperation provisions, that must be submitted to HEW within 6 months and if there is failure to do so HEW would impose such plan (with a procedure provided).

S. 3546 would provide for imposition of Federal standards where the States fail. S. 3546 is more detailed than the Administration's proposed revision in that it calls for the Secretary to act within 180 days to establish regulations to notify interested parties, to hold a conference, and at the conclusion of the conference publish the proposed standards and within 90 days promulgate the imposed standards. The Administration bill would require the Secretary only to have a public hearing, taking testimony from interested parties, and following such public hearings, to promulgate such regulations. The minimum time under S. 3546 approximately 10 months; the minimum time under the Administration proposal would be approximately 2 months before such federally imposed regulations were promulgated.

(f) to amend the Secretary's abatement authority to provide that he may initiate abatement upon (1) violation of ambient air standards due to failure of a State or interstate agency to enforce its "Plan." The abatement authority requires the State to act within 90 days of the Secretary's notice or the Secretary refers the matter to the U.S. Attorney General for court abatement.

S. 3546 also imposes penalty provisions including fines up to $25,000 per day violation.

(g) preserves the enforcement and abatement procedures on international pollution from U.S. Source culminating in court action, following notice and conference.

S. 3546 also preserves this authority with some modification.

(h) authorizes the Secretary of HEW to set, by regulation, emission standards (effluent standards) for stationary sources. The Secretary would (1) prohibit or condition construction and operation of those sources having emissions "extremerly hazardous to health"; (2) require installation of devices on existing sources; and (3) require that any new source of emission shall be constructed with the most advanced applied technology. Although the President's message indicates that this authority was restricted to "new sources" a fair reading of the proposed legislation discloses no such limitation and it appears that the authority is only limited to new or existing sources that "contribute substantially to endangerment of public health and welfare, and (2) can be prevented or substantially reduced." Although there is provision that a State can adopt Federal stationary source emission standards in its implementation plan, it is not clear if a State can impose more stringent emission standards for such stationary sources.

In addition, an abatement provision is provided that if following notice of violation and after a time set in such notice for compliance, there is non-compliance, the Secretary then refers the matter to the Attorney General.

S. 3546 will also require emission requirements for all sources of air pollution in a region to be filed with the implementation plan.

(i) To provide general Federal enforcement authority for violation of air quality standards resulting from a failure to enforce implementation plans. This is initiated by the Secretary furnishing notice of required remedial action that must be taken in not less than 60 days. If there is non-compliance with such notice the matter is referred to the Attorney General for court proceeding. There is also provision that the court *may* impose a fine up to $10,000 for each day after the end of the period set for compliance in the notice from the Secretary. This authority may or may not exist in present law.

S. 3546, as does the Administration bill, abbreviates the enforcement procedure. Whenever the Secretary finds a violation of standards he shall issue an order to the person causing or contributing to such violation requiring abatement as soon as possible except that in the case of a violation of emission requirements such time shall not exceed 72 hours. Except for an order requiring abatement of violation of an emission requirement, the alleged violator may request a public hearing after which the Secretary shall make a finding of fact giving due consideration to technologic feasibility complying with such standards and issue a decision. Such decision is reviewable in the Court of Appeals. Following such decision the Secretary shall institute civil action in the District Court for abatement.

S. 3546 would mandate a fine for violation up to $25,000 or 1 year in prison or both.

In addition to the governmental abatement provided in the existing law and proposed to be modified in both the Administration bill and S. 3546, S. 3546 would add provision that the District Courts shall have original jurisdiction to hear complaints brought by citizens for alleged violation of air quality standards and plans for implementation. The remedy sought is limited to declaratory and equitable relief.

S. 3229 would authorize the establishment in HEW of an Office of Noise Pollution Abatement. The President's message was silent on Noise.

Senator MUSKIE. Our first witness this morning is Dr. Ruth Weiner, president of the Colorado Citizens for Clean Air.

Dr. Weiner, it is a pleasure to welcome you this morning, and to receive your testimony.

STATEMENT OF DR. RUTH WEINER, PRESIDENT, COLORADO CITIZENS FOR CLEAN AIR, DENVER, COLO.

Dr. WEINER. Thank you very much.

It is a great honor to be here, to be asked to appear before the committee.

I am here as representative of the Colorado Citizens for Clean Air, which presently has a membership of about 250 citizens, mostly of Denver, and I am also representing the Colorado Open Space Coordinating Council, which is a federation of about 26 conservation-oriented organizations, with an accumulative membership of 25,000, mostly citizens of Colorado.

Professionally, I am a professor of chemistry at Temple Buell College in Denver, and I hold a doctorate in physical chemistry from Johns Hopkins University.

I would like to comment, first of all, on the national program which sets up ambient air quality standards. Let me say, we are extremely grateful for Federal leadership in this area. Without Federal leadership, we would have no pollution control at all, I am certain, in Colorado, or anywhere else. However, there are certain aspects of the Federal program which I don't think work quite as they are intended.

The ambient air standards, which are set up under section 108 of the existing act, have become, on the statewide level, a kind of low-numbers game. If you look on the ambient air standards as a goal, then the obvious goal should be zero, or background, whatever the case may be.

To set anything higher as a goal implies that some community will be permitted to pollute up to a certain level. And it is our opinion that the total pollution burden of the earth, if you will, can no longer bear that kind of addition.

You have got to, instead of saying to a community, as setting an ambient air standard does, "OK, this particular level of pollution is an OK level," so this is in a sense a license to pollute up to that level.

Senator MUSKIE. That really isn't what the act says.

Dr. WEINER. I know it isn't what it says, but it is sort of the way it really works in practice.

We have got ambient standards in Colorado, and this is the way they are interpreted. I know it is not what the act says, but it is the interpretation that has resulted.

Senator MUSKIE. Let me ask you a question. Do you think there is a way of establishing a control mechanism which will achieve zero of purely manmade pollutants?

Dr. WEINER. No; I don't think there is, because there are always leaks.

Senator MUSKIE. So I gather what you mean, or what I understand you to mean, is that we need a way of tightening the screws on polluters, which means that you have got to do it as fast as technology permits.

Dr. WEINER. That is correct.

And I think my own feeling about the way this should be done is to set emission standards, not at some ambient levels, or some permissive level, but at the ultimate level of control, and then to keep revising them as control mechanisms become available in an off-the-shelf fashion.

Senator MUSKIE. Might I say in response that just as we can't expect zero as the goal for purely manmade pollutants under ambient air standards, in the same way if you have national emission standards you have got to set those in stages.

Dr. WEINER. I think if you set——

Senator MUSKIE. If you set them in stages, isn't your first stage a permission, a license to pollute?

Dr. WEINER. Yes, it is; and I think that I would envision that over the next 5 years you could set for stationary emitters of certain pollutants of the major pollutants, sulfur dioxides, nitrogen dioxides, nitric oxide, and hydrogen sulfide, an approaching goal of zero emission.

It is now possible to control anything that comes out of a stack, because in the laboratory, we do it all the time, and you test stacks quantitatively. It is not economic, and part of the point——

Senator MUSKIE. The very limited point I am making is that whatever mechanism you adopt, you have got to approach your ultimate goal in stages.

Dr. WEINER. Yes.

Senator MUSKIE. And you are saying that because the 1967 act recognizes the fact that you have got to approach it in stages that the first stage amounts to a license to pollute. And all I am saying is that if you adopt your mechansm, since it also depends upon approaching it in stages, the first stage is going to be interpreted as a license to pollute.

Dr. WEINER. Yes, I think you are right, and perhaps I should alter my own thinking, and not adopt the first stage.

Senator MUSKIE. What we are all striving for is the ultimate goal, which you state, and that is where there would be no manmade pollutants, and where we approach background levels. Since you can't do it tomorrow morning with whatever mechanism you adopt—I think we have to consider all, including national emission standards, ambient air standards, and so on. I think we will gradually put together—I hope, at least, we will—a mechanism that will begin to tighten the screws effectively. But to concentrate upon the first stage, only, I agree with you, is misleading. It is discouraging. We ought to recognize that whatever mechanism we are talking about, whether it is the 1967 act or the one you propose, we are going to have to propose to move toward it in stages. The real test really is how rapidly your mechanism permits you to move to the ultimate.

Dr. WEINER. Yes, and this is the place where I would think that a mechanism which sets emission standards, which is the basis on which you actually have enforcement—you don't really enforce against ambient standards, you enforce against emission standards—would move more rapidly toward a state of cleaner air than the present and continued mechanism of setting ambient standards, and then setting forth an implementation plan which will meet the ambient standards.

Senator MUSKIE. Of course, the approach of the ambient standards is this: If you talk only about national emission standards, I assume you have got to identify the national polluters. You are not going to control the backyard burning, under a national standard, presumably. I don't know what you have in mind.

A lot of pollution sources are not national in their scope. In a given community, they could be heavy contributors to that community's air pollution problem.

The whole idea of the ambient standards is not that you don't control emissions; of course you have to control emissions. They are the source of pollution. But the idea behind ambient standards is that they give you a mechanism to get at all polluters, whether national, or regional, or local, in impact.

Dr. WEINER. Yes. And this is, in that sense, a very good mechanism.

But what we would envision is that the relationship between national emission standards, State emission standards, and local emission standards is somewhat the way under the new bill which was just passed in Colorado, we have a relationship between State and local: the local agencies may set more stringent standards than the State.

In other words, if you don't ban backyard burning on a national level, you still permit a given community, as Denver, in fact, does, to prohibit backyard burning, whereas another community, such as Fleming, Colo., which is very small, permits backyard burning.

So this much leeway is allowed.

My only quarrel with the ambient standards is that what happens with ambient standards becomes a little misleading. You permit a given emitter to say, "How can you prove that this particular ambient level of sulfur dioxide is due to my emission?" And the enforcing agency, or in some cases the citizens group, then has to go through a long routine with the diffusion model, and everything else, proving that it was in fact his emission. This is a question I don't think we should ever have to answer. We should never have to say to anyone, "It was you, and therefore, you have to stop."

You should be able to say to an emitter, "Because you are emitting sulfur dioxide"——

Senator MUSKIE. I agree, but I think also that you can't ignore the relationship between a whole range of emissions and their results in terms of ambient air quality.

Dr. WEINER. No, I don't propose to ignore it.

Senator MUSKIE. It seems to me that we need both, under whatever mechanism of control we use. They are interrelated. In the case of the 1967 act, we haven't really started. This is one of my complaints about it, frankly; in the administration of the program, we haven't really started to implement it.

Dr. WEINER. Yes.

Senator MUSKIE. And we do not understand, or at least we haven't made clear, the connection between emissions and the ambient air quality. As long as that point is involved, I think your criticism is perfectly valid.

But I don't think that it needs to be endowed under the 1967 act, and that is why some of the amendments that we are considering are before us. I think, eventually, we have to move into increasing the range of national emission sources that we control.

The internal combustion engine is one. That is the national standard. We ought to establish others, for local sources.

I didn't mean to interrupt your statement at this point. I wish you would continue with that and we will get into some of these questions, maybe, more thoroughly after you have finished.

Dr. WEINER. Thank you. Thank you very much.

The next point I was going to make involves exactly the connection between ambient standards and the implementation plan study. There are really only two ways of judging an implementation plan.

At least, from various materials we have received from NAPCA.

The first one is a sort of general——

Senator MUSKIE. First, where are you picking up?

Dr. WEINER. Oh, I am picking up at the last paragraph on page 1.

Senator MUSKIE. I wish you would go back and pick up that fourth paragraph, because that is a Denver situation, and I would like to have that.

Dr. WEINER. Oh, I am sorry.

We have in Denver a very high particulate background. At Cherry Creek Dam, which is considerably outside the city limits of Denver and which is generally considered, in the Denver air quality region, to be a pollution-free area, we measure a background annual arithmetic mean of 55 micrograms per cubic meter, which is very high. Now, how we can expect to get our particulate level in Denver below this escapes me, and I don't think that NAPCA has given sufficient consideration to the fact that we do have a high ambient background.

The other problem that we have with the Federal criteria is that we have very little sulfur dioxide. The present standards in the Colorado law are such that Colorado is essentially a sulfur dioxide haven, the industries have taken the attitude that, because there isn't any problem, they can come right in and create one. We only have about three significant sulfur dioxide emitters in the Denver metro area, and one of those shouldn't be operating at all; they should be shut down.

We would like to have more consideration given soon to what our real problem is, which is the production of nitric oxide and nitrogen dioxide. This is the really bad constituent of the Denver problem, because there is reason to believe now that nitric oxide is the photochemical trigger, it is the energy absorber, for photochemical radiation.

Senator MUSKIE. What kinds of emitters do you have that produce that?

Dr. WEINER. All high temperature emitters do. Our powerplants do, the foundries—we have a couple of foundries in South Denver, a number of refineries north of Denver city limits, and Adams County, and since they emit fairly hot gases, they are heavy producers of nitric oxide, and of course all of the automobiles produce nitric oxide at the exhaust, and the four power-generating stations in the South Platte Valley.

The problem is that we are subject to temperature inversions, very severe temperature inversions, and our industries are situated along the South Platte Valley, which is the low point, so that everything collects and builds up during the day, and the typical brown color of nitrogen dioxide on bad smog days screens the mountains from Denver. It is a visibility thing. You can see it very well.

This is why we are so aware of this.

Senator MUSKIE. You see that in a lot of those mountain cities out there, don't you?

Dr. WEINER. Yes, it is becoming an increasing problem.

Well, this was my point about the background.

My point about the implementation plan is that there are only two ways of judging it: one the reduction of percentages; the other is by a diffusion modeling technique, and insofar as I am familiar with the diffusion modeling technique it doesn't take enough of the variables into account. It does not, for example, take into account the photochemical reaction between different sources of pollution. Although you can put different sources into the diffusion equation, it is not developed to a point where you can include the products of reactions, largely because the reaction mechanisms are not well established.

So it is a little difficult to see on what basis our implementation plans are going to be judged as being adequate, and here is one place where S. 3546, on page 3, does set up some criteria for judging this, which includes emission standards.

It seems to me that in order to judge an implementation plan NAPCA has got to consider what the local emitters are, and what the local emission standards are. They can't simply plug into a diffusion model and say, "It is good," or "It is bad." I would also hope that in judging any of these implementation plans differences in altitude are taken into account. We have a very severe problem in Denver because of the high altitude, because we are operating at nine-tenths of an atmosphere, rather than one atmosphere pressure.

Senator MUSKIE. I would like to make two points here.

One, we had intended that emission requirements be taken into account in the 1967 act, and the confusion which has developed under it is one of the reasons why this provision is in this bill.

The second point is that one of the reasons why we took the regional approach in 1967 is the very one that you have touched upon; that is, there are differences, altitude, and so forth. In my part of the country, we are presumably ventilated by the ocean breeze. The ventilation doesn't work very efficiently, but, nevertheless, the fact that we are located on the ocean is one of the reasons why there is a different approach. The regional plan is a way of taking into account the variables.

Dr. WEINER. I think part of this has been in the actual working of the plan, and in Durham, N.C., where our plans were criticized, they often don't have any real picture of what the Denver situation is.

I know that S. 3466 includes national ambient standards, and I have failed to see what effect they are going to have at all.

It seems to me any national ambient air standard just is going to foul Denver up hopelessly. It would be a disaster for Denver.

We are in a situation where a little smog goes a long way, and I am sure that any national standards would be set above the level that Denver could tolerate.

Senator MUSKIE. I have my own ideas of why that language was used, but we will get it defined tomorrow, with the Secretary.

Dr. WEINER. I think this would be a very bad way to go, myself. I think this is something we are already arguing with our own enforcement agencies, that for an emergency alert system, for example, we can't use Los Angeles measurements. We have got to make a correlation in Denver of what the citizen of Denver perceives as bad smog, versus what our single monitor downtown measures as bad smog, and we have as yet been unable to convince our own enforcement agencies or anybody else that this is the case.

The Citizens for Clean Air is starting a voluntary program of correlation, getting the data and correlating it with what various people around Denver see as bad smog on that day, or as a good day, for that matter. So far as I know, this is the only program of its kind in the country. There is a lot of correlation with health effects. There is almost no correlation with visible or esthetic effects. It seems to me that is extremely important, because this, in a sense, the esthetic effect is an early warning system. Smog is unpleasant a long time before it is bad for you, and in Denver, especially, we are accustomed to a visibility of 80 miles, and when it is cut down to 1 or 2 miles, people still aren't dropping dead, nor are we having increased hospital admissions, but it is noticeably bad and unpleasant, and it does serve as a warning to everyone.

I would like to see some visibility standards adopted.

Senator MUSKIE. We ought to get some smell from that, too.

Dr. WEINER. And some smell. But this is very difficult to get in.

Another problem, incidentally, to get back to the diffusion modeling, is that we do have agricultural opening burning taking place in agricutlural counties which are near major or urban centers. There is an agricultural area included in the present Denver air quality region, and it is impossible to include those in the diffusion equation, because you don't know when the people are going to burn, you don't know where they are going to burn, what the extent of the burning is; it may be just a ditch, it may be a fence row, it may be a whole field, and this does contribute significantly to the pollution problem in Denver.

For example——

Senator MUSKIE. Is it seasonal?

Dr. WEINER. It is somewhat seasonal, and we have had bad situations where tree burning has been done in the city of Denver, because of Dutch Elm disease, and at the same time, some fellow in Adams County burns off a field, and the sky is just dark brown everywhere.

Senator MUSKIE. For what purposes are the fields burned off?

Dr. WEINER. I am not a farmer, so I don't know. I think there is a lot of debris that collects in ditches. Partly, we suspect, they burn off their own trash. If you drive around in rural counties, you do see huge piles of old tires and papers and stuff being burned. The farmers claim that the city slickers dump a lot of trash on their ground, and they have to burn it.

Senator MUSKIE. I can't blame them. I think that is true.

Dr. WEINER. And I can't blame them for that at all.

My point is only that it is a relatively uncontrolled source, and no matter how much we try to control it this will be a limited control at best, and should be taken into account in any judgment of our implementation.

Senator MUSKIE. There are some parts of the country where burning is associated with the crop itself.

Dr. WEINER. Yes.

Senator MUSKIE. That isn't so in the Denver region?

Dr. WEINER. There is some, and I really couldn't answer to that with any kind of knowledge, because I have none.

The Federal criteria have concerned themselves primarily with health effects, and that has gotten us into a trap, especially with the industrial emitters in Denver, because they keep saying, "Well, all right, such and such a level is immediately below the demonstrable health effects, so beyond that, you don't have to control," and this definitely doesn't take into account long-term effects of pollutants building up in the atmosphere.

I see no way to take this into account.

Again, I would like to make the point that the esthetic effects is an early warning system for the health effects, and I think we should control below the level of discernibility, if we possibly can.

This was our point when we had the Federal hearings last October in Denver, and we were very much attacked for it.

This was the reason for suggesting nationwide emission standards, at least for some pollutants, and for some processes, because it seems to me every emitter should be controlled to the point where the emission can be controlled.

Senator MUSKIE. I would like to just make this point: It was not the intent that ambient air standards be related only to health effects. The ambient air standards were supposed to be designed, the statute says so, for health and welfare. Welfare included esthetics, smell—which we have a little bit of in my State, because of the manufacturing processes we have. The standards should go across the whole range. I would agree with you that if it would relate wholly to measurable health effects, we would have very little control. Crisis situations, potential crisis situations, are pretty limited. Still, in spite of the air pollution problem, long-term, low-level, health effects haven't yet been measured well enough to give us any rule. I would agree with you on this point.

Dr. WEINER. I am just talking about the way the thing seems to work, rather than the intent of the act.

Senator MUSKIE. And the only reason I am interrupting is because I think this is going to be an issue in these hearings. I just wanted at key points to indicate what our intent was, so that we can get the true record in the hearings.

Dr. WEINER. Yes.

Senator MUSKIE. May I make another point here? Again, I am saying this for the purpose of the record: There is a difference, of course, in health effects with different groups of people, old versus the young, the ill versus the healthy, and so on. In setting standards, not only ambient standards but emission standards, I would assume as we proceed through the stages, we must be concerned with the health effects upon the most vulnerable in our population rather than upon the healthy groups.

Dr. WEINER. Yes. I think this is very important, and it is very important to us.

Denver is a community where a great many people move to retire, in order to retire, and elderly citizens, retired citizens, form a large segment of our population. I think the effects on them should be considered very much.

We also, of course, have a hospital for asthmatic children, Children's Asthma Research Institute, and National Jewish Hospital, which for many years has been a center for people with lung disease, so we are quite concerned about effects on the vulnerable population, and we still have very little health effect in Denver, although everyone concedes that the smog is terrible.

I would like to go on to the subject of vehicle emissions. In Colorado, we have just been through the throes of passage of a new State air pollution law, and the Federal preemptions of emission standards for new vehicles has hurt us very much, mainly because, again, the difference in altitude is not taken into account. Most of the time when a car in Detroit is manufactured even to meet Federal standards, it won't meet those standards in Denver, much less at the top of Loveland Pass, which is 11,000 feet above sea level, and we are getting bad pollution situations in high-altitude areas, primarily over the major highways of the State. If you stand by U.S. 40, just below Berthoud Pass, at about 10,000 feet, you can smell the exhaust. It just builds up hugely, and I am sure it will only be a matter of time before we get enough that there will be photochemical reaction, and you will have a visible haze, which will destroy Colorado as a tourist State.

The visible smog is already having an effect on the tourist industry in Denver and I would hate to see this go to high altitudes.

Senator MUSKIE. Here is a case where national emission standards don't work.

Dr. WEINER. Well, what I was going to suggest is, again, the same thing that we have in Colorado between State and local agencies, that we permit localities to set more stringent standards, because in some locations, they are needed. Wouldn't it be possible to permit more stringent standards to be set for vehicles by some States, and have, let us say, a Federal emission standard, and permit the States to be more stringent, if they could?

I realize this is not going to find a happy audience in Detroit, but I think it would be a better situation all round.

Senator MUSKIE. You put your finger on one of the points that troubled us in 1967 when we were considering these two approaches. It was clear from the testimony then that when we talked about national emission standards, we were talking about minimal standards, whether it is automobiles, or steel mills, or paper mills, or any other polluters. And there are two difficulties: One, that if you are dealing with the kind of national technology which you have in the automobile, and you contemplate the possibility of requiring 50 makes, 50 different models of automobiles in a given year to fit 50 different sets of standards, you impose perhaps an impossible requirement.

The other side of it is that minimal standards tend to be interpreted as licenses to pollute. And industry says, "Well, now, these are the Federal standards, and we meet those. So if we meet those, that ought to be good enough." You are right back where you started from, because the people will say, "Now, if you force us to do more than the Federal standards require, you are going to drive us out of business." These businesses will go into States which are content with the Federal standards.

See what you get into?

Dr. WEINER. Yes, I can see, and I would prefer that the standards which would be acceptable in the high altitude regions of Colorado be adopted nationwide. This would be ideal, because it would mean less pollution.

Senator MUSKIE. Yes, but it also may mean that if we designed these standards to meet Colorado conditions, the standards might not meet conditions in other States. You might be imposing difficulties upon other States that they would be just as restive under as you are with respect to the present national standards.

Dr. WEINER. I don't see how an emission standard which would be acceptable in Colorado would be unacceptable anywhere else, because the difficulty in Colorado is that because of the relatively low oxygen pressure at high altitudes, you get less complete burning of fuel than you do at lower altitudes, so that the carbon monoxide and hydrocarbon problem is always worse.

Our big problem with cars is incomplete combustion, and this is where our standards should be more stringent than low altitude standards, so it seems to me that a standard that is acceptable at 10,000 feet is certainly going to be preferable at sea level, too, because the engine functions much more efficiently.

Senator MUSKIE. When you talk about the automobile, I think you must have—and this is the whole theory behind the 1965 act—the toughest standards that technology permits. That ought to mean as soon as possible emission free. I don't buy the view that the 1965 act is geared to Los Angeles, or to Maine, or to some other place.

I think we gave California an exemption from the preemption feature of the 1965 act because California has the most urgent problem and is in a better position to press against the frontiers of technology than some other areas would be inclined to do. But we think that whatever it is possible to do, and I think we ought to press to expand the possibility, ought to be done; but ought not to be geared to some acceptable level of pollution from the automobile. If we do not now have standards with respect to the internal combustion engine that are even slightly tougher than technology permits, then we haven't done a good enough job.

Dr. WEINER. Well, then maybe this is the problem. One of the problems with standards is, in my opinion, they can never be in terms of parts per million. Parts per million is a concentration standard, and you can always meet these just by putting more air through the engine, which is in fact done; they should always be in terms of grams per mile, which is an absolute standard.

Senator MUSKIE. I think that is the new measure.

Dr. WEINER. That is the new measure and, in addition, I don't see any reason for having very big engines. You are always going to get the situation where given the ultimate level of control of the internal combustion engine, a 400-horsepower engine pollutes more than a 90-horsepower engine, and I see absolutely no reason for having anything over 200 horsepower.

Who needs it anyway?

It seems to me that these things should either be outlawed outright, or taxed very heavily.

I don't see why anyone would want them; if they were not so heavily advertised, nobody would want them, and this is one of our major problems.

Denver depends very heavily on automobiles for transportation—much too heavily—and this is one of our big problems, that the people drive these things with huge engines, and they turn on 300 horsepower to go down to the store and get a box of Wheaties, and who needs it?

This is where the immediate control should come.

Now, I am speaking as a citizen. I don't sell cars. We have only one car. I ride a bicycle to work.

Senator MUSKIE. As a matter of fact, maybe more often than not, we ought to walk to the store and get that box of Wheaties, rather than ride at all. Should we go that far?

Dr. WEINER. Well, there should be some control, and if it is immediately only in the direction of small engines, it seems to me this should be done.

There is no pollution-free internal combusion engine. Such a thing thermodynamically can't exist. Nor, for that matter, can a pollution-free of any other type engine.

This is part of the trap, if I can talk about physical chemistry; it is part of the trap we are caught in with the second law of thermodynamics, that there is no machine that is 100 percent efficient, and you are always throwing out waste heat.

Senator MUSKIE. Of course, we could go a step further. We could say what I think is quite true. In a consumer-oriented society, anything we produce and use ends up as waste, so that maybe we ought to prohibit rises in the standard of living, because the rise will be more consumer products. The more consumer products we have, the more waste we have to dispose of.

You are talking about the size of an automobile engine. It goes much beyond that. Take the new types of containers that are being produced. If we went back to the old glass bottle, we would have less of a difficult kind of waste to dispose of than we have now. This is a problem in a consumer-oriented society. How far do we go? I am sure it is an area of inquiry that will open up more and more as public concern with the environment intensifies.

How far do we go in actually limiting the kinds of products that can be produced, the kinds of consumer tastes to which private enterprise will be free to serve? Just what limitations do we impose, in a consumer-oriented society, that is also free in the kinds of products that we manufacture, the kind of products that people can buy?

It is relatively easy to say—the size of an automobile engine is an obvious one. But then you go beyond that, and we are going to have disagreement as to how big an automobile engine. Then there are going to be those who say maybe we ought to go to something else, that we ought to get away from the internal combustion engine altogether.

On this kind of decision, for instance, I raised this question. It is conceivable there is emerging—the SST may be an example—there is emerging a technological development that can be just as serious in terms of the environment as the internal combustion engine has proved to be.

We have no mechanism for preventing the reemergence of that kind of a development. We couldn't prevent Henry Ford from inventing the automobile today. We couldn't prevent him from mass-producing it. We couldn't prevent him from distributing, so something like that could develop again. In a free enterprise society, there is no way of inhibiting it or limiting it.

It wouldn't necessarily be in the field of transportation. It could be in the field of some household appliance.

The disposal is such a thing. At the very time when water pollution was already a runaway problem, we put the disposal on the market. And we put into the waste treatment plants and the streams of our country the things that we formerly sent out to the dumps, either for landfill or the incinerators.

We moved the pollution from one form to another, and greatly intensified this one. There is no way to limit that. You have opened up a very interesting field of inquiry.

Dr. WEINER. Well, if I can answer your comment for a moment, I also agree with you, incidentally, about total waste, and it seems to me there are two ways of approaching it.

One is the incentive method. If people realized the relative pollution of large engines versus small engines, or some sort of containers versus another, there could be incentives to use the less polluting form as long as there is a choice, and in most cases, there is a choice, and you don't have to use a disposal, either.

Perhaps it would be better if you didn't.

Senator MUSKIE. Yes, but we all feel that somebody else's waste is the real problem.

Dr. WEINER. Well, I am for one thing very much opposed to the "no deposit, no return" bottle. These things are immortal, anyway, and I think we should stop using them, and go to consumer pressure to reuse as much as possible.

So there is the incentive mechanism, and it seems to me that we could put incentives on the greater promotion of smaller engines.

And there is also the question of equal time in advertising. Now I noticed that the people who are opposed to cigarette smoking have obtained equal time to answer the cigarette ads.

I wonder what would happen if we could obtain equal time to answer the 400-horsepower car ads?

Senator MUSKIE. Cigarettes have been taken even beyond that. After 1970, advertising is absolutely prohibited. Should we have a governmental agency deciding which consumer products should be permitted to be advertised and which ones not?

Dr. WEINER. No, I don't think we have to go quite that far, but I do in all seriousness make the equal time suggestion.

Senator MUSKIE. Who will pay for that time?

Dr. WEINER. Who is paying for it in the case of cigarette ads? It has been done as a public service.

Senator MUSKIE. It is the proliferation of products that you are going to try to provide equal time—that is the problem.

As a matter of fact, it is the problem in the political field. You see, it is easy to deal with the problem in presidential campaigns. But when you get down to all of the other campaigns, Senators, Congressmen, Governors, local councilmen and so on, there isn't enough time on the air.

You have a similar problem with cigarette advertising related to health. Public opinion finally supports legislation to prohibit it, or to control it, at least. But if we give this kind of control to all products that contribute to waste, which means all products, would there be enough time?

Dr. WEINER. Well, I am just making the suggestion, as something to think about.

But the additional problem with cars is that there is Federal subsidy of highways and Federal subsidy of suburban housing that promtes further use of automobiles. This subsidy should be reversed.

We have two instances in the Denver metropolitan area right now, branches of the Interstate System that, by the State highway department's own admission, are being constructed only because Federal money is available.

These are Interstate 470, and Interstate 1 South. Interstate 470 goes from nowhere to nowhere. It runs around the southwest corner of Denver just east of the foothills, and there is nothing there at present, not even suburban development. Of course, once the interstate is there, there will be. This is also a temperature inversion pocket.

The smog problem will be tremendous, if there is ever any buildup of housing. Interstate 1–S again runs just east of the mountains from Boulder north to, I guess, about Fort Collins or Loveland, or something like that. It parallels Interstate 25, which already exists, is not that heavily traveled.

We do not yet have the need for these highways, and of course, once the highways are built, like every other highway, they will be used, and we will get lots and lots of use, and more and more cars.

We need a subsidy for mass transit system. We don't need any more subsidies for highways.

And I wish I could make this point more strongly. Denver could really benefit from a good urban, interurban, and intraurban mass transit system. It would benefit the many elderly people who live there who are physiologically unable to drive cars. It would benefit the poor people, who now can't get to jobs.

We have a huge Hispano population in Northwest Denver. They can't get to Southeast Denver. The Denver Technological Center is miles away from the nearest mass transit. This is true all over.

We have dispersed industry, and we desperately need a mass transit system.

If we had one, we could make the tourist attractions that are within a 20- or 30-mile radius of Denver that much more available to people who now really have only an individual automobile to get there. And this has been the direct result of Federal highway subsidy, and I think this highway subsidy is ruining us.

I recognize this is somewhat beyond the scope of this subcommittee, but it is a real problem, and if there were some way to reverse it immediately, I would be all for reversing it immediately.

It was wrong ever to put an east-west interstate highway through Colorado. I think everyone admits that now. It is just criminal.

You go and you see these bulldozers just chopping up the mountains, and it makes you ill, physically. There are places where we now question whether the interstate should go at all.

I don't know if you have heard about the Glen Canyon controversy, but this is all part of the same problem, and the continued subsidy of roads leads in effect to an increased use of cars and a promotion of a sort of "one man, one car" philosophy, and especially in the urban areas, this has got to be reversed right now, if we are ever to get anywhere with this.

Finally, I would like to say a word about visible emissions. There is plenty of evidence that visible emissions from diesels can be completely controlled, and it seems to me here is a national standard that we do need to go to, and that is zero visible emission from diesels.

Again, this is a particular problem at high altitudes. It is not a health problem, but it is certainly an esthetic problem.

You get these buses going over the passes, and the snow all around the highway is black. Sometimes you can't even see the bus, it is so black.

Senator MUSKIE. I guess any one of us who has been stuck behind a diesel on a two-way road knows.

Dr. WEINER. We have tried in Colorado at various times to pass laws prohibiting visible emissions from any vehicle, and we have been unsuccessful in doing this, and here is some place where we need Federal help.

Senator MUSKIE. I might remind you that during the war I was a destroyer escort engineer. We had this sort of emission. We were required, under the interests of the security on seas, to so operate our engine plants that there were no emissions because emissions were visible at great disance. It was possible to do it—to operate them, and to maintain them—at levels that would absolutely cut out emissions. We did it.

It drove home a very good lesson to me. Of course, one of the great problems concerning not only diesel engine emissions but emissions from all vehicles is maintenance, which is dependent upon owner conscientiousness and attention. If every automobile and truck was operated at the highest standard of performance, that would mean periodic trips to the service station. You could greatly reduce emissions without any new technology. But then, you might have the problem of finding the help at these service stations to carry the load.

Dr. WEINER. We also have the problem that many diesel trucks, the interstate trucks, are tuned for low altitudes, and they are not tuned for high altitudes, and this gives us an additional visible emission, and then to get over the passes, they gun the motors, and just, you know, quantities of unburned fuel come out. I am sure that the visible emission is also in proportion to the invisible not completely burned fuel emission, so that the whole problem is worse.

Senator MUSKIE. I think you are right.

Dr. WEINER. And we could get rid of that some way.

The problem of Federal grant aid has been a difficult one, and again, I speak from my own experience since we have just been through passing a new law. It is very evident that the same factions in the State that are opposed to air pollution control in the first place are the same ones who don't want Federal control. They are apt to be State legislators in Colorado who don't believe there is any such thing as air pollution because they don't live in Denver, and where they live, there isn't any.

We had a problem with our recent legislation where a given provision, had it been included, would have made us ineligible for Federal grant aid. The same people who want it included, also don't want us to get the Federal grant aid, so in a sense, withholding of Federal funds, if the State laws or implementation plans are not adequate, is punishing the wrong people. It is punishing the people who are trying to get good pollution control in the first place.

I don't know how you handle this problem. I really have no solution to offer; maybe a direct Federal intervention. In other words, if the State does not come up with an appropriate plan, then the Federal Government substitutes their own plan for it.

Senator MUSKIE. How about a little people pressure?

You sound to me like—and this isn't the first time I have had the privilege of listening to your concern and articulateness—a great potential leader for building up public pressure in Denver, Colorado has passed some good laws on this subject.

I am sure you are constantly trying to strengthen them, but I think as compared to other States, Colorado has done reasonably well.

Dr. WEINER. Well, I don't point this out as a theoretical problem. During our present fracas over the law, we actually had one legislator get up and say on the Floor of the House, "Well we don't want that Federal money anyhow."

Senator MUSKIE. I am sure of that, although it doesn't happen often enough, as I look at our Federal budget.

Senator DOLE. You had better give us the name.

Dr. WEINER. Finally, we have a problem which is probably peculiar to Denver. We have had Federal installations, which really contribute fairly heavily to the pollution problem, and the worst one is the Rocky Mountain Arsenal, which is immediately north of Denver.

Presently, the Arsenal is undertaking a demilitarization program of stored mustard gas and nerve gas. Aside from the unpleasantness of having enough nerve gas to wipe out the city of Denver several times over stored about 20 miles north of Denver, we also have the problem that the Army is intending to burn the nitrogen mustards, and this is going to release large quantities of both nitrogen oxides and sulfur dioxide.

The original proposal was that they would wait until the wind was right—toward eastern Colorado, I presume—so that the smoke wouldn't blow over Denver, but it seems to me that the arsenal could afford to burn absolutely clean. They are not in the business of making a profit. It is going to cost them less in any case to get rid of the stuff than it cost them to produce it in the first place, and I see no reason why stringent controls should not be applied.

They have said that they will comply with the State law—our present State law—which is not terribly good. Even the new one would not much address itself to this problem, and finally, we can't get much indication of what it is they actually are emitting, because some of these processes are classified.

Now, HEW does have monitors, within the confines of the arsenal, but they won't tell the State enforcement agency what it is they are emitting.

There is also a Shell pesticide plant within the arsenal grounds. They lease land from the arsenal, and workers at the Shell plant say that on Interstate 70, which is somewhat south of there, and on Interstate 25, they can smell the chemical constituents of the pesticides being released.

We know that there are plant breakdowns, and that stuff does get by the filter and does get emitted into the air.

These are, chemically, bromine and chlorine compounds, and pesticide precursors. They are not good for you in any case.

We have had several episodes of very bad odors, where people actually did get sick, in the Commerce City area, which is quite close to the Shell plant. These episodes could never be traced to anything largely because the State enforcement agency has no idea of what is being emitted.

And it seems to me a simple way to clear up this problem would be to give a fairly high-ranking official in our State agency a security clearance, so that at least he could be the recipient of this information, and could work with the Federal installation to control the emission.

Right now, it is a very scary business. We don't know what is being emitted; we don't know how dangerous it is, and we don't know to what extent it is covering the Denver area.

We also have this problem with the Dow plant operated for the Atomic Energy Commission at Rocky Flats, and I am sure that even here in Washington people are aware that there has recently been evidence found of plutonium oxide in the soil, all around Denver, which is emitted at one time or another from Rocky Flats.

Again, this is a secret installation, they do classified work, and we have no idea of the extent of radioactive wastes leakage from this plant.

On a minor basis, we have the same problem with Fitzsimmons Hospital, with the Veterans' Administration hospital, in Denver; they emit and they feel quite free to emit in violation of the State laws, even our present State law, which is not a very good one, and it is more or less a continuing problem of cooperation and liaison, and perhaps something could be done about this at the Federal level, but we are simply unable to do in Denver.

Senator MUSKIE. I agree with that. It has been of concern to this subcommittee, almost from the time it was created, to try to make the Federal Government a good citizen, a good environmental citizen, and it has not been easy.

Two questions from the Executive Office. I think it might be well to include both at this point in the record, just so that we have that record.

Congress is about to approve the Water Quality Improvement Act of this year, which creates some additional tools in this area. I think maybe one of the stickiest kinds of problems is this one that deals with Defense Department facilities of the kind you are concerned with here in your statement.

Perhaps we ought to look at them to see what we can learn about the problem from our vantage point here. The Federal Government should set an example for the industrial establishment.

Senator MUSKIE. Please continue, Dr. Weiner.

Dr. WEINER. The question of Shell is a particularly sticky one, because this is a private industrial operation, which to the best of our knowledge, is not doing any classified work, and because it is on government land, the State inspection people have a great deal of difficulty entering and inspecting and monitoring their emissions.

And here, I have no idea how this problem is handled, but it seems to me Shell should have definitely come under the State enforcement and the emissions there are quite obviously detrimental to public health.

Senator MUSKIE. The Secretary of HEW, as I said earlier, will be testifying tomorrow. We will be happy to bring these to his attention and ask the Department to check out the points you have made.

Dr. WEINER. Well, that is the end of my statement.

(Dr. Weiner's prepared statement follows:)

PREPARED STATEMENT OF RUTH WEINER, REPRESENTING COLORADO CITIZENS FOR CLEAN AIR

My name is Ruth Weiner, and I am here as representative of the Colorado Citizens for Clean Air, Inc., an organization of about 250 members, of which I am chairman. I am also representing the Colorado Open Space Council, Inc. a federation of 26 organizations interested in environmental preservation, with a cumulative membership of about 25,000, mostly residents of Colorado. I am presently on the faculty of Temple Buell College in Denver, as assistant professor of chemistry; I received the Ph. D. degree in physical chemistry from the Johns Hopkins University in 1962.

The Air Quality Act of 1967 was evidently intended to assist states in setting up strong and effective air pollution control programs. If the act is to accomplish this end, some fundamental revisions are needed. First, the ambient air standards promulgated under Section 108 of the act have become, in fact, a kind of low numbers game. The uitility of ambient air standards in achieving clean air is questionable. Ideally, of course, the ambient air quality *goal* for each region should be zero for purely man-made pollutants and background for those pollutants that also emanate from other than man-made sources.

In the long-range view of the overall pollution problem, we should not permit ourselves the view that we will remain satisfied with some level of ambient air pollution, because the total pollution burden of the atmosphere only increases—it can never decrease. We must instead adopt the attitude that any source of pollution which *can* be controlled, *must* be controlled. Any ambient standard above background becomes, in effect, a license to pollute up to a certain amount. No community or air quality region can elect to live with a given level of air pollution, because the air does not stay over that community.

It is also not clear by what criterion NAPCA will find a given set of ambient air standards acceptable or unacceptable. The Denver region is a case in point. A little smog goes a very long way in Denver, and the level of SO_2 (which does enter into the photochemical smog reaction) which may be quite tolerable at sea level, may well be intolerable in Denver. No one, including NAPCA, has yet made a systematic correlation of monitored levels of pollutants with the average person's perception of "bad smog." Colorado Citizens for Clean Air is presently engaged in such a study, and I believe it will be the first in the nation. In a city like Denver, where the visibility is more than 60 miles on a clear day, photochemically producer haze is much less tolerable than in other parts of the country. What we think of as "bad smog" may be considered quite acceptable elsewhere, and I cannot see how this situation could be judged by NAPCA.

As far as particulates are concerned, the background in the Denver region, at Cherry Creek Dam, is quite high: $55\mu g./m.^3$ annual arithmetic mean. If NAPCA does not take this into account, and they do not appear to, how can they judge our ambient standards?

The intent of the act is that NAPCA should judge whether a region can meet its ambient goals with its implementation plan. There are only two methods for judging the efficacy of an implementation plan: the very crude method of estimating percentage contribution of each sources, and a diffusion model. Even the latter can only approximate the actual situation. There are pollution sources in the Denver basin, such as agricultural burning in the surrounding counties, that the diffusion model cannot take into account. Nor does the diffusion equation as it now exists consider photochemical reactions between pollutants which play a large part in Denver's smog problem. The diffusion model cannot do this because neither the rates of these reactions nor, in most cases, the mechanisms, are known or understood. A diffusion model concerned only with SO_2 and particulates makes little sense for Denver anyway, because our primary problem is NO and NO_2

Finally, the Federal criteria concern themselves primarily with health effects, and we should not permit any level of pollutant at which there is any discernible short-term effect on human, plant, or animal life. Such a level is already much too high, since we have no way of predicting long-term effects of lower levels of pollutants. *Instead of ambient standards, we should have nationwide emission standards,* for every known pollutant and every known emitting process. The criteria for these should be the greatest possible level of control, and should be revised at least every other year as better controls become available.

I would like to turn my attention briefly to the subject of vehicular emission. Federal pre-emption of emission standards for new vehicles has hurt Colorado. Because of the altitude, intense sunlight, and consequent ease of photochemical smog formation, we cannot tolerate as much vehicular emission as lower altitude areas. We need more stringent emission standards, not only for the state as a whole, but even with greater degrees of stringency in those parts of the state above 8,000 feet above sea level.

Because of rapid growth in recent years, and the FHA subsidy of suburban housing, the residents of Denver depend too heavily on private cars for transportation. We have a totally inadequate mass transit system, which is constantly on the verge of bankruptcy. In addition, we are victims of the Federal road subsidies. Right now, two branches of the interstate system, I–470 and I–15, are being planned in the Denver region *only* because Federal money is available, and for no other apparent reason. If I could make only one appeal, it is this: stop subsidizing highways now and subsidize mass transit systems instead!

Although I recognize that this plea is somewhat outside the scope of this bill, I want to bring it to your attention. In Denver we are caught in a smog trap: the Federal government refuses to let us set our own standards for vehicular emissions, although their effect is demonstrably worse in Denver than elsewhere, and at the same time seduces our state highway department into building more and more roads and producing housing patterns that force more car use.

Automobile emission standards should never be in terms of parts per million (ppm), which is a concentrated measurement, but *always* in terms of an absolute measurement such as grams per mile. Large engines, which in fact always pollute more than small ones can meet ppm standards by putting more air through the engine and diluting the exhaust. In general, a car pollutes in direct proportion to the engine displacement. In my opinion, engines of more than 200 cubic inch displacement on automobiles should be either outlawed outright or very heavily taxed. No one needs them and no one would want them were they not so heavily advertised.

Visible emissions from diesels and jet engines should be outlawed nationwide. Diesels can be totally controlled—this is evident even at Colorado's altitudes.

I would like to deal briefly with the question of federal grant aid to state pollution control programs. You must remember that the same elements in a state legislature which do not want pollution control, also are not anxious to have properly funded enforcement programs. They are, in fact, delighted if federal money is withheld, and are only too glad to write laws to make sure that this happens. The people in a state who suffer by withholding of Federal funds are exactly those who are working for stronger pollution control. As a punitive measure, withholding of Federal funds punishes the wrong people. Isn't there another way?

I would like to ask the aid of the committee in a problem which is perhaps peculiar to Denver. We have two installations very near Denver—the Rocky Flats plant of Dow Chemical Company and the Rocky Mountain Arsenal—where classified work is done. We have good reason to believe that the latter installation, and the Shell Chemical Company plant within its confines, contributes substantially to the air pollution problem in Denver. The demilitarization of the nitrogen mustard gases at the Arsenal involves production of large quantities of oxides of sulfur and nitrogen. The pesticide production at the Shell plant releases pesticide precursors and other toxic chemicals used in the production process into the air. Some of these are identifiable by their characteristic odor in north Denver.

HEW monitors emissions at the Arsenal, but will not release this data to the state enforcement agency—the Colorado Department of Health. If the nature of this data is also classified, surely at least one high-level state employee could be appropriately cleared to receive such data. It should be mandatory for this type of data to be shared with the state enforcement agency, so that we may know where these emissions fix into the total pollution picture. In fact, it should be mandatory for all Federal installations to operate absolutely clean. We in Denver are not happy about the proximity of the Arsenal, because of its vast stores of nerve gas. At least the Arsenal, and other Federal installations, should not contribute to our air pollution problem.

Senator MUSKIE. Thank you.

I have asked you several questions in the course of your testimony. I would like to invite Senator Dole at this point to ask any questions he might have.

Senator DOLE. I read your statement and don't have any specific questions.

We in Kansas flock to Colorado because it is known as the clean air country. I wonder what polluted air will do to your tourist business. However, I was particularly interested in your comments concerning Veterans' hospitals in Denver.

Now, what specific problems do you have there?

Dr WEINER. I think it is just with their incinerator and heating plant, that——

Senator DOLE. I visited there a number of times, and I hadn't noted any smoke billowing in the air, but maybe I didn't look in the right place.

Dr. WEINER. It varies very much from day to day. On very bad inversion days, we sometimes get a temperature inversion where the mixing level of air close to the earth, with higher air, is no more than 300 feet, and on very bad inversion days, it kind of collects over the hospital.

These are also extremely cold days, so that it is a cumulative problem. Mostly, I think, from the heating plant, and the incinerator, things of this sort.

Senator DOLE. Are there any other Federal installations in the Denver area that we might check on?

Dr. WEINER. I don't know of any, but I am sure that the Colorado Department of Health would have this kind of information. They keep pretty good tabs on the Federal installations in and around Denver.

Also, the Denver Air Pollution Control Agency would know. But these are the only ones that I know of.

Senator DOLE. Do these two agencies see any improvement? Do you visit with them frequently?

Dr. WIENER. Yes; we certainly do, and that is another whole story in itself. We have very poor enforcement of our own laws. I don't quite know why this is. We have a relatively nonaggressive State agency, and up until the new law was passed, which was just last week, we have had overlapping jurisdiction between State and local agencies, and in the Denver area, for example, we have three agencies, the Denver city agency, tricounty, which are the three counties surrounding Denver, and the State agency, and what they do most of the time is bicker with each other, instead of cooperating with each other, but this is a problem that I am at a loss to see how the Federal Government can help us out with.

Senator DOLE. Well, they could provide another party to bicker with. That would be three instead of two.

Dr. WEINER. Maybe that would be a good thing.

Senator DOLE. The question I raised, then, and I am not familiar with either the ordinances in Denver or the State laws—do you feel that if they were adequately enforced, many of your problems could be resolved?

Dr. WEINER. Yes; I very definitely do. There would not even have been a need for a new State law, had the old one been really adequately enforced, and had we had any kind of an aggressive State enforcement agency.

One of the problems, incidentally, is that the CAMP monitor in Denver is run by the city of Denver agency, which then won't release data to the State or to the citizens on request, and we have had to threaten them with suit under the Colorado open records law, so that they would give us the data from the monitor.

This is just one instance, but another thing has resulted: because the State enforcement has been so poor, the legislature is reluctant to appropriate more money to an agency that hasn't done a good job with what they received in the first place.

We hope to rectify some of this with the new laws, because we have set other somewhat more stringent guidelines for the State agency, and we have eliminated some of the overlapping jurisdiction between the State and local agencies.

Senator DOLE. Of course, this is an area that we can't do much about here, but it emphasizes that perhaps additional laws aren't as necessary as enforcement of existing provisions. The chairman has pointed out that takes people pressure at home.

If you have the law, and it is not being enforced then concerned citizens must act.

Dr. WEINER. It is very difficult to put pressure on civil servants, who are completely insulated from this sort of pressure, and this has been our problem, really.

They don't have to listen to us, if they don't want to listen to us, and they don't want to listen to us.

Senator DOLE. You have seen some improvement because of the efforts of people like yourself?

Dr. WEINER. We have seen some improvement. I would say it is a concerted effort. We do have a couple of members of our State legislature, notably Senator John Birmingham, who continuously needles them, needles the State agency into better enforcement procedures, and we can do this somewhat through publicity. That is, they don't like to get a lot of phone calls complaining, and so on, and there is eventually a response.

But it is very difficult to put pressure on people who are in a position where they are not immediately affected by any pressure.

Senator DOLE. Thank you, Mr. Chairman.

Senator MUSKIE. On this question of potential people to achieve response, you obviously agree with the concept that there ought to be public participation and the setting of public policy in this field. You are aware that under the Air Quality Act of 1967, as well as the Water Quality Act, we have built in the whole concept of public participation in the setting of standards?

Dr. WEINER. Yes.

Senator MUSKIE. You suggest that this isn't always as effective as it might be. I was interested in the development of the air quality standards for the city of Pittsburgh. I don't know if you followed that or not.

Dr. WEINER. A little bit, yes.

Senator MUSKIE. The conference was set, under the law, and it was set for a relatively small room. But somebody took hold and generated public interest. The crowd that descended on that room obviously exceeded its capacity.

So the room was changed. There was such great public interest that industry statements which had been prepared were filed rather than read. The hearings were pretty much, I think, dominated by public testimony, with the result that we have quality standards in Pittsburgh which have been described by the National Air Pollution Control Administration as the toughest established in the country under the act. Here is a very specific instance of how effective public interest, concern, and response can be.

The problem always is to sustain public interest so that there is follow through as well as an initial burst of interest. This is the great problem, which I am sure you run into, as I used to, years ago, before I was in politics, and just involved in civic affairs.

Dr. WEINER. It is also quite a different thing to generate public interest for a single hearing, which we also did when we had our Federal hearings in October, and we were helped along by the fact that the day before was one of the worst smog days Denver had ever experienced, and to sustain public interest in the more detailed and less immediately romantic aspects of air pollution control. Someone has to attend all the various board hearings, keep needling the State agencies, when you see that they are not enforcing, and this is difficult and time-consuming, and it is something that most citizens are not technically prepared to undertake.

Senator MUSKIE. What you have to do is operate your public programs much as taxi drivers or chauffeurs or drivers of Russian cars years ago used to; I don't know if they still do or not. But in 1959, I spent 30 days in the Soviet Union, and I was taken by the way that the Russian drivers handled their automobiles. They would build up a burst of speed, 70, 80, 90 miles an hour, and then shift into neutral, and just coast for as long as the car would run. Then they would turn on the engine again and build up another burst. They did this on mountain roads. It scared you to death. You would be coming down a corkscrew road, and they would build up to top speed then turn off the engine, go into neutral, and coast.

In a way, you almost have to do that with public opinion in this country. You have to build up speed at a crisis stage and then coast. You have to hope that the momentum will carry you through some of these jobs, dull technical periods of the formation and implementation of public laws.

Dr. WEINER. I must say that the Federal act has been very helpful in helping to generate public opinion, and helping to guarantee public participation.

If we had this kind of activity in all conservation efforts, we would be way ahead, in the environmental game.

Senator MUSKIE. We think the public participation is important. The administration bill would eliminate that feature of it. I hope we are able to persuade the administration to a different point of view. I don't know what was involved in reaching that decision.

We will have an explanation of that tomorow, I hope, but I think that these public conferences and hearings on the setting of standards are a terribly important part of this whole process. I would like to see them continued.

Dr. WEINER. If I can comment on the new bill in that respect.

Senator MUSKIE. Yes.

Dr. WEINER. It is very dangerous to limit public participation, because as it is, the citizens groups don't have the facilities, they don't have any staff; ours, for example, has none whatsoever, nor any money, and it is very difficult to make our presence felt at all, in the first place, and if it is not encouraged a little bit, it will just never happen, and things will move out of the hands of the citizen entirely, and into the hands of those groups that have more immediate access to legislatures and to enforcement agencies than we have. I think this would be a very bad thing.

Senator MUSKIE. Thank you, Dr. Weiner.

Thank you very much for the contribution you are making in this whole field.

Dr. WEINER. Thank you for having me appear.

Senator MUSKIE. Our next witness, Dr. Vincent J. Schaefer, is director, Atmospheric Sciences Research Center, State University of New York at Albany.

Dr. Schaefer, it is a pleasure to welcome you here this morning, sir.

STATEMENT OF DR. VINCENT J. SCHAEFER, DIRECTOR, ATMOSPHERIC SCIENCES RESEARCH CENTER, STATE UNIVERSITY OF NEW YORK, ALBANY, N.Y.

Dr. SCHAEFER. Thank you, Senator.

I am Vincent Schaefer, director of the Atmospheric Sciences Research Center of the State University of New York at Albany.

I have been measuring atmospheric particles for more than 25 years. Much of the effort of my group at the university is directed toward basic and applied research in the air pollution problem.

I might say that the testimony and comments that we have just been hearing from Professor Weiner are very much to the point and I think beautifully demonstrate the kind of problems that we are all confronted with, both those in the political arena as well as in the universities, and with the general public.

I wish we had a great many more people like Professor Weiner.

I would like to present some of the evidence I have been accumulating for the past 10 years related to the effect which is exerted by very small particulate matter and gases.

The particles I wish to discuss have a size range from 0.1 to 0.3 micron. Many atmospheric particles are smaller than 0.5μ and in fact, the majority are quite invisible to the unaided eye. Even the most sensitive light microscope will not resolve most of them.

While these particles have very little mass, they constitute the largest number of the particulates in polluted air.

Concentrations of these particles in different environments I have given in a table, and this table indicates the sources, as we have measured and observed them, and the degree of pollution which seems to be related to those measurements.

(The table referred to follows:)

TABLE 1.—POLLUTION RANGES (INDICATED BY CONDENSATION NUCLEI (CN))

Typical source	Concentration of particulates	Degree of pollution
Oceanic and polar air	Less than 1,000 per cubic centimeter	Clean.
Country air	1,000 to 5,000 per cubic centimeter	Light.
Suburban air	5,000 to 50,000 per cubic centimeter	Medium.
Urban and industrial air	More than 50,000 per cubic centimeter	Heavy.

Dr. SCHAEFER. In oceanic and polar air if we measure the total number of particles, for example, we find in general less than 1,000 per cubic centimeter. And we consider that concentration to be quite clean air. That is the characteristics of the global background of particulates at the present time.

Senator MUSKIE. Does that global background build up at all?

Dr. SCHAEFER. It has, unfortunately. It used to be that measurements showed 50 to 200. Now quite frequently, we find 1,000, under the same kind of conditions.

For example, if we go to a place like Newport, Oreg., and wait for the air to move in from the ocean, for 2 or 3 days we will get the values that we generally find in the middle of the Pacific. It takes 2 or 3 days to get true oceanic air because of the effluent of the continent, the eddying around of the particulates from the continent that come from pollution.

In many places, where one used to find what I would call clean air, I have observed a tenfold increase in the past 10 years.

That, I think, is one of our problems, and that is why I am so concerned about the small particles which are invisible.

Senator MUSKIE. And these particles are carriers.

Dr. SCHAEFER. Absolutely.

Well, I intend to say something about that, Senator.

In country air, which is the cleaner air that is available to dilute the polluted city air such as has happened in the past we find 1,000 to 5,000 per cubic centimeter. This we consider to be characteritsic of light pollution.

Suburban air, as we are now measuring it, contains 5,000 to 50,000 per cubic centimeter, which we consider to represent a medium degree of pollution, and then in the urban and industrial category of air—values of more than 50,000 up to 500,000, depending on where the measurements are made.

And, of course, that is heavy pollution.

Senator MUSKIE. May I ask you this question?

Dr. SCHAEFER. Yes.

Senator MUSKIE. You have classified these as degrees of pollution. Is that an official classification?

That is a trial balloon, Senator. We are trying to obtain a concensus among the people that we are in contact with. Thus far we seem to have fairly good agreement among the scientific community that we are in touch with, and we are just proposing these values as something that we would like to have considered because our experience indicates that these categories represent a realtistic classification.

Senator MUSKIE. So now you have four categories: Clean, light, medium, and heavy.

Dr. SCHAEFER. That is right.

Senator MUSKIE. Have you gone to the point of defining what those mean in terms of health effects, or esthetic effects?

Dr. SCHAEFER. Not yet, Senator. These are things we are working on at the present time.

Senator MUSKIE. Those categories are simply a measurement of the physical side of it?

Dr. SCHAEFER. That is right, yes.

If one looks at the air along a freeway or other heavily traveled road, very little if any exhaust smoke can be seen coming from the traffic. Going through a long vehicular tunnel, however, a bluish haze will be seen in the air and if windows are open a foul smell can be noted. Such air contains tremendous numbers of small particles as well as gases of combustion, particularly CO, CO_2, the nitrogen oxides and hydrocarbons.

Measurement of the small particles in such restricted places will show values which may be higher than 500,000 particles per cubic centimeter. Similar measurements along roads frequented by automobiles commonly exceed 150,000 per cubic centimeter since the auto is now a major source of the polluted air in all large cities. Small particles, even those which are quite invisible, are playing an increasingly important role in the pollution problem of America.

First of all, as you just mentioned, Senator, they serve as carriers of other substances. This is particularly true of carbon particles. Instead of being a solid chunk of matter, most tiny carbon particles consist of cage-like structures of extremely small primary particles chained together into a space enclosing skeleton. Such particles are essentially inert but they can serve as frameworks on which gases adsorb and other liquids and solids agglomerate. While carbon is probably a very important "getter" for gases and an effective nucleus for other liquid and solid particulates, a vast host of other substances behave in a similar manner or coalesce to form microscopic liquid droplets.

I am dismayed by the all-pervasive bluish and greyish hazes that increasingly limit the visibility of distant hills and mountains and even the ground as seen from a high-flying plane, and I might mention that this morning, flying down from Albany, it was exactly this situation. From takeoff until landing here in Washington, the visibility was limited to 5 to 7 miles, and, as far as I could see, the pollution was up to our flight level, which was probably about 20,000 feet.

A particularly distressing feature of this hazy atmosphere is its uniformity and massive extent. I commonly notice it over at least half of the United States, am not surprised to see it on the continental scale. On several transoceanic flights during the past 6 months—one to Japan, the other to Czechoslovakia—I have seen evidence that it may have reached global continuity, at least in the middle latitudes of the Northern Hemisphere.

The source of such widespread pollution is not easy to establish. It is now possible to fly over large cities such as Los Angeles without seeing a single visible smoke source. In fact, I have considerable difficulty in recent years to ascertain the direction of the wind at low levels as I could in the past by using smoke plumes as wind indicators.

Pollution control agencies have succeeded in eliminating nearly all visible sources of air contamination in many urban localities. Visible smoke sources are relatively easy to detect, and those responsible can be cited and penalized.

If most visible plumes have been eliminated, why are we confronted with an increasingly serious air pollution problem? The blame can be placed quite easily—most of the pollution comes from effluents which consist of invisible particulate matter and accompanying vaporous gases which cannot be seen when they are released into the atmosphere.

It is easy to demonstrate this principle. If a large transparent plastic bag is placed over the exhaust pipe of an idling automobile, it will become full of an ordorous effluent in a few seconds. This bag is now filled with air, water vapor, gases and particulate matter, the latter having a concentration of 10^7/cc or more.

With a simple instrument—the Gardner small particle counter is what I use, available from Gardner Associates, Schenectady, N.Y.—the concentration of small particles can be determined. Such a measurement shows that a typical idling automobile engine emits at least 100 billion small particles per second. Most of these particles are submicroscopic and invisible. However, if the bag is observed carefully, it will soon have its inside coated with a dense layer of water drops, and if some of the trapped effluent is transferred to a box made of clean sheets of glass and illuminated with a strong beam of light, such as a home movie or slide projector, a visible bluish or grayish shaft of scattered light will be seen.

Because of the very high concentration of particles emitted by the idling motor, the original invisible particles have coagulated to form the now visible aerosol.

Thus a measurement of the number of particles in the sample after 20 minutes will show a drop in concentration of a hundredfold as coalescence proceeds and the particles become visible by their scattered light. Very few particles fall out, however, since the effect of gravity on such small particulates is negligible.

As particles grow from their original invisible size range of 0.02 microns to the visible sizes of 0.1 to 0.3μ diameter—producing a bluish haze—their light scattering effectiveness becomes quite noticeable, especially in the blue end of the visible spectrum. Such particles scatter almost as much light back toward the illuminating sources—such as the sun—as in a forward direction.

This effectiveness in the scattering of visible light reach a maximum with a diameter of about 0.6μ, and it was this feature that caused us to produce particles of that size during World War II when we successively hid our armed forces from surveillance and bombing at the Anzio Beachhead in Italy and during the crossing the the Rhine River in Germany.

There has been a tendency on the part of some engineers and others to employ afterburners and similar devices to vaporize an effluent so that ordinarily visible emissions are reduced in size so as to become invisible. Where this is done in a manufacturing process, only a measurement of the stack effluent with a small particle counter or observations by a careful observer will detect the subterfuge.

Thus, a plumeless chimney or clean-looking jet engine or an automobile exhaust pipe does not necessarily mean that the removal of an offending pollutant has been achieved. In fact, I believe that in some instances the so-called improvement produces a worse situation than before.

One of the other subtle results results of this shift from large to small particle size in the pollution production of a large city is that the "dust fall," high-volume sampling and other measurement at ground and building top level will quite likely show a decrease from earlier measurements. This can be very misleading since the end results will be the extension of the effect of the city into regions down wind of the source.

During the past few years I have seen the plume of the Los Angeles Basin area in such areas as the Owens Valley, the Mojave Desert, The Charleston Mountains in Nevada, and a few weeks ago in the vicinity of Palm Springs and Palm Desert. I have even observed pollution plumes from southwestern California near Spokane, Wash., and central Nebraska when carried by low level jet streams.

To measure such plumes, one must depend primarily on aircraft although during my recent observations in California I was able to obtain data by direct measurements at the desert floor and on the slopes and near the summit of the mountains called Baldy, near Claremont, and San Jacinto, near Palm Springs.

While the hot flame temperature needed to vaporize an otherwise visible effluent might achieve improved combustion, it also oxidizes some of the natural nitrogen in the air to produce nitrogen oxides. In addition to being poisonons, these gases are believed to be an important catalyzer for the photochemical reaction which converts hydrocarbon vapors to particulates.

When converting visible particles to invisible sizes, the residence time of such particles is also greatly extended. Thus a very large aerosol particle of say 50 microns (0.002 inch) diameter if ejected into the atmosphere at the top of a 100-meter (300 feet) chimney would fall to the earth in less than 15 minutes.

If such a particle was vaporized and then condensed so that the resulting particles were invisible (say 0.02 microns in diameter) a single 50 micron particle would produce more than 10 billion of the smaller size.

Such particles would have a residence time in the atmosphere of months or years depending on where they were carried by the wind or whether they were removed by precipitation. As mentioned earlier, gravity has little effect on such particles. They are primarily removed from the atmosphere by growing much larger through agglomeration, a very slow process, by the scavenging effects of snow or rain, or diffusion to various objects on the earth's surface.

If the vaporized particles recondensed to form a bluish smoke (around 0.2 micron diameter), a single 50-micron particle would produce about 10 million of the smaller size but they also would have a residence time in the atmosphere of weeks or months unless removed by the processes just mentioned.

This points up one of the many problems which will develop when high flying aircraft such as the SST fly in the stratosphere in large numbers. The stratosphere is a very stable region without benefit of a cleansing mechanism like snow or rain. We must consider the possible effect of large concentrations of small particulates and gases such as would be emitted into this region and the effect which an accumulation of these aerosols on the present equilibrium of that region of the upper atmosphere. What will such pollutants do to the ozone concentration, the radiation balance and similar properties?

Thus far I have not succeeded in obtaining satisfying answers to these questions.

The effect of small particles on health is becoming recognized. I have recently suggested that a possible additional hazard confronting the smoker is that air pollution particles passing through the burning zone of a cigarette are vaporized and the lungs then serve as a test tube where synergistic reactions can occur to form a myriad of exotic particles coating the surface of the entire respiratory tract.

Thus the persons who smoke in an urban air region commonly insult their lungs with the vapor from at least fifty to a hundred thousand more particles than produced by the burning tobacco.

This then brings me to my final point which is related to inadvertent weather modification. I am convinced that man-caused pollution raises a host of new problems which I didn't contemplate when in the 1940's I was conducting my experiments of seeding supercooled clouds with dry ice fragments and other substances.

Supercooled clouds were of common occurrence in the Northeast and in fact we carried out more than a hundred experimental seeding flights in New York and New England between 1946 and 1950. Extensive areas of supercooled clouds were of common occurrence and in our Project Cirrus activities we learned many scientific facts about the possibilities and limitations of cloud modification durng that period.

I would be reluctant to conduct a similar research program in that same area at the present time. It is my experience over the past 5 years that extensive areas of supercooled clouds are of less frequent occurrence and that massive areas of ice crystals at low level and more frequently encountered than 20 years ago. These high concentrations of low level ice crystals are so high as to produce brilliant undersuns [1] such as we only saw during our early experiments in stable, heavily seeded areas produced by our experiments.

Where are these ice nuclei coming from? I have presented my ideas on this source in several papers published in the scientific literature. I am not alone in my findings. Briefly stated, we have found abundant evidence that a potent source of ice nuclei is to be found in air polluted with automobile exhaust from leaded gasoline. Submicroscopic lead compounds apparently react with small quantities of iodine vapor to form lead iodide. These activated nuclei must be very small to be most effective since they apparently act as sublimation nuclei; that is, the water molecules in the air form ice crystals directly from the vapor phase.

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[1] The undersun is an optical phenomenon caused by the specular reflection of the sun from the surfaces of myriads of hexagonal plate ice crystals. It occurs at the same angle below the horizon as the sun is above it. In order to produce an undersun, it is necessary for the crystals to consist of smooth-surfaced plates which float with their long axes horizontal to the ground. Thus they act as many tiny mirrors. If the crystals were not hexagonal plates but rather prisms, the optical effects would include under parhelia and other reflections which are well known and have been related to crystal types during our winter studies at Yellowstone Park.

If these particles were larger so that the water condensed to form liquid droplets the lead compound would dissolve destroying its effectiveness as an ice nucleus. The number of these potential ice nuclei in polluted air is from hundreds to a hundred thousand times more than is found in clean air.

I have also observed and photographed a great many examples of high concentrations of ice crystals in polluted air. Such areas are so extensive that I believe they could exert an effect on the weather patterns over America.

I previously described the misty rains and very light snows which I believe can be attributed to automobile pollution. An interesting and rather paradoxical effect can be postulated which suggests that a superabundance of effective ice nuclei over extensive areas could reduce as well as increase precipitation. High concentrations of ice nuclei would stabilize clouds containing low amounts of liquid cloud water and thus reduce or prevent precipitation.

On the other hand, if a rich source of moisture moved into a region and entrained extensive areas of polluted air containing many potential ice nuclei, it could produce excessive amounts of snow or rain.

This is not to say that only pollution can cause a reduction or an increase in precipitation. What I anticipate based on an increasing amount of cause and effect field observations I have obtained is that the frequency of such unusual weather phenomena may increase as air pollution increases.

In conclusion I would like to emphasize that we are dealing with an extremely complex problem which will require a much greater involvement of our total society than has occurred at present. The type of legislation required at the Federal level must consider aspects of the problems that can't be solved by the individual States. I am sure that we must also establish global rules of conduct if we are to halt the rapid deterioration of the environment that has alarmed us.

I believe that the university community has an important role to play in solving some of these problems. It is heartening to see the way in which many young people in our universities are espousing the cause of environmental improvement. They are actively seeking education and guidance in their concern and have responded in a wonderful manner to our action programs.

The time is passing when the American community will tolerate arrogance, hypocrisy, or cynicism on the part of anyone or any group whose activity will further degrade the quality of our environment. This is not a fad. Anyone who believes it is does so at their peril.

I am an optimist. Any system that can put a man on the moon in 10 years can certainly solve the technical aspects of our pollution problem. At the same time we must rethink our sense of values and probably reorder many of our current procedures so that together we can seek goals that are addressed to community well-being in every sense of the word.

Senator MUSKIE. Thank you, Dr. Schaefer, for your excellent paper. Since you spent considerable time in your paper emphasizing the fact that some of the present technology dealing with particulate matter exacerbates rather than solves it, do you have any thoughts to communicate to us about what are the best approaches to deal with it?

Dr. SCHAEFER. Yes; I think I do. I would say first of all eliminate leaded gasoline. I think that the leaded gasoline could lead us to problems, I mean, serious problems in terms of climate, much sooner than we are ligely to be troubled with a lack of air to breathe.

Now I could be wrong about that, but the more data I gather, the more concerned I become, that we are already in a situation that might be producing atmospheric change.

Then I would certainly agree with Dr. Weiner's proposals that we reduce the engine zine in our autos. I think it is absolutely ridiculous that we should use the fantastic volume of steel that we use at the present time to move ourselves from one place to another. It just doesn't make sense.

I think we have to establish much more effective ways of mass transport. I think that is essential.

I think we should outlaw the use of private automobiles in cities.

You know, we are back to a horse-and-buggy speed in most of our big cities.

Senator MUSKIE. Or even slower.

Dr. SCHAEFER. Yes; I saw it this morning coming down. Fantastic traffic jams, on the roads leading into New York City. Intolerable.

I think we have to reduce the unnecessary use of electricity. The electrical industry has done a marvelous job of selling the people on the need for electricity. We don't turn off our lights, and we do a lot of silly things, that I think are nonessential. We must begin to reorder our sense of values.

In terms of what we do about small particles, I think we need to completely reverse the present trend. We need to learn how to make particles grow bigger faster, so we can use gravity fall to get the particles out of the atmosphere. Once we have grown a big particle it is a lot easier to grab hold of it.

Now, obviously, that is going to raise our solid waste disposal problem, but I am sure you are aware of the fact that we have hauled flyash thousands of miles, because it makes better concrete. As I have been told, some of our big dams in the West were built using flyash as one of the components.

So I think there are a lot of good things that we can extract from these effluents that at the present time we are putting into the atmosphere, in a way that we can't ever get it back again. It produces hazy air which from my standpoint is inexcusable.

We heard about the deterioration of the situation in Denver. I first saw Denver about 20 years ago, in a beautiful part of our country. I go back there quite frequently, because of some of the work I do. It is dismaying to me to see the fantastic decrease in the quality of the air that is occurring in that region. Something that my Denver friends haven't yet considered—which relates to the refining of the oil shale, in northwestern Colorado and the southern part of Utah. Unless carefully planned such processing will ruin one of the choicest parts of America. The Colorado Rockies, are second to none, and yet, we may not see them at some future time if the present trend of resource exploitation keeps on, which is tragedy.

Senator MUSKIE. In your response to my question, you emphasized automobiles as a source of particulate matter, rather than stationary sources. Do you intend that emphasis?

Dr. SCHAEFER. No, I would say about half of our problem is from automobiles. The other half is from incinerators, from our own individual heating plants, from trash burning, which is done without much thought. There are all sorts of things, including the fixed installation of industry.

Now, as I said earlier, you go into a region such as any big city and look for visible plumes, and you have great deal of trouble seeing them, and yet there is the smog. And I am sure that at least half of the smog comes from industrial processes of one kind or another and the other sources I just mentioned. If you reduce particulates to gases then we have gas to particle reactions, which finally ends up as producing this bluish haze I am concerned about.

Senator MUSKIE. What is the answer to that?

Dr. SCHAEFER. Well, I think that one of the things which must be done in terms of fixed installations, involves a redesign about how we put our industrial plants together. One of the things I have proposed, and I am sure that a lot of people will not agree with me, is the elimination of vertical chimneys. Chimneys are no longer used for which they were originally invented. They were made to provide a draft for a fire. The effluent from most chimneys nowadays, emerges four or five times faster than it could possibly obtain from just the heat of the chimney. Chimneys at present are nothing but atmospheric sewer pipes just like a water outfall spilling into a river.

As I said earlier, I think we need to design a new approach, where we have horizontal chimneys, if you want to call them that, which are designed in such a way that we take advantage of gravity. We make the particles just as big as we can make them, so that gravity will cause them to fall out.

Now, that is not going to be easy, and we have to put the best brains of our scientists and technical people and engineers to address themselves to that problem. Once the particle enters the atmosphere as an invisible or a bluish haze type of particle, there is nothing on earth going to get it back except slow diffusion and the scavenging by precipitation.

Senator MUSKIE. You have no objection, I assume, to the electrostatic precipitator?

Dr. SCHAEFER. Oh, no, no, of course not. That is one very good way of removing the smaller particles.

Senator DOLE. Mr. Chairman?

Senator MUSKIE. Yes, I will yield to Senator Dole for some questions.

Senator DOLE. The staff has indicated that the Smithsonian Institute has recorded that since 1910 instant sunlight striking the Mall has decreased 16 percent. Is there any evidence that this phenomenon is not restricted to urban development? Is anyone studying this area? What effect will this have on crop production in rural areas in the next 10, 15, or 100 years?

Dr. SCHAEFER. Yes, Well, Senator, this is the very thing that concerns me, because I am beginning to see this, in our countryside. The one trouble is that these very small particles, because they don't fall out, diffuse and gradually work themselves up to the base of the stratosphere, so we are getting more and more of the troposphere filled up with these small particles. It takes an awful lot of them to have an effect on sunlight, to reduce "insolation"—incoming solar radiation.

It takes a lot of them to hide a mountain. But still, that is what we are beginning to see.

And, the trouble is, the mass method of weighing atmospheric particulates is not going to really pinpoint the problem we are now up against. Because you see, with a very small particle, about as much light is reflected back toward the sun as comes through. That is another factor, which is important.

And now that this vast region of the troposphere is being affected with these kinds of particles, then the kind of measurements that the Smithsonian is noting is some of it from local sources, but I think a lot of it is from a distance.

We recently completed the tenth transcontinental flight made, at low level for measuring small particles so we have obtained a feeling for the three-dimensional nature of this atmospheric pollution on a large scale. While it is true that the majority of the pollution materials are in the lower 5,000 feet, concentrated in that location. There is an increasing amount extending to the inversion level, at the top of the troposphere at 30–35,000 feet.

Most people don't realize the tremendous amount of particulate matter that is up there, and it is only when a stagnant air situation develops that the region below the lower inversion begins to fill up, and they become alarmed.

If they had to live at this inversion level they would have been in trouble a long time ago.

Senator Dole. What finally happens to these small particles?

Dr. Schaefer. The only way that they are eliminated is as they serve as nuclei for ice and snow or precipitation when they diffuse to the precipitation particles. That is a primary way in which the atmosphere is cleaned.

Senator Dole. In other words, they stay in the atmosphere. Yesterday was Sunday, for example, and I was flying around different cities, Dallas, Kansas City, Dayton, and in every area there was a haze. And this was Sunday, with no industrial plant operating that I could see. So it just hangs around for days, apparently.

Dr. Schaefer. Gravity has no effect on it, to speak of, because the particles are so small, brownian motion drives them up just as much as it drives them down, so they are just floating in the air until they are cleaned up by precipitation. If we don't have precipitation, then it just gets worse and worse.

Senator Dole. So it is not beyond speculation that, if something isn't done in the next hundred years, that this might have an effect. Air pollution that originates in Los Angeles may end up in the State of Washington, or the State of Nebraska.

Dr. Schaefer. Right.

Senator Dole. So it is not beyond speculation that this could have an effect not only in urban areas, but rural areas.

Dr. Schaefer. That is right.

Senator Dole. And even on agricultural products, and growth and production.

Dr. Schaefer. These are some of the effects which are very difficult to assess, but I am sure are very important. And it goes way beyond just the esthetic aspects of the environment.

As you point out, it could be changing our radiation balance, it could be doing a number of things. We are not smart enough to say what all of these effects are likely to lead to in relation to our health, the corrosion of our buildings, and many other things that we haven't thought too much about.

Senator DOLE. Mr. Chairman, I need to go to another committee. I wanted to point out that we have Congressman Hechler from West Virginia, who has been long interested in this subject matter, visiting this morning.

Thank you.

Senator MUSKIE. Thank you, Senator Dole.

It seems to me you have just ended in discussing another problem that troubled us in 1967, and I think we need to refocus on today. There was some feeling in 1967 for the idea of regional airsheds, as a basis for creating the mechanism or the institutions to deal with the air pollution problem and controls.

Is there, from your point of view, any validity to that idea?

Dr. SCHAEFER. Very little, Senator. I feel that the airshed concept is a very misleading one. I think it could get us into a great deal of trouble. Unlike water, which follows gravity, the particles that I am concerned about pay no attention whatever to gravity.

They are moved by the air. The air and its particles which we are breathing here probably was 500 to a thousand miles away a day or so in the past.

And therefore, except for the nighttime inversions, which will cause local build ups of particles over cities, I think the airshed concept is a misleading one.

We in New York State are quite concerned about pollution and I think we have done a very good job, in facing up to the kind of problems that we are confronted with on the local scene. But if we are getting a load of particles, coming in from the West and the South or the Southwest much of our effort will be diluted by pollution from distant sources.

We have the evidence, and that is what really bothers me.

Senator MUSKIE. What variables are there in the atmosphere, variables, depending on local or regional conditions, that ought to be taken into account in developing control mechanisms or control policy?

Dr. SCHAEFER. We must initiate a much more comprehensive monitoring program. We must develop an aerosol climatology. There is a small amount of work in this direction going on with the NAPCA agency— the meteorological group which is located in North Carolina are paying some attention to the problem but I believe they have only one scientist who is really concerned about meteorological aspects of pollution on a large scale.

I believe that much more attention needs to be paid to this problem, and I think the Weather Bureau have the personnel who could do it. They certainly need additional funds to focus a major effort in this direction. I think it is very important.

I think, too, that one of the extremely important potential programs for particulate studies, could be related to the World Weather Watch, and the global atmospheric research program. Much more emphasis should be paid to the global levels of air pollution because after all, we can do a good job in America, and if we are getting a big flow, of these particulates coming in from distant sources, as I am sure will occur then some of our work goes in vain.

It certainly isn't all lost effort, but we have to look at the atmosphere as a global problem.

Senator MUSKIE. You have emphasized that throughout your testimony. I think it is very helpful.

You use the phrase "global continuity." I think that increasingly we become aware that it is something more than a local phenomenon.

Dr. SCHAEFER. Yes.

Senator MUSKIE. And that what we do in one community, however small, does have an impact, however small.

Dr. SCHAEFER. That is right.

Senator MUSKIE. On a much wider region than the local political jurisdiction.

Dr. SCHAEFER. That is why it is so important for the Federal Government to move into this area in a way so that, for example, in a local situation, where an industry is criticized for the damage it is doing to the local environment, one of the things they cannot say is "Well, if you don't like it, we are going to go somewhere else."

Well, thanks to your efforts, there is no place to hide in America; but, on the other hand, there are many other countries that will tolerate this for a while, and the next thing we are going to hear is that the industries are going to say, "Well, if you don't like it in America, we will take it to some other country where they aren't concerned about clean air."

So I believe that the U.N. must address itself, as it apparently is, to this problem on a global scale.

Senator MUSKIE. In a very real sense, then, as the world's greatest industrial country, we are mortgaging the future air supply of other less industrialized or less developed countries.

Dr. SCHAEFER. We have made a proposal, rather informal so far, but I think that this is one thing I would like to see given much attention, is realted to the great reservoir of clean air which at the present time is over the Atlantic and the Pacific Oceans. This is where the last really clean air is located, together with the air in the polar areas.

We need to be monitoring the quality of this air on a much bigger scale than we have, thus far achieved. I believed the U.S. Navy has a major role to play in accomplishing this objective. It is just as important for the success of their mission as it is for our objectives. And I would strongly urge that very careful thought be given that the Navy be given the job of keeping track of this big mass of clean air. This air is cleaned periodically by oceanic storms on a vast scale.

Senator MUSKIE. Senator Baker and I have introduced a bill that we hope will stimulate widespread interest, a bill to create National Environmental Laboratories. The idea is something much broader in concept than the usual scientific research laboratory; something comparable, I suppose, to the National Institutes of Health, in which the total nature of the environment would be taken into account to evaluate what we are doing to the environment, what we must do to reduce our insults.

Dr. SCHAEFER. Yes.

Senator MUSKIE. Is it a concept to which you respond?

Dr. SCHAEFER. I would respond in this way, Senator: I strongly feel that something of this sort could be marvelous, provided the people in those laboratories are the very best we can find in America, if not the world.

There should be a small group of those people, and then they should relate to the universities, in my opinion, because the universities have very high competence in many areas which are not being effectively used. I think a combined, hard-core national institute, with very strong relationships with the best people in the universities, and especially the younger people—one of the real problems in America at the moment is we have trained a lot of brilliant young people, and they can't get jobs, because they have been trained to be specialists.

One of the most serious problems confronting us is this large group of bright young people are now being frustrated, because they have been trained in an area where they can no longer use their brain power.

Now, fortunately, the environment is a problem that is almost like a sink. I mean, there is almost no end to the things that have to be done if we are going to solve the problems about which we are concerned. One of the things we are addressing ourselves to at our university is how do we retrain these brilliant young people enough, and then how do we find suitable jobs for them after they have been retrained?

I personally think that there are going to be lots of jobs, but we have to do a lot of this on faith.

Senator MUSKIE. In the age of specialization we have assumed that as society became larger, more compliacted and sophisticated, each of us had to narrow our perspective to that piece of it with which we dealt. Actually the environment is demonstrating that we should have been broadening our perspective all the time, becoming generalists rather than specialists.

Dr. SCHAEFER. Yes, of course. Well, I have mixed feelings about this. I think we need the specialist who is also a generalist. I think the specialist should at least have some understanding of the ecological pattern that he fits into. I think this is terribly important, and this is where I think the universities and the lower schools have been inadequate.

We need to start when the kid is, you know, just beginning to comprehend things, and then continue on from kindergarten on up, a social awareness of all of these complex relationships. And such a person, a person educated in this general way, is going to be very careful about what he does to his environment, because he will understand the fragility of it.

Senator MUSKIE. I would like to ask another more specific question, Dr. Schaefer.

You have expressed concern over the environmental air pollution aspects of the SST. I wonder if you would summarize the reservations that you have with respect to the SST? I would like to refer you to the statement made by Dr. Bryson of the University of Wisconsin, who said that at any one time there are 385,000 square miles of cloud cover, produced by cirrus cloud formations stimulated by jet contrails.

I would like to have your impression of the SST's relationship to that.

Dr. SCHAEFER. Well, I am not sure that the SST is likely to produce a cloud cover. I sure hope it doesn't. If you look at the moisture relationships up there. it probably will take quite a lot of moisture to saturate the air above the tropopause.

The thing I am concerned about is the small particles will undoubtedly come from the exhaust. The small particles and gases, and just what their lifetime is likely to be. I am not an expert on this kind of reaction mechanics, and I am relying quite a bit on my colleagues to try to work up the answers: but, when you attempt to get firm information as to exactly what it is that will come out of the tailpipes of the four jets per plane and the 500 or more planes that are going to be flying, and then you work out the dimensions, a quick measurement shows either that it is going to be on the ragged edge of being important, or maybe it is going to be quite important. It doesn't say it is of no consequence.

It is one of these iffy things, that perhaps, until we do it, we are not going to be really sure that what we are saying is true.

But, on the other hand, I think we need to take an awfully hard look at that. Is there a real need to go so far so fast?

As one who does a lot of traveling, I find that it takes me a couple of days to get back to normal when I land in Japan, so that saving a few hours isn't really going to help much. So I think we have to give a lot of careful thought to the real value of such a thing. I think it is a classic example of something that we certainly can do, but is it the smartest thing to do it?

And we are going to have many of these decisions that we have to make, over the next few years—including more power from electrical powerplants.

I see electricity being used for a lot of rather silly things at the present time. And I have a feeling that you know there is a limit to all of such activties. We can't just keep on going up, in terms of production of everything that we think that we have to have. I think, basically, this is what the young people are saying: That we have to begin looking at the values that we have developed in this wonderful country of ours, and see whether or not there aren't some things that need to be rethought.

I, for one, am willing to do without some things that I now consider to be something I am entitled to, provided I can see that it is going to be good from the standpoint of everything else.

Senator MUSKIE. Institutionally, that is one of the toughest problems we face. How do we control consumer demand, and the many ways we have to stimulate consumer appetites? It is a tough one.

Dr. SCHAEFER. We have to find, Senator, a much better way of contacting the general public, and while I don't agree with everything that Vice President Agnew says, on the other hand, he has certainly touched some tender nerves, in some of the things that he has been talking about.

We have really not used our mass media as well as it could be used.

Now, I understand why these things happen, but when I see what a magnificent job of communication can be done with radio, television, newspapers and magazines, and the word of mouth, and see the lack of imagination that we have permitted to develop in this country, it is sometimes rather dismaying.

We are much smarter than what we do.

Senator MUSKIE. We don't concentrate enough on doing the important.

Dr. SCHAEFER. I think you are right.

Senator MUSKIE. I think we have the capacity for doing it, if we can agree on what it is.

Dr. SCHAEFER. Absolutely, and especially the young people. We have a fantastic reservoir in our youth. I consider this our greatest natural resource. And yet we are doing a miserable job in using it.

Senator MUSKIE. I would agree.

Dr. Schaefer, I am going to include in the record at this point—and there is no one here to object except me, and I won't—an article that you wrote in the Bulletin of the American Meteorological Society for last year. I think it would be a very helpful addition to the record. Also included will be an article written by you for BioScience.

(The article follows:)

[Reprinted from Bulletin of the American Meteorological Society, vol. 50, No. 4, April 1969]

THE INADVERTENT MODIFICATION OF THE ATMOSPHERE BY AIR POLLUTION

(By Vincent J. Schaefer, Atmospheric Sciences Research Center, State University of New York at Albany)

ABSTRACT

There has been a very noticeable increase in air pollution during the past ten years over and downwind of the several large metropolitan areas of the United States such as the Northwest—Vancouver-Seattle-Tacoma-Portland; the West Coast from San Francisco-Sacramento-Fresno-Los Angeles; the Front Range of the Rockies from Boulder-Denver-Colorado Springs-Pueblo; the Midwest—Omaha-Kansas City-St. Louis-Memphis; the Great Lakes area of Chicago-Detroit-Cleveland-Buffalo; and the Northeast—Washington-Philadelphia-New York-Boston. The worst accumulation of particulate matter occurs at the top of the inversion which commonly intensifies at night at levels ranging from 1000 to 4000 ft or so above the ground. This dense concentration of air-suspended particles is most apparent to air travelers. Thus, it has not as yet disturbed the general public except during periods of stagnant weather systems when the concentration of heavily polluted air extends downward and engulfs them on the highways, at their homes and in their working areas.

1. RECENT MODIFICATION OF OUR AIR ENVIRONMENT

Until recently there is little question that except in very exceptional cases, natural processes dominated the mesoscale weather systems by initiating the precipitation mechanism. The effluent from the larger cities was quickly diluted by the surrounding "country air" so that at a distance of a few miles downwind of a city, little evidence of air pollution could be detected.

The recent spread of urban developments due to better roads and the massive proliferation of people and automobiles has led to a nationwide network of county, state, and interstate highways. This interconnection of thousands of smaller towns and with large cities and the phenomenal increase in auto, truck and air traffic has caused a massive reduction in the regions which have "country" type air. This increase in massive air contamination is of fairly recent origin. It is not easy to document this fact in the detail I would prefer since we have not had reliable automatic recording equipment for measuring Aitken, cloud and ice nuclei until the last few years. However, using simpler devices with which we made measurements at a number of scattered locations during the past ten years, we have in the past year used the same techniques to make comparative observations. The measurements indicate an increase in airborne particlates at these sites of at least on order of magnitude during this ten year period. At Yellowstone Park in the winter-time which has the cleanest air we have found in the continental United States, the background levels of Aitken nuclei have increased from less than 100 to the 800–1000 ml^{-1} range within a five-year span. At Flagstaff, Ariz., where in 1962 the background levels ranged from 100–300 the concentration now lies between 800–3000. At Schenectady, N.Y., the average concentration of these nuclei has risen from less than 1000 to more than 5000 with values occasionally exceeding 50,000 ml^{-1}.

While it is difficult to ascribe these increases to any one cause, it is obvious that the increased demand for electric power, the large increase in garbage and trash incineration and the automobile, are likely to represent the major sources of increased pollution, especially since many industrial plants have been forced to reduce their pollution due to more rigorous regulations.

Just as it is not easy to place the blame for increased air pollution specifically on the power plants, incinerators and automobiles, it is equally difficult to demonstrate clear cut or unequivocal atmospheric modification to these sources. I am confident that in time there will be ample proof of these effects which are now inadvertently modifying the atmosphere.

The presence of high concentrations of visible as well as invisible particulates above and downwind of our cities produces a heat island effect as real as a sun-drenched Arizona desert or a semitropical island in the Caribbean.

Those cities like Boston, New York and Philadelphia which are not affected by geographic barriers as is Los Angeles, Salt Lake City, or Denver are able to get rid of much of their effluent whenever the wind blows. Their plumes of airborne dirt extend as visible streamers for many miles downwind of the source areas. In the case of the metropolitan New York City-northeastern New Jersey complex, these plumes will be found in the upper Hudson Valley, in southeastern New England or over the Atlantic Ocean.

Commercial airline pilots flying the Atlantic are often able to pick up these pollution plumes hundreds of miles at sea. Hogan recently obtained data which provides a quantitative measurement of the New York effluents near the surface of the Atlantic between the United States and Europe. This same paper [1] amply demonstrates a similar zone of air pollutants being exuded over the seas surrounding Europe, the British Isles and the east and west coast of the United States.

2. PROPERTIES OF MARITIME AND "COUNTRY" AIR

We have known for twenty years that maritime air is characterized by low levels of both cloud droplet and Aitken nuclei. Vonnegut [2] showed by a very simple experimental device that about 50 effective nuclei at low water saturation droplet formation existed on the upwind coast of Puerto Rico where the trade wind clouds are seen. We were all much surprised when we established the nature of trade wind clouds during our research flights near Puerto Rico in 1948 [3]. Following these activities, I pointed out [4] the large difference noticeable even then between the "raininess" of the clouds upwind of the island and those which formed over the land after entraining the polluted air from San Juan, the sugar fields and refineries, the cement mills and the myriads of charcoal pits which dotted the island, each sending out its plume of bluish smoke. In our studies in the vicinity of Puerto Rico we observed that in many instances trade wind clouds would start raining by the time the clouds had a vertical thickness of not more than a mile while those over or immediately downwind of the island often reached three times that thickness without raining.

During a continent-wide flight over a large area of Africa, I found [5] an even more spectacular effect of inadvertent cloud seeding. As a result of the massive bush and forest burning initiated by the inhabitants preceding the onset of the rainy season, huge cumulus clouds, some of them reaching a height of more than 35,000 ft. (vertical thickness 4–5 miles) were observed which were not producing any rain. Instead the clouds grew so high that very extensive ice crystal plumes hundreds of miles long extended downwind of the convective clouds. No evidence of glaciation was observed in the side turrets of the clouds indicating a deficiency of ice nuclei at temperatures warmer than the homogeneous nucleation temperature of —40C. Thus it appeared that the precipitation process was being controlled almost entirely by coalescence and that so many cloud droplet nuclei were being entrained into the clouds from the fires below, that the coalescence process was impaired so that no rain developed. If ice nuclei were present, they were probably deactivated by the high concentration of smoke particles and gases flowing into the base of the clouds. Similar effects have been observed on a smaller scale in the Hawaiian Islands. During the trade wind cloud regime, clouds which form over sugar cane fields when they are burned prior to harvest are actually larger than the surrounding clouds but they have never been observed to rain even though smaller ones nearby produce showers. Warner more recently has documented such observations [6].

A further observation of secular change in the microphysics of clouds has been observed in the vicinity of large cities during airplane flights through convective clouds. The observations I have noted in particular were made in commercial twin engine planes over the past ten years. Of recent years it has been noticed that such clouds often have so many cloud droplets in them that visibility is restricted so much that the engine is hardly visible. In my earlier observations I can never recall being in clouds so opaque that the wing tips could not be seen. Several of my colleagues have reported similar experiences.

Perhaps the most impressive field evidence of inadvertent weather modification is the overseeding of supercooled clouds which is readily observed over and downwind of our northern cities in the wintertime.

3. ICE CRYSTALS FROM POLLUTED AIR

Although I have been observing such phenomena for more than ten years, the effect was brought to my attention in a vivid way during a flight from Albany to Buffalo on 20 December 1965. After flying above a fairly thin deck of supercooled stratus clouds downwind of the Adirondack Mountains, I noted a massive area of ice crystals above and downwind of Rochester, N.Y. The crystals were so dense that the reflection from the undersun* was dazzling. Since that time I have observed similar high concentrations of crystals at low level above and downwind of most of the large northeastern cities such as New York, Albany, Utica, Syracuse, and Buffalo as well as Detroit, Chicago, Sacramento and Los Angeles. In all instances the ice crystals were observed at low level (below 5000 ft. above the ground in most instances), and extending for at least 50 miles downwind of the city sources and without cirrus clouds above the areas affected. In a few instances when the plane passed through the crystal area, I observed the particles to be like snow dust, though in a number of instances after landing I observed very symmetrical though tiny hexagonal crystals drifting down from the sky.

4. MISTY RAIN AND DUST-LIKE SNOW

For the past several year I have also been observing a number of strange snow and rain storms in the Capital District area in the east central part of New York State. These storms consist of extremely small precipitation particles. When in the form of snow, the particles are like dust having cross sections ranging from 0.02 cm (200 μ to 0.06 cm (600 μ). When in the form of droplets, they often are even smaller in diameter, at times being so tiny that they drift rather than fall toward the Earth. When collected on clean plastic sheets, the precipitation is found to consist of badly polluted water. It is a well-known fact that precipitation "cleanses the air." In the past much of this cleansing action has been ascribed to the sweeping up of suspended aerosols by rain and snow. Little attention has been given to the possibility that submicroscopic particulates from man-made pollution may in fact be initiating and controlling precipitation in a *primary manner* rather than being involved in the secondary process wherein precipitation elements coming from "natural" mechanisms serve to remove the particles by diffusion, collision and similar scavenging processes.

My first evidence that there might be substances in urban air which would react with other chemicals was encountered while studying ice nucleation effects at the General Electric Research Laboratory in 1946 [7]. At that time I found that laboratory air contained aerosols which would react with iodine vapor to form very effective ice nuclei but that when the air was free of particulate matter, no further ice particles would form.

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*Note: The undersun is an optical phenomenon caused by the specular reflection of the Sun from the surfaces of myriads of hexagonal plate ice crystals. In order to produce an undersun, it is necessary for the crystals to consist of smooth-surfaced plates which float with their long axes horizontal to the ground. They thus act as many tiny mirrors. If the crystals were not hexagonal plates but rather prisms, the optical effects would include under parhelia and other reflections which are well known and have been related to crystal types during our winter studies at Yellowstone Park.

5. POTENTIAL ICE NUCLEI FROM AUTO EXHAUST

In 1966 I published a paper [8] which suggested that air pollution in the form of automobile exhaust could account for the high concentration of ice crystals which I have observed downwind of the larger cities in the United States and in any area where a considerable number of automobiles are used. My laboratory studies have shown that submicroscopic particles of lead compounds produced from the combustion of leaded gasoline can be found at concentrations exceeding 1000 cm^{-3} in auto exhaust. These were measured by exposing auto exhaust samples to a trace of iodine vapor before or after putting the samples into a cold chamber operating at —20C. Presumably this reaction with iodine formed lead iodide which is an effective sublimation nucleus for ice crystal formation. Evidence that the active ingredient in auto exhaust consists of submicroscopic particles of lead was determined by comparing its temperature ice nucleation activity pattern with that of lead oxide smoke produced by electrically sparking lead electrodes which was also reacted with a trace of iodine vapor. One of the problems related to the evidence that leaded gasoline is responsible for the ice crystals observed in laboratory and field experiments concerned with auto exhaust is the source of the iodine needed to produce the lead iodide reaction. All evidence thus far encountered shows that only a few hundred molecules of iodine are required to produce a nucleating zone for ice crystal formation. The amount of iodine reported in oceanic [9] air (the order of 0.5 U G. m^{-3}) is orders of magnitude greater than would be required to activate such particles.

I have recently completed further studies in Arizona, New York and France [10, 11] and have found that wood smoke and other organic sources add iodine to the air which could react with the auto exhaust submicroscopic lead compounds which are always present in urban pollution. Hogan has recently showed [12] that similar reactions will proceed from the vapor phase.

Admittedly we are dealing with chemical reactions in the realm of surface and even "point" chemistry as Langmuir termed such molecule by molecule reactions. This is an area of particulate research for which there is very little experimental data or practical experience. The size of the primary lead particles from auto exhaust which are 0.008–0.010 diameter are far too small for analysis by any currently available chemical reaction techniques. All of my laboratory experiments indicate that the submicroscopic particles in auto exhaust which react with iodine vapor act only as nuclei for ice formation from the vapor phase. No evidence has been found that they act as freezing nuclei.

6. THE EFFECT OF LARGE CONCENTRATIONS OF ICE CRYSTALS

The presence of high concentrations of tiny ice crystals in air colder than 0C over thousands of cubic miles raises interesting aspects of the dynamics of weather systems. Such crystals continually modify small supercooled clouds soon after they form. The net results is a reduction in the number of local rain or snow showers and the production of extensive sheets of "false" cirrus. Bryson has pointed out (13) that cirrus sheets and even the presence on a large scale of airborne dust exerts a measurable decrease of insolation. If a much larger supply of moist air moves into such a region, the entrainment of high concentrations of crystals by more vigorous supercooled clouds may trigger the formation of a massive storm through the release of the latent heat of sublimation. Langmuir described [14] such a storm system which he believed was initiated and then intensified when dry ice in successive seeding operations was put into the lower level of a rapidly developing storm.

7. FINDINGS OF PROJECT AIR SAMPLE

In order to determine whether or not polluted air above cities contained particles which would react with free iodine molecules, eight transcontinental flights have been made by Atmospherics, Inc., under our auspices during the Fall of 1966 and 1967 and the Spring and Fall of 1968. A Piper Aztec aircraft was fitted with instruments which could measure in a semiquantitative manner the concentration of atmospheric particulates which would become ice nuclei by the reaction with iodine, and which would also measure natural nuclei for ice crystal formation. The iodine reactions were conducted in a cold chamber at —20C. The determination of naturally occurring nuclei was done at —22C. In addition, measurements were also made of Aitken nuclei (a measure of polluted air) and cloud nuclei. This last measurement which is made at very low water saturation is also a measure of the degree of air pollution since values above about 50 cloud nuclei and 500 Aitken nuclei per cubic centimeter is indicative of some degree of air pollution. The flight samples were made mostly just below the top of the haze layer which ranged from 1500 to 5000 ft above the ground throughout the flights. Of the 266 measurements in November 1966, 31 were made on the ground. All of these showed excessive pollution levels. Great care was exercised in making these observations to avoid contamination from the engine exhaust of the aircraft being used for the measurements.

At several locations observations were made above as well as within the upper part of the haze layer. In every instance the air above the visible top of the haze layer was low in lead particles while that just below the top or farther down showed very high concentrations.

All other locations where counts of the ice nuclei were low involved regions free of pollution sources. Of the 266 observations 108 or 40% of the measurements were in areas such as upwind of cities (9); above large lakes (8); above haze layers (22); and above woods and farms (33). The 60% remaining had values of potential ice nuclei of 100 per liter or more. Some 115, all of them above or downwind of cities had values in excess of 200 per liter which I consider would lead to definite over-seeding of the atmosphere with ice particles if suitable moisture was available. Values of 1000 per liter or more occurred at 101 of the stations. If concentrations of ice crystals that high occurred the cloud would resemble a stable ice fog as occurs at Fairbanks, Alaska, or the Old Faithful area of Yellowstane Park [15] when the temperatures are colders than —40C. With crystal concentrations of this magnitude, the particles grow very slowly if at all and thus remain floating in the air for extended periods. This then reduces the incoming solar radiation to a noticeable degree. If such areas are extensive, they cannot help but cause changes in the weather patterns of the affected areas.

Similar findings characterized our second, third and fourth round-trip transcontinental flights covering more than 25,000 additional miles and consisting of over 1500 more observations. In practically every instance where polluted air was present, high values in potential ice nuclei (using the iodine reaction) was found. The only exceptions were instances where the plumes of steel mills, forest fires and other highly concentrated effluents were measured in areas where auto exhausts could contribute very little if anything to the sampled air.

Fig. 6 [not reproduced herein] illustrates the type of pollution which still occurs along Lake Erie at Buffalo and Fig. 7 [not reproduced herein] a zone of snow falling from low clouds about eighty miles downwind of Buffalo at a location where the iodine-activated nuclei had dropped from 5000 per liter measured at Buffalo to 500 near Cayuga Lake and the Aitken count from 25,000 ml^{-1} to 4500 as measured at 3000 ft above the terrain.

Fig. 8 [not reproduced herein] illustrates the fantastic amount of smoke which shrouded the metropolitan New York area on 23 November 1966, when one of the first dangerous smog alerts was sounded by New York City health officials. Just prior to obtaining this picture the airplane was flown up through the smog. At 600 ft the cloud nucleus count was 2000 ml^{-1}, the Aitken count 25,000 and the ice nuclei measured were 0 for the natural background and 50,000 to 100,000 per liter for ice nuclei activated with iodine vapor.

Fig. 9 [not reproduced herein] shows the conditions at Albany, N.Y., on the previous day. At 1200 ft the cloud droplet nuclei numbered 900 ml^{-1}, the Aitken count was 4000, the natural ice nucleus background was 0 but the concentration of ice nuclei activated with iodine was 50,000 per liter. These are concentrations which are commonly observed in the air below the top of the inversion over and downwind of all large cities. In many instances the smoke concentrations in such areas is not as spectacular as shown in Figs. 7 and 8 since a considerable portion of the pollution is submicroscopic. These aerial photos were taken by Thomas Henderson who also made the air measurements.

8. FLIGHT OBSERVATIONS OF INADVERTENT SEEDING

It is quite feasible to detect and observe the massive systems of ice crystal nuclei which produce inadvertent effects on cloud and weather systems due to man's activities. This is accomplished most easily by riding on the sunny side of a jet aircraft.

I observed and photographed three such systems in 1967 during a flight from Buffalo, N.Y., to Denver, Colo., by way of Chicago, returning directly from Denver to New York City.

(a) Ice crystals related to polluted air

On Wednesday, 6 November 1967, I left Buffalo at 1035 by Boeing 727 landing at Detroit and Chicago. Upon take-off I noted a heavy pollution pall over Buffalo extending westward to the horizon. Just west of Buffalo we climbed above stratiform clouds estimated to be at 15,000 ft or lower which consisted of very high concentrations of ice crystals as established by an undersun. This extensive zone of ice crystals was observed all the way to Detroit and was associated with visibly polluted air. We flew at 20,000 ft where the temperature was —20C. Enroute from Detroit to Chicago I found the same condition to exist from the 1108 take-off until 1132 at which time only supercooled clouds were visible. At the same time all evidence of polluted air disappeared, visibility between cloud decks was unlimited and no further trace of ice crystals could be seen as we landed at Chicago The air pollution from Chicago was being carried to the southeast over Indiana about 30 miles south of our jet route.

(b) Ice crystals produced by dust from plowed land

Upon take-off of Chicago in a Boeing 707 at 1320 CST, the air was clear, several decks of stratiform clouds were visible with no evidence of ice crystals. Heading west I saw no ice crystals until 1424. Just previous to that time a peculiar zone of dusty air could be seen ahead of us extending toward the southwest. Within a few minutes a brilliant undersun could be seen which persisted for the next half hour. When we finally emerged from the affected zone over northeastern Colorado it was quite obvious that the 300 miles long zone of ice crystals was due to very extensive dust storms caused by 50–100 mph katabatic ground winds pouring down out of the Front Range of the Rockies and blowing top soil from the extensive wheat fields extending from northeastern Colorado to the region about 50 miles east of Pikes Peak. The low level dust was rising only from tilled land, the grassy areas such as the Pawnee Grass Lands were unaffected.

A similar massive dust storm which produced very extensive cloud seeding was observed by me on the afternoon of 12 April 1967, between Amarillo, Tex., and Denver, Colo. This affected region was so extensive and had such a profound effect on the Great Plains and midwest weather systems that I was able to identify it and see its effects over western Illinois two days later.

On the return flight from Denver on 8 December, a third source of inadvertent weather modification was observed. Take-off in a DC9 occurred at 1206 MST on a non-stop jet flight to New York City. Very fine snow was falling at the ground upon take-off. Four minutes afterward we climbed above an extensive area of ice crystals. A bright undersun became visible and was seen continuously all the way from the Denver area to the Atlantic Ocean east of New Jersey. Jet contrails appeared to be the source of these crystals throughout the entire flight which was conducted at 37,000 ft. More than a dozen different planes were seen coming from the east within the flight corridor we were using, most of them several thousand feet below us. From time to time we were close to contrails being made by planes at our level but ahead of us.

The most striking effect observed was the sharp line of demarcation between the area affected by contrail seeding along our flight corridor and an extensive area of high altocumulus cloud (or cirrocumulus) which paralleled our zone at its southern extremity. This region of non-modified clouds was estimated to be about 10 to 20 miles away and extended over large regions of the country. I expect that an effect such as was observed could be seen on satellite cloud photographs.

Perhaps the most disturbing feature about inadvertent weather modification is that in a subtle manner it seems to be changing the nature of clouds over increasingly large areas of the globe. Much of our current consideration of cloud seeding assumes the ubiquity of supercooled clouds and the effectiveness of a seeding material for triggering the instability of such systems.

If pollution sources lead to increased dustiness from ill-used land, more cloud nuclei from burning trash and many more ice nuclei from the lead-permeated exhaust of internal combustion engines, not only will we lose the possible advantage we now have of extracting some additional water from our sky rivers, but we might even be confronted with a drastic change in our climatological patterns.

Interesting climatological evidence of inadvertent weather modification has been found by Changnon [16] to exist in the area downwind of the Chicago, Illinois-Gary, Indiana, complex of extensive urban, highway and steel mill concentrations.

A very noticeable increase in precipitation and storminess is evident in the records of the past three decades. The LaPorte, Indiana region whose record is cited as evidence of this effect is downwind of the heavy pollution source mentioned above as well as the close proximity to a very moist air source in the form of Lake Michigan. It is a common observation to see a lake effect street of cumulus clouds extending in the convergence zone south and southeast of Lake Michigan. The combination of very moist air and an abundance of ice nuclei are apparently in very favorable juxtaposition for an optimum reaction to occur. The LaPorte anomaly was first observed by a local weather observer which was then evaluated by Changnon. He found that there has been a notable increase in precipitation starting about 1925 with definite increases since that time also of the number of rainy days, thunderstorms and hail storms. There has been a 31% increase in precipitation, 38% of thunderstorms and 240% increase of hail incidences. The increases show a marked correlation with the production of steel.

Since this data was obtained entirely from an evaluation of the climatological records, it is of great importance that careful "on-the-spot" field observations should be made in the LaPorte area to establish the atmospheric dynamics which are responsible for the apparent change in the precipitation pattern of that area. It is particularly important that the concentration of particulate matter be correlated with storm patterns. The weather systems at the mesoscale level should especially be sudied to determine whether the area receiving increased precipitation is in the center or edge of the city-industrial plume effluent and the properties of the moist air moving in from Lake Michigan.

9. EXPERIMENTAL PRODUCTION OF LARGE AREAS OF ICE CRYSTALS

During the past ten winters field operations have been developed by our Yellowstone Expeditions in which we have established certain relationships of ice crystal concentrations in the free atmosphere. The early morning inversions of the Old Faithful Geyser Basin in the wintertime often have liquid water contents ranging from 0.5 to 1 gm m^{-3}. This rich supply of moisture is contained within a strong ground-based inversion having a vertical thickness of about 100 m. At a distance of 2000 m from a point source of seeding, ice crystal concentrations up to 10,000 per liter have been measured. Such crystals at —12C are hexagonal plates with cross sections of from ten to a thousand microns, the size depending on concentration and moisture supply. Those of 200 μ occur typically at a concentration of 200 per liter with a fall velocity of 10 cm sec^{-1}. The brilliance of the undersun and related optical phenomena indicates that the number of crystals observed in areas caused by air pollution, jet contrails or dust storms often have concentrations as high or higher than observed in our experiments. Thus at Yellowstone we have an ideal outdoor laboratory to study some of the factors which must be better understood if we are to work out the physical interactions resulting from the inadvertent modification of the atmosphere.

10. THE NEED AND OPPORTUNITY TO STUDY THESE PHENOMENA

The effects cited are but a few examples of many which I have observed and photographed during the past few years. It is the rule rather than the exception that such massive zones of ice crystals can be observed over large areas of the country which can be related to man-caused modification.

Such occurrences must be exercising a detectable effect on the weather systems of the Northern Hemisphere. I feel that nowhere near enough effort has been directed toward the establishment of an organized and continuing study to determine the effect of such inadvertent seeding mechanisms on the synoptic weather patterns of our country. Such studies should have a major place in the World Weather Watch and the Global Atmospheric Research Project. I strongly recommend that the part played by atmospheric particulates should become an important research feature of this program.

There is a critical need for knowledgeable field scientists having an extremely broad scientific background who can work effectively in the real atmosphere under all types of conditions and extract quantitative and meaningful data from such systems.

Our Universities must place far more emphasis on this type of training than is being done at present. The eventual understanding of these complex interrelationships do depend on computers, electron microscopes, mass spectrometers and other costly instruments and equipment. However, the real atmosphere is the thing that must be understood and it is not enough to rely on data obtained by automatic instruments and uninformed field men as is too often the case. It is not easy to conduct efficient field operations. We must approach nature to an ever increasing degree but this confrontation must involve "intelligent eyes," an understanding of the physics, chemistry and electricity of the reactions which can occur and a zeal to understand the things which combine to produce atmospheric phenomena.

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[Reprinted for BioScience, vol. 19, No. 10, October 1969]

Some Effects of Air Pollution on Our Environment

(By Vincent J. Schaefer*)

The rapid increase in air pollution is a fact that even the casual observer can see—and often smell. In some areas it is so bad that eye-watering conditions from smog are not uncommon. This condition has happened and is actually getting worse despite considerable effort on the part of air pollution control officials, industry, and the enforcement of a number of local laws controlling trash burners, brush burning, and other practices.

Many observers are puzzled about this buildup of pollution especially when they notice that visible plumes from chimneys and smoke stacks are rarely seen except from electric power plants, steel and pulp mills, cement plants, and some chemical plants.

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One of the major sources of air pollution consists of invisible plumes of particulates so small, as they emerge from the combustion chamber, chemical reaction, or gaseous vapor source, that they are optically invisible. Such particles have cross sections less than 0.1 μ. One source of such particles is the automobile. When in good operating condition, the effluent from the auto exhaust pipe is quite invisible. However, if one measures the number of particles emitted by an idling automobile, it is the order of one hundred billion (1×10^{11}) particles per second. Another potent source of invisible particles may actually result from an air pollution law which is directed at the control of visible smoke plumes. While this law was designed to force industrial plants to install electrical precipitators, scrubbers, and other smoke control devices, it is possible in some instances to pass the effluent from an industrial process through a hot flame (an afterburner) to vaporize it and thus as with the automobile, the pollution plume becomes invisible. The concentration of tiny particles is so high, however, that agglomeration often occurs and the knowledgeable observer will detect the plume downwind of the offending source. Under such conditions the use of the afterburner is particularly bad since in addition to making the particles much smaller than they would normally be, they then have a longer residence time in the atmosphere because of their smaller size. Also, the afterburner will generate nitrogen oxide, a poisonous gas which also serves as one of the catalysts for particle growth involving unburned gasoline vapor.

Although some persons believe that unless pollution is curbed in the near future we will run out of breathable air, I believe that other problems will confront us before that happens. The human body is a highly resistant mechanism to airborne particles. If this were not the case, I do not see how smokers could live! In the process of somking, the individual insults his lungs with a concentration of at least ten million smoke particles per cubic centimeter. This is a concentration that is 10 to 100 times greater than is encountered in a vary badly polluted urban area like Los Angeles or New York City. While there is increasing evidence that the smoker is, in fact, shortening his life by the act of smoking, there are many contradictory facts about smoking which require more understanding about this complex question.

In considering this problem I have called the cigarette a "synergistic reactor." By this term I mean the following: when a cigarette is smoked, there is a very hot zone at the site of the burning tobacco. When the smoker inhales, this burning zone increases in temperature as more air ventilates and intensifies the burning of the tobacco. If the cigarette is smoked in air which contains pollution particles, many of these particles (with a concentration of 10,000 to 100,000 per cubic centimeter or more) are drawn through the burning zone and vaporized. Thus, besides receiving the products of combustion of the tobacco and paper of the cigarette, an additional load comprised of a wide variety of chemical substances is also taken into the lungs. Through vaporization these chemical substances are now in a highly reactable condition with the lungs virtually serving as a test tube, the concentration of gaseous vapors being so high that many reactions can take place and consequently a host of new chemicals may form. These new precipitates being small are readily adsorbed, dissolved, or precipitated on the moist surface of the lungs.

When one considers the nearly infinite variety of substances which float in the air of the urban environment, is it any wonder that confused information is an inherent part of the health records of smokers in an urban region?

One of the disturbing aspects of the increase in air pollution over the past decade is that it has apparently increased by nearly an order of magnitude in the area upwind of our cities. This tenfold increase in particulates in areas which previously were characterized as clean "country" air has been measured in northern Arizona near the San Francisco Peaks, in northwestern Wyoming at the Old Faithful area of Yellowstone National Park, and in the Adirondack Mountains of northeastern New York.

When the country air becomes contaminated, then it can no longer dilute the pollution sources to the degree which once was possible.

During the past 3 years we have measured the concentrations of particulates in many parts of the contiguous United States (Schaefer, 1969). In eight transcontinental flights which encompased most of the major cities of the country and the majority of the clean and polluted regions of the country in between, we have been able to gain a very broad view of the degree to which polluted air covers the country. These findings show the extent to which pollution sources spread their pall over large areas of the continent and clearly shows the fallacy of the "air shed" idea. Unlike water which is primarily controlled by gravity and thus can be related to a particular drainage system often called a water shed, the air and its load of particulates is not controlled by geographical barriers in most instances as it moves rapidly from one region to another, controlled primarily by pressure systems and the weather accompanying them. It is only during periods of clear, quiet weather that local inversions intensify the pollution loads and thus cause local concern as the concentration of particles builds downward from the lid of the temperature inversion and the general public becomes aware of the pollution haze and is sometimes frightened by it.

It is the measurable increase in the continental and global levels of particulates which concerns me at the present time, since I believe certain components of the polluted air may affect us in a more subtle way which may become a more serious problem than the foul smell and eye-watering components we now associate with polluted air.

For a quarter of a century I have been observing, studying, and measuring the characteristics of atmospheric clouds. In the mid-1940's, supercooled clouds were frequently observed in the northeastern United States. During the period 1946–52, we conducted more than 150 flight studies of supercooled clouds in eastern New York, mainly over the Adirondack Mountains. During the past 5 years, supercooled clouds have become relatively rare in the same region while low-level ice crystal clouds (false cirrus) are of common occurrence.

This disapperance of supercooled clouds has been accompanied by the occurrence of a strange kind of precipitation which I have called "misty" rain and "dusty" snow. The mist consists of water droplets of about 0.050-cm. diameter, so small that they tend to drift down rather than fall.

The "dusty" snow has a slightly larger cross section, but the droplet from a melted crystal has about the same size as the misty rain. Thus, it is likely that some of the mist originated as snow but melted as it fell into warm air. When this type of snow is falling, only a thin dust-like layer of snow accumulates on the ground.

I believe the origin of both of these forms of precipitation are produced by air pollution. A superabundance of both cloud nuclei and nuclei for ice crystal formation are commonly observed in polluted air. The water vapor in the air collects on such particles, but since there are so many of them (often 10 to 20 times more cloud nuclei and hundreds of times more ice nuclei), the particles are so numerous and so small that they inhibit the precipitation process by stabilizing the clouds. Such stable clouds prevent sunshine from reaching the earth and thus may effectively change some of the dynamics of weather systems. Whether such effects will eventually cause changes in climate can only be determined by much more intensive research.

The type of air pollution which produces a large increase in the concentration of cloud nuclei could be almost any smoke from the burning of organic materials such as garbage, wood, paper, the effluent from pulp mills, a majority of chemical plants, and electric power plants emitting sulfur residues. On the other hand, only a few sources of ice crystals have been identified. A very definite increase in such nuclei may be found in the smoke from steel plants (Chagnon, 1969). By far the greatest and ubiquitous source is the automobile. The most effective source is the auto whose exhaust is quite invisible. I have recently found that an auto equipped with the so-called anti-pollution devices is as effective a source of potential ice nuclei as a car without such a control mechanism. If anything, it appears to produce even more nuclei! The material responsible for the production of ice crystals is the submicroscopic residues produced by the burning of gasoline. This mechanism and the results have been previously described in some detail (Schaefer, 1966; Hogan, 1967; Schaefer, 1968a and b) and will not be repeated here.

If our studies continue to show the increase in occurrence of overseeded clouds, the persistence of clouds for longer periods of time due to their stabilization in areas of polluted air, there is a strong possibility that such conditions will lead to serious environmental and ecological problems resulting from this inadvertent modification of the weather and precipitation.

I hope I am wrong about these mechanisms and their consequences. However, the more data I accumulate and the more observations I make increases the evidence that some major effects in the atmosphere are occurring over hundreds of thousands of square miles. Since the weather systems of our planet are interconnected on a global scale, these effects may lead to an ever-increasing impact on the climatic patterns of the world. While such effects are not necessarily irreversible, it would require major changes in the present trend of our scientific and technological developments to reverse the present situation.

Only an educated and aroused public is likely to demand a change in this deterioration of our environment. There are some hopeful signs that the public is aware of some of these abuses and dangers. Many more efforts like the "Conversation in the Disciplines" in which we have participated are needed. I hope this will happen; otherwise we will encounter a host of serious problems within the next generation.

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Senator MUSKIE. I note as we close this morning session that you have been the first witness in the years we have held testimony on this subject to emphasize the importance of this particular area.

Dr. SCHAEFER. Thank you.

Senator MUSKIE. It is one of the reasons that we asked you to begin this series of hearings. I think it has been very helpful. Thank you very much, sir.

Dr. SCHAEFER. Thank you very much, Senator.

Senator MUSKIE. We will include statements received relevant to the bills and amendments at this point in the record.

(Statements follow:)

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
Washington, D.C., March 2, 1970.

HON. JENNINGS RANDOLPH,
Chairman, Committee on Public Works,
U.S. Senate,
Washington, D.C.

DEAR MR. CHAIRMAN: Since submission of our draft bill, the "Clean Air Act Amendments of 1970", on February 10, 1970, which has been referred to your Committee, it has been called to my attention that a provision in the bill may be given a construction which we had certainly not intended.

The proposed section 112 of the Clean Air Act, relating to "Stationary Source Emission Standards", was intended to authorize regulation of new and existing sources which would be extremely hazardous to health and of other new sources which would "contribute substantially to endangerment of the public health or welfare." Subsection (b) of this section correctly refers only to regulations for these sources of emissions. Subsection (a), however, is not clearly limited to these sources and might be open to the construction that it applies also to existing sources which are not extremely hazardous to health. This was certainly not our intention.

To obviate any such unintended interpretation, I would appreciate it if, prior to reporting the bill, subsection (a) of the proposed section 112 could be amended by changing the first sentence to read: "The Secretary shall from time to time by regulation, giving appropriate consideration to technological feasibility, establish standards with respect to (1) emissions, which are extremely hazardous to health, from any stationary sources, and (2) other emissions, which contribute substantially to endangerment of the public health or welfare, from any new stationary sources."

Sincerely,

CREED C. BLACK,
Assistant Secretary for Legislation.

STATEMENT OF THE NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS ON S. 3466

The 66,000 members of the National Society of Professional Engineers appreciate the opportunity to present their views on S. 3466, a bill to amend the Clean Air Act.

The National Society of Professional Engineers, a nonprofit organization headquartered in Washington, D.C., consists of engineers who are engaged in virtually every aspect and phase of engineering practice as well as educational and governmental employment. Each has qualified by virtue of academic training, experience, and demonstrated fitness for a license to practice engineering under one or more of the various state registration and licensing laws. Organized at chapter, state, and national levels, the Society is the authoritative voice for these professionals.

Society members all across the country actively participate in programs intended to correct, control, and prevent pollution of our air. These engineers not only design pollution control equipment, direct its installation, and supervise its operation, but they also serve on governmental pollution control boards and other concerned agencies and groups, both formal and informal, at all levels of government. Engineers are, because of their training, discipline, and involvement, most conscious of the serious threat which air pollution poses to the public health, safety, and welfare. Moreover, they are alert to the heavy obligation they share in providing leadership in the nation's air pollution abatement efforts. They are, at the same time aware of the need to insure that these efforts are based upon sound engineering, economic, and governmental principles.

In recognition of their leadership role in this area, the membership of the National Society of Professional Engineers, acting through its Board of Directors, has continuously considered how best to deal with air pollution problems in the United States, and has arrived at a number of conclusions.

Engineers are convinced that the total responsibility for activities relating to the prevention and control of air pollution involves all levels of government—local, state, and Federal—and includes private industry and individual citizens.

Engineers are equally convinced that abatement of air pollution through regulatory action should be the primary responsibility of state and local government, utilizing, to the extent feasible, a regional approach.

In order to strengthen the national effort for prevention and control of air pollution, engineers feel that the Federal government should take at least the following positive steps:

(a) Conduct and support research, development and demonstrations through intramural programs, contracts and grants, in cooperation with public and private institutions.

(b) Encourage the development of effective state and local programs, and provide financial assistance in furtherance thereof.

(c) Stimulate and financially support training and educational activities to increase the quality and quantity of engineering and other essential manpower resources, including technicians; sponsor conferences, seminars and other methods to explore new developments in combating air pollution, and disseminate information resulting from such discussions.

(d) Control air pollution resulting from Federal installations and direct Federal activities.

(e) Control *interstate* air pollution through regulatory action, if, after the responsible states have been allowed the prescribed period of time, adequate abatement measures have not been taken.

(f) Include appropriate professional engineering representation on the National Advisory Committee on Air Pollution.

Engineers believe in the principle that primary regulatory responsibility for the prevention and control of *instrastate* air pollution should rest with the state and local governments. We agree with the statement of this principle as set out in Section 101(3) of the Air Quality Act of 1967 as follows: "The prevention and control of air pollution and its sources is the primary responsibility of state and local governments."

S. 3466, would, however, provide for substantial Federal control over states' internal affairs, and appear to be in direct contradiction to this established principle.

The Clean Air Act of 1967 provides for interstate air quality control regions. Basically, this is a field in which the Federal Government should provide guidance and support for cooperative efforts by contiguous states, and much has already been done in establishing interstate regions by the National Air Pollution Control Administration of HEW.

There appears to be a legitimate basis for concern over some of the proposed interstate regions involving cities and associated air pollution sources which are widely separated, raising a question about the basis for Federal intervention. A reasonable application of the interstate control principle is understood, but some of the interstate regions recently announced appear to be unnecessary and deliberate attempts by the National Air Pollution Control Administration to impose its authority where it is not needed.

Some analysts of S. 3466 see no need for a Federally-established air quality standard for the entire country. They note that all states will have segments of interstate air pollution control regions where Federally-approved air quality standards must be adopted, and feel that those states not having general intrastate standards can and will readily adopt them.

These same analysts note the National Air Pollution Control Administration's record in having failed to set up its intended number of interstate air quality control regions as scheduled, and wonder whether it is therefore reasonable to assume that HEW can be expected to assume the larger task of setting up standards and control air pollution in all state of the United States.

S. 3466 genuinely presents the question of whether, under its provisions, state and local air pollution control boards and staffs would not cease to have authority except for "rubber stamping" Federal action, and would not, in substance, become enforcement agencies for the National Air Pollution Control Administration.

Engineers believe that care should be exercised so that the real progress which is being made under existing state and local control is not jeopardized through federalization.

Areas in which there does exist an undisputed need for substantial Federal activity do, however, exist. The conduct of research, development, and demonstration is one. Reliable research is very much needed to determine the effects on health of various pollutants. The authorization and funding provided in the Clean Air Act of 1967, for rsearch, we feel, should be continued.

Pollution resulting from internal combustion engines of motor vehicles is another appropriate area for Federal action. This source contributes about 64 percent of all air pollutants on a national average annual basis—80 percent in Washington and 88 percent in Los Angeles. Federal governmental action affecting the manufacturing process of internal combustion engines for motor vehicles, aimed at reduction in this source of pollutant emissions, is a function that cannot be successfully undertaken by the states and would therefore appear properly within the province of the Federal sphere. Regulatory action necessary for the continued maintenance of air pollution control devices on motor vehicles, on the other hand, is properly a state function. We believe that this division of responsibility in connection with motor vehicles is a sound one, and recommend it be considered in connection with S. 3466.

Engineers sincerely believe in the need for adequate and reasonable control of air pollution. But they also believe that there exists a real danger of unwise proposals becoming law in the current clamor for air pollution control. The possibility of a harmful over-reactiton through enactment of unnecessarily rigid controls is ever present, and we urge the need for sound judgment at the National level.

Statement of Michael Treshow, Professor of Biology, University of Utah

More and more, standards are being based on citizen pressure and emotion rather than scientifically established threshold concentrations of effects: each State is trying to outdo its neighbors in setting lower standards. Alarmists and foresayers of doom are pressing for complete removal of pollutants, and recommended standards for almost every pollutant are approaching zero. While a zero pollution level is a noteworthy goal, it rarely provides a realistic standard.

Some States (e.g. Oregon) have adopted a plan of developing desired air quality goals to supplement the standards. Hopefully standards would be realistic and could be met using today's technology. Goals provide a long term ideal to be sought and achieved as more effective technology becomes available in the future.

Approaches to setting air quality standards, and the standards themselves, are almost as numerous as the states developing them. Nearly every state is developing different standards and basing them on different criteria. This inconsistency in standards is confusing to control officials but is still more disturbing to the general public who don't know what to believe. The confusion is particularly critical near state boundaries where air regions overlap boundaries, and standards differ within the same air mass.

Such confusion can only be resolved by establishing federal standards to be met by all the States. Resolving the inconsistencies among State Air Quality standards is vital to an effective nationwide air quality program.

Senate bills S. 3229, S. 3466, and S. 3546, the *Air Quality Improvement Act*, the *Clean Air Act Amendments of 1970*, and the *National Air Quality Standards Act of 1970* should adequately unify air quality standards across the country and minimize the existing confusion.

Legislatively, the needs for air quality standards were most recently established in the Clean Air Act of 1967. But placing the authority for establishing standards with the States was a mistake.

In the first place, few states possess the expertise essential to developing realistic standards even with help of the Federal Air Quality Criteria. Many States are even so naive as not to know who to contact for help. Utah's Air Conservation Committee, for instance, in developing sulfur dioxide standards, called on only five "experts"—all from industry and all with questionable qualifications to discuss the subject.

One still more obvious weakness in State standards lies in the pressure large industries may be capable of exerting, and the influence they can wield in setting standards. The importance of major industry to a State's tax base cannot be underestimated. No rational state government is likely to jeopardize this base regardless of the hazards the pollutants from the industry might impose on the environment. Concerned industry may cooperate to the extent of moral obligation or economic feasibility, but is not likely to go much beyond this if its competition across the state line is spared the expense of maintaining a stringent control program.

Too often State air pollution control officials are too naive or too oblivious to demand stringent controls on new facilities even if backed by adequate laws. A current case in point is the power generating plants under construction near Page, in northern Arizona. Proposed control facilities are inadequate, and over 700 tons of SO_2 and 200 tons of fly ash will be deposited on the surrounding desert biome each day. Stacks 700 to 800 feet high are planned which will simply disperse the wastes over a wider area. The sensitivity of desert species to SO_2 is not known, but the bulk of the emissions will drift over and into Glen Canyon creating first an aesthetic insult to the thousands of boaters hoping to enjoy the pristine majesty of this remote National Recreation area. Secondly, pollution of Lake Powell itself is inevitable. The seriousness of this to the stability and productivity of the lake isn't known, but the sulfates will add measurably to the already saline waters, and the increased acidity may have a serious impact on the aquatic biota as demonstrated in smaller bodies of water subjected to far less pollution.

Regrettably, Arizona is accepting these power plants without demanding maximum control emissions. If S. 3466 were in effect, boaters, campers, fisherman, sightseers, and the public at large would not have to be concerned with the impending desecration of the Lake Powell Recreation area.

Such areas are for the enjoyment of the entire nation, not just the citizens of a small corner of one State. It is imperative that our natural areas be protected: it is the responsibility of us all to see they are!

Power plants and other major sources of pollution are being constructed in many parts of the country. Each contributes its share of wastes into regional air sheds oblivious to State boundaries. Where the State is remiss in its obligations by not demanding maximum emission control, excessive wastes are dispersed into neighboring air sheds where they may violate the air quality standards of that State.

Uniformity in standards, as can be attained only through federal standards, is needed to uniformly protect the natural ecosystems of the country to say nothing of the agricultural crops, recreation areas, parks, and home landscapes. Such standards must not be set loosely at concentrations expedient to industry but failing to provide adequate protection to the land. Nor must they be based on the unqualified emotions of a few alarmists, and set so stringent that present technology does not enable compliance. Such a situation either forces violating industries to shut down, to be granted variances, or the law to be ignored—all situations no one wants. Yet, such situations exist now due to inadequate deliberation and consideration given prior to establishing air quality standards.

Finally, States and air quality regions are duplicating each others efforts. Many lack the capability or competence to develop realistic standards. Federal air quality standards, developed in accordance with recommendation of the most knowledgeable experts in the country, must be provided. Standards for major pollutants must be established rapidly but sagaciously. Only then can our health and esthetics be adequately protected, and our natural and cultivated lands receive the uniform protection needed for their preservation.

State of Maryland,
Office of the Secretary,
Department of Health and Mental Hygiene,
Baltimore, March 26, 1970.

In re S. 3466.

Hon. Edmund S. Muskie,
Chairman, Subcommittee on Air and Water Pollution, Senate Committee on Public Works, U.S. Senate, Washington, D.C.

Dear Senator Muskie: We have reviewed Senate Bill 3466, which proposes various amendments to the Clean Air Act. After considerable thought, we have developed some opinions which we hope will be useful to your committee in making its determinations as to what action should be taken on the bill.

The bill calls for establishment by the U.S. Secretary of HEW of nationally applicable standards of ambient air quality. The existing requirement for publication of air quality criteria prior to setting air quality standards would be deleted. This is considered to be undesirable for the following reasons:

1. Standards set at the National level would probably not call for air as clean as would standards set by many (if not most) States under existing arrangements because National industrial and commercial pressure groups could concentrate all of their influence on a very few Federal officials while the capability of the general public (which has been very influential in standard setting in recent months) to influence decisions would be greatly weakened. Few citizen groups could afford the cost of trips to hearings. True, a few States may propose air quality standards which do not call for adequately clean air. But these could be upgraded by provisions for Federal review and approval and the setting of adequate standards through a Federal mechanism, if a State fails to adopt adequate standards.

2. Without published air quality criteria, carrying the weight of broad backing from the scientific community, the ability to overcome the statements of doubt offered by those who do not favor an aggressive clean air approach would be seriously impaired. The public at large, State and local governments, and others do not often have the resources to conduct comprehensive literature reviews and thus, would be at a disadvantage when discussing standards with industrial and commercial representatives who do have the capability to search the literature. Even Federal officials would be at a disadvantage if they had not invested the time and effort needed to prepare a public criteria document. True, the preparation of criteria takes time but it is time well spent.

3. If nationally applicable standards are set by the Federal government, it may well be the *only* standard. The chances are remote that any State could overcome the opposition of those not favoring an aggressive clean air policy to a standard calling for better air quality than that prescribed in a National standard. The contention would likely be that any National standard *must* represent the lowest justifiable pollution levels since the basic Federal law has as its purpose "— to protect and enhance the quality of the Nation's air resources—"

"— and to promote the public health and welfare." Yet, truly desirable standards are unlikely at the National level, because of the situation described in No. 1 above.

4. Public backing at the State and local level for truly aggressive clean-up programs would be weakened by National air quality standards. When the public has been involved in and has had an evident and strong voice in setting community goals (air quality standards), the public commits itself to taking the steps necessary to achieve the goals. Without this extensive, broad, and intimate involvement in goal setting, it may well be impossible to get needed public backing for such necessary sweeping changes as elimination of small on-site incinerators, controls on pre-1968 vehicles and mandatory heating plant maintenance, which involve direct expenditures by a great many private citizens.

The bill proposes that the Secretary of HEW be empowered to promulgate emission regulations applicable to sources which contribute substantially to endangerment of the public health or welfare." Certain special provisions would apply to regulations relating to emissions which are "extremely hazardous to health." We would agree that because of the uniqueness of such "extremely hazardous sources", the shortage of expertise in some State and local governmental agencies and the necessity of being as sure as possible that there will be no plants built which are extremely hazardous to health, regardless of other considerations, that the Federal government should set standards for emissions which are "extremely hazardous to health." However, a list of typical emissions should be given in the bill which would provide guidelines as to the kinds of emissions intended to be regulated. (For example, beryllium, asbestos, cadmium, arsenic, pathogenic aerosols, war gases.) There should be no problems in requiring absolutely minimum possible emission of such materials on a National basis because of the health hazard involved.

With regard to emission of other materials (those not extremely hazardous to health), we believe that the establishment of standards should be left to State agencies, with provision for Federal review and approval and for promulgation of standards by the Federal government for a jurisdiction when a State agency fails to adopt adequate standards. Our reasoning is along the lines of the concepts expressed in items number 1 and 3 above in regard to ambient air quality standards. A further factor is the generally recognized suitability of variations in emission regulations from one locality to another. It is our opinion that with a system such as we prefer, emission standards would tend to gravitate toward those representing "best possible control" whereas with National standards, they would tend more to gravitate toward some less restrictive, Nationally acceptable and "reasonable" level, such as might be needed at a source located in an isolated area. Our concept number 3 above would be especially valid. A National emission standard which was more restrictive than that which made sense for a plant in an isolated area would not seem likely.

Beyond these major considerations, some other observations and suggestions concerning the bill as written are as follows:

1. Page 10—lines 2 and 3—The Federal agency should be *required* to send the proposed regulations to all air pollution control agencies in the Nation, even though this is usually done on a voluntary basis.

2. Page 12—lines 6 through 25—There is no requirement that before the Secretary approves a State's implementation plan that he *must* determine that such plan will prevent inequitable contributions to pollution levels in a neighboring State or unduly contribute to excursions of pollution levels above the ambient air quality standards of a neighboring State. This seems to us to be a key element (interstate flow of pollution) in the Federal role and should be provided for.

3. Page 14—line 7—The Federal agency should be required to send the proposed regulations to concerned air pollution control agencies, even though such might be considered almost automatic.

4. Page 14—line 25—The ninety day time allowance seems unduly short in view of the rather substantial actions that might be needed. It would seem appropriate to allow the Secretary to specify the time for taking action (but no less than six months) so that he could vary the time to suit the circumstances.

5. Page 15—lines 11 through 14—We do not understand why the adversely affected States should not be represented on the hearing board, if the "polluting" States are. We suggest deleting this language from the bill.

6. Page 17—line 4—This condition ("can be prevented or substantially reduced") should be omitted. It might preclude the Secretary from the desirable action of setting a standard, to go into effect in the future, for sources for which control is not currently practical.

7. Page 18—lines 11 and 12 and lines 16 and 17—Provision should be made that plans which are more restrictive than those promulgated by the Secretary will be considered satisfactory.

The bill does not propose to give authority and responsibility to USDHEW in two important fields which we believe it should. First, we believe that HEW should be charged with promulgation of standards for emissions from aircraft engaged in interstate commerce and that a mechanism for enforcement of such standards by an appropriate Federal agency should be established. Secondly, we believe that HEW should be given authority and responsibility for prescribing the characteristics of solvents in materials which are shipped in interstate commerce. The materials involved are such items as paints, adhesives, printing inks, etc. Pure solvents, used as such in degreasers, dry cleaning, etc. could be regulated effectively by State and local agencies. The objective would be to minimize use of photochemically more reactive solvents in formulating various compounds. To have a variety of regulations in this field in the several States would cause substantial problems in the producing industry and in national organizations using solvent containing materials, such as the Federal government.

We appreciate this opportunity to submit our views on this important bill. If we can be of further service, please let us know.

Very truly yours,

NEIL SOLOMON, M.D., Ph. D.,
Secretary of Health and Mental Hygiene.

OFFICE OF THE SECRETARY,
DEPARTMENT OF HEATH AND MENTAL HYGIENE,
Baltimore, Md., March 27, 1970.

In re S. 3229.
Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Senate Committee on Public Works, U.S. Senate, Washington, D.C.

DEAR SENATOR MUSKIE: We have reviewed Senate Bill 3229, which amends the Clean Air Act. We would like to offer the following comments for consideration by you and your subcommittee.

Section 104 would require a public hearing, after 30 days notice on proposed implementation plans. While most states are already required, by State law, to hold hearings on proposed regulations, there is rarely any such requirement concerning a full implementation plan. The idea of involving the public in development of implementation plans is a good one and we suport it.

Amendments to section 202(a) of title II would give the Secretary power to prescribe standards for vessels, aircraft and commercial vehicles and for new noncommercial vehicles, vessels, commercial vehicles or aircraft engines or new noncommercial vehicle engines. We believe this proposal has merit and we support the general concept. However, implementation and enforcement of any such standards with regard to other than new items would pose major operational problems for a Federal agency, except perhaps for aircraft, because of the great numbers of items to be kept under control and their mobility. Perhaps a workable approach would be for the Federal government to publish recommended standards for non-new items for guidance of the States and leave much of the enforcement to the States. Hopefully, the States would incorporate the recommended standards in their own laws or regulations and enforce them. Also accompanying the standards should be testing procedures for field use by semi-skilled personnel and specifications for any needed testing equipment. We believe that railroad locomotives should be included in the items for which standards should be set. As we interpret the definitions, they would be.

Provisions of the bill regarding registration of fuel additives are unchanged from the existing law. We believe that the Federal government should be authorized to regulate the characteristics and composition of fuels used in transportation and of additives to such fuels.

In regard to a program to limit the impact of solvents on air quality, we feel that the proposed bill is not sufficiently direct and strong. The problem is, as you know, a matter of reducing emissions of organic solvents which are relatively more active in atmospheric photochemical processes. This can be done by use of emission control devices or by substitution of less reactive solvents for more reactive solvents. The uses of solvent may be divided into two general classes: (1) Use of solvents by themselves in such operations as degreasing or dry cleaning. Often only a single solvent is used in a given application; and (2) Use of solvents as part of a mixture of materials as in paints, adhesives and printing inks. State agencies can reasonably be expected to establish needed regulatory programs in the first instance but the Federal government is in a much better position to regulate in regard to the second instance. States can also readily operate programs to achieve control of emissions by application of emission control devices such as afterburners and absorbers. Therefore, we would favor legislation which would empower the Federal government to prescribe standards for the kinds of solvents incorporated into such materials as paints, adhesives, and printing inks.

We appreciate this opportunity to offer our views on this important legislation. If we can provide further information, please let us know.

Very truly yours,

NEIL SOLOMON, M.D., PH. D.,
Secretary of Health and Mental Hygiene.

STATE OF MARYLAND,
OFFICE OF THE SECRETARY,
DEPARTMENT OF HEALTH AND MENTAL HYGIENE,
Baltimore, March 27, 1970.

In re: S. 3546.

Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Senate Committee on Public Works, U.S. Senate, Washington, D.C.

DEAR SENATOR MUSKIE: We have reviewed Senate Bill 3546 which would amend the Clean Air Act. We would like to offer some comments for consideration by you and your subcommittee.

Sections 2 and 3 of the bill would accelerate the process of establishing air quality control regions. We endorse this objective. However, to clarify the matter of whether the Secretary of HEW or a State is to be responsible for designating a particular region, it is suggested that specific dates be added into the two sections. It could be specified that the Federal government shall designate appropriate regions on or before (say) January 1, 1971 and that after such date, the States should define regions to cover all parts of their respective States not then included in Federally designated regions. On July 1, 1971, the Federal government would again become active and designate the remaining regions not designated by the States or by previous Federal action. (As you may know, the State of Maryland has already divided the entire State into definite air quality control areas.)

The proposed amendment of paragraph (1) of section 108(c) is an improvement over the existing law and we concur with it, even though the shortened time schedule will put severe pressure on our newly developing staff of relatively inexperienced people. We suggest however that the words "and plan" be inserted after "standards" in (B) and after the last word "standards" in (G). We also suggest that an additional criteria be set forth for use by the Secretary in determining the adequacy of any standards and plans. It would relate to contributions to pollution levels in a neighboring State. No standards and no plans of a State should be considered adequate if they would allow an inappropriate increase of pollution levels in another State.

Section 3(b) of the bill is difficult to comprehend in several places. The difficulty seems to be associated with an inconsistent use of the terms "air quality standards" "implementation plans" and "emission requirements." The concepts and phraseology should be straightened out and be made consistent throughout the proposed new sections 2 through 11 of section 108(c).

In proposed section 108(c)(2)(C), an additional item should be added for use by the Secretary in determining whether State standards are adequate. It should require that the standards of one State must be such that air quality in a neighboring State will not be inappropriately degraded.

The proposed section 108(c)(3) (last sentence) forbids revised standards which would allow higher pollution levels than previous standards. While this has some merit, it does not seem to allow for proper consideration of recently developed facts nor for reasonable allowances associated with the changing nature of a community or changes in the purposes and goals of its citizens. It is suggested that the last sentence be deleted.

The Federal government appears to be authorized to initiate abatement actions in connection with violations without any prior consultation with the State concerned, by the language of proposed section 108(c)(7). This could generate a lot of work for Federal authorities and could well lead to friction between Federal and State authorities and confused situations. We would suggest that when the Federal government learns of a violation of standards that it first advise the State thereof and specify a time for the State to take action to bring about abatemen action. If the State then failed to act, direct Federal enforcement action could appropriately ensue.

In this same section 108(c)(7), we feel that allowing not more than 72 hours to abate an emission regulation violation be unrealisitcally short in most cases. It is suggested that the time allowed to abate such violations be left to the descretion of the Secretary. It might be appropriate to require a public hearing if the contemplated time allowance were more than a given period, perhaps one year.

We do not understand the reasoning for requiring that a copy of a petition be sent to the State water pollution control agency, as specified in section 108(c)(9). Was it intended that this be sent to the State air pollution control agency?

Violators who have been issued final orders to abate may be required to provide data on their emissions, under provisions of section 108(c)(11). This is a useful requirement but it should be broadened to authorize the Secretary to require submission of such data at any time the Secretary has just cause for believing that a violation is occurring.

The new section proposed for addition to section 108 (shown as (i) but (1) is probably correct) would authorize the Secretary to issue regulations to insure that new installations are provided with good emission control. While this is a laudable idea, it would appear that the cost of administering such a program would be very large and that effectiveness would be very difficult to achieve. It seems to us that this is a function better left in the hands of State and local governments.

Similarly, the concept embodied in section 5 of the bill is attractive but the problems and cost of administration of such a program would appear to be so formidable as to make it unwise to attempt it.

We hope that these observations and suggestions will be helpful to you and your committee.

Very truly yours,

NEIL SOLOMON, M.D., Ph.D.,
Secretary of Health and Mental Hygiene.

KARL E. WICHERT,
Des Moines, Wash., March 21, 1970.

Re Air contamination by exhaust fumes—*Report in Seattle Times* March 16 about activity of the subcommittee on air pollution.

Senator EDMUND S. MUSKIE,
Old Senate Building, Washington.

DEAR SIR: May I be permitted to submit some technical remarks to the suggestion by Mrs. Ruth Weiner to limit the horsepower range of cars.

(*A*) *Limitation of Horsepower.*—Although newspaper reports let often missing some vital details, the cited report said that it was suggested to limit the engine power to 200 hp. This is misleading, because:

1) It is impossible, to drive a tank or a tractor with the same limited amount of power as a passenger car.

2) It should read .... *passenger* cars to be limited to *50 hp.*

So far, i.e. in the past, the industry had settled for mainly three standard engine sizes: 120 hp, 170 hp 220 hp. These engines are applied to a very wide range of vehicles from passenger cars to trucks.

Concentrating on passenger cars, it is shown in the Addendum (1) that only 50 hp are utilized when driving under normal conditions. The rest of the installed power is wasted weight. Everybody can observe that a Volkswagen or a Volvo or any foreign car in that class performs as well as a heavier car. If a Volkswagen-engine would be installed in a Plymouth, Ford or etc., these cars would perform as wel for normal driving conditions; the difference would be in some additional gear shifting. The extra gear in the transmission costs less than the gain in price by using the smaller engine. Furthermore, especially for use by nonprofessional drivers, hydrostatic transmissions are on the market with efficiencies of more than 90%, which provide a smooth elegant stepless power conversion without any gear, not even for reverse.

If designed to standard practive, best engine efficiency is obtained at nominal rating power. At part load, such as 20%, the engine efficiency is "louzy", indicating a poor combustion. This means that an oversized engine has a poor burning rate all the time and therefore contributes maximum amounts of air contamination, while a "right-sized" engine (50 hp for passenger cars) operates with a high efficiency, i.e. good burning rate, mostly all the time when equipped with adequate "gearing" in an attempt to run the engine close to optimum speed.—The word "gearing" includes hydrostatic and hydrodynamic transmissions.

Therefore, an engine with 50 hp or less produces little air contamination.

(B) Air Contamination.—(falsely called "air pollution") A clear definition of air contamination is mandatory.

Tolerable are all combustion products of natural characteristics, i.e. as can be found present in air under normal environmental conditions:

Oxygen—O and O_2
Nitrogen—N and N_2
Water—H_2O
Carbondioxyd—CO_2 and combinations thereof

(In gaseous or solid form (the latter can lead to ice fog in arctic regions).)

Not tolerable are all unsaturated combustion products, because poisonous, and irritating fumes are produced by evaporation and/or partial combustion:

Carbonmonoxyd CO
Unsaturated Water
Oil fumes which can recondensate
Fumes of additives, such as sulphur, metals (lead), etc.

The definition demands a thorough publication of nontolerable products, their concentration in air samples and their probable sources. This information is already available, but not broadly published.

The most common energy production is by HEAT.

The most common fuel is OIL.

The oil industry will be furious if somebody would advocate the idea to abandon oil from the market or even to limit its use. Facing facts, oil in its various forms is and will remain for long time to come the major fuel.

The exact chemical combination of each fuel on the market must be honestly published, which information is already available in various places, but most likely locked in safes.—Unlock it.—

Chemical Engineering, no doubt, will have no difficulties to determine:

(a) what minimum burning temperature must be achieve to avoid unsaturated combustion products and what maximum temperature can be tolerated to avoid dissociation.

(b) what minimum oxygen supply through air is necessary.

(c) what additives to the fuel are required to provide chemical reaction with fuel ingredients of non-hydrocarbon character to avoid irritant fumes.

(d) ban certain fuels from the market due to their present chemical characteristics until such time when they are improved by proper processing.

This outlines a program, simple to comply with, regarding the present knowledge and capability of our chemical industry. With these informations available, the power industry will have no difficulties to create engines capable of producing exhaust gases at low level contamination.

(C) Suitable Approach in Engine Design.—The attached addendum (2) presents a brief description of an engine having features which make it easily adaptable to the different requirements outlined above.

Some additional remarks came into mind after finishing this letter:

Police cars shall remain equipped with 200 hp or more.

Other persons wishing to drive a car equipped with more than 50 hp shall obtain a special license and pay for it.

The use of engines of foreign origin, as suggested in the addendum (1), is assumed for preliminary test purpose only.

ROAD TEST—PERFORMANCE CHECK—RAMBLER 660

To obtain an approximate idea of fuel consumption and performance a check was made on a Rambler Classic 660—V8 with a rated power of more than 220 hp.

Checkpoints: Des Moines, Wash. to downtown Seattle—round trip.

Distance: 50 miles.
Time: 1 hour, using Interstate (5).
1.5 hours, using normal roads, i.e. Highway (99) or 1st Ave.
Fuel consumption: 3 gallons; practically the same for both roads.
Performance: $50/3=16.6=$appr. *17 miles/gallon.*

The specific fuel consumption, referred to power, is to be expected *more than* 0.2 kg/hp.h=0.44 lb/hp. h.

The specific gravity of gasoline amounts to 0.8 or the specific weight of 7.5 lb/gallon, which varies widely within the different brands, depending on the combination of ingredients and how much useless air is dissolved in the fuel. Hence sfc=0.0587 gallon/hp.h.

Based on these favorable figures, the consumption of 3 gallons/h indicates an average power utilization of 3/0.0587=51 hp.h. (HP=51 hp.)

Two factors will change this figure in one way or the other:

(a) Driving conditions on normal roads require many stops at traffic lights etc., where the engine runs at idle and uses unnecessary fuel and even more during the following acceleration.

However the one-hour figure was taken from checks along Interstate (5) with no interruptions by traffic lights. Using the normal-road test with 1.5 hours, the average power consumption is obtained to: HP=51/1.5=3/0.0587.1.5=34 hp which, again, is a mean value (0 to max) between stops including idle time. Assuming ⅓ of the time to be idle, the figure changes back to 51 hp maximum.

(b) The initially assumed sfc of 0.44 lb/hp.h is valid only for high efficient engines, such as Diesel, and only at rated load. At part load the figure of sfc=0.66 lb/hp.h is much more likely, hence a power output of 34 hp maximum is certainly the more accurate amount, which would also confirm the mileages of small foreign cars, which claim 22 to 25 miles/gallon.

To avoid misinterpretation, the objective is to have a normal American standard middle class car (Plymouth, Mercury, Rambler, etc.) equipped with an engine of foreign origin for test purpose.

The writer would be glad to undertake the assembly of such vehicle and test it, if funds were available.

Patent Application Group 342, Serial 777642

1. Brief Description.
2. Claims.
3. Drawings are not attached, due to lack of copying machine.

References Application, Rotary Internal Combustion Engine—Filing Date, Nov. 21, 1968, Group 342 Serial 777642

It is believed that this engine will be of interest to you. The principle of the engine is a combination of known reciprocating machines and turbine effect, but has no alternating moving parts; the working parts are strictly rotating around their axis. The bearings have to carry only the load of the rotor weight and therefore these bearings can be simple ball bearings, the lubrication of which will be "turbine oil," which gives an easy start even at extreme cold conditions (Arctic).

Furthermore the *mean* gas temperature, the main components are exposed to, are at such level that cooling, especially water cooling, is not required. This becomes even more obvious if the engine is used as a constant speed drive whereby the power output is controlled by varying the combustion temperature rather than throttling the breathing air for part load. For car application it would match ideally with a hydraulic transmission at variable filling or with a hydro-static transmission at variable plate angles.

The engine can be easily adapted to the various fuel burning rates, i.e. ordinary gasoline, Diesel oil and/or bottled gas, such as to comply with State's requirements for prevention of air contamination.

The ignition does not require a timing device inasmuch either a spark plug is used in combination with high frequency ignition system, or a glow plug is used for starting purpose in combination with grooves in the end walls firing zone, to provide crossfiring from a burning cylinder into the following which just entered the combusion sector.

The electric power requirement during start, etc., is so little that a battery of 8 Ah capacity would be fully sufficient instead of a conventional 80 Ah battery.

The auxiliary power drive such as an exhaust gas turbine puts out excessive power if built of minimum practical size (not being too small for manufacturing), that an all electric system becomes most obvious with all the advantages of convenient location and simplicity of controls.

The main advantages are "constant volume" combustion without moving valves, the rotor containing the combustion chambers acts at the same time as a turbine, the expansion is not limited as in reciprocating machines, a mechanical compression is not required—the compression being strictly a thermal one. All forces are completely balanced.

Since there is no mechanical compression and therefore, as in reciprocating machines, a built-in limited expansion ratio, the full expansion head to practical atmospheric pressure is available for conversion into shaft horsepower, which however depends substantially on the form of the expansion nozzles, which therefore become a very important part of the engine and will require some development work.

The fuel consumption can be expected to be: sfe=.2 kg/hp h=.44 lb/hp h.

The applications of the engine are for all kinds of cars, marine vehicles and light propeller-driven airplanes.

Setting up a small special division, the first engine would be within 15 months or less, with relatively simple test facilities involved.

What I Claim:

1. An internal combustion engine with constant volume combustion and no mechanical compression, said engine producing high pressure gases by thermal compression only, said pressurized gases producing work by fully expanding through nozzles without restriction by mechanically built in expansion ratios, said nozzles comprising a convergent and a divergent portion, the combination of size and number thereof being such that maximum expansion of the gases is achieved by means of supercritical velocities therein. Said engine comprising in combination an outer member, an inner rotating member disposed within said outer member and adapted to rotate relative thereto: at least one bore arranged within said inner member coaxially thereto, a plurality of apertures communicating between said bore and the peripheral surface of said inner member, means to admit a combustible mixture to said bore means to ignite said mixture within said bore whereby high pressure gases are produced, said gases being exhausted from said bore through said nozzles in a tangential fashion thereby imparting a reactionary force to said inner member relative to said outer member.

2. The combination as claimed in Claim 1, wherein the axial surfaces of said outer member adjacent to the inner member are provided with sealing surfaces.

Senator Muskie. We will recess until 10 a.m. tomorrow morning.

(Whereupon, at 11:40 a.m., the subcommittee recesed, to reconvene at 10 a.m., Tuesday, March 17, 1970.)

AIR POLLUTION—1970

TUESDAY, MARCH 17, 1970

U.S. Senate,
Subcommittee on Air and Water Pollution
of the Committee on Public Works,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to recess, in room 4200, New Senate Office Building, Hon. Edmund S. Muskie (chairman of the subcommittee) presiding.

Present: Senators Randolph, Muskie, Spong, Eagleton, Boggs, Cooper, and Dole.

Also present: Richard B. Royce, chief clerk and staff director; Bailey Guard, assistant chief clerk, minority; Thomas C. Jorling, minority counsel; Leon G. Billings and Richard D. Grundy, professional staff members.

Senator Muskie. The committee will be in order. This series of hearings began yesterday. Obviously this testimony this morning is important opening testimony in the real sense. I opened the hearings yesterday with a statement. Senator Randolph was not here yesterday to make a statement.

Senator Randolph?

HON. JENNINGS RANDOLPH, A U.S. SENATOR FROM THE STATE OF WEST VIRGINIA, AND CHAIRMAN, COMMITTEE ON PUBLIC WORKS, U.S. SENATE

Senator Randolph. My statement will be relatively brief. I regret that it was impossible for me to join you yesterday for the beginning of these hearings on the status of our effort. It must be a very strong effort if our country is to reduce the level of air pollution.

We were gratified by the productive nature of our hearings of the past 3 weeks when the subcommittee was presented with a significant amount of information on the problems of solid waste disposal, plus the new and imaginative technology being developed to cope with them.

I am sure, Mr. Chairman, that these hearings on air pollution will be equally informative and challenging.

As you know, the Air Quality Act of 1967 was a very significant milestone in the struggle—and it has been a struggle—to progress toward cleaner air.

It was a good basic law that made available to the various levels of government the machinery to move against air pollution.

Since that law was enacted, it has become obvious that additional legislation is needed; the consideration of new or strengthened air pollution law is our concern now.

Mr. Chairman, I am not a carping critic, but I do want to say that I am disappointed to note the hesitant manner in which the Air Quality Act of 1967 has been implemented. The administration has moved neither far enough nor fast enough in taking the steps toward establishing controls over air pollution.

The Department of Health, Education, and Welfare originally estimated that it would have designated 57 air quality control regions by April of this year. That deadline was later postponed to December of 1970.

At this time, however, fewer than half the designations—25 on January 1, I believe—have been made.

I think it is important, Mr. Chairman, for me to state, as chairman of the Public Works Committee, that there seems to have been too little urgency in publishing the criteria and technology available for achieving the objectives of the 1967 act.

Since these are to be the foundations on which the standards for control of individual pollutants are set and accomplished, the air pollution control program is in serious danger of being shortchanged.

Prior to yesterday, we had knowledge of criteria published for only two pollutants. Then, when the hearings opened yesterday, we received criteria on three more pollutants and information on four control technologies.

STATEMENT OF ROBERT H. FINCH, SECRETARY, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PRESENTED BY JOHN VENEMAN, UNDER SECRETARY, HEW, ACCOMPANIED BY C. C. JOHNSON, ADMINISTRATOR, ENVIRONMENTAL HEALTH SERVICE; DR. JOHN MIDDLETON, COMMISSIONER, NATIONAL AIR POLLUTION CONTROL ADMINISTRATION, ENVIRONMENTAL HEALTH SERVICE; DR. ALEXANDER COHEN, CHIEF, NATIONAL NOISE STUDY, BUREAU OF OCCUPATIONAL SAFETY AND HEALTH; AND SIDNEY SAPERSTEIN, ASSISTANT GENERAL COUNSEL

Senator RANDOLPH. Mr. Under Secretary, the standards study under the national emission program was due on November 21, 1969.

Mr. VENEMAN. That is correct.

Senator RANDOLPH. These came to us, for all purposes, only yesterday, and also the printed report on the cost of the clean air program that was forwarded to us. Then the third annual report on pollution control came at the same time. These were really due in January of 1970.

Now, Mr. Chairman, we have 1,800 pages of detailed reading matter delivered to us at approimately the same time—much of it long overdue.

It is our proper role to express concern that progress has been made so slowly. Mr. Chairman, I believe you will agree with me that the criteria should already be determined for at least eight or 10 other dangerous substances that are released regularly and in large quantities into the air.

Our hearings will focus attention on these deficiencies and the implementation of the Air Quality Act, not only of 1967. But we will look forward, too, and prepare for the challenging responsibility that are with us on a continuing basis.

It is imperative that the administration and the Bureau of the Budget act immediately to provide the funds and the manpower, to accelerate the preparation and publishing of criteria and the designation of air quality control regions.

You and your associates, Mr. Secretary, have responsibility to help us as a subcommittee and a committee to act affirmatively and thoroughly, and as quickly as possible.

So, Mr. Chairman, under your able leadership, I am sure the subcommittee will give serious consideration to ways and means to assure more expeditious action, I think, in a very critical area of our life.

Senator MUSKIE. Thank you, Senator Randolph.

Senator Boggs?

Senator BOGGS. I am sorry for being late, Mr. Chairman. I was attending a meeting on another matter in which I am vitally interested.

Mr. Chairman, I want to join you in welcoming Secretary Veneman and Commissioner Middleton to this important hearing. I know that each member of the subcommittee looks forward to the very helpful testimony you will give.

The Clean Air Act, under the leadership of Secretary Finch and Commissioner Middleton, has proved to be an excellent foundation for the efforts to improve air quality in America. For example, Secretary Finch just a couple of weeks ago approved the air quality standards for my State of Delaware, an important step in the efforts in Delaware to enhance the environment.

The legislation we are considering today will augment the efforts to improve air quality by setting emission standards in certain cases and by accelerating the enforcement procedures. But we cannot expect that such innovations will bring us 1871 air by 1971. We are involved in a struggle that has consumed 7 years since the Clean Air Act was adopted. It is a struggle that will require many more years, yet a struggle that we must pursue relentlessly.

Mr. Under Secretary, we value your leadership in this struggle, and we will value your testimony and your analysis of the pending legislation.

Today is the day for the wearing of the green. Let that green stand for the green fields and green forests that will flourish in an environment less burdened with air pollution.

Thank you, Mr. Chairman.

Senator MUSKIE. Thank you, Senator Boggs. Senator Cooper?

Senator COOPER. Mr. Chairman, I think our committee can take some satisfaction, perhaps a great deal of satisfaction in these proceedings. Several years ago, under the leadership of the chairman of the subcommittee—and I may say the ranking member of the minority on this committee, Senator Boggs—that legislation was initiated and passed dealing with several aspects of the environmental quality, water, air, and now solid waste. I think this has contributed a great deal to the emphasis that is now being manifested throughout the country on the environment.

But we know that the solutions are not all at hand, and I am sure in these hearings great progress will be made.

I am very glad that the Under Secretary is here to represent Secretary Finch to testify on air pollution legislation. I think the President and Secretary Finch are to be commended for the commitment which has been made to work unceasingly for the solution of environmental quality. An outstanding manifestation of this commitment is the administration's bill S. 3466 which has been introduced. It is a proposal, in my view, based on the experience of the Clean Air Act which was enacted by this committee.

I know the President's recommendation will receive thorough consideration from the committee resulting in fair and just legislation.

This committee has been cited, and I think notably, for being a nonpartisan committee. Our problems deal with the country's problems, and I think all of us will try to be nonpartisan, and I think we hope to continue to be so.

I think constructive criticism is well taken and necessary. It could be that we have the problems in the States and regions. I know that new ideas and concepts are presented by the administration. It may be a fact that your proposal of a national standard rather than regional standards may have something to do with this. But I am confident we will go forward, and I am sure this committee will assist in every way we can, as we have worked together in the past.

Senator RANDOLPH. Mr. Chairman, may I add a comment?

Senator MUSKIE. Certainly.

Senator RANDOLPH. I would like to comment further upon the statement by Senator Cooper, the ranking minority member of the full committee. I was very careful to say that I have not desired to be a carping critic. I have not assumed that role. I will call attention, however, to the matters that are important.

I will ask, Mr. Chairman, to place in the record my recent Senate remarks in the Congressional Record of February 17, 1970, in which I stated that we would proceed in the bipartisan manner that we have in the past.

(The remarks referred to follow:)

ENVIRONMENTAL QUALITY MEASURES COSPONSORED BY SENATOR RANDOLPH IN INTEREST OF BIPARTISANSHIP

Mr. RANDOLPH. Mr. President, another period of intense activity in the Congress on legislation to improve the quality of the environment impends. As always, it is one of our most challenging areas of legislative endeavor. The need for quality improvement—vast improvement—is as vital as any requirement confronting society. The environment in which we live has become so complex that the really effective solutions to problems created by man's befoulment of it are elusive because the environmental problems generally are complex, too.

Our proven leader in this body in the pollution control effort, Senator EDMUND S. MUSKIE, of Maine is developing again to develop a broad agenda for the Public Works Subcommittee on Air and Water Pollution, which he chairs so ably and vigorously. As chairman of the full Public Works Committee, I am coordinating the committee's agenda with that of the subcommittee headed by the Senator from Maine, who is preparing to introduce broad legislative measures to expand and improve upon the antipollution laws heretofore enacted under his leadership.

President Nixon indicated clearly in his state of the Union message the emphasis his administration places on the need to upgrade the quality of the environment. And his special message to the Congress on the environment, delivered February 10, spells out the administration's understanding of the problems and pronounces the points and methods of attack on these problems. The Nixon administration's versions of legislative remedies have been prepared and made available to us and will be introduced formally as legislative measures by the minority leader, the senior Senator from Pennsylvania (Mr. SCOTT), who has invited cosponsorship.

In a letter today to the minority leader, I wrote that Senator MUSKIE invited me to cosponsor the bills he will introduce, and I have accepted. And I asked

Senator SCOTT to list me as a cosponsor of the legislation he will introduce to implement the President's proposals.

As I noted earlier in a communication to Senator MUSKIE, I also informed Senator SCOTT that I agree in principle on the objectives espoused by the Senator from Maine and those espoused in the Nixon administration measures. I expressed the belief that we will be able to negotiate solutions where we may have some differences on methods of reaching the environmental goals to which I ascribe the same high priority expressed by the President, by Majority Leader MANSFIELD, by minority Leader SCOTT, and by Senator MUSKIE.

In communicating my desire to cosponsor the Muskie bills and the Nixon administration proposals. I called attention to the fact that in our Public Works Committee and in our Subcommittee on Air and Water Pollution, legislation to improve the quality of the environment never has been considered on partisan political lines. I reiterate the belief that the same conditions will prevail in this session of the Congress and that vital questions relating to upgrading the quality of our environment will have bipartisan consideration.

It is in this tradition that I am gratified to cosponsor in principle and purpose the bills of the Nixon administration and those which Senator MUSKIE will introduce, based on his lengthy and comprehensive experience with environmental legislation.

Senator RANDOLPH. For that reason, I am a cosponsor, as Senator Cooper knows, of all the administration legislation that has been sent to the Congress. My name is also listed, Mr. Chairman, to show my cosponsorship of all the legislation that you have introduced relating to the environment. I support these legislative proposals in principle on a bipartisan basis.

I will not belabor this point because I feel it is not necessary. We will continue as we have to move forward constructively. But where there are deficiencies, where there are problems, we would want to address attention to them. Also, we would want you gentlemen to be equally conscious of your responsibility to speak to the members of the subcommittee and the full committee concerning actions which you believe we should take with dispatch.

So I feel that we meet in an atmosphere of clarification, somewhat, but, more importantly, with a purpose to move forward in this job.

Senator MUSKIE. Thank you very much, Senator.

Senator Spong?

Senator SPONG. Thank you, Mr. Chairman. I have no extended statement at this time. I would like to observe that we meet here today with an administration bill that represents in some aspects a new approach to a problem that we have had under study for some time. I would join with Senator Randolph in expressing the hope all of us will recognize a sense of urgency about this legislation. I hope this subcommittee, between the approaches advocated by some of us on the one hand and the administration on the other, will develop legislation which will be effective and be presented in such a way that those charged with administering it will seize upon it with the urgency that we view is necessary.

Senator MUSKIE. Thank you very much.

Senator Eagleton?

Senator EAGLETON. No comment at this time, Mr. Chairman.

Senator MUSKIE. I would just like to make, as chairman of the subcommittee, one or two observations. First of all, I think we are all conscious that for the first time in 7 or 8 years there is a tremendous reservoir of public concern and support for effective action in this field.

I think our primary challenge is to use that resource in developing the soundest and most effective legislation of which we are capable.

I think the first thing we ought to do, in light of that challenge, is to review critically, not only the administration of public policy in the years that we have been writing it, but the statutes we have written, as well.

This legislation, in many instances, incorporated compromises that were the product of a kind of public support we might like to have to write public law at that time.

So we have an opportunity—and we might regard it as such—to review everything that has been done up to today, to review all of the concepts that underlie our current legislation and current programs, to subject them to critical review and to examine every new idea advanced—national emission standards, regional approaches—every new idea incorporated in the administration's bill, in the legislation that we have introduced. We need to produce the best policy of which we are capable at this time.

I guess that criticism across party lines is unavoidable, especially in an election year. I will be tempted, as well as everybody else, and if I am, I will get my reactions in time. That is all right; that is part of the game. But let us not forget the primary challenge, which is to sort out all of the ideas we have in front of use, and all others that will be presented to us by witnesses, and put together some good legislation. I think that is our challenge.

If we criticize, even though there may be overtones of partisanship, what we are really trying to do is to get through the hard-core stuff that we need to write the legislation.

With that as a preliminary, may I welcome as our first witness the Under Secretary of HEW, John Veneman. May I express my regret that Secretary Finch could not be here. I understand fully why he cannot. He is suffering from a temporary indisposition; and I understand fully, having had a touch of the same in the past myself. But it is our pleasure to welcome the Under Secretary. It is a pleasure to welcome Dr. Middleton, who is a long-time friend and advisor in this field, and your other colleagues. Please identify them for the record, Mr. Under Secretary.

Mr. Veneman. Thank you very much, Mr. Chairman. Let me say at the outset that I do appreciate the tone that has been expressed by the members of the subcommittee, for I believe that not only the Department of Health, Education, and Welfare, but this administration, justly stand committed to solving what is a key problem in this country today, as do the members of this committee, and I am confident that by working together, that the public attitude and public mood are such that we can obtain some good results at the present time.

Let me also, on behalf of the Secretary, express his regrets for being unable to attend because of illness. We would hope that if the hearings do proceed at some future time that he may be able to appear before the committee himself.

Senator Muskie. May I say at this point that you have the new criteria and the suggestions for control technology. Whatever the reason for the timing, we haven't had time to examine these. At some point, we may want to call some of the witnesses back so we may get into questions suggested by this material. It is voluminous, and it would be premature to get into it this morning.

Mr. VENEMAN. I think we can work that out. I think, Mr. Chairman, that many of the technical questions that pertain to the criteria can be answered by Mr. Johnson and Dr. Middleton to the degree that you would like.

But, as I have indicated, I am sure the Secretary would be pleased to come and cover the policies you would like to discuss.

Let me introduce the rest of those at the table. Mr. C. C. Johnson, who is the Administrator of the Environmental Health Service, to my left. To my far right, Mr. Sidney Saperstein, Assistant General Counsel of the Department of Health, Education, and Welfare. To my immediate right is Dr. John Middleton, Commissioner of the National Air Pollution Control Administration of the Environmental Health Service.

Mr. Chairman, I have submitted a detailed statement on behalf of Secretary Finch. What I would like to do is cover some of the highlights and comment upon S. 3466, the Clean Air Act Amendments of 1970, and also convey some of our remarks regarding S. 3229 and S. 3546, plus make some references to title II of S. 3229, which addresses itself to the problem of noise pollution.

STATEMENT OF HON. ROBERT H. FINCH

Mr. Chairman and members of the subcommittee, in his message to the Congress on February 10, 1970, the President described the air as our most vital resource and air pollution as our most serious environmental problem. To strengthen and to speed up the Nation's attack on this problem, he proposed a series of amendments to the Clean Air Act. These proposals are before you today in S. 3466. I welcome the opportunity to testify in support of the bill, and to comment on S. 3229 and S. 3546 which you also have under consideration.

Enactment of the administration bill would enable the Department of Health, Education, and Welfare to extend and accelerate its national program of air pollution research and control. S. 3466 does not represent a radical departure from the present Clean Air Act; rather, it preserves the best features of that act and provides for change where change seems necessary. There would be a high degree of continuity with ongoing efforts.

The administration bill is unique, however, in its reflection of the fact that the Nation's air resource is indivisible. Air, polluted or not, crosses the maginary lines that divide State from State. Air quality, therefore, is not a matter of purely local or regional concern but rather of national concern. That national concern must be reflected in the way air quality standards are established—and it is so reflected in the administration bill.

Under the proposed bill, two other matters of national concern also would be the focus of national effort: (*a*) new stationary sources of air pollution that would contribute substantially to endangering public health or welfare; and (*b*) any stationary source emitting pollutants that are extremely hazardous to health. National leadership in dealing with such sources is essential, and the administration bill would provide it by authorizing the establishment of national emission standards for these sources.

National standards, however, whether air quality standards or stationary source emission standards, obviously would have to be applied to many different situations. Accordingly, the administration bill provides for continued decentralization of the responsibility for implementation and enforcement.

The administration bill also would provide new tools for dealing with a problem that has long been recognized as national in scope—the problem of motor vehicle pollution. Of particular importance are those provisions dealing with fuels and fuel additives. Motor vehicle engines are not the sole cause of the problem. Engines, fuels, and additives are interrelated causes and must be treated as such.

Now, let me describe the provisions of S. 3466 in greater detail, and discuss corresponding provisions of the other bills you have under consideration.

Under S. 3466, section 6 would authorize the Department of Health, Education, and Welfare to establish national air quality standards, and section 7 would call upon each State to adopt an implementation plan for each area within the State. Each standard would, as State standards now do, set maximum permissible concentrations of a pollutant per unit of ambient air.

National air quality standards would provide for protection of public health and would guard against the environmental and economic effects of air pollution. They would be derived from the best available scientific knowledge and would be developed with the assistance of experts within and outside the Federal Government.

Once formulated, such national standards would be published in the Federal Register, and all interested parties, including the general public, would have the opportunity to submit comments for consideration prior to issuance of the standards.

Thus, where as each State now sets air quality standards for specific pollutants on the basis of Federal air quality criteria documents—which describe effects of pollutants at various concentrations—the Federal Government would, under S. 3466, establish uniform nationwide standards. We anticipate that these Federal standards would also be based on criteria documents.

The provisions for national air quality standard-setting would not impair any State's right to establish standards requiring higher levels of air quality. This right is stated as a national policy in section 109 of the Clean Air Act, and there would be no change in this policy.

Following the promulgation of national standards, each State would have 90 days to signify its intention of adopting an implementation plan. Each State would be expected to describe the steps it would take to develop such a plan and to indicate which areas of the State would be given priority.

In their implementation plans, the States would have to spell out the measures to be taken to achieve and preserve national air quality standards. As I have indicated, they would have the option of designing their implementation plans to achieve or preserve higher than national quality levels, if they wished to do so.

As you know, one of the express purposes of the Clean Air Act is "to protect and enhance the quality of the Nation's air resources" (emphasis added). Accordingly, it has been and will continue to be our view that implementation plans that would permit significant deterioration of air quality in any area would be in conflict with this provision. We shall continue to expect States to maintain air of good quality where it now exists.

State implementation plans would have to include provisions for intergovernmental cooperation, particularly in dealing with interstate air pollution problems. Under the administration bill, it would be a responsibility of the Department of Health, Education, and Welfare to designate significant interstate problem areas. We estimate that there are about 50 such areas at present. This number includes 21 of the first 57 areas marked for designation as "air quality control regions" under the provisions of the existing Clean Air Act.

Finally, implementation plans would have to include provisions for (*a*) enforcement; (*b*) preventing the occurrence of pollution episodes during periods of adverse meteorological conditions; and (*c*) making modifications to take account of changes in standards or the availability of improved pollution-control techniques.

States generally will be expected to submit their implementation plans to the Department of Health, Education, and Welfare no more than 180 days after filing their letters of intent. If, however, their letters of intent indicate that implementation plans for some areas cannot be developed within this time period, and if there is good reason why more time should be allowed, then the Department would be authorized to grant an extension. If a State does not spell out any such problems in its letter of intent but subsequently requests an extension, one still can be granted, but for not more than 90 days.

Upon enactment of this bill, States will be expected to begin attacking air pollution in all their cities, counties, and towns. Many States, not surprisingly, have not yet been able to mount such a broad effort, and we cannot realistically expect every State to shift gears overnight. For our part, we intend to support their efforts. We will continue and indeed augment our technical and financial assistance.

We expect that implementation plans would be developed on schedule, particulary for areas where air pollution is most serious. For other areas, however, extensions may be necessary. Indeed, by granting more time for the development of implementation plans for areas of least urgency, we can encourage the States to allocate their resources most efficiently by focusing initially on areas of greatest immediate concern.

If a State fails to adopt an implementation plan for any area, the Department would be empowered to prepare one and, after a public hearing, to publish it in the Federal Register. If the State still had not adopted a plan, the Department would promulgate the one it had developed.

In provisions corresponding to those I have been discussing, S. 3546 would provide for continued regional air pollution control efforts along essentially the same lines as the Clean Air Act. S. 3546 calls for accelerated designation of air quality control regions through a combination of Federal and State action. States would have 6 months from enactment of the bill to designate air quality control regions in any areas where none had been designated by the Department of Health, Education, and Welfare.

States would continue to be responsible for adopting air quality standards and implementation plans after the Department issued air quality criteria and reports on control techniques. The timetable for

State action would be cut down by 2 months through a reduction in the time allowed for filing letters of intent.

As a general rule, under the administration bill, the timespan for State action leading to submission of an implementation plan would be 9 months. Under the present act the timespan is 15 months. Under S. 3546 it would be 13 months.

The administration bill and S. 3546 are aimed at the same objective: to insure that air quality standards and implementation plans are put into effect across the entire Nation. There is, however, a significant difference between them in regard to responsibility for adopting air quality standards. In my view, there are three principal advantages in uniform nationwide air quality standards, established by the Federal Government:

First, there would be an opportunity to take into account factors that transcend the boundaries of any single State. States cannot be expected to evaluate the total environmental impact of air pollutants, or take it into account in standard setting.

Second, States would be able to concentrate their resources on the complicated and critical tasks of developing and carrying out implementation and enforcement plans.

And third, the process of putting air quality standards into effect would be accelerated, primarily because there would no longer be any time consumed in reviewing and approving air quality standards for each air quality control region.

For these reasons, I believe that the approach we have proposed promises far more effective results than that contained in S. 3546.

The administration bill and S. 3546 have common provisions for public hearings prior to adoption of State implementation plans.

Public participation in State hearings on air quality standards has been highly productive. I strongly feel that continued public involvement in the evolution of State air pollution control programs must be encouraged. Participation in hearings on implementation plans will give citizens even greater opportunities to influence the course of air pollution control efforts in their States and communities.

Among other things, S. 3546 also calls for review of air quality standards at least every 5 years. Such a periodic reexamination would be desirable whether air quality standards are set by the States, as proposed in S. 3546, or by the Federal Government, as proposed in the administration bill. Indeed, the reexamination process—with respect both to quality standards and control technology—should be continuous.

I come now to the second major element of the administration bill: The provisions that would authorize the Department of Health, Education, and Welfare to establish national emission standards for certain stationary sources of air pollution. I refer to our proposed section 112, in section 8 of the bill. With one important exception, such national emission standards would apply only to new stationary sources, of certain designated classes or types. The exception would involve air pollutants which are extremely hazardous to health; in such cases, national emission standards could be applied to all stationary source emissions.

In general, existing stationary sources of air pollution are so numerous and diverse that the problems they pose can most efficiently be attacked by State and local agencies. Even with air quality standards being set nationally, as proposed in the administration bill, the steps needed to deal with existing stationary sources would necessarily vary from one State to another and, within States, from one area to another.

In the years ahead, however, many potentially significant new stationary sources of air pollution will come into being as a result of the Nation's growing demands for electric power, manufactured goods, and other necessities and amenities of modern life. Large stationary sources, such as electric generating plants, iron and steel mills, and petroleum refineries frequently have adverse effects not only on public health and welfare in their own communities but also on air quality over broad geographic areas. This problem is one that demands national attention. If we are ever to begin preventing air pollution, instead of just attacking it after the fact, then we must at least insure that major new stationary sources, wherever they are located, are designed and equipped to reduce emissions to the minimum level consistent with available technology. The application of national emission standards would also tend to minimize the competitive advantage of locating a new facility in an area where emission standards are less rigorous than in other areas. This would eliminate "polluter havens."

With respect to pollutants that are extremely hazardous to health, national emission standards could be applied to existing, as well as new, stationary sources. Among those pollutants that might require application of national emissions standards are asbestos, beryllium, cadmium, biological aerosols, and chlorinated hydrocarbons. Under the administration bill, new sources of extremely hazardous pollutants could not be constructed or operated without a specific exemption from the Department of Health, Education, and Welfare; such exemptions would be granted only where we are satisfied that emissions would be controlled sufficiently to preclude hazards to public health. Existing sources would be required to take any measures necessary to comply with the applicable national emission standards.

States would be expected to assume the primary responsibility for enforcing national emission standards. Following the adoption of such standards, States would be expected to develop enforcement plans. If a State failed to do so, or if it developed a plan which was inadequate, the Department would be empowered to promulgate such a plan after holding a conference of appropriate Federal and State agencies.

S. 3546 approaches the prevention of air pollution from new stationary sources in a different way. It would provide for issuance of Federal regulations to insure that new buildings, structures, or other facilities are equipped with the best available air pollution control techniques. A Federal or State certificate of compliance would have to be obtained before construction could begin.

This provision apparently would apply to all new buildings, including single-family homes, and would necessitate the establishment of a Federal-State system for review of construction plans.

From the standpoint of most efficient use of the resources available for air pollution control activities, the provisions of the administration bill are superior, because they would provide for efforts to be focused on the most significant new stationary source problems and on those existing sources whose emissions pose the greatest threat to health.

Under the administration bill, enforcement of air quality and emission standards would be primarily a State responsibility, as I have indicated, but the bill provides for effective Federal action in those cases where States fail to get the job done. The scope of Federal enforcement authority would be broadened to cover all air pollution problems, whether interstate or intrastate, and enforcement procedures would be greatly streamlined.

The principal enforcement provisions of the administration bill are contained in the proposed section 113. Federal enforcement action could be initiated whenever (a) air quality fails to meet the applicable air quality standards, or stationary source emissions are in excess of applicable national emission standards, and (b) this results from a State's failure to carry out its implementation plan. There would be a two-step procedure, rather than the three-step procedure prescribed by the Clean Air Act. A hearing would be the first step. Following such a hearing, the Department would specify the remedial action to be taken and allow a period of not less than 60 days for such action to get underway. Then, if the specified action were not taken, the Department could ask the Attorney General to bring suit to enjoin continued failure to comply. Federal district courts would be authorized to assess fines of up to $10,000 per day for failure to take remedial action specified by the Department. This procedure would be more expeditious and effective than present provisions.

Under S. 3546, Federal enforcement would involve issuance of abatement orders, with compliance to be achieved in no more than 72 hours in any case where violation of emission control requirements is said to be occurring. In other cases, presumably those in which a number of sources are alleged to be contributing to a violation of aid quality standards, the alleged polluters could request a hearing on the abatement orders. Any decision made by the Department of Health, Education, and Welfare after such a hearing could be appealed in court, but the Department's findings, if supported by substantial evidence on the record considered as a whole, would be conclusive. If necessary for the purpose of enforcing an abatement order, the Department would be empowered to institute civil action.

In our judgment, the enforcement procedure proposed in the administration bill is preferred because it is simpler and more direct. An important advantage is that it would require that the Department simply specify the remedial action to be taken, while S. 3546 would require that abatement orders "contain a detailed description of the conditions or practices which cause or constitute a violation."

S. 3546 includes two other provisions relating to control of air pollution from stationary sources. One would give the Department of Health, Education, and Welfare the right of entry to buildings, structures, or other facilities and would authorize the Department to require polluters to measure emissions in cases where a final abatement order has been issued. If the first part of this provision were modified to provide explicitly for inspections and access to relevant information, we would view it favorably; such authority, within the framework of the administration's bill's enforcement provisions, could help to insure an effective enforcement program.

The other provision dealing with stationary sources would require compliance with applicable air quality standards and emission control requirements as a condition of eligibility for Federal loans, grants, licenses, permits, and contracts for construction and Federal procurement of goods or products.

We have serious reservations about this provision. Effective enforcement would require a very substantial and probably unwarranted investment of resources. Moreover, the objective would be accomplished more simply and directly through State or Federal enforcement of air quality and stationary source emission standards, as proposed in the administration bill.

I turn now to the area of motor vehicle pollution control. The establishment and enforcement of national emission standards for new motor vehicles constitute the cornerstone of our program. The administration bill would improve our enforcement activity in three principal ways: (1) by authorizing assembly line testing of new motor vehicles; (2) by providing for revocation of certificates of conformity when assembly line testing shows that new vehicles do not meet the standards; and (3) by prohibiting importation of motor vehicles that are not equipped to comply with the standards.

Under the existing provisions of the Clean Air Act, testing of prototypes in advance of actual production is the principal means of determining whether new motor vehicles will comply with the standards. If prototype testing indicates that vehicles will comply, the manufacturer is issued a certificate of conformity valid for a period of not less than one year. We are finding, however, that production models do not perform as well as the prototypes.

To help rectify this situation, we intend to make changes in our test procedures under our present statutory authority. But to insure that motor vehicles are capable of meeting the standards when they come off an assembly line, we must test them at that point. Furthermore, if such testing shows that vehicles are not capable of meeting the standards, we must be able to require that manufacturers make whatever adjustments are necessary. Clear authority to revoke certificates of conformity would enable us to accomplish this.

With regard to importation, the existing provisions of the Clean Air Act require that new automobiles imported for sale in this country must be equipped to comply with our national standards. This means, however, that if the title to a vehicle was transferred to the purchaser before the vehicle was brought in, or if a vehicle is brought in for purposes other than sale or resale, such a vehicle is exempt from compliance with the standards. One effect of this exemption is that persons returning from other countries may legally bring in noncomplying motor vehicles. Since all the major foreign manufacturers make vehicles equipped to meet our standards, there appears to be no justification for this exemption.

The administration bill also would enable us to open a second front in the Nation's fight against air pollution from motor vehicles. I refer to the bill's provisions for registration and regulation of fuels and fuel additives used in transportation. There is great potential for improving the Nation's air quality through modification of motor vehicle fuels, particularly gasoline. By controlling the chemical composition of gasoline and the use of fuel additives, we can significantly reduce motor vehicle emissions.

The problem of motor vehicle pollution is the product of a complex combustion system involving engines, fuels, and fuel additives. Emissions can be reduced to some extent through alterations of any of these elements or through such other means as the use of control devices of one kind or another. But it is necessary to bear in mind that all the elements of the motor vehicle combustion and emission control systems are interrelated: if engines are altered, the fuel may also need to be altered. This means that effective control of motor vehicle pollution requires a capability of dealing not only with engines and control device, but also with fuels and fuel additives. Under the existing provisions of the Clean Air Act, however, Federal action can be taken only with respect to the motor vehicle itself. Fuels are beyond our reach. The Federal Government must be in a position to require fuel modifications and changes in the use of additives. The provisions of the administration bill are intended to open the way for an effective regulatory program.

I now turn to S. 3229, which, like the administration bill, would extend the duration of the Clean Air Act for another 3 years and would amend the act in several respects.

S. 3229 contains provisions designed to stimulate the development of low-pollution vehicles of various types. One of these would explicitly authorize the Department to support, by means of grants and contracts, programs for the development of low-pollution alternatives to the internal combustion engine. We fully agree that support for such programs is desirable. But it does not require new legislation. Under section 104 of the Clean Air Act, we are greatly increasing our program of research and development in the area of motor vehicle pollution control. A major portion of this increased effort will be focused on development of low-pollution alternatives to the internal combustion engine. Furthermore, to stimulate parallel efforts in the private sector, a program involving the purchase and testing of low-pollution vehicles individually and in fleets is being implemented. In fiscal 1971, we are proposing to earmark at least $12 million for these activities, about $9 million of which would be devoted to the development of unconventional power sources.

Another provision in S. 3229 designed to stimulate development of low-pollution vehicles would authorize the Secretary of Health, Education, and Welfare to prescribe "special" emission standards for any class of vehicles: such standards would have to be at least 50 percent more stringent than the standards required for such class of vehicles. Voluntary compliance with such "special" standards would be rewarded by certification of the vehicle or engine as being a "low-emission" vehicle or engine.

It is not clear what incentive for development of a "low-emission" vehicle is provided by the mere assurance of such a certificate. In contrast, our existing program, described above, of purchasing low-pollution vehicles individually and in fleets for testing does provide what would seem to be a requisite financial incentive.

In this connection, it may be noted that the emission standards we plan to prescribe for 1975 model vehicles would reduce emissions more than 50 percent below current levels.

The new carbon monoxide standards, proposed for the 1975 model year, represent a reduction of 52 percent below the current standards. The new hydrocarbon standards, also for the 1975 model year, represent a reduction of 77 percent. The proposed nitrogen oxides standards, proposed for the 1973 model year, will reduce nitrogen oxides emissions by 50 percent; a further reduction is proposed for the 1975 model year. Finally, the proposed standards for particulate emissions, to take effect in the 1975 model year, would produce a reduction of 66 percent.

Another provision of S. 3229 would authorize the Department to require automobile manufacturers to provide warranties on air pollution control equipment installed in compliance with standards established under the Clean Air Act. While the exact nature and scope of such warranty requirements would have to be worked out, the proposed authority appears to be a desirable additional means to insure proper performance of emission control systems throughout the useful life of an automobile.

Also with respect to the problem of motor vehicle pollution, S. 3229 would authorize the Department to establish separate emission standards for commercial vehicles, both old and new. Present provisions of the Clean Air Act make no distinction between commercial and noncommercial vehicles. Furthermore, we currently are authorized to establish standards only for new vehicles.

This proposal appears to have merit. The proposed new authority would enable us, for example, to establish special emission standards for commercial vehicles operated in fleets, such as taxicabs. Fleet vehicles generally are used more intensively than noncommercial vehicles and thus make a proportionately greater contribution to the problem of air pollution, particularly in large urban areas. But fleet operation has an offsetting advantage. The centralized maintenance and servicing facilities usually associated with fleet operations offer opportunities for the application of air pollution control techniques, such as the use of special fuels, that generally would not be practical for family cars.

The proposed authority to set standards for commercial vehicles also could be used to broaden our attack on the obnoxious problem of diesel smoke and its odors. Techniques capable of producing a significant reduction of diesel smoke are becoming available in 1970. But while we began to set standards for new diesel-powered vehicles under existing provisions of the Clean Air Act, there is no way of insuring that new techniques will be applied to older diesel-powered vehicles.

S. 3229 also would authorize the Department to establish national standards for the control of emissions from aircraft, vessels, locomotives, and agricultural vehicles. While vessels, locomotives, and agricultural vehicles are not major sources of air pollution at this time and do not require immediate attention, we support the principle of making them subject to emission controls.

Aircraft also account for only a small fraction of the total air pollution problem, but their emissions are substantially concentrated in the vicinity of metropolitan airports. Moreover, air traffic is steadily increasing. The Department of Health, Education, and Welfare, in conjunction with the Department of Transportation, has already taken a major step toward controlling air pollution from aircraft. At a meeting on January 20, 1970, attended by representatives of 31 airlines, we presented our estimate of the shortest feasible schedule for installation of "smokeless" combustors in JT8D engines. These engines account for a major share of the jet aircraft smoke problem. The airlines have agreed to install such combustors in accordance with this schedule, which means that this program will be substantially completed by late 1972. By mid-April, we expect to have detailed action plans from the airlines. The Federal Aviation Administration will furnish us with quarterly reports on the progress of this work.

Smoke is not the only pollutant emitted by aircraft. Accordingly, we are conducting and supporting research to define more precisely all components of aircraft emissions and to explore various means of controlling gaseous emissions, including nitrogen oxides. We will seek prompt application of new knowledge that is obtained. If the enactment of laws and regulations becomes necessary, we will recommend that approach. But where we can make progress in the absence of legislation, we will do so.

Another provision of S. 3229 would authorize the Department to register organic solvents and solvent-containing products, to recommend emission standards applicable to such products, and to establish such standards in the event that there are conflicting State regulations or that an air pollution problem associated with solvents poses an imminent and substantial danger to public health or welfare.

The use of solvents and solvent-containing products, such as paints, is a source of hydrocarbon emissions into the atmosphere and thus contributes to air pollution, particularly photochemical smog. The magnitude of this contribution varies significantly from one area to another.

In the National Capital area, for example, solvents account for an estimated 4 percent of hydrocarbon emissions; in New York, they account for about 26 percent; and in Los Angeles, for about 20 percent. In Los Angeles County and the San Francisco Bay area and in New York State, regulations pertaining to solvent emissions and the solvent content of paints and other architectural coatings are already in effect.

Since varying State and local regulations may cause problems not only to manufacturers of solvent-containing products but also to organizations such as the General Services Administration and the Department of Defense, which have their own specifications for such products, there may be a need for Federal involvement in dealing with solvent emissions. The provisions of S. 3229 would provide a basis for such involvement, but further study is necessary to determine what measures would be most effective.

In summary, I believe that enactment of the administration bill is essential to the Nation's attack on air pollution. Some of the provisions of S. 3229 and S. 3546 would also contribute to this effort. I recognize that we do not all agree on all the provisions of these bills. But I am sure we can agree on the need to itensify and expand our efforts beyond the existing provisions of the Clean Air Act.

I turn now, Mr. Chairman, to the proposals regarding noise contained in title II of S. 3229. Unwanted sound is a major component of environmental pollution. It is a growing problem, and there is need for intensified research leading ultimately to effective abatement and control procedures. Dr. Alexander Cohen, the Department's leading noise expert, will describe for you the present state of the art and our ongoing programs later this morning.

The problem is not whether to tackle "noise pollution" but how best to proceed. Perhaps some background would be useful.

When the Environmental Quality Council (now the Cabinet Committee on the Environment) was established, the importance of this environmental problem was recognized in the creation of a Committee on Noise, chaired by the Secretary of Commerce, with the Secretaries of Housing and Urban Development, Transportation, and Health, Education, and Welfare as members. This Committee developed a preliminary strategy for a national attack on noise pollution. With the passage of the National Environmental Policy Act of 1969, the newly created Council on Environmental Quality is undertaking a comprehensive review of the Committee's report.

S. 3229 would establish a new Office of Noise Abatement and Control in the Department of Health, Education, and Welfare. We do not think it would be desirable to separate out in this way the problems of noise from all our other environmental and health programs.

Beyond this reason for recommending against enactment of title II of S. 3229, there are two others of even greater weight:

(1) We strongly believe that it would be unwise to establish such an office by statute. To do so would diminish the organizational flexibility that is so essential to the Department's efficient and effective use of its total resources.

(2) As I have noted, the Congress recently created the Council on Environmental Quality with a comprehensive mandate in the area of ecology. It has just embarked on thorough reviews and studies of noise pollution and all other environmental components. We do not recommend any further assignment of statutory function, pending the Council's recommendations to the President and those of the White House Council on Government Organization.

It will now be a pleasure to take your questions, Mr. Chairman, on all the subjects we have covered in this statement.

Mr. VENEMAN. Mr. Chairman, also, I think the committee is to be commended for their efforts in the past and their interest in developing legislation that has set an objective to work toward.

As far as Senator Randolph's opening statement is concerned, I will try to respond to the various issues he raised in more detail, or Mr. Johnson or Dr. Middleton might.

But to bring you up to date on the air quality control regions, we presently have 29 of the 57, and we anticipate having 40 by June 30, and we propose that all 57 will be designated by September 1.

With regard to the reports that were received by the committee on Friday, I shall not attempt to make excuses for the Department for the delay. I realize that the one report was due in November and the other two were due in January. They were held up in the review processes. We would hope that in the future the committee would have additional time in receiving this.

Mr. Chairman and members of the subcommittee, I think the concern that has been expressed in the preliminary statements is also shared by the President, who rightly described the air as our most vital resource and air pollution as our most serious environmental problem. To strengthen and to speed up the Nation's attack on this problem, he has proposed a series of amendments to the Clean Air Act. These proposals are before you today in S. 3466.

The administration bill is not a radicial departure from the present Clean Air Act. Rather, it preserves the best features of that act and provides for necessary change. It guarantees continuity with ongoing efforts.

The administration bill does break new ground in its recognition of the fact that the Nation's air resource is indivisible. Air, polluted or not, crosses the imaginary lines that divide State from State. Air quality, therefore, is not a matter of purely local or regional concern. It is of national concern. And that national concern must be reflected in the way air quality standards are established.

Under the proposed bill, two other matters of national concern also would be the focus of national efforts: (*a*) new stationary sources of air pollution that would contribute substantially to endangering public health or welfare; and (*b*) any stationary source emitting pollutants that are extremely hazardous to health. S. 3466 would authorize the establishment of national emission standards for these sources.

National air quality standards and stationary source emission standards obviously would have to be applied to many different situations. Thus, the administration bill provides for continued decentralization of the responsibility for the implementation and enforcement aspects.

The measure would also provide new tools for dealing with a problem that has long been recognized as national in scope—the problem of motor vehicle pollution. Of particular importance are the provisions dealing with fuels and fuel additives. Automobile engines are not the sole cause of the problem. Engines, fuels, and additives are interrelated problems and must be treated as such.

Later in this statement I want to make note of certain actions we already are taking in this area of fuels and fuel additives—pending congressional action on our proposed legislation.

Now, let me highlight the specific provisions of the bill. Section 6 would authorize the Department of Health, Education, and Welfare to establish national air quality standards, and section 7 would call upon each State to adopt an implementation plan for each area within the State. Our objective is to insure that air quality standards are put into effect across the entire Nation. We see three principal advantages in the establishment by the Federal Government of nationwide uniform standards:

First, no State can be expected to take into account, in standard setting, the total effects of air pollution beyond its own boundaries.

Second, States would be able to concentrate their resources on the critical tasks of implementation and enforcement.

And, third, the process of putting air quality standards into effect would be accelerated, because there would be no time consumed in reviewing and approving standards for each air quality control region.

National air quality standards would be derived from the best available scientific knowledge, developed both within and outside the Federal Government.

Once formulated, such national standards would be published in the Federal Register, and all interested parties, including the general public, would have an opportunty to submit comments for consideration prior to issuance of the standards.

Therefore, whereas each State now sets air quality standards for specific pollutants on the basis of Federal air quality criteria documents—which describe effects of pollutants at various concentrations—the Federal Government, under our bill, would establish uniform standards nationwide.

The provisions for national air quality standard setting would not impair any State's right to establish standards requiring higher levels of air quality.

I think we should particularly emphasize that point, that this right is stated as a national policy in the Clean Air Act, and it is a right that we reaffirm.

Following the promulgation of national standards, each State would have 90 days to signify its intention to adopt an implementation plan, describe the steps it would take to develop such a plan, and indicate which areas of the State would be given priority.

In their implementation plans, the States would have to spell out the measures to be taken to achieve and preserve national air quality standards—or even higher air quality levels.

One of the express purposes of the Clean Air Act is "to protect and enhance the quality of the Nation's air resources." It will continue to be our view that implementation plans that would permit significant deterioration of air quality in any area would be in conflict with the provisions of the act. We do not intend to condone "backsliding."

If an area has air quality which is better than the national standards, they would be required to stay there and not pollute the air even further, even though they may be below national standards.

State implementations plans would have to include provisions for intergovernmental cooperation, particularly in dealing with interstate air pollution problems. Under the administration bill, it would be an HEW responsibility to designate significant interstate problem areas.

We estimate that there are about 50 such areas at present. This number includes 21 of the first 57 areas marked for designation as air quality control regions under the provisions of the existing Clean Air Act.

States generally will be expected to submit implementation plans no more than 6 months after filing letters of intent. If there is good reason why more time should be allowed, for some areas within the State, then an extension would be authorized.

In provisions corresponding to those I have been discussing, S. 3546, sponsored by the chairman, would provide for continued regional air pollution control efforts along essentially the same lines as the Clean Air Act. S. 3546 calls for accelerated designation of air quality control regions through a combination of Federal and State action.

The States would continue to be responsible for adopting air quality standards and implementation plans. The timetable for State action would be cut down by two months through a reduction in the time allowed for filing letters of intent.

As a general rule, under the administration bill, the time span for State action leading to submission of an implementation plan would be 9 months. Under the present act, the time span is 15 months. Under S. 3546, it would be 13 months.

I come now to the second major element of the administration bill: authorization for the Department of Health, Education, and Welfare to establish national emission standards for certain stationary sources of air pollution.

With one important exception, such national emission standards would apply only to new stationary sources of certain specified types and classes. The exception would involve air pollutants that are extremely hazardous to health in such cases, national emission standards could be applied to all stationary source emissions.

In general, existing stationary sources of air pollution are so numerous and diverse that the problems they pose can most efficiently be attacked by State and local agencies. Even with air quality standards being set nationally, dealing with existing stationary sources would necessarily vary from one State to another and, within States, from one area to another.

In the years ahead, however, many potentially significant new stationary sources of air pollution will come into being—to meet growing demands for electric power, manufactured goods, and other necessities and amenities of modern life. Large stationary sources, such as electric generating plants, iron and steel mills, and petroleum refineries, often have adverse effects on air quality over broad geographic areas, and this is the kind of problem that demands national attention.

If we are ever to begin preventing air pollution, instead of just attacking it after the fact, then we must at least insure that major new stationary sources, wherever they are located, are designed and equipped to reduce emissions to minimum feasible levels using the latest available technology.

The application of national emission standards would also tend to minimize the competitive advantage of locating a new facility in an area where emission standards are less rigorous than in other areas. This would eliminate "polluter havens" that exist today.

With respect to pollutants that are extremely hazardous to health, national emission standards could be applied to existing, as well as new, stationary sources. Such pollutants might include asbestos, beryllium, cadmium, biological aerosols, and chlorinated hydrocarbons.

Under the administration bill, new sources of extremely hazardous pollutants could not be constructed or operated without a specific exemption from the Department of Health, Education, and Welfare. And such exemptions would be granted only where we are satisfied that emissions would be effectively controlled. Existing sources would be required to take any measures necessary to comply with the applicable standards.

S. 3546 approaches the prevention of air pollution from stationary sources in a different way. It would provide for Federal regulations to insure that new buildings, structures, or other facilities are equipped with the best available air pollution control techniques.

This provision apparently would apply to all new buildings and would mean establishing a Federal-State system for review of construction plans.

From the standpoint of most efficient use of available resources, we feel the provisions of our bill are preferable. It would focus on the most significant new stationary source problems and on those existing sources whose emissions pose the greatest threat to health.

Although States would have primary responsibility for enforcement of air quality and emission standards, our bill provides for effective Federal action where States fail to get the job done.

Federal enforcement action could be initiated whenever (*a*) air quality fails to meet the applicable air quality standards, or stationary source emissions are in excess of applicable national emission standards, and (*b*) this results from a State's failure to carry out its implementation plan.

There would be a two-step procedure, rather than the three-step procedure under the existing act. A hearing would be the first step. Then the Department would specify the remedial action to be taken, and allow a period of not less than 60 days for such action to get under way. If the specified action were not taken, the Department could ask the Attorney General to bring suit to enjoin failure to comply. Federal district courts would be authorized to assess fines up to $10,000 a day.

Under S. 3546, Federal enforcement would involve issuance of abatement orders. If alleged polluters requested a hearing on an abatement order, a decision made by the Department of Health, Education, and Welfare after such a hearing could be appealed in court. The Department's findings, if supported by substantial evidence on the record considered as a whole, would be conclusive. If necessary, in order to enforce an abatement order, the Department could institute civil action.

In our judgment, the enforcement procedure we propose is preferable because, as already described, it is simpler and more direct.

S. 3546 includes two other provisions relating to control of air pollution from stationary sources. One would give our Department the right of entry to buildings, structures, or other facilities and would authorize us to require polluters to measure emissions in cases where a final abatement order has been issued.

We view this provision favorably, but we would suggest that it be made more explicit to provide specifically for inspections and access to relevant information. Such authority, within the framework of our bill's enforcement provisions, could help to insure an effective enforcement program.

The other provision would require compliance with applicable standards and control requirements as a condition of eligibility for Federal loans, grants, licenses, permits, and contracts for construction, and Federal procurement of goods or products.

We have some reservations about this particular provision, which is the concept of enforcement through Federal procurement that is presently being studied at the Federal level. But effective enforcement would require a very substantial and possibly unwarranted investment of resources.

Moreover, the objective could most likely be accomplished more simply and directly through State or Federal enforcement or air quality and emission standards, as proposed in the administration bill.

I would now like to turn to the area of motor vehicle pollution control. The establishment and enforcement of national emission standards for new motor vehicles constitute the cornerstone of our program. The administration bill would improve our enforcement activity in three principal ways: (1) by authorizing assembly line testing of new motor vehicles; (2) by providing for revocation of certificates of conformity when such testing shows that new vehicles do not meet the standards; and (3) by prohibiting importation of all motor vehicles that are not equipped to comply with the standards.

Under the existing act, testing of prototypes in advance of actual production is the principal means of determining whether new motor vehicles will comply with the standards. If we find that they will, the manufacturer is issued a certificate of conformity. We have found, however, that production models do not perform as well as the prototypes.

To insure that vehicles meet the standards when they come off the assembly line, we must test them at that point. And if they fail to measure up, we must be able to require that manufacturers make whatever adjustments are necessary. Clear authority to revoke certificates of conformity would enable us to accomplish this.

The administration bill also would enable us to open a second front in the fight against air pollution from motor vehicles. I refer to the bill's provisions for registration and regulation of fuels and fuel additives used in transportation.

Effective control of motor vehicle pollution requires that we deal not only with engines and control devices but also with fuels and fuel additives.

Under the existing act, however, the Federal action can be taken only with respect to the motor vehicle itself. Fuels are beyond our reach. The Federal Government must be in a position to require fuel modifications and changes in the use of additives.

There has been a great deal of discussion about the standards we recently proposed in the Federal Register for 1975 model automobiles. And much of it has centered on the lead additive now used in almost all gasoline.

The proposed 1975 standards call for major reductions in emissions of carbon monoxide, hydrocarbons, and nitrogen oxides. They also require, for the first time, control of particulate emissions. Much of this form of emissions is lead—and it appears unlikely that the 1975 standard for particulates can be met without the removal or major reduction of lead in gasoline.

Moreover, devices that the auto manufacturers plan to use in order to achieve the 1975 standards for gaseous emissions cannot be used with leaded gasolines.

Most firms in both the automobile and petroleum industries have recognized that lead must soon be removed from gasoline. Automobile manufactures are preparing to market 1971 cars that can operate satisfactorily on low-octane unleaded fuel. A number of major oil companies either have plans or have indicated a willingness to make unleaded gasoline available for those vehicles.

There are still many questions to be resolved—such as the timing of the removal of lead from gasoline, and the number and types of fuels to be marketed. And the answers will have a significant impact both on consumers' pocketbooks and on the quality of the air we breathe.

Members of the industries involved have recognized the need for Federal leadership in suggesting the answers, and our bill would give us the needed regulatory authority.

In the meantime, we must take advantage of the commendable willingness of most petroleum companies to provide unleaded fuels. We want to avoid fragmented and possibly counter-productive actions by individual firms. Therefore, we are sending letters this week to executives in the petroleum industry requesting their views on the basic issues as well as information on their present plans, resources, and problems.

Then, on the basis of their responses—and working also with the automobile and lead additive companies—we will seek to develop an interim course of voluntary action.

I now turn to S. 3229, which, like the administration bill, would extend the Clean Air Act for 3 years and amend it in several respects.

S. 3229 contains provisions designed to stimulate the development of low-pollution vehicles of various types. We certainly fully agree with that objective, as the President's environmental message clearly indicated. But we do not feel that new legislation is required, except for Federal procurement.

Under section 104 of the existing act, we already are greatly increasing our program of research and development—with primary emphasis on the development of low-pollution alternatives to the internal combustion engine. And to provide financial incentives for efforts in the private sector, HEW has initiated a program for the purchase and testing of low-pollution vehicles, individually and in fleets.

In fiscal 1971, we propose to earmark at least $12 million for these activities—about $9 million of which would be devoted to the development of unconventional power sources.

Another provision of S. 3229 would authorize the Department to require automobile manufacturers to provide warranties on air pollution control equipment. While the exact nature and scope of such warranty requirements would have to be worked out, the proposed authority might well be a desirable additional means to insure proper performance of emission control systems throughout the useful life of an automobile.

S. 3229 would also authorize the Department to establish separate emission standards for commercial vehicles, both old and new, and we believe this proposal appears to have merit.

It would enable us, for example, to establish special emission standards for commercial vehicles operated in fleets, such as taxicabs. We have found that fleet vehicles generally are used more intensively than noncommercial vehicles and thus make a proportionately greater contribution to the problem of air pollution, particularly in the large urban areas.

On the other hand, the centralized maintenance and servicing facilities usually associated with fleet operations offer opportunities for the application of control techniques—the use of special fuels, for example—that generally would not be practical for family cars.

The proposed authority to set standards for commercial vehicles also could be used to broaden our attack on the obnoxious problem of diesel smoke and its odors.

S. 3229 also would authorize the Department to establish national standards for the control of emissions from aircraft, vessels, locomotives, and agricultural vehicles.

While vessels, locomotives and agricultural vehicles are not now major pollution sources, and do not require immediate attention, we support the principle of ultimately making them subject to emission controls.

Our Department, in conjunction with the Department of Transportation, has already taken a major step toward controlling air pollution from aircraft.

At a meeting last January, attended by representatives of 31 airlines, we proposed a tight schedule for installation of "smokeless" combustors in JT8D engines. These engines account for a major share of the jet aircraft smoke problem. The airlines have agreed to our schedule, which means that this program will be substantially completed by late 1972. By mid-April, we expect to have detailed action plans from the airlines, and the Department of Transportation will furnish us quarterly progress reports.

Of course, smoke is not the only pollutant emitted by aircraft. We are exploring various means of controlling gaseous emissions as well. And we will seek prompt application of new knowledge. If the enactment of laws and regulations becomes necessary, we will recommend that approach. But where we can make progress in the absence of legislation, we will continue to do so.

In summary, I believe that enactment of the administration bill is essential to the Nation's attack on air pollution. Some of the provisions of S. 3229 and S. 3546 would also contribute to this effort. I recognize that we do not all agree on all the provisions of these bills. But I am sure we can agree on the need to intensify and expand our efforts beyond the existing provision of the Clean Air Act.

Mr. Chairman, I would like to speak very briefly to the proposals regarding noise contained in title II of S. 3229. Unwanted sound is a major component of environmental pollution. It is a growing problem and there is need for intensified research leading ultimately to effective abatement and/or control procedures.

Dr. Alexander Cohen, the Department's leading noise expert, will describe for you the present state of the art and our ongoing programs later this morning.

I think we would like to emphasize that the question is not whether we should tackle the noise pollution problem, but the question is how we can best tackle the noise pollution problem.

When the Environmental Quality Council (now the Cabinet Committee on the Environment) was established, the importance of this problem was recognized in the creation of a Cabinet-level Committee on Noise. This Committee developed recommendations for a national attack on noise pollution.

Following passage of the National Environmental Policy Act of 1969, the newly-created Council on Environmental Quality is undertaking a comprehensive review of the Committee's report.

S. 3229 would establish a new Office of Noise Abatement and Control in the Department of Health, Education, and Welfare. We do not think it would be desirable to separate out, in this way, the problems of noise from all our other environmental and health programs.

Beyond this reason for recommending against enactment of title II of S. 3229, there are two others of even greater weight:

1. We strongly believe that it would be unwise to establish such an office by statute. To do so would diminish the organizational flexibility that is so essential to the Department's efficient and effective use of its total resources.

2. We do not favor new statutory assignments of noise control responsibilities until the Council on Environmental Quality has com-

pleted its review of ongoing activities and submitted its recommendations to the President.

Mr. Chairman, I believe that I have covered most of the subjects that are incorporated in the statement that was filed with the committee. I would be very pleased to respond to any questions the members of the committee may have. Those that I cannot respond to, I will pass off to the experts from the Department who have been around since the Clean Air Act was adopted.

Senator MUSKIE. There are two other statements, one of Dr. Cohen. Is that going to be presented by Mr. Saperstein?

Mr. VENEMAN. No. Dr. Cohen's statement we anticipated would be submitted this afternoon, along with Mr. Johnson's. Or do you want to attempt to do it after the discussion now? We can do it either way.

Senator MUSKIE. At any rate, they are not essential at this point?

Mr. VENEMAN. No.

Senator MUSKIE. I think, because of the number of committee members present, we ought to enforce a 10-minute rule for questioning on each of us, if there is no objection from the committee.

The new concept that the administration bill introduces with respects to air pollution control and national ambient air standards, combined in the case of two categories of industries, is national emission standards.

It is going to take a little time, I think, to sort out the differences from the approach incorporated in the 1967 act.

I will try at least to begin the sorting out with a few questions, if I may.

First of all, as I read the administration bill, it will repeal the authority to designate the air quality control regions. You have stated in your testimony that you are proceeding with the designation of air quality control regions under the 1967 act. Can you relate to me how you would move from the air quality control regions into this national ambient air standard? Why would you repeal the authority to designate such regions if you proposed to use them?

Mr. VENEMAN. Well, first of all, with regard to moving ahead on the 57 regions, we do not have a new act at this point. Of course, we are going to continue to proceed in that particular area. I will let Mr. Johnson speak to the question of the new procedure for getting the entire Nation under air quality regions and the need for making the modifications in the proposal.

Senator MUSKIE. It might be helpful for the record if I might justify my understanding of how the present act works.

Upon the designation of the air quality control regions, there is a necessary precondition, or the triggering device, for setting in motion the standard-setting machinery.

The standard-setting machinery then applies to the criteria which have been issued by the Department and which now include, I take it, five in all.

Mr. VENEMAN. Yes, five, and we anticipate there would be nine by January 1.

Senator MUSKIE. So if you proceed with the designation of the air quality control regions, you would continue the settings of the ambient air standards under the 1967 act. This raises two questions: (1) Whether the air quality control regions, and whatever is done for setting the standards under the 1967 act, would be rendered useless. If the administration proposal were adopted, what would be the relationship?

Mr. JOHNSON. Well, actually, Mr. Chairman, we would build on what we have now. We think that what we are doing is still good. We don't think we are moving fast enough. The new procedure in the administration bill would give us, within a meaningful period of time, actual national standards covering the entire Nation, all 50 States and attendant territories, within a period of about a year and a half.

We would build on the air quality standards that are now existent in the present air quality control regions. No regions would be dissolved until such time as future needs would determine that there is a better configuration. So the 57 or more than we would have at the time that the new bill came into effect would still be in force.

Also, the new bill recognizes that there will be situations which would be interstate types of situations in which the Federal Government should help work those problems out.

Senator MUSKIE. Would you have in mind eventually State control machinery at the air quality control region level?

Mr. JOHNSON. Very definitely, sir. The whole point is to place the States in control of the implementation of the national air quality standards and the enforcement of those standards.

Senator MUSKIE. That is fully consistent with the present act.

Mr. JOHNSON. That is correct.

Senator MUSKIE. In your statement, Mr. Under Secretary, you said that the national ambient air standards should be based on criteria documents. The proposed bill would repeal the section of the 1967 act which provides for the establishment of criteria.

Mr. VENEMAN. No. I think we have to distinguish between the criteria and standards. We would continue to develop criteria. It would be the intention to base the standards upon the criteria that were developed. Criteria, of course, are facts. Each criteria document is the assimilation of factual information and data which are available to help determine what the standards should be, which would be no less than the criteria.

Senator MUSKIE. Why do you provide for the repeal of the authority in the present law or mandate—it is not authority, but it is a mandate. The provision of the law is that "the Secretary shall after consultation with the appropriate advisory committees, Federal departments and agencies, from time to time, issue to the States such criteria of their quality that in his judgment may be requisite for the protection of the public health and welfare," and so on.

One of the reasons we wrote that into the 1967 act was that the authority which was created in the 1963 act to establish criteria was never implemented. We wanted to make sure in the 1967 act that the Congress regarded this as an essential activity.

Now, you propose to repeal it. If you propose to continue to use it, why don't we keep it in the law?

Mr. VENEMAN. Well, I think it is a point we could easily give, Mr. Chairman. The basis upon which the standard would be set would require the continuation of establishing criteria.

Now, if it makes the act clearer, the requirement that we establish criteria, I think, could be very easily written back into the bill. I don't think there would be any technical or administrative objections to that.

Senator MUSKIE. The reason I emphasize the point is the first one I already made.

Second, you say in your statement that the national ambient air quality standards are minimal standards, and that States are in a position to impose higher standards, if they so desire.

If the higher standards are to be imposed, it would seem to me that they ought to be related to the criteria which must be developed by the Federal Government. If they have developed uniform approaches to the problems, there ought to be criteria to trigger that action on their part.

Mr. VENEMAN. It would be essential that there would be criteria, Senator, and the kind of information by which the national quality standards were developed, such as the criteria, would be made available to the States.

Now, as I say, I don't see any particular problem with being more specific in the language. I don't think it causes any particular problem.

Senator MUSKIE. Then the next question I would ask is with respect to the standards. You also would repeal the provision for standard-setting conferences. It is my impression that these are proving to be a very useful way of involving citizen participation in the standard-setting process. In the case of the city of Pittsburgh, for example—I am told this is the judgment of NAPCA—the conference on citizen participation resulted in the toughest standards that have been set. And this has all been accomplished because we have found a way to channel public concern into an institutional form. Why, then, repeal the standard-setting conferences?

Mr. VENEMAN. Well, I think we have to recognize two things, one of which is the fact that we are establishing national standards. It is not as it was previously where the hearings were conducted within the State, which is a relatively simple thing to do.

Senator MUSKIE. The national standards are in two limited areas, however, important. There are other areas, which you say you are not going to touch on. You are going to touch on your national standards.

Mr. VENEMAN. Let me point out, I think in my testimony I attempted to make it clear that during the period when the State was developing its implementation plans that there would be the opportunity for public participation; for public input. It is not a hearing in the sense you have described it, as in the previous act. But there is the opportunity for public comment.

Senator MUSKIE. Public comment is different from a hearing.

Mr. VENEMAN. Well, when you are setting a national standard, I find it difficult to see how we will set up a national hearing process. Now, we have seen some of that occur in Government. We have it before our Department right now. We have had hearings going on for over 2 years on food and drugs, and I don't think that is what the public wants when they are dealing in setting standards. I think they want action more rapidly than that.

Senator MUSKIE. My time is up, and I must leave this point. I will return to it, unless my colleagues cover it further. But let me say this: As I understand the national ambient air quality proposal, it deals with ambient air. Standards, to me, imply mass machinery implementation, as well, at the level of those pollutants which are the objective. But you leave implementation to the States. It seems to me that the States ought to be in a position, then, since your ambient quality standards are minimal rather than maximum, to participate in the standard-setting procedure in a way that would put into motion the toughest standards that the community wants at that time.

If you just issue minimum air quality standards that are applicable nationally and open up a temptation to buy those—whatever the community's needs may be—and you don't provide for public participation to screw up the local courage, to stiffen the standards as it may be necessary in a community, then it seems to me you may be setting up here a minimal standard rather than a maximum one, which we need in some metropolitan areas.

Mr. VENEMAN. We don't preclude that. If the State wanted to go above the national air quality standard, they could have public hearings as frequently as they desired and as lengthy as they desired.

Senator MUSKIE. It wouldn't be provided in national legislation—required, a mandate. I know one of the things industries don't like is this public participation. I like to give it the blessing of national legislation by writing it into the law. Senator Boggs can pursue this. I am sure he is interested in the same point, and I don't want to trespass on my colleague's time.

Senator BOGGS. You are not. We want the chairman to take all of the time he wants. You are very generous about sharing the time with us.

To pursue that point a bit so that we can try to understand what we are talking about: Section 7 of S. 3466 says, "Such State or interstate agency adopts a plan for the implementation, maintenance, and enforcement of such standards of air quality, which adoption occurs within 180 days after the filing of such letter of intent and other material pursuant to subparagraph (A) and after public hearings held not less than 30 days following publication of a proposed plan for implementation," and so forth.

This specifically provides for public hearings at the State level in support of whatever implementation plan the State may propose after the national standards have been issued. Is that correct?

Mr. VENEMAN. When the State is developing an implementation plan, there would be an opportunity for public input, that is correct.

Senator BOGGS. The implementation plan by the State is proposed after the national air quality standards have been published, is that correct?

Mr. VENEMAN. Well, the State implementation would be the plan by which they would put into effect within their State, the national ambient air quality standards.

Senator BOGGS. Or higher?

Mr. VENEMAN. Or higher. And I think the issue the chairman is questioning is whether or not there must be public input into the development of the national ambient air quality standards. There are public hearings prior to development of the State implementation plans. I think this is where we have to distinguish.

Senator MUSKIE. Will the gentleman yield?

Senator BOGGS. I yield.

Senator MUSKIE. It troubles me very much. This committee has had long discussions about the difference between standards and criteria.

The criteria establish the relationship between pollutant and the health and welfare effects. This is scientific and technical, and it is a necessary base for setting the public policy.

But standards, in my understanding of them, include the implementation plan. That is the definition we have always had, and yet, you are talking about the State plan to implement standards by the standards already set by the Government, which presumably include timetables. If not, what is the meaning of "standards" under what we are discussing?

Senator Boggs. Would you discuss that further?

Mr. Johnson. I think we are talking about three things, Mr. Chairman. One, we are talking about the criteria against which all standards are developed. National ambient air quality standards would be developed from criteria.

Now, in order to meet these standards, you have to have developed point source emission standards to give you the mix that ultimately produces the ambient air quality that a community has to enjoy.

Now, in the development of the ambient air quality standards on a national basis, this would be done by the Federal Government. It would be proposed and published in the Federal Register, and we would invite public comment on those national ambient air quality standards.

Now, it is important to point out here that these are not minimal. These would be very tough standards designed to carry out the intent and purpose of the Air Quality Act, to enhance and protect the public health and welfare. Now, once we did——

Senator Muskie. Let me read from the Secretary's statement. It says, "The provisions for national air quality standard-setting would not impair any State's right to establish standards requiring higher levels of air quality."

Mr. Johnson. That is true.

Senator Muskie. If higher standards of air quality are technologically possible, then why does your proposed policy admit the possibility that the national standard would require something less than is technologically possible?

Mr. Johnson. That is very easily explained, Mr. Chairman. You take an area like, let us say, Miami. They need very good, exceptionally high-quality air that is much better than you are likely to get, even with the best technology, in New York or Chicago, in order to continue to take care of their tourist trade.

Now, when they do this, they are going to be protecting against the encroachment of that air quality by the introduction of new industries, even with the best technology, which would cause some deterioration in the quality of that air.

Now, that is where a local community can do more to carry out even more stringent standards than would be proposed on a national basis. You could carry that into any number of other situations and come up with somewhat the same conclusion.

Senator Muskie. What you are talking about relates to public policy as it bears upon the siting of new industry, the zoning of land.

Mr. Johnson. That is correct.

Senator Muskie. What I thought we were talking about were air quality standards and standards that would be met by standards of pollutants and by the way in which we control emissions.

Mr. JOHNSON. Remember, I said we have three things we are considering. One is criteria, against which you set stnadards; two, the national ambient—that is the general air quality—standards set by the Federal Government; three, the implementation plan. A State has to tell how it is going to control the point source emissions that contribute to whatever air pollution they are attempting to control, the power sources, the industrial sources, the home incineration, this type of thing.

They will set point source emission standards that they feel are designed to achieve at least the national air quality or better, if they so choose.

They can hold public hearings in order to do this so that the public gets an opportunity to determine how much better than the national standards they want their air quality to be.

Senator MUSKIE. I am interested in all that you have said, but I still haven't had an answer to the question. The Secretary's statement clearly implies—and you said so—with respect to the performance of existing polluters, the national air quality standards must be exceeded by local standards or State standards. That means the State conceivably could, under the policy you are enunciating, require a stricter application of technological possibilities than the national standards. Do you mean that or don't you?

Mr. JOHNSON. Perhaps there is another element that is being confused here, Mr. Chairman. Within the existing legislation, and even within the proposed legislation, there are certain responsibilities and authorities given to the Federal Government for even point source emission standards, as opposed to ambient air quality standards.

For instance, under the proposed legislation we would set national standards for those types of new sources that contribute substantially to the pollution of the air and that affect on the health and welfare of the people.

In that instance, there would be at the Federal level point source emission standards that would be applicable throughout the Nation and that would be required by all people that came within the purview of that portion of the act.

Senator MUSKIE. I still haven't had an answer to my question, but I will get back to it later. In order to fully pursue it, I have to raise some other questions.

Thank you.

Senator BOGGS. I have several other questions on other topics, but I would like to yield to the other members of the committee if they wish to pursue this question, Mr. Chairman. I think it is important that we get an understanding of this.

Senator MUSKIE. Senator Spong?

Senator SPONG. I would just like to ask one question. Under the present bill, S. 3466, there is no provision for public hearings prior to the establishment of national standards; is that correct?

Mr. VENEMAN. Prior to enactment.

Senator SPONG. So prior to this legislation at the present there is no provision for public hearings, and you contemplate hearings at the State level when the enforcement procedures are being reviewed?

Mr. VENEMAN. During the 6-month period when they are developing their implementation plans there is requirement of public hearings. There is an opportunity for public comment as it relates to the establishment of Federal standards.

Senator MUSKIE. May I ask one question?

Senator SPONG. I yield.

Senator MUSKIE. I just want to know where we get into the machinery or the process of setting higher standards by the States. If you merely issue national standards, whether they are minimal or maximum, I am not satisfied. But put that aside for the moment. Let us suppose you issue national standards and then you give the State time and you provide hearings on implementing those standards. Now, suppose the State wants tougher standards?

All you are asking of them is not to demonstrate implementation of tougher standards. You are not inviting them to make their input at that point to raise the standards. You are saying, "Give us a plan to implement the national standards."

You issue standards that aren't tough enough for a particular community. Then you say, all you have to show us is your plan for implementation of these standards. And they give you such a plan. Haven't you, in effect, frozen the situation for some time and really diluted the potential for stricter standards?

Mr. VENEMAN. Well, let me, first of all, speak to the question of whether or not we want additional language than we have in the proposed bill.

Mr. Chairman, section 109 of the Clean Air Act, which would not be repealed, provides:

"Nothing in this title shall prevent a State, political subdivision, intermunicipal or interstate agency from adopting standards and plans to implement an air quality program which will achieve a higher level of ambient air quality than approved by the Secretary."

Senator MUSKIE. But you see, that provision would be in a different context under the law as you would revise it than under the present law. In the present law, that would be in the context of a procedure which leaves the initiative for setting the standards in the first instance at the State level. But you propose to eliminate that. You are setting national standards. Then when you set them, you go to the States and say, "Give us a plan for implementing these."

Now, that isn't a time for them to set higher standards; that is the time for implementation, you say.
proposed bill.

Mr. VENEMAN. But there is nothing to preclude them from setting higher standards at that time, Mr. Chairman.

Senator MUSKIE. Under the present law, we go to them and we say, "You set the standards. These standards shall measure the requirements of health and welfare in this air quality control region. There is nothing minimal about it. If you don't do it, we will do it; and we will do it in terms of your requirements, the requirements of your people."

This isn't minimal. If you go to New York City, under the present law, there is nothing about minimal or maximum. You go in and say, under the New York situation, "If you don't set standards sufficient to meet the health and welfare requirements of your people, we will set them."

Under present law, you are not fooling around with whether the national needs are tough enough. Should they be tougher? Are we involved in an implementation plan?

You put a clear-cut responsibility for initiating the standards necessary for particular control of the area right at the State level. You pinpoint and you trigger the time for their initiative to run. When that time is up, you give them no extension of time, such as your bill provides, for delay. When that time runs out, if they haven't set those standards, the Federal Government has a clear responsibility to go in and not set minimal national standards.

Mr. VENEMAN. Minimal standards.

Senator MUSKIE. You would have to revise your statement. The standards that are implied apply by the imperatives of the local situation.

As I said at the outset of the hearing, we are interested in new ideas; and we are going to explore yours. The question I am raising, a very important one, is: At what point do you trigger the setting of the highest standards required in a particular problem area?

It seems to me that you have opened the door to the possibility that by seting national standards—whether you call them minimal or not, standards that could be exceeded by your own language, something less than maximum for the Nation—and asking for only implementation of those standards, you open up the possibility that the States may be satisfied with something less than they ought to be in the given problem area.

I think your legislation, even if your concept is sound—and we might buy it, I don't know—I think a loophole here needs to be closed. That is why I raise the question.

Mr. JOHNSON. I would like to speak very briefly to that because there is a very definite point at which the States do get into the act. They have an opportunity to work for higher standards, if that is what they desire in their particular locality, and that is the time at which they have to develop the implementation plan.

As they develop this implementation plan, they are obligated to divulge what quality of air will obtain when they implement this implementation plan.

By doing that, those citizens that are desirous of a higher quality of control than required by the national standards can at that time insist upon emission control procedures in terms of point source emission that will give them that higher quality of air.

Senator SPONG. I think we all understand the difference here, Mr. Chairman. I think it has been clearly stated, and we will just have to resolve where the middle ground is.

We have all agreed that there is an urgency, and there has been some mention of an overall time schedule when an effective program could be initiated. But in reading this over, the proposed changes to section 107 would require publication of regulations establishing air quality standards within 6 months of enactment of the bill, but there is no time schedule for the standards to go into effect. When will the standards become effective?

Mr. VENEMAN. Well, the bill provides 90 days after the setting of standards for them to declare their intention to come up with their implementation plan, then 6 months for them to come up with the plan, so after 9 months they would be covered.

Senator SPONG. I don't think that is sufficiently spelled out, but in the interest of time——

Mr. JOHNSON. There may need to be clarification on that. The intent is that each time new national air quality standards were developed, that within the 9 months' time there would be an implementation schedule and plan for that particular standard.

Senator SPONG. Well, I would suggest, Mr. Johnson, that we have to spell that out in the section.

Also, there is no definite timetable for issuance of information on pollution control techniques to the State, such as you have in section B of 107. It seems to me that this also has to be spelled out. Do you have any comment on that?

Mr. JOHNSON. I am sorry, sir. Would you ask that question again?

Senator SPONG. What I am seeking is, first of all, when the standards would become effective. When we move down to section B, when will the information be disseminated to the States under that section? Is there any time schedule called for? It just seems to me we have a gap in here, between the time the bill is enacted and the time the States actually go into action. I am just exploring this to ask if that is your impression, also.

Mr. JOHNSON. The intent is that no later than 6 months after enactment of the bill, the Federal Government would issue such ambient air quality standards as they have in preparation—and we have indicated that we would probably have nine such standards by about January of 1971.

Senator SPONG. They would be published in the Register?

Mr. JOHNSON. Yes, they would be published.

Senator SPONG. Then would they become effective?

Mr. Chairman, I have used my 10 minutes.

Senator RANDOLPH. Thank you, Senator Spong. Senator Cooper, have you a desire to question further?

Mr. VENEMAN. Mr. Chairman, may I make one correction, on when the standards would be in effect. The Secretary would have to——

Senator SPONG. All he would have to do is publish—30 days after they have been published, with due consideration given to the comments received from the public and other interested parties, they would become effective.

Mr. VENEMAN. Yes; publish in the Federal Register. And it does not specify 30 days. There would be reasonable time for comment thereon by interested parties.

Senator SPONG. I don't want to "nit-pick," but I will say that I think if this bill is enacted, we must spell out a better timetable.

Mr. VENEMAN. Perhaps Mr. Saperstein from the General Counsel's office can comment.

Mr. SAPERSTEIN. We can work with you, if you think that is necessary. I just want to point out the rationale. Senator Muskie was worried about our having public hearings throughout the country before we establish the standards. That, of course, would take quite a bit of time if we had to go all over the country and hold hearings on what the standards should be.

What we have done is to take another method of promulgation of regulations which is used by the Federal Government, and that is to allow a reasonable time, as it says in the bill, for comment. Then it says, we shall, after considering the comments, promulgate the regulations establishing the standards.

Now, if the committee thinks we have to have some kind of a time limitation specified in the statute, we would be glad to work with you on that. But I think you can rely upon the Secretary to try to provide a balance between giving the people a reasonable period of time in which to comment and, on the other hand, trying to make these standards effective as rapidly as possible in order to protect the public interest.

Senator SPONG. Thank you.

Senator RANDOLPH. Senator Cooper?

Senator COOPER. I am sure I won't take long. But I want to pursue the line of inquiry that Senator Muskie opened, and I hope I don't confuse the issues.

I want to speak first to the ambient air quality standards. I want to set aside for a moment the emission standards. As I understand it, there are two approaches. The Muskie or this committee's approach is to develop regional air quality standards as opposed to national air quality standards.

You proposed to immediately or as quickly as possible establish national ambient air quality standards, and let me say that I think that proposal has value. If you wait until every region has established standards, it could be a very long time the kind of delay that Senator Randolph spoke of.

I suppose by establishing national air quality standards, you establish what might be called a level below which no region in the country could pollute the air; is that correct?

Mr. VENEMAN. That would be correct. But I think you have to bear in mind, Senator, that the establishment of these standards would be pursuant to the national air quality criteria, so that your criteria are the basis by which you would establish the standards.

Senator COOPER. You have a situation in which the standards would control perhaps the area in the country which is the worst polluted. There might be other areas in the country where higher standards could be established; is that correct?

Mr. VENEMAN. There could be other areas with better air quality, because of stricter implementation plans.

Senator COOPER. Why wouldn't it be possible to accept the proposal of the administration to establish immediately, or as quickly as possible, national ambient air quality standards to place a control on pollution all over the country, but at the same time, why couldn't we retain the procedure in existence—not just saying they may do this, but providing the criteria, so that the regions can make the standards, implementing them with public hearings. Thus you would enable every region in the country to have the opportunity to provide more efficient and higher ambient air quality standards?

If you preserve the procedure in existence, I think you could accomplish both aims: you could have immediately a standard which would protect the country to some degree, and a very high degree, and at the time assist in other areas, to look at their own situation and circumstances and develop higher quality standards of that is desirable.

Mr. VENEMAN. I think, Senator Cooper, this might erode the concept of having the national air quality standards in the first place.

If you were trying to set up—I shouldn't use the word "minimum," because the standards that are adopted are tough enough standards.

I asked Dr. Middleton, trying to put this thing in perspective a little bit, to give me an example so that maybe we can make it clear. For example, in the criteria that were established for sulphur oxides, the minimum identifiable human health effect occurs at a level of 0.04 part per million.

Now, in establishing a national air quality standard, it would be below that. It would not be above that.

Now, what we are suggesting is that you do not set standards just at the point of minimum impact or effect upon human health. They have to be below it. We are suggesting that if a State or an area within a State, even in the intrastate regions, wants to reduce that even below the national standard, they would have the prerogative.

Senator COOPER. What I am proposing is the suggestion, to the proposition you make, that as quickly as possible to establish national standards but maintain the current procedures. In effect, the regions would have the procedures, as we have them in the committee bill, to effect higher quality air standards. I think you say "they may." Our bill, in effect say they "shall" if the conditions require it.

Mr. VENEMAN. Well, Senator, let me toss one out, having spent several weeks with the Ways and Means Committee discussing welfare reform, and this is not too much different.

In the concept where you are establishing a national minimum standard and then permitting the States to supplement, what if we were to build in a maintenance of effort provision. Now, I am sure my attorneys and administrators would be shaken up about that, but what if we were to say that any State or locality that is above the national minimum standards that were adopted would not be permitted to go below what they have presently in effect?

Senator COOPER. Well, I think I have made my case, and I think we can argue it in the committee. But I make the same proposition to emission standards and the agents that pollute the air. We can accept your proposition of the national emission standards, but at the same time provide the regions, if they desire, to adopt higher standards.

One other question that I will pose, I notice some place in your statement, I think, you said that if the region or an area had a certain air quality which might be higher than other areas of the country, that that would be maintained. It could not be degraded; is that correct?

Mr. VENEMAN. Yes. We pointed out we did not want deterioration of the air in those areas that may be below what the standard is at the present time.

Senator MUSKIE. Senator Cooper, may I interject at this point?

Senator COOPER. Yes.

Senator MUSKIE. We always regard a criteria as, in a sense, a standard. A criteria identifies the health and welfare effect of pollutants. This is factual. It has no relationship to what may be attainable in a given community. This should be the ultimate.

If you establish your criteria scientifically, you ought to be able to move in the direction of just background quantities of pollutant. That is what criteria are. This is why we want them published, so that the public would know what the best scientific brains in the country ought to know in terms of eliminating possible dilatory effects upon health and welfare.

You have repealed that section as a mandatory requirement. Now, a standard—in the sense we understand a standard—doesn't it identify effects that ought to be pretty well understood by the public? And from there, the application of the knowledge is in terms of what is achievable, I take it?

The standard is something different from the criteria; isn't it?

Mr. VENEMAN. The criteria are the basis upon which you establish the standard.

Now, getting back to the sulfur oxide example, the criteria is now 0.04 parts per million. If you were to adopt a standard which has to be below that—well, that is the minimum at which effects upon the health of a human being occur, the 0.04. That is the minimum level. So you would establish a standard which would be below that.

Senator MUSKIE. How does that differ from a criterion? What else is there of the standard? You have said they are the same at a point. What else is there in a standard that differs from this? If you say on this point it is health effects, it is identical with criteria, but what does a standard establish in addition?

Mr. VENEMAN. Your point has something to do with the environment. As well as the health aspect, there are esthetic, economic, and other aspects. You may want to take other things into consideration in your standards.

Senator MUSKIE. "Standard" is the word used in the 1967 act. According to Dr. Middleton, standard is the way for implementing the criteria or any different level of achievement that may be possible. Let me quote Dr. Middleton's testimony:

> Air quality criteria are an expression of the scientific knowledge of the relationship between various concentrations of pollutants in the air and their adverse effects on man, animals, vegetation, materials, visibility, and so on. Air quality criteria can and should be used in developing air quality standards. Criteria and standards are not synonymous. Air quality criteria are descriptive; that is, they describe the effects that can be expected to occur whenever and wherever the ambient air level of a pollutant reaches or exceeds a specific figure for a specific time period.

That is what the 1967 act required to be published, so that the public would know these affects.

Further—

> Air quality standards are prescriptive. They prescribe pollutant levels that cannot legally be exceeded during a specific time in a specific geographic area.

Is that what you are talking about?

Mr. JOHNSON. That is right.

Mr. VENEMAN. We can also let Dr. Middleton respond, because I think those are his quotes.

Dr. MIDDLETON. Senator Muskie, I believe that is what all of us have been trying to tell you again.

Senator MUSKIE. With different spokesmen, it didn't come through as clearly.

Mr. VENEMAN. We will start over.

Senator MUSKIE. I am sorry, Senator Cooper.

Senator COOPER. I am finished.

Senator MUSKIE. I have used up my time for 3 days. Senator Eagleton?

Senator EAGLETON. I have just one question now, but I will have an entire series of questions that in the interest of time I will submit to you later in writing.

(Included in questions from Senator Muskie to Secretary Finch. See p. 193.)

But I would like to ask this one basic question with respect to S. 3466, the administration bill. As I read sections 107 and 108, contained on pages 9 through 16 of the administration bill—it appears to be a prescription for another 18-month delay. We would tragically, in my judgment, be turning the clock back to zero and starting all over again.

Here we are now, in point of time, close to the end of the 3-year startup period of the 1967 act. As I read 107 and 108, we would be starting all over again and going into another 18-month period.

Apparently, you try to save that from happening. As I read section 10 on page 21 you are theoretically going to try to maintain the pressure of the old air quality procedures of the 1967 act until the State has successfully met the pressures of the new procedure.

I will make this observation. In point affect, this effort would surely fail. It would fail because as long as you keep the old procedures—the 1967 act—in a sort of limbo on the statute books, the bureaucracy will concentrate their attention on the news procedures. I think the old ones would be largely ignored.

My point is this. You may be, perhaps inadvertently, creating a whole new mechanism and a whole new time delay period for the issuance and the promulgation of air quality procedures. The net effect of this being that here, in 1970, after we have been laboring under the 1967 act for 3 years and are now almost at the point where plans have been established at the local regions, including my region of St. Louis, and where implementation of those plans are now forthcoming, we are about to scrap all of those plans and place them in suspended animation and start off on another 18-month long process. So, by the year 1972, we will be back here where we are today with very little having been accomplished in the interim.

Mr. VENEMAN. Well, Senator, I just can't concur. No. 1, we don't anticipate taking the pressure off the provisions of the 1967 act.

If we are going to take this attitude, we would never change anything. You wouldn't change any legislation, if that were to follow. This is in bill form. It is still speculative. NAPCA isn't going to slow down the implementation of the current law.

Senator EAGLETON. You recommend that S. 3466 should become law. If we adopted it without changing one letter or one comma, the present procedures would go into limbo for 18 months, while the new ones are being cranked up.

I have added up the various time periods that are contemplated under sections 107 and 108 of the new bill.

Mr. SAPERSTEIN. The existing plan would continue to be effective until we issued national standards—ambient air quality standards—and the particular State implemented those standards by the adoption of a plan which provided emission standards and a means of enforcement.

Until this happens the existing standards, which would be both the ambient air quality standards and the emission standards, would continue to be effective.

Now, I think, Senator, this is a problem that you have, as the Under Secretary pointed out, whenever you have any new legislation. We have it all the time in our grant-in-aid legislation where people say you are going to delay the salutory action that individuals have taken now to build new hospitals or to establish water pollution control plans, and so on.

If you propose legislation which would encourage them to act by providing grants, some are concerned they will then wait until the grants are effective.

I think the same thing may be true here, I think you have to balance the two considerations. As the Under Secretary says, you would never change the legislation if you were to adopt these approaches.

Senator EAGLETON. Let me comment on that. I find that interesting because Dr. Egeberg of your Department—HEW—was in to see me last week. Dr. Egeberg asked me to consider delaying any new consideration on population control, because if we considered new legislation, it would delay the ongoing thrust and hamper the effectiveness of their existing programs. They asked us to postpone consideration of any new legislation.

Mr. VENEMAN. Our Department and the administration have a family population proposal on the Hill right now.

Senator EAGLETON. Yes, that is the famous midnight bill that was submitted to Congress the night before our public hearings.

Mr. VENEMAN. We are advocating changes.

Senator EAGLETON. I would call them titular changes—I come from a rural State.

The point I am trying to make is a very important one. While you are cranking up your new national standards during what I add up to be a possible 18-month period—perhaps my mathematics are wrong, as Senator Spong thinks it is longer because it is opened-ended * * * the whole thrust, focus, and effort on both the national and regional basis will be on what the news standards are going to be.

Time and again you will find industry—and I believe you will find it in my area of St. Louis, for example, Missouri Portland Cement, National Lead, Monsanto Chemical and other polluters in the St. Louis area will say, "Look, we are going to have a new ball game within the next few months. Give us more time." The enforcement agencies will fall for it, and with your proposal, I don't think we will be one iota farther along than we are here today in 1970.

Mr. VENEMAN. I think there are two or three things that are misleading in that respect. First of all, I don't see how it can be an 18-month period. You have got to take into consideration that we are not going to slow down on the 1967 act. These things are moving ahead.

What we are going to do is really provide for a procedure where, within 9 months, implementation plans would have to be submitted. We are going to provide for a procedure where we are not going to wait for regions to be designated, but where plans will be adopted throughout the States and territories at one time. We are going to do it at once.

I think we are expediting rather than delaying. We are not slowing any procedure down in the 1967 act, and we are expediting the overall procedure. We are going to be better off with the proposal we submitted.

Senator EAGLETON. I yield to Senator Spong.

Senator SPONG. I think 20 States have submitted their standards, and standards have been approved for New Jersey, Pennsylvania, and Delaware. You are talking in terms of moving ahead rapidly and continuing under the 1967 act.

Now, here are States that submitted their standards in October of 1969, going forward to January of 1970, and only three States approved.

If what you say represents your present plan for this interim period, am I to take it that you intend to act upon all of these almost immediately?

Mr. VENEMAN. As I stipulated at the opening of my statement in response to Senator Randolph, we anticipated that 40 would be established by June 30 of this year and 57 would be in by September.

Senator SPONG. I am speaking of State plans. Let me say to you that I share some of Senator Eagleton's concern, because it has been necessary in other instances of pollution, not specifically air pollution, for the State to go back and pass new laws, as in my own State, in recent sessions of the general assembly. Immediately when it was learned there would be a new ball game, an attitude developed to wait and see what the national standards are going to be.

I want to know, in terms of these 20 States, whether there will be an immediate review of what they have submitted and if the 1967 act will remain in effect until we have new legislation, if it is contemplated that you will act on those as well as designate additional regions.

Mr. JOHNSON. The answer is yes to both of those, Senator Spong. I think what we need to understand is that we did recognize that the procedure that we now have is a little bit long in coming to fruition in terms of actually getting implementation plans going. We would, by the procedure in the administration bill, expand this beyond a region-by-region operation, such as 57 by September, and we would require the States to develop all of their regions by the end of the time, I think indicated as a 9-month period, after national ambient air quality standards are set.

This gives you, then, a speedup in covering the entire Nation, not just the 57 regions, but the total country in terms of air quality control and the plans they would have to adopt. This does speed up, in many respects, the current procedure that we have.

Senator SPONG. Thank you.

Senator EAGLETON. Thank you, Mr. Chairman.

Senator DOLE. Senator, I have just a couple of questions. First of all, there has been something said about public hearings. Now, as I read the administration bill, there are public hearings provided at the time and implementation of the State plan; is that correct, the only difference being on the formulation of standards? Then you would have comments and, of course, they can be comments by any interested party, as I read that section of the act.

Mr. VENEMAN. That is correct, Senator. In setting the national air quality standards for ambient air, the bill would not provide for public hearings, per se. It would provide for the publication of the standards in the Federal Register with a reasonable length of time for comment.

I just don't see, administratively, from any practical standpoint, how we can run around this country and hold public hearings on national air quality standards. I just don't think it is a practical thing to do if we want to solve the problems confronting this Nation.

Senator DOLE. But it is practical when it reaches the State level, and this is where it is provided for.

Mr. VENEMAN. Right. When you get to that point, then you have public hearings.

Senator BOGGS. The State would have hearings on the question of emissions from a certain source; is that correct?

Mr. VENEMAN. Right.

Senator BOGGS. In other words, a cement plant near Wilmington, Del., might have to have to meet more rigid requirements than a cement plant in a rural area of Missouri in order that the area's air meets the national air quality standards. There wouldn't be any comparison in the emission levels each would have to achieve; is that right?

Mr. VENEMAN. Unless it is in excess of national standards.

Senator BOGGS. As the air in Delaware or any industrial area might be already loaded up with pollutants, a plant in a rural county in Missouri might be allowed to emit a whole lot of things that you couldn't emit in Delaware; that would be the difference; wouldn't it?

Mr. VENEMAN. I think that there would be different judgmental factors that go in. I think you have to recognize there would be national emission standards for certain stationary facilities, as defined in the bill. It wouldn't be all of them.

Senator BOGGS. Therefore, there wouldn't be any uniform restrictions on emitters under the national air quality standards. Their emission levels would depend on their location in the country?

Mr. VENEMAN. That is true as to old plants, particularly, unless they emitted extremely hazardous pollutants. The old ones would all be controlled by the State. They would implement and enforce.

Senator DOLE. I think that is a good point. In other words, we are not depriving the public of a right to be heard. We are trying to do it in a time that has some meaning and when it has some impact. And you indicate that the standards are different in Kansas than they are in California, or at least the problems are different in reference to air pollution and water.

So it might serve some function to have a national public hearing, but I am not certain it could be any great benefit. But I see a reason for it if it is a regional or State concept at the time the plan is implemented.

Mr. VENEMAN. That is provided for.

Senator DOLE. Is this really—and I know the word "transition" worries my colleagues on the left, as we have been going through one now—but is there any substance to the concern expressed by the Senator from Virginia and the Senator from Missouri? Are we, in effect pyramiding programs or permitting some delay in what might be an ongoing program now?

Mr. VENEMAN. No; and that is the point I was attempting to make. On page 21, that Senator Eagleton referred to, we provide in section 10 that everything would stay in effect that was done prior to the enactment of this bill.

Senator DOLE. At least I can understand the concern. Even though it is not effective until these two things happen in section 10, what would be the practical effect on someone, say, in St. Louis? Would they be permitted to wait until this Act became effective, or would they be required to proceed under the present law?

Mr. VENEMAN. If they are violating any laws, they would be subjected to the penalties or requirements under the existing law. Whenever you supersede one piece of legislation with another, you just don't turn off the clock when you introduce a bill. The clock is turned off when it is enacted.

Senator DOLE. I think it will make it clear, though, but I think he does have a real concern.

I have a question in concern to Federal enforcement. It seems to me that section 103 would give the Secretary of HEW almost interminable discretion on whether or not you should proceed against a violator. It says that first of all he allows a reasonable time. Then it says the remedial action should be taken in not less than 60 days.

It seems to me you ought to take out the "less" and put in "not more than 60 days." Then you say he may request the Attorney General to bring suit, and it seems the word "will" should be inserted in that section.

The point is that it doesn't seem to be moving in the direction of really abating pollution, if that is necessary, to be done very quickly, because of all of the time lag between the violation and the charge.

Why not provide an injunctive process immediately and then let the violator make the corrections and have the injunction dissolved after the abatement procedures have been filed on?

Mr. VENEMAN. Well, it is a matter of procedure, and I think the point you are making has a great deal of merit. Mr. Saperstein was deeply involved in trying to get together on the enforcement procedure. I think I will let him speak to this particular section of the bill.

Mr. SAPERSTEIN. Senator, I think it is true that if we change the provisions the way you suggested, we could expedite enforcement very greatly.

Now, I want to point out that the existing law's provision under which, if there is an imminent danger to health, we can get into court immediately and get an injunction, would still be in the law.

Senator DOLE. That is not repealed?

Mr. SAPERSTEIN. No, sir; that is not repealed. That is still retained. Now, I think there is a choice to be made. You can set up a procedure where you hold a hearing and then issue an order and the polluter is required to comply with that order immediately. He must take the initiative to go to court. If he doesn't go to court, the penalties apply immediately.

Or you could provide that we hold the hearing and issue an order which is not effective until we go to court.

Now, I think you will notice in our bill, when we go to court, the court may assess the penalty back to the date when we ordered the polluter to comply with the order. So he is taking a risk if he continues to pollute.

I think I would also like to call attention to the fact that we have proceeded on the assumption that the States are going to have to have implemention plans and we would act only if the State is not carrying out its implemention plan. Ordinarily, we would assume the State would continue to implement the standards and would proceed against the violators as expeditiously as they are supposed to.

Senator DOLE. In other words, the Federal enforcement would be second: is that right?

Mr. SAPERSTEIN. That is right.

Senator DOLE. In the plan submitted by the State would be provisions with reference to enforcement, as I read the bill?

Mr. SAPERSTEIN. Right.

Senator DOLE. Maybe that would explain it. But it appears to me that if there were a case—and certainly we don't want to harass who may be unintentionally at fault—but if there were a case and the Secretary had to become involved because there was no action taken at the State level, then it would seem to me he should have the authority to immediately issue some type of cease-and-desist order to protect the public and then proceed with the hearing, and, if necessary, then go on to court procedure.

But the only question I raise—maybe I just haven't studied it carefully enough—but it says, for example, on page 20, "The remedial action must be taken in a time not less than 60 days, in which such person must take such action." In other words, are they permitted to continue whatever they might be doing, a violation for 60 days before they are required to act?

Mr. VENEMAN. Well, it gives them that period of time to take remedial action. I think, actually, this enforcement section was patterned after the enforcement section in the water pollution control bill, Senator.

Senator DOLE. It may satisfy, particularly where you assess the penalty and it is retroactive to the date the order is made. It is one I think that might deserve some study, and I know it is difficult to protect the interest of the public and not be in a position of harassing those who might be attempting to comply and might not be able to do so.

Mr. SAPERSTEIN. I think you must balance the interests. We would be glad to work with the committee in trying to work this out. It was our judgment this was the best way to proceed at this time, to follow the pattern in the water pollution control bill rather than proceed the other way.

Senator DOLE. And I think the conference has potential and you might eliminate a lot of court action in conference on a friendly basis, which would save costs and other problems. You are not suggesting we appoint a noise administrator: is that right? You are suggesting we already have a cabinet level——

Mr. VENEMAN. I recommended in the Secretary's testimony this morning that we not set up an office of noise in the Department of HEW as recommended, as a statutory provision. But I also certainly recognize the environmental problem caused and created by the noise pollution. I also recognize the health factors that are involved, and that we have a responsibility in HEW in this particular area.

Senator DOLE. The recognition is there. You have already an ongoing program concerned with this problem and there wouldn't possibly be any need for any separate agency.

Mr. VENEMAN. Well, we have Mr. Cohen, who will be available this afternoon, and who has submitted testimony, who has indicated he has recognized the need. We just don't feel it is necessary to set up an office of "noise" in the Department of HEW which is in line with this office at the present time.

Senator DOLE. Thank you, Mr. Chairman.

Senator MUSKIE. I have just one question I would like to ask at this point on another subject. I am reading from the testimony:

> I turn now to the area of motor vehicle pollution control. The establishment and enforcement of national emission standards for new motor vehicles constitute the cornerstone of our program. The Administration bill would improve our enforcement activity in three principal ways: (1) by authorizing assembly line testing of new motor vehicles; (2) by providing for revocation of certificates of conformity when such testing shows that new vehicles do not meet the standards; and (3) by prohibiting importation of all motor vehicles that are not equipped to comply with the standards.
>
> "Under the existing act, testing of prototypes in advance of actual production is the principal means of determining whether new motor vehicles will comply with the standards."

That is not the way I read the existing act:

> Upon application of the manufacturer, the Secretary shall test, or require to be tested, in such manner as he deems appropriate, any new motor vehicle or new motor vehicle engine submitted by such manufacturer to determine whether such vehicle or engine conforms with the regulations prescribed under Section 202 of this title. If such vehicle or engine conforms to such regulations the Secretary shall issue a certificate of conformity, upon such terms and for usch period not less than one year, as he may prescribe.

As I read it, you do this now.

Mr. VENEMAN. Well, I will turn that over to Dr. Middleton, Mr. Chairman. We went through a lengthy discussion on this yesterday before Chairman Rogers' subcommittee.

Senator MUSKIE. Let me add that we went into a considerable discussion when the law was written as to whether we ought to put the standard in the law, whether we should give sufficient authority to the Secretary to do the job, and we wrote the law with the intention of giving the Secretary every authority he could conceivably need.

Dr. MIDDLETON. Perhaps your statement would make mine shorter. The problem that you pose is a real one and the reason we test prototypes is based on the fact that we need to test vehicles in advance of their production for sale.

Senator MUSKIE. But the law doesn't say you must test prototypes and nothing else.

Dr. MIDDLETON. But the practice of giving a certificate in order that manufacture takes place requires that there must be an earlier determination of the suitability of such vehicles for sale purposes. The law also says that the vehicles shall be manufactured in substantially the same way or of substantially the same material. I don't remember the exact words.

What we are learning through this system is that the prototypes, while they meet the standards—I am advised by the Assistant General Counsel it is the same construction—what we are finding is that there apparently is a difference in the quality control of such vehicles.

Senator MUSKIE. What I am saying is that as I read the language of the 1967 act, you have got the authority.

Dr. MIDDLETON. It is possible that that interpretation could be made. We are saying that if it would be clearly made, there would be no question about it.

Senator MUSKIE. Let me read it again:

Upon application of the manufacturer, the Secretary shall test, or require to be tested, in such manner as he deems appropriate.

That seems clear.

Mr. SAPERSTEIN. We are not disagreeing with you, Senator. We are just not having a meeting of the minds because what I think you are talking about is the production-line vehicle and what Dr. Middleton is talking about is the fact that we test a prototype and that the vehicles——

Senator MUSKIE. I am not complaining about how you do it.

Mr. SAPERSTEIN. And that the vehicles that come off the production line later, although they are of substantially the same construction, do not test out satisfactorily. And we do not think the existing legislation is clear on the point that we may revoke a certificate when the producion line vehicle is of substantially the same construction as the prototype that we tested earlier.

Senator MUSKIE. The law says, "shall issue a certificate of conformity, upon such terms as he may prescribe."

You are able to spell out the terms you think you are able to describe in this testimony. Why can't you do this with the certificate?

Mr. SAPERSTEIN. Having been in the business of drafting legislation for the past 25 years, I realize that every time we draft legislation we try to do the job successfully, but sometimes we don't succeed.

In this case, I think you have to read the statement you are quoting along with the next subsection, which says that if the vehicle is of the same construction as the prototype, it is deemed to comply with the regulations.

Now, that is the difficulty, Senator, and I would like to clarify the law. Certainly we would like to administer it the way you are suggesting. However, we would like to make it clear that we may test the vehicles as they come off the production line. The automobile manufacturers know what the situation is, and we don't want a series of law suits that drag on for years.

Senator MUSKIE. The word "prototype" doesn't appear in the statute.

Mr. SAPERSTEIN. No, but it says they are to submit something for us to test; and the whole theory was that they would do this in advance of the production of the vehicles so that they wouldn't have to wait to find out as these vehicles came off the production line, whether they would comply.

Senator MUSKIE. You say that the law gives the manufacturer the prerogative of telling you what vehicles you should test?

Mr. SAPERSTEIN. That is a different issue, Senator.

Senator MUSKIE. No. You are saying that they submit a prototype and you test it, and you can't test anything more.

Mr. SAPERSTEIN. We may test other vehicles, Senator, but as we interpret the law, it is the fact that other vehicles which come off the production line don't perform as well as even though they are substantially of the same construction as the vehicle they submitted for purposes of getting this certificate.

Senator MUSKIE. What you are saying is that the vehicle submitted is the only one you can test?

Mr. SAPERSTEIN. We could require them to submit another one.

Senator MUSKIE. Couldn't you require them to submit the whole assembly line? Can't you require them to do so?

Mr. SAPERSTEIN. I don't think so.

Senator MUSKIE [reading]:

Upon application of the manufacturer, the Secretary shall test or require to be tested as he deems appropriate.

Mr. VENEMAN. Mr. Chairman, may I point out that these regulations that were applied to section 206 were adopted during the previous administration, and we are doing our very best to straighten it out.

Senator MUSKIE. Then change it, Mr. Secretary. Don't take time to delay the legislative process. You won an election in November of 1968. You have the authority to change it.

Mr. SAPERSTEIN. We have got to interpret the law as we see it, and we have serious doubt that we can do what you are saying. Now, lawyers can disagree on this, but that is the problem.

Senator MUSKIE. If this language, "as he deems appropriate," doesn't give you enough authority, then I guess we are going to have to spell it out, comma by comma, to satisfy you. We are going to be writing awfully long law, and it is going to take an awfully long time.

Mr. SAPERSTEIN. All I am suggesting is that subsection (b) has language which is not consistent with the language you are quoting, and we have to read both subsections together.

Senator MUSKIE. All I can say is that this is a much slower process in the interpretation. As I read the language, you have the authority to do exactly what you are proposing. But I guess I can't force that interpretation upon you.

Senator RANDOLPH. Mr. Chairman, I believe it is important for us to realize that there is a responsibility on the Secretary, and on the administration, to draft and forward to the Hill legislation on which this committee would work its will. And there is a responsibility also on the members of this subcommittee and on the full committee to develop legislation within our own jurisdiction, with the cooperation of the executive establishment.

I think sometimes we do allow those downtown, and this is no criticism of the agencies, to draft the legislation, forward it here, and then, in a sense, feel that we should take it and send it with little refinement to the Senate floor.

Our responsibility goes much deeper than that, as you well realize, Mr. Under Secretary.

Mr. VENEMAN. I fully appreciate that responsibility, Senator.

Senator RANDOLPH. On the other hand, there can be the cooperative effort which, I feel sure, all of us prefer.

Now, as you recall, Mr. Veneman, our subcommittee was largely responsible for section 104 in the Air Quality Act of 1967. Section 103 was a feature of the measure from its inception, but there was a reason why I moved forward, perhaps with a certain amount of personal leadership, in reference to the inclusion of section 104.

I did so because I realize that we needed to define a legal basis for supporting projects involving construction and installation of pollution control equipment on private property for the purpose of testing. This was one reason.

There should be cooperation and partnership between government and industry. Above all, however, pollution control technology must be expanded.

Industrial plants often are the best possible sites for making the realistic tests and evaluations of the economic and technological feasibility of processes for the control of pollution problems such as sulfur oxides, and others. Would you agree with that?

Mr. VENEMAN. I would agree. It is my understanding that section 104 remains in the act. We certainly recognize the desirability of that particular provision.

Senator RANDOLPH. Thank you very much. There was another reason, perhaps as important as the one I have just given, for providing the funds that would be available until expended. I think that in research and development we have to provide that flexibility.

It is oftentimes necessary in the planning and scheduling of research and development and demonstration projects that they extend beyond the end of a fiscal year. Is this not right?

Mr. VENEMAN. Yes, certain research grants do.

Senator RANDOLPH. That is correct. As you know, I represent a coal State where huge tonnages of bituminous coal are produced and marketed. But most of it is not low in sulfur content.

So I was wondering, naturally, about the domestic low-sulfur fuel requirement as we seek to effectuate air pollution control. I wanted others to join me in thinking in terms of reduction in the sulfur oxide concentration due to the burning and combustion of fuels with high sulfur content.

It was obvious that we needed new and certainly we need additional technology to accomplish any substantial amount of reduction in sulfur oxide concentrations.

I am speaking in some detail on this matter because I believe the Senators from the respective States have responsibilities in connection with their industries and those working within them. When the Department of HEW published the sulphur oxides criteria, there was very little technological backup. I am not sure whether or not you agree with that.

Mr. VENEMAN. I am not in a position to speak.

Mr. RANDOLPH. Well, certain people here can address that subject, and that is why I am going to direct my questions to Dr. Middleton, and those who join him here.

Senator COOPER. Would the gentleman yield a moment?

Senator RANDOLPH. I yield.

Senator COOPER. I am glad to see you are pursuing that line of inquiry and wish to be associated with it, or considering the problems which are inherent in the state of the art of planning techniques with relation to certain fuels. I think the funds which have been authorized are, or at least a substantial amount of those funds, should be made available for research.

Senator RANDOLPH. I thank you, Senator Cooper. We do know that sufficient quantities of domestic low-sulfur coal will not be available to meet the requirements of air pollution control. In the first place, it is metallurgical coal needed in steelmaking. The same problem relates to domestic residual oil. Without a reduction in sulphur oxides, the concentrations of them will be harmful. But do we have technology to achieve the reduction? Dr. Middleton, I know, has given very much attention to this.

Now, I will try to be as brief as possible, but still cover the ground. How far toward development of technically and economically feasible sulphur oxide technology has this section 104 research, and research in general, progressed?

Dr. MIDDLETON. I think we have made substantial progress, Senator Randolph, in identifying the systems that must be employed to reduce the sulphur oxides. I would have to agree with your earlier statement that the control technologies available to abate and control sulphur oxides are not all they should be. And it is true that the use of section 104 has the accent on the problems, such as the cost sharing with industry in an R. & D. development system that we are presently demonstrating, for example, with the Tennessee Valley Authority in a dry limestone injection system, which we expect to complete in about a year.

We are setting up a program with wet limestone scrubbing to work out what are better known as bugs in the systems which are available from certain commercial organizations.

Not only are we concerned with these specific items, but we are presently looking at three others in a cost-sharing arrangement and are dealing now with the General Counsel's office on business arrangements so we can enter into contracts to install demonstration systems.

Further, I would say we are now limiting our sulphur oxide research to stack gas cleaning but, as you earlier recognized, also accenting the need for cleaner fuel. Today only about 8 percent of the coal used by utilities has a sufficiently low level of sulfur to permit their use, based on sulfur content alone.

We have looked at some 100 utility coals, coals used by the power generating companies, and have learned that at least 17 percent are cleanable and can be used after they have been cleaned. So we are now in the process of developing a system, Senator Randolph, which would permit us to remove pyritic sulfur from coals that contain more than 1 percent sulfur.

Senator RANDOLPH. When could we reasonably expect feasible sulfur removal or reduction devices to be available to be used by our electric generating plants to help meet the ambient air quality standards in the various areas of the country where the standards have already been invoked?

Dr. MIDDLETON. Depending on the location of the powerplant and the economy of the area, we may already be able to use a system demonstrated by a private company, such as Monsanto.

Through improvements in the combustion engineering wet limestone process; that may be used if those companies guarantee performance.

The dry limestone injection, which we call a throwaway process, would mean its use is limited to existing powerplants, and we would not recommend its use in a new plant. Finishing investigative work in TVA in this next year would mean it probably could be used in commercial applications in about 2 years from then.

So a specific answer is about 1973. There would be no reason for not having this system available for certain utility plants.

Senator RANDOLPH. Well, I think your answer is very specific and, in a sense, it is somewhat comforting. Naturally we realize that you must base it on expectation to grow out of experimentation and pilot projects. Is that right?

Dr. MIDDLETON. That is right. It may be comforting, but we do not yet have available for use the high-efficiency control systems required, and we must work toward them.

Senator RANDOLPH. But it is gratifying to know that you look toward something with a reasonable degree of hopefulness. We have followed with intense interest the early history of section 104 developments. I insisted on section 104 and Senator Cooper supported it with vigor, as did other members of our committee, including our distinguished subcommittee chairman.

As we continue research and development efforts, such as you have discussed, we are thinking of the sulfur oxide emission control problem. The questions that continue to arise in my mind relate to the adequacy of the methods to offset the increased emission estimated to occur in the future.

I have some figures—I am not sure that they are correct—but we believe that emissions of sulfur oxides will be an estimated 37 million tons in 1970. Is this correct?

Dr. MIDDLETON. Yes, Senator.

(Figures referred to and later supplied follow:)

ESTIMATED POTENTIAL SULFUR DIOXIDE POLLUTION WITHOUT ABATEMENT—UNITED STATES [1]

	Annual emissions of sulfur dioxide				
	1967	1970	1980	1990	2000
Powerplant operation (coal and oil)	15.0	20.0	41.1	62 0	94.5
Other combustion of coal	5.1	4.8	4.0	3 1	1.6
Other combustion of petroleum products	2.8	3 4	3.9	4.3	5.1
Smelting of metallic ores	3.8	4.0	5.3	7.1	9.6
Petroleum refinery operation	2.1	2.4	4.0	6.5	10.5
Miscellaneous sources [2]	2.0	2.0	2.6	3.4	4.5
Total	30.8	36.6	60.9	86.4	125.8

[1] February 1970 estimates by National Air Pollution Control Administration.

[2] Includes coke processing, sulfuric acid plants, coal refuse banks, refuse incineration, and pulp and paper manufacturing.

Senator RANDOLPH. And that they are expected to increase to about 65 million tons by 1990; in the power industry alone. Is that right?

Dr. MIDDLETON. Yes.

Senator RANDOLPH. This causes us to realize the enormity of the problem which we face, and I think it is important that we insert in the record of this hearing, the material of Paul Spaite and Robert Hangebranck, of NAPCA, on this particular subject. Do you think that would be helpful?

Dr. MIDDLETON. I think it would be helpful to have the information produced and provided for the record.

(The information later furnished follows:)

POLLUTION FROM COMBUSTION OF FOSSIL FUELS

(By Paul W. Spaite and Robert P. Hangebrauck, Bureau of Engineering and Physical Science)

INTRODUCTION

About half the air pollution from industrial and commercial activities is produced by the burning of coal, oil, and natural gas. Currently, emissions of fly ash, sulfur oxides, and nitrogen oxides by these fossil-fuel-burning sources come to about 45 million tons per year in the United States, and consumption of fossil fuels is doubling every 25 years. At predicted rates of increased consumption, in 30 years total emissions could be well over 130 million tons per year. These emissions originate in power plants, industrial boilers, and smaller installations used for commercial and residential heating. Electric power production, which is the largest and fastest growing category, is doubling every 8 to 10 years.

Today, our ability to control pollution from fossil-fuel-burning sources is very limited. Much of the fly ash from combustion can be collected by available hardware, but methods for effective control of sulfur oxides, nitrogen oxides, and very small particulates need greatly increased research and development to provide methods that can contain the problem without excessive impact on our economy.

If we assume that the work we are doing now to develop and apply control methods is successful, overall amounts of sulfur oxides and nitrogen oxide emissions can be held to relatively modest increases over present levels, instead of increasing by a factor of five as seems probable otherwise. Although it is apparent that the cost of controlling pollution will be high, (1) the benefits to be gained in reducing the impact on the environment will be substantial. The cost of economic damage to vegetation and materials is estimated at billions of dollars per year at current emission levels. Increases of the magnitude that are foreseen without controls would seem to be intolerable. Even with controls increases in emissions will be significant, e.g., SO_2 emissions from the power industry are expected to increase with controls by an estimated 2 to 3 times by the year 2000. Clearly, air pollution from fossil fuel combustion is a national problem of great importance, and every avenue of attack to bring about additional controls should be vigorously pursued.

THE NATURE OF THE PROBLEM

The potential for damage to health and property, the rate at which emissions are increasing, and the long lead time necessary to develop and apply air pollution control technology make it impertive that we act now. Dealing with the overall problem of controlling air pollution is complicated by the necessity of simultaneously coping with technical, economic, social, and political constraints. The problem is multiplied by the diversity of the engineering solutions that must be developed for the different combustion processes and different kinds of pollutants they produce. For each of the three major pollutants—sulfur oxides, fine particulates, and nitrogen oxides—the overall problem is characterized by the complexity and non-uniformity of the technical subject matter. Still we must deal with the problem in the shortest possible time, without undue impact on our economic system.

Because of the need to quantify the magnitude of problems associated with sulfur oxides emissions from the utility industry of the United States, the National Air Pollution Control Administration (NAPCA) analyzed predictions of power industry growth. By interpreting projections by the Atomic Energy Commission, the Edison Electric, the Federal Power Commission, and the President's Office of Science and Technology, NAPCA developed estimates of how much sulfur oxides pollution we might expect from production of the electric power that will be required by our expanding economy over the next 30 to 50 years. These estimates ([1,2]) have been carefully examined in detail. Independent experts both inside and outside of government have generally concurred that NAPCA's estimates of sulfur oxides pollution potention and the cost of control are realistic estimates based on the best available information for projected levels of power production.

To provide a broad perspective of the total problem of polilution from combustion, the basic data on power industry growth have recently been further analyzed. Estimates have been made of the quantities of nitrogen oxides and particulate pollution that will accompany anticipated increases in power production unless prevention action is taken. Also, consumption of fossil fuels for non-utility uses was considered so that projections for the utility industry could be expanded into a projection for all consumption of fossil fuels in the United States. The results of these analyses with general comments on the problems associated with control of predicted emissions are discussed below.

Sulfur oxides

The emissions of sulfur oxides from power production and other sources are shown in Figure 1. The sources of information used in making the projections were mentioned and referenced above. The individual factors considered included projections of electric utility capacity, nuclear generating capacity, hydroelectric capacity, fossil fuel capacities, sulfur levels in fuels, heat rates, and capacity factors.

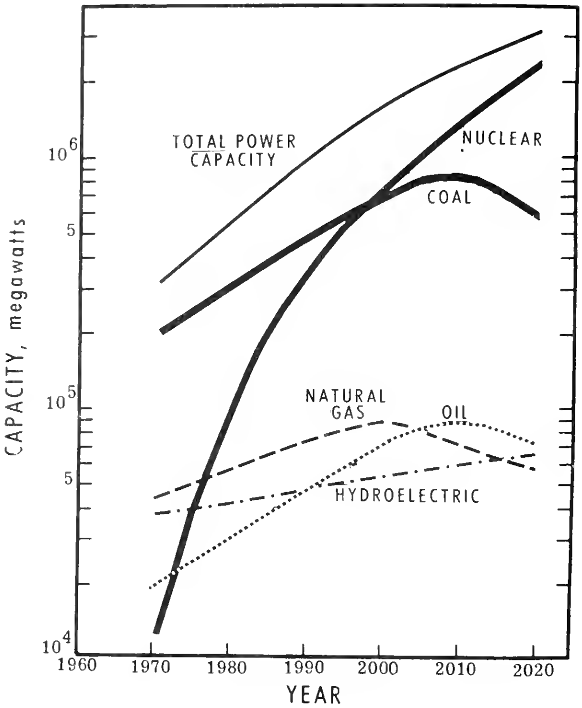

FIGURE 1. PROJECTED POWER GENERATING CAPACITY OF ELECTRIC UTILITIES IN THE UNITED STATES (WITH BREEDER).

From these data it is apparent that power production, which accounts for 70 percent of the present total sulfur oxides emissions from combustion and over 90 percent of the total anticipated in 30 years, is by far the most important source judged on the basis of total contribution from all combustion sources. Even recognizing that other combustion generally takes place in centrally located furnaces that emit their effluents at low levels so that they have a disproportionate eeffct on ambient air concentrations in urban atmospheres, it seems apparent that control of surface emissions from power production deserves paramount consideration.

It is further recognized that part of the impact of increased emissions from power production will not be felt equally in all parts of the country; some areas will be affected more or less than the national average. It is clear, however, that public concern about the health hazards and damage imposed on the public by present levels of pollution is such that 3- to 4-fold increases in overall emissions will not be tolerated.

About 90 percent of the sulfur pollution from power generation comes from the burning of coal. Even when consideration of the nature of the control problem is limited to coal burning power plants, the problem of non-uniformity in the processes which must be controlled still is apparent. Factors such as plant size (which may vary by a factor of 10), plant age, and a host of considerations associated with location make each power plant a unique control problem. For example, a large modern power plant (1000 mw) burning a typical 2.5 percent sulfur content coal produces 1.7 million standard cubic feet per minute of effluent containing about 0.2 percent SO_2. A process to clean this gas and recover the by-product sulfur as sulfuric acid would have to have assured markets for over 500 tons of acid each day.

Nitrogen Oxides

Nitrogen oxides emissions from all combustion of fossil fuels are shown in Figure 2. These projections were made using the same fuel usage data developed in making the sulfur oxides projections, plus nitrogen oxides emission factors for the various fuels and classes of combustion equipment. The tonnages involved range from an estimated 9 million tons at present for the most recent estimates to about 25 million tons by the year 2000. These tonnages represent 50 to 60 percent of the total NO_x pollution expected from all sources, including motor vehicle, for the foreseeable future. Even though the role of nitrogen oxides in the overall pollution problem is not well understood, it seems apparent that the documented role of NO_x in the production of photochemical smog is sufficient evidence to justify giving immediate attention to development of ways to limit future emissions. With NO_x, as with SO_x, the power plant is a major contributor that will become an increasingly dominant contributor. At present 30 to 40 percent of all NO_x emissions from stationary sources come from power production. This contribution will increase to 60 to 70 percent in 30 years. Thus, in the year 2000, it appears that the power plant and the automobile will present potential problems of equal magnitude measured in terms of total projected amounts of pollutant emissions.

It should be noted that the curves shown on Figure 2 are probably conservative, since they are based on available data on NO_x concentrations in combustion off-gases. The emission factors used came from studies of older boilers; modern boilers operate at higher temperatures and therefore are expected to emit substantially higher concentrations of NO_x.

Particulates

Controlling particulate emissions from combustion processes is, contrary to some opinions, likely to require development of new technology. Overall emissions of fly-ash from all combustion sources are shown on Figure 3. These future emissions were calculated using the same fuel usage data mentioned earlier. A

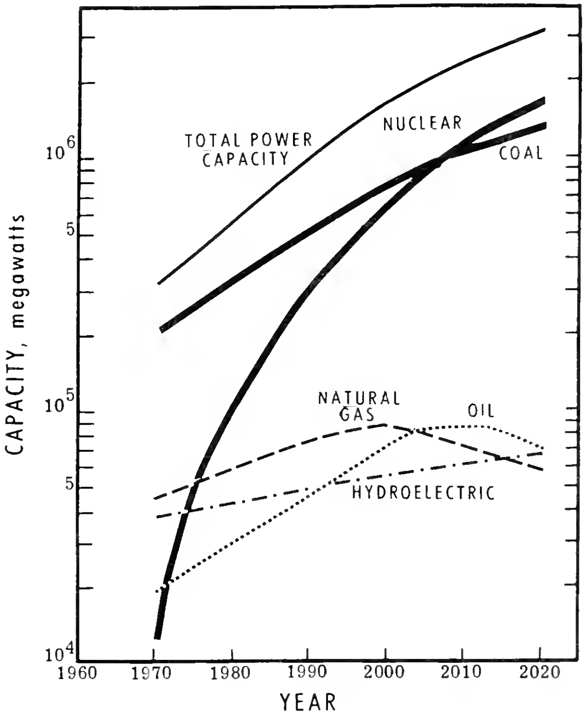

FIGURE 2. PROJECTED POWER GENERATING CAPACITY OF ELECTRIC UTILITIES IN THE UNITED STATES (WITHOUT BREEDER).

fuel ash content of 11.9 percent was assumed; the present and future extent of control equipment application and efficiencies for both utility and various non-utility boiler hardware types were estimated. The curves show what can be expected if the increase in control equipment application continues at the present rate. In terms of overall particulate emissions, our situation does not seem to be as critical as it is with SO_x and NO_x. The overall picture may be misleading, however, because it fails to take into consideration the fact that presently available equipment for fly-ash control does not efficiently collect particles less than approximately 1.0 micron in diameter.

The lower curve in Figure 3 shows what it is reasonable to expect in the way of increases in fine particulate emissions. In addition to the estimates mentioned above on fly ash generation and present and future extent of control equipment application, the estimates of fine-particle emissions were based on extrapolated data on fly ash particle size distribution and fractional efficiency of electrostatic precipitators for particles less than 1.0 but greater than 0.2 micron in diameter. Figure 4 shows projected numbers of fine particles that will be emitted by utilities with and without control by conventional electrostatic precipitators. With control, emissions are lessened slightly, but the number of particles in this size range increases by a factor of 4 from the 1970 to the year 2000. This is particularly significant because the particles in this range are the most objectionable in several respects. They tend to stay suspended in the upper atmosphere where they may accumulate to a degree that is serious; accumulation of fine particles in the upper atmosphere could lead to significant climate changes.[3] Particles in this size range reduce visibility and inhibit world-wide solar radiation. Finally, particles of this size are the most hazardous to health in that they tend to be inhaled and retained in the lungs.

CAPABILITY FOR CONTROL

From the control point of view combustion sources can be be divided into three classes with distinctly different characteristics as far as the nature of the control problem is concerned: (1) boilers under 500 million Btu/hr capacity (70 mw equivalent), (2) existing boilers larger than 70 mw, (3) large new boilers that will be built in the future and for the most part will be 500 mw to 1000 mw in

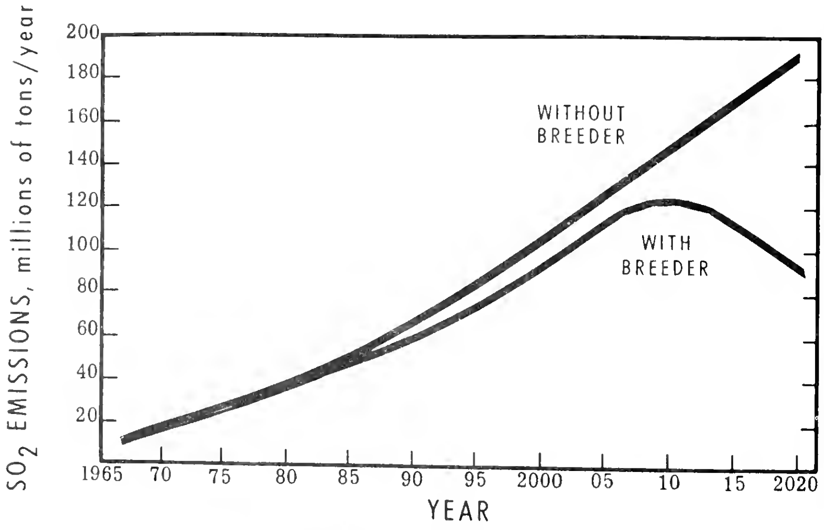

FIGURE 3. PROJECTIONS FOR TOTAL UNCONTROLLED SO_2 EMISSIONS.

size. These three classes are not all inclusive, but they account for a very large percentage of all of our present and projected fuel consumption. There will be many individual exceptions to general rules as they apply to each category, but certain valid overall observations can be made.

Boilers Under 70 Megawatts

It has been estimated that we have about 950,000 boilers that are in the range of 500 thousand to 500 million Btu /hr (70 mw). As a class, this group includes essentially all non-utility combustion units (with the exception of residential-sized units) and about 30 percent of the utility boiler capacity. This group represents over three-quarters of *all* of our capacity to burn fossil fuels. The total pollution production potential for this group is not as great as these figures suggest, however. The overall capacity factor or use factor for units in this class is low, and in many instances, they burn gas or distillate fuels that are essentially non-polluting from the standpoint of particulate of sulfur oxides emissions. Also, these units generally operate at lower peak temperatures so that nitrogen oxides production is less than would be expected from equivalent fuel consumption in larger and newer units that operate at higher temperatures. Unfortunately, this group is made up in large degree of single boiler installations that are operated intermittently, and therefore, control of sulfur oxides or particulate pollution by any means other than fuel substitution is not feasible. Also, many are located in urban areas and usually their emissions are vented to the atmosphere through short chimneys so that the impact on ground level pollutant concentrations can be of special significance.

Existing Boilers Over 70 Megawatts

Practically all of the existing boilers over 70 mw equivalent are utility boilers. This class includes about 1100 boilers that range in size up to 1000 mw. These boilers are located at power plant sites where the total capacity at a given site usually ranges from 300 mw to 1000 mw, but may run higher than 2000 mw. The age of these boilers varies from newly installed to over 35 years, but most of the fuel consumption (70%) is in boilers less than 15 years old, so that pollution from existing boilers can be expected to prevent problems for a considerable period.

At present electrostatic precipitators could be used to control much of the fly ash, but only about 40 percent of existing boilers are equipped with precipitators. Further, precipitators now in operation frequently function inefficiently, either because they were designed to meet less stringent requirements than are needed today or because they have suffered losses of efficiency with time. Even with the best available equipment, the collection efficiency for particles smaller than 2 microns in diameter is estimated to be only 60 percent. To deal with the problem we are now facing, we need to upgrade existing systems as well as improve techniques for control of submicron particles.

Control of sulfur oxides pollution from many existing utility boilers by application of flue gas cleaning devices should be practical in the short term. Being larger, newer, and located in closer proximity to other boilers than is customary with smaller utility and industrial boilers, boilers larger than 70 mw are more amendable to control by flue gas cleaning methods that can be fitted into space available at existing sites.

In general, the lower the capital cost, the more economically feasible a process will be for existing boilers. For this reason, the so-called "throwaway" processes, which involve reaction of SO_x in flue gas with lime or limestone so that calcium-sulfur compounds can be collected in precipitators or wet scrubbers, are most likely to find application to sources in this class. In addition, certain regenerable aqueous scrubbing processes, because they are relatively compact systems, may be especially applicable to existing boilers.

At present, commercially proven methods for controlling SO_x from this class of boilers are not available. Certain processes have been offered commercially, but none have been demonstrated to be capable of the long-term reliability necessary for routine application in the utility industry. Others are in advanced stages of development, but are still several years away from commercial availability.

Our ability to control nitrogen oxides emissions from existing boilers is not clearly defined. It appears that SO_x control processes that may be applied in the future may provide some incidental NO_x control—about 20 percent might be collected by systems that remove sulfur oxides. Also, it has been demonstrated feasible to minimize NO_x emissions from some types of existing boilers by modifying combustion conditions to minimize peak temperatures, but the methodology and economic feasibility of approaching this problem on a broad scale has not been defined. If significant reductions are to be made in the projected emissions from existing sources, considerable attention will have to be given to development of reliable control methods that can be applied as the need is demonstrated.

New Utility Boilers

Control of pollution from boilers yet to be built offers possibilities that are not economically feasible for existing industrial or utility boilers. Improved control processes that may be developed in the immediate future can be designed into the equipment prior to construction. Further, new units tend to be much larger, and therefore, economy of scale can be realized. At present, however, reliable, commercially proven processes are not available for control of either SO_x or NO_x.

For control of particulates even the best available equipment will not be adequate for future needs. We have recognized limits on present capability for high-efficiency collection of high-resistivity dusts, e.g., fly ash from many low-sulfur coals. Further, the previously discussed inefficient collection of fine particles, which may be tolerable at present levels of 300,000 tons per year, may pose a critical problem in the year 2000 and beyond when emissions are expected to reach 1,300,000 tons per year, as shown in Figure 3.

Although several sulfur oxides control processes have been offered commercially or are in advanced stages of development, only a few demonstration studies will be completed by 1972–1973, even if present plans are accelerated. How fast processes will be applied after firm data on design and economics are available is speculative. Much will depend on legislative pressure and the public willingness to pay the cost of control.

For nitrogen oxides control from new utility boilers, we will have to depend on what the boiler makers can accomplish using empirical approaches to design based on qualitative understanding of the relationship between boiler operating conditions and nitrogen oxides production. Beyond this, little can be expected unless we begin to implement existing research and development plans that have been developed to improve our understanding of how NO_x emissions are related to combustion hardware configuration and how SO_x scrubbing systems can be more effectively applied for NO_x control. Even if planned work is undertaken in the very near future and is successful, it may be 10 years or longer before new boiler configurations and new scrubbing systems can be designed for minimum NO_x production.

SUMMARY AND CONCLUSIONS

At present, our capability for control of increasing emissions of nitrogen oxides, sulfur oxides, and the fine particulates from combustion sources is seriously limited. The rate of increase of these emissions is related principally to growth of the power industry, but other combustion sources are making significant contributions to pollution. Unless we act now to prevent it, the insult to our environment will be massive.

For control of particulates, our most important need is for high-efficiency devices for collection of fine particulate. This pollutant produces damaging effects on health, visibility, and the climate of urban areas. Also, fine particulates tend to remain in suspension in the upper atmosphere, where continued buildup of such materials could produce unacceptable worldwide climate changes. For control of sulfur oxides, we need to develop sources of low-sulfur fuel for the large number of small combustion sources that will be with us for many years. For control of SO_x emissions from existing and planned fossil-fuel-fired power plants, we need accelerated programs for development and application of processes that will prevent SO_2 emissions, as well as additional sources of low-sulfur fuel. For control of nitrogen oxides, we need to develop better capability for designing combustion equipment and scrubbing systems so that NO_x emissions are minimized without undue economic penalty. Without these improved control capabilities, we may produce irreparable damage on a global scale and we will certainly produce urban conditions that are intolerable from the standpoint of health effects and damage to vegetation and materials.

From information available to NAPCA it appears that national expenditures, including those by government and industry, for research and development aimed specifically at evolving improved control methods will total well under $50 million this year. By the year 2000 we can expect that the power industry will be spending many hundreds of millions of dollars per year to keep air pollution within acceptable limits. Even though this expenditure will amount to modest percentage increases in the cost of producing power, the expenditure will be so great that we can't afford to attempt to do the job with marginally acceptable methods that will unnecessarily add to the cost. Further, we know that failure to control air pollution from combustion will result in large economic losses. Losses resulting from damage to vegetation and materials will unnecessarily add billions more per year to the pollution penalty we are paying for continued economic growth. Even without consideration of health effects, the savings to be realized by minimizing the cost of control and by minimizing property damage make the increased development effort required to do the job an economic necessity.

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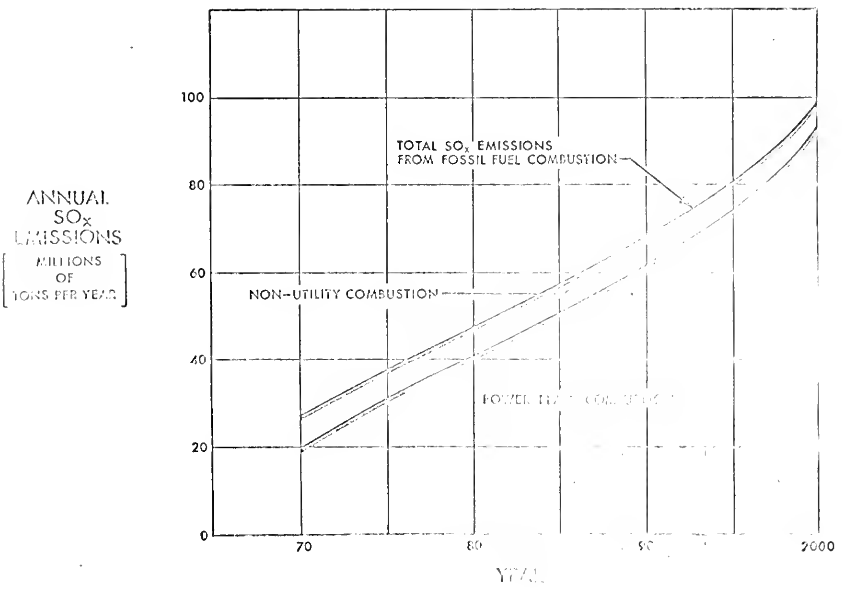
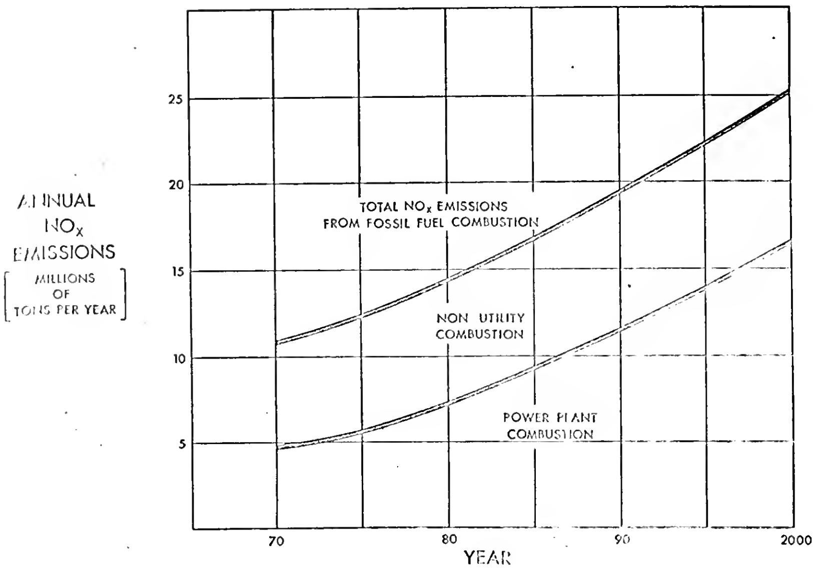
3. McCormack, R. A., and J. H. Ludwig. Climate modification by atmospheric aerosols. Science 156:1358–1359, June 9, 1967.

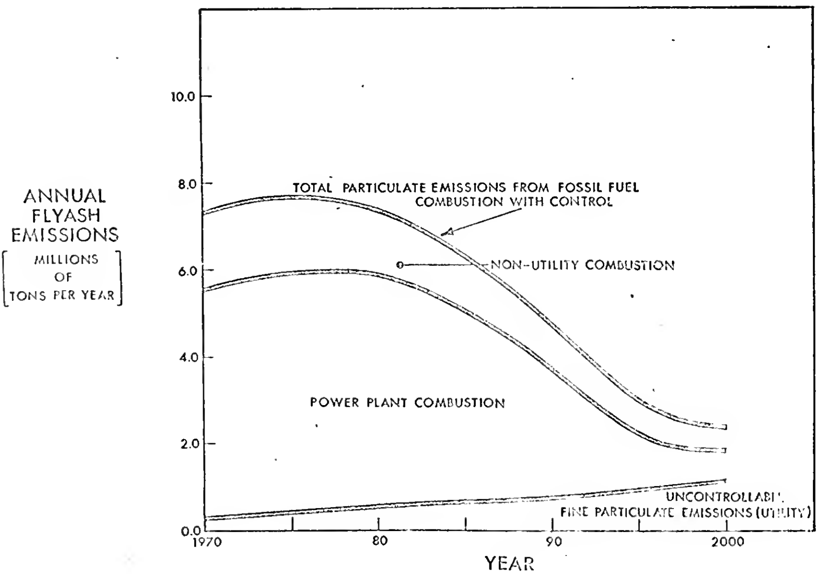
POTENTIAL UNCONTROLLED SO_x EMISSIONS FROM COMBUSTION OF FOSSIL FUELS

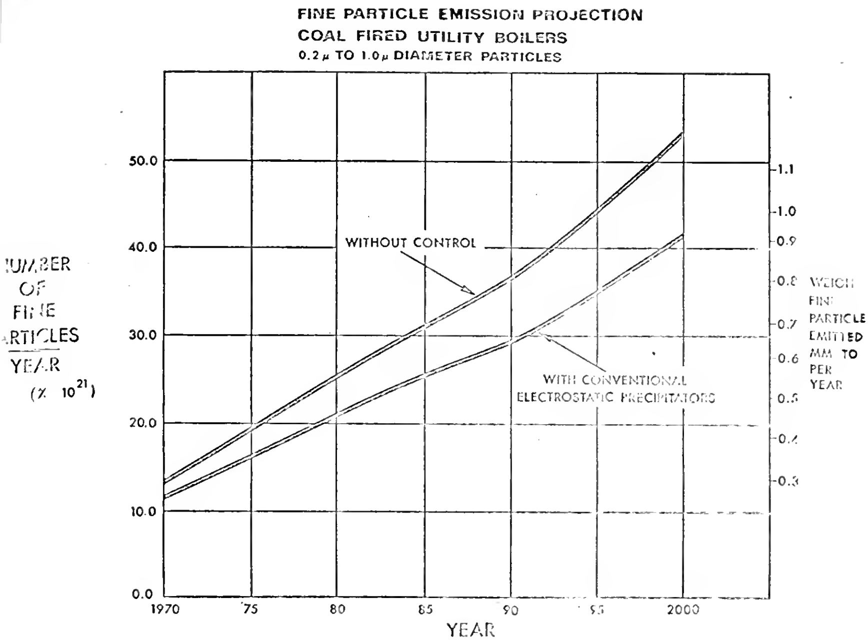


POTENTIAL UNCONTROLLED NO_x EMISSIONS
FROM COMBUSTION OF FOSSIL FUELS



PARTICULATE EMISSIONS FROM COMBUSTION
OF FOSSIL FUELS





Senator RANDOLPH. Dr. Middleton, I presume that you may have data that would help us to understand the capability of our current research and development effort to meet these projected increased emissions of sulfer oxides that we have been discussing. Is that correct?

Dr. MIDDLETON. That is correct. You are perhaps aware of the earlier report on the Federal plan for control of sulfer oxide, and we are in the process now of updating that and making a more recent assessment, particularly taking advantage of the work of Professor Sherwood and his colleagues in the National Academy of Engineering.

Senator RANDOLPH. Dr. Middleton, of course you are familiar with these matters, and I bring them into discussion for the record. There was the study in 1967 by the Stanford Research Institute on sulfer oxide pollution control, and the Federal research and development and planning and programing, 1968 and 1972.

I have read it in part, only in part. It is a study to provide a systematic plan of required research and development to cope with sulfer oxide emissions. Is that correct?

Dr. MIDDLETON. Yes; it is.

Senator RANDOLPH. And we want to rely, at least in part, on the information in there. That plan, as I understand it, has called for an expenditure approximating $255 million over a 5-year period, so let us say 1965 to 1972.

Now, the actual expenditures, as you know, Dr. Middleton, have been much less than authorized for section 104. As you have said, section 104 deals with more than just sulphur oxide. Isn't that correct?

Dr. MIDDLETON. Yes. It deals with products of fuel combustion, both from stationary and mobile sources.

Senator RANDOLPH. That is correct. And for what it is worth, I refer to fiscal year 1968, when the figure was $9 million. Is that a correct figure?

Dr. MIDDLETON. Yes.

Senator RANDOLPH. And for fiscal 1969, a $13 million figure. Would that be correct?

Dr. MIDDLETON. Yes.

Senator RANDOLPH. And for fiscal 1970, $20 million. Would that be correct?

Dr. MIDDLETON. With the funds presently available we will have an amount available for obligation that would be about $37.8 million.

Senator RANDOLPH. Well, then that would total possibly something close to $40 million. That would be an approximate figure?

Dr. MIDDLETON. Yes.

Senator RANDOLPH. Our committee authorized expenditure of $270 million for this same 3-year period. Is that correct?

Dr. MIDDLETON. That is a matter of record, Senator.

Senator RANDOLPH. Yes; that is a matter of record. Dr. Middleton, will you supply the figures indicated, the expenditures under section 104 of the Air Quality Act. Not necessarily at the moment.

Dr. MIDDLETON. I would be pleased to supply this for the record or I can give you something at this time.

Senator RANDOLPH. Briefly you might touch on a few of the figures available to you.

Dr. MIDDLETON. The appropriations for 1969 under section 104 were $18.79 million, and we were able to obligate $13.1 of that. For 1970, you, of course, know we have just recently received an appropriation of $45 million, and we would expect to be able to obligate $37.8 million of that.

Senator RANDOLPH. I think a useful review, Dr. Middleton, of the sulfur oxide control technologies that we have under development is the study by Dr. Sherwood. Is he a doctor? I think he works in chemical engineering.

Dr. MIDDLETON. He is a chemical engineer and he bears the title of professor from the Massachusetts Institute of Technology.

Senator RANDOLPH. Well, I checked briefly his article in the January 1970 issue of Technology Review. I would like to insert that in the record. Do you think it would be helpful, Dr. Middleton, at least parts of it?

Dr. MIDDLETON. Yes, it would.

(The document to be furnished follows:)

[From Technology Review, January 1970]

The sulfur oxides are a major health hazard in air pollution. But our supplies of low-sulfur fuel are few and our technology for sulfur removal is inadequate to give us comfort

Thomas K. Sherwood
Professor of Chemical Engineering, Emeritus
M.I.T.

Must We Breathe Sulfur Oxides?

The control of our deteriorating environment has become a national goal of high priority. Many Americans are increasingly alarmed by our pollution of air and water and concerned about noise and about solid waste disposal. Increasingly stringent control legislation is being proposed by Congress and by the states. College students—especially in engineering—want to use their education to tackle these problems. A recent newspaper poll placed pollution control fourth on a list of national priorities. Government and industry are spending hundreds of millions of dollars annually in efforts to understand and control pollution.

The much-quoted 1967 estimates by the Department of Health, Education and Welfare give the following figures for total discharge, in millions of tons each year, of the atmospheric contaminants of greatest present concern: carbon monoxide, 72; sulfur oxides, 26; nitrogen oxides, 13; hydrocarbons, 19; and particulate matter, 11—a total of 141 million tons per year, or some 140 pounds per year for each acre of the continental U.S.

Impressive as these figures are, they mean little unless each pollutant can be assigned a weighting factor indicating its relative importance as a health hazard and as a source of annoyance. Unfortunately, the medical evidence as to health hazards is incomplete and contradictory, and the extent to which any form of pollution simply annoys people is highly subjective.

Many pollutants are suspected of contributing to the pollution hazard, but health authorities appear to consider sulfur dioxide—and the very unpleasant trioxide by which it is invariably accompanied in small amounts —as the most serious single threat. Though automobiles contribute some 60 per cent of the total mass emissions of air pollutants, the Department of Health, Education and Welfare spends several times as much money on research directed to sulfur oxide control as on work toward abatement of the pollution from auto exhaust.

About 80 per cent of the sulfur oxides discharged into the atmosphere come from the combustion of coal and oil. Gasoline contains almost no sulfur, so emissions from automobiles contribute little. But the combustion of coal, averaging about 2.5 percent sulfur, accounts for more than half the total SO_2. Heavy fuel oil, burned in apartment houses and power plants, contributes quite substantially.

H.E.W. predictions shown in the table (page 30) indicate that total SO_2 pollution may triple in the next thirty years if not controlled more effectively than at present. Nuclear power plants emit no SO_2, but the use of coal for power is increasing steadily and will more than triple by 2000 before leveling off after the turn of the century as large nuclear power stations replace those burning fossil fuels.

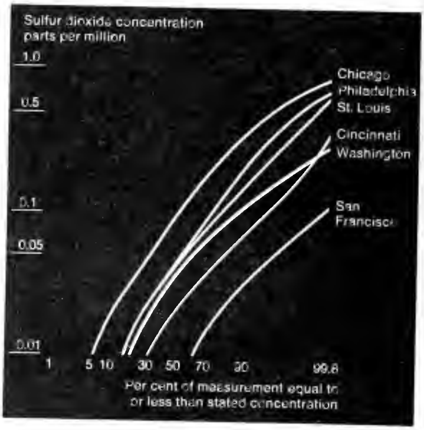
The Health Hazards of Sulfur Oxides

Much of the alarm about the health hazards of sulfur oxides stem from publicity regarding several "episodes" in which people died during periods of heavy air pollution. These occurred in the Meuse Valley in 1930, in Donora, Pa., in 1948, in London in 1952 and 1962, and in New York in 1953 and again in 1966. Some 4,000 more people died in the few days of the London episode in 1952 than would normally have succumbed in a similar period of time. These "excess deaths" are usually blamed on SO_2, though the smog at the time contained many other pollutants.

Congress has asked the Department of Health, Education and Welfare to publish summaries of data on the effects of various individual pollutants on health. These are intended to provide "criteria" which the states and "quality control regions" will use in establishing "standards" of acceptable atmospheric pollution levels. Only criteria for SO_2 and for particulates have been issued to date. Most of the data quoted were obtained in laboratory experiments with animals; there have been few clinical studies on man with SO_2 concentrations typical of polluted city air. The first publication on SO_2 in 1967 was widely criticized on the grounds that the research studies cited as justification for the criteria were "frequently vague, incomplete, or quoted out of context." The second publication on SO_2 standards, in 1969, repeated the earlier conclusion that ambient SO_2 concentrations of more than 0.1 p.p.m. for 24 hours in any consecutive 100-day period may produce adverse health effects in particular segments of the population.

Without control measures, most coals now burned in power plants would cause this concentration to be exceeded in large cities. (The maximum average 8-hour concentration reported for U.S. cities is 1.5 ppm, in New York).

The evidence regarding SO_2 (or almost any other pollu-



Concentrations of sulfur oxides in the atmosphere in the U.S. range up to 3.2 p.p.m., the higher figures appearing in commercial and industrial sections of solid-fuel-using cities. The chart shows a frequency distribution of sulfur oxide data for six American cities. (Chart: Arthur C. Stern, Air Pollution)

tant) is highly confusing, but one conclusion appears valid. It is that people with bronchitis, emphysema, or lung cancer are highly susceptible to prolonged exposure to SO_2—or to generally polluted city air which always contains SO_2.

As Dr. William H. Stewart, Surgeon-General, told Senator Edmund S. Muskie's committee in 1967, "It is rarely possible . . . to point to an individual case and say with certainty, 'This man died because of air pollution.' " And Dr. P. J. Lawther, a leading British authority, has stated that "experimental exposures to SO_2 or sulfuric acid in the kind of concentrations which may be found in towns have never resulted in significant or consistently reproducible increases in airway resistance in human subjects." Yet Dr. Stewart has shown convincing evidence that SO_2 seriously affects people with respiratory diseases, though the possibility that it may cause such diseases is not proved. Dr. Lawther, referring to the increased death rates during periods of heavy air pollution, confirms this evidence: "The excess deaths are among the old and the frail, the newborn, and those suffering from diseases of the respiratory and cardiovascular system." That the old and weak are more susceptible is supported by the fact that the SO_2 standard set by the American Conference of Governmental and Industrial Hygienists is 5 p.p.m. for an eight-hour exposure by healthy industrial workers.

Much has been made of the probable health hazards in presenting the case for SO_2 control. But there are additional reasons to limit pollution, perhaps even more persuasive. One is the damage it does to property and plants. Another is the fact that people *just don't like polluted air.* This last is really a pretty good reason, since pollution annoys almost everyone. In the modern U.S. economy we can afford to get rid of serious nuisances, and we are (erroneously) believed to have the technology to control SO_2.

Demoting pollution to a serious nuisance, however, would demote its control to a lower position on the list of national priorities than if it could be shown that New York was about to become a large-scale Donora.

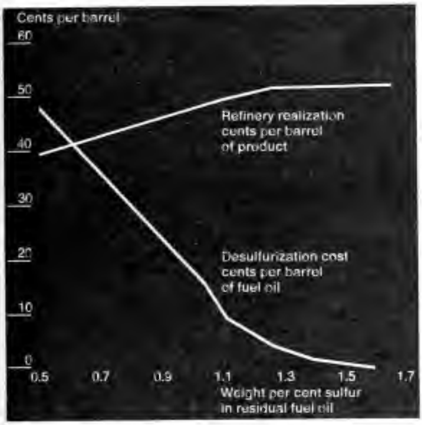
Though a great deal of clinical research is needed to clarify the impact of pollution on health, H.E.W. is convinced, as Dr. Stewart has stated, that "it would be foolish to say that we do not need more research. . . . It would be equally foolish and much more dangerous to suggest that we must wait for more knowledge before we begin to control pollution. We can, and we must, proceed now," he insists. In any case, both Congress and the public and the public are aroused, and the country is committed to action.

Limiting the Sulfur Content of Fuel

The obvious way to reduce air pollution by sulfur oxides is to limit the sulfur content of the fuels burned. About 60 per cent of the total SO_2 discharged into the atmosphere comes from the burning of coal; of this 80 per cent is emitted from power plants. The relation between the SO_2 concentration in the atmosphere to that in the coal varies with meteorological conditions and topography, but it is estimated that the standards suggested by H.E.W.'s criteria would be met if the coal burned were limited to 1.0 per cent sulfur, or substantially less in some large cities.

The New York-New Jersey Metropolitan Area has set standards requiring a maximum of 1.0 per cent sulfur for fuels burned in existing power plants, and other regions are following suit. Bituminous coal containing more than 1.0 per cent sulfur cannot now be sold in New Jersey, and the limit will drop to 0.3 per cent in 1971. But the

To reduce the sulfur content of residual fuel oil—the product commonly used for power generation—is within the power of present-day technology. But the cost is so high that it represents an increase in basic fuel cost of 20 to 35 per cent. At 50 cents per barrel of oil, desulfurization is adding 0.7 mills per kwh. to the cost of power. (Data: Chemical Engineering Progress)



supply of low-sulfur coal and oil is limited, and it appears impossible to provide the needed fuels if this standard were to be enforced across the country.

Half the U.S. coal reserves are east of the Mississippi and half west. But 90 per cent of the low-sulfur coal reserve, much of it low-grade, is in the west, remote from the large eastern markets. The low-sulfur coal produced in the east amounted to but 34 per cent of the coal mined in 1964. Approximately one-quarter of our low-sulfur coal is in fact exported, and much of the rest of it is sold at a premium for metallurgical use. Consolidated Edison (New York) is reported to have entered into a long-term contract to purchase low-sulfur coal at $1.50 per ton more than its usual price in the past.

The dilemma is apparent. If all fuels were to be limited to 1.0 per cent sulfur in order to control air pollution, there would simply not be enough coal to meet the growing demand for power, and much of the coal industry would be put out of business. We must control sulfur emissions, and we must have the power. The situation is like that of an irresistible force and an immovable object.

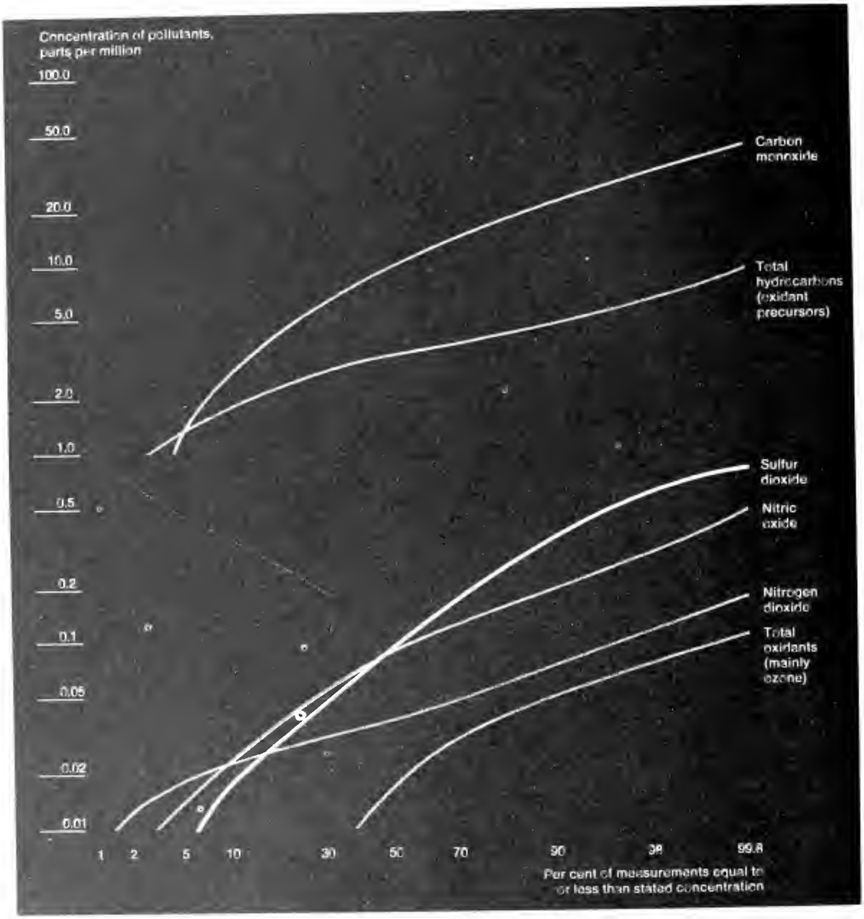
There would appear to be four solutions to this dilemma: undertake a massive program to quickly build nuclear power plants; remove sulfur from fuels before they are burned; remove the SO_2 from the combustion gases before emission to the atmosphere; and employ very high stacks or other means to deliver the gases at such a high elevation that they are dispersed and diluted to an acceptable level before they reach the ground. New power plants can be located in sparsely-populated regions.

The first approach is impractical because of the prohibitive expense. Tall stacks are being promoted in England but appear to have limited applicability. The second and third approaches offer the best promise in the U.S. The processes to accomplish sulfur removal from fuels and combustion gases are not fully developed, however, and not immediately available for wide application.

Sulfur is readily removed from distillate oils and the technology is well established. Residual fuel oils are more difficult to treat because they contain metals which deposit on the solid catalysts employed. The petroleum industry has spent a very large amount of money on the development of ways to desulfurize "resid," however, and there is no doubt that these schemes will work. Esso, for example is now installing desulfurization units in Venezuela to produce 100,000 barrels per day of low-sulfur residual fuel oil primarily for U.S. east-coast power plant use. The investments required in such plants are enormous, and the added refining step to reduce the sulfur content from 2.6 to 0.5 per cent will apparently increase the price of residual fuel to the power station by 50 to 80 cents per barrel (assuming a five-year pay-out)—an increase in fuel cost of 20 to 35 per cent. Fifty cents per barrel of oil is equivalent to an increase of about 0.7 mills per kwh. in power costs.

Coal is quite another matter. The sulfur is present both as pyrite and as complex organic substances. The first can be largely removed by grinding and washing, using existing technology. No one seems to have a good idea as to how the organic sulfur might be removed, except by expensive hydrogenation and liquefaction processes. The two forms of sulfur exist in coals in widely varying ratios, and segregation of those readily washed to remove pyrites is difficult. The National Air Pollution Control Administration is actively studying the problem, and it appears that the supply of low-sulfur coal may be

The sulfur oxides are not—by far—the grossest polluters of our urban air. But many health authorities consider them the most serious single threat. The curves show the amounts (in parts per million) of various pollutants in the atmosphere of Chicago, Ill., during the period 1962 to 1964, as published by the U.S. Public Health Service in 1966 (Data Arthur C. Stern, Air Pollution)



increased appreciably by wet cleaning methods. Preliminary results suggest that perhaps 15 to 20 per cent of the high-sulfur utility coal is washable to 1.0 percent sulfur at an incremental cost of 25 to 75 cents per ton.

Where fuel desulfurization is practical at reasonable cost it offers the most obvious and direct method to reduce SO_2 pollution from combustion. Though they are not yet economically attractive, there are several processes under development for the production of liquid fuels from coal, and these will perhaps be employed commercially within a decade. In the meantime most of the needed coal cannot be adequately desulfurized at acceptable costs.

Controlling Power Plant Emissions

This leaves us with the third of the solutions to the dilemma: burn high-sulfur fuels, but remove the sulfur from the stack gas. Many ways of doing this are being actively developed at the moment. All involve some means of bringing the gas in contact with some substance which picks up SO_2, leaving the gas going to the stack relatively free of this pollutant. There are some 25 such processes under development in this country by industry and by the National Air Pollution Control Administration (N.A.P.C.A.), and many others are being developed in Japan and Europe. Most are small-scale laboratory projects, but several have reached the pilot-plant stage. Only one has been installed in sizable operating power plants.

Several of these processes will doubtless turn out to be technical successes, but the economics are not yet well established for even the most advanced. Contrary to a widely held belief, the technology does not in fact now exist to effectively control SO_2 emissions, and it is coming along too late to prevent a very substantial increase in SO_2 pollution levels during the next ten to fifteen years.

The limestone injection process uses limestone in two ways. Powdered limestone blown into the combustion chamber picks up some of the SO_2. The gas is then cooled and scrubbed with an aqueous suspension of lime or limestone to remove the solid particles of sulfite and sulfate, fly ash, and most of the remaining sulfur oxides. It is then reheated to maintain plume buoyancy leaving the stack. The scrubber is necessary because less than half of the sulfur is picked up by the powdered limestone in the combustion chamber. The total solids to be disposed of amount to nearly three times the normal fly ash from a coal containing 10 per cent ash. These solids are essentially worthless and present something of a disposal problem—for example, 160,000 tons per year for a 200-MW. power plant.

The lime-scrubbing process has been installed to treat all of the stack gas from two 125-MW. boilers—one at the Meramec Station of the Union Electric Company in St. Louis, the other at the Lawrence plant of Kansas Power and Light Company. Both plants have had start-up troubles but are expected to meet the design objectives of 82 per cent sulfur removal and 99 per cent removal of particulates.

Though the wet scrubber appears to be necessary because of the low SO_2 removal in the combustion chamber, the possibility remains that dry limestone injection alone, with no scrubber, can be developed to remove sufficient SO_2 to be useful with many coals. This simpler and cheaper version of the limestone process is being tested in a 150-MW. boiler at the Tennessee Valley Authority under a contract with N.A.P.C.A.

Several processes employ aqueous solutions of substances which react chemically with SO_2 and remove it from the gas. The chemical agents must be regenerated and reused, since they are relatively expensive. These processes usually require a high-efficiency electrostatic fly-ash eliminator, an absorber in which the gas comes into contact with the solution, a mist eliminator, and, in most wet scrubbing processes, some provision for reheat of the gas going to the stack.

The regeneration of the solution liberates the absorbed sulfur, normally as SO_2. This can be sold as such, or it may be converted to sulfuric acid or to sulfur. Sale of these by-products can conceivably offset the cost of the entire operation. One process regenerates the solution with steam, another by electrochemical methods. Most schemes of this type involve the addition of a chemical plant of considerable size to the power-generating facility.

A variation of the aqueous solution schemes is the use of a molten mixture of inorganic carbonates. This mixture has a high capacity to absorb SO_2 chemically, and the circulation rate is small. The sulfites and sulfates are converted to sulfides, which are treated with reducing gas to yield hydrogen sulfide. The product gas is suitable as the feed to a Claus plant for the production of salable sulfur. The stack gases contact the molten salt at 800° F. in a simple spray device, and no reheat is required. Only laboratory bench-scale studies have been made.

Sulfur oxides can be absorbed chemically by various dry solids, including several metal oxides. The finely divided or pelleted material contacts the gas in a packed or fluidized bed or in some form of "raining solids" device. It is then regenerated by use of a reducing gas. The SO_2 ends up as marketable sulfur. Processes of this type have received something of a set-back because of recent difficulties with the Bureau of Mines "alkalized alumina" process. The solid reacting agent was found to be insufficiently stable, physically or chemically, to last through the large number of cycles of absorption and regeneration required to make the process economically attractive.

Solid carbon in the form of inexpensive char has been used in Germany to pick up SO_2 from stack gas. A related process using activated carbon has been operated in a fair-sized pilot plant in this country. The carbon contacting the gases at 300° F. in a fluidized bed acts as a catalyst to produce sulfuric acid, which is held by the carbon. The acid is removed from the carbon by chemical methods and the carbon is recycled. No gas reheat is required, and marketable SO_2, sulfuric acid, or elemental sulfur can be produced.

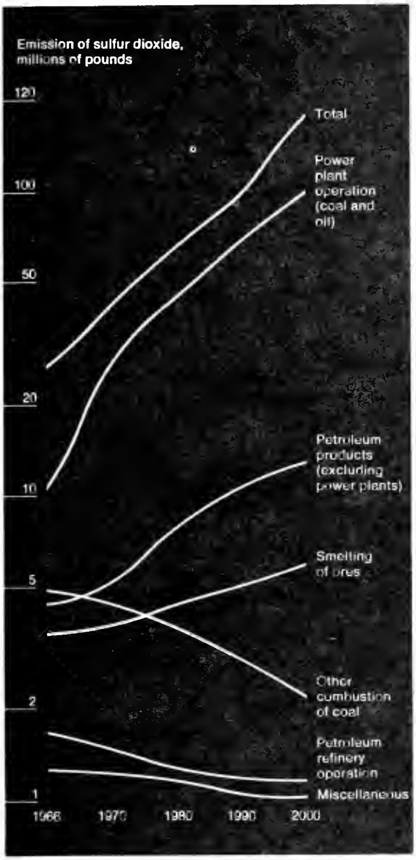
One final example will illustrate the varieties of the processes being developed for SO_2 control from stationary sources. This is the catalytic oxidation process, now well developed, based on the well-known technology of sulfuric acid manufacture. The gases pass from the boiler to an efficient high-temperature electrostatic precipitator and then to a bed of solid catalyst which converts SO_2 to SO_3. The latter is absorbed in weak acid to produce 70-80-weight-per-cent sulfuric acid. This contains a trace of fly ash, but is directly useful in the manufacture of fertilizers, the principal market for this acid in the U.S.

These examples illustrate the diversity of the stack-gas treatment processes being developed. One type produces a "throw-away" product; the others will yield SO_2 (with a very limited market), sulfuric acid (with a market limited by shipping costs), or elemental sulfur, which is easily stored and shipped. The total sulfur effluent of all utilities would now supply more than half the U.S. sulfur market.

As noted above, none of the stack-gas cleaning processes has been operated in a large power plant for more than a few weeks. Costs, therefore, are highly speculative. The less advanced the development, the lower the estimated costs. Cost estimates range from zero to one

	Annual emission of sulfur dioxide (millions of tons)				
	1966	1970	1980	1990	2000
Power plant operation (coal and oil)	13.0	28.0	42.0	60.0	97.0
Other combustion of coal	4.7	4.3	3.5	2.9	2.5
Combustion of petroleum products (excluding power plant oil)	4.4	5.3	7.1	9.6	12.7
Smelting of ores	3.5	3.7	4.1	4.5	5.0
Petroleum refinery operation	1.6	1.4	1.2	0.9	0.8
Miscellaneous sources*	1.3	0.9	0.5	0.3	0.2
Total	28.5	43.6	58.4	78.2	118.2

* Includes coke processing, sulfuric acid plants, coal refuse banks, and refuse incineration.



Atmospheric pollution by sulfur oxides will increase as U.S. power consumption increases during the last 30 years of this century. By the year 2000 power plant operation—the major source—will add nearly 100 million tons of sulfur dioxide to the atmosphere unless restrictions more severe—and costly—than any now in effect are applied. Other sources make relatively modest contributions to the sulfur dioxide burden of the atmosphere. (Data. October, 1969, estimates of the National Air Pollution Control Administration)

mill per kwh. If the proven cost turns out to be 0.5 mills per kwh., the annual charge to U.S. electricity consumers would be about $500 million in 1970 and $2 billion in the year 2000. (The investment in facilities at $10/kw. would be some $8 billion by 2000.) These costs, of course, would be added to the bills sent to users of electric power.

The Future of Sulfur Control

The future of sulfur control is not hard to predict, at least in general terms. The country is committed to do something about air pollution, and increasingly stringent standards regarding sulfur concentrations in the ambient air are beginning to be enforced. Users of high-sulfur fuels will turn first to natural gas, desulfurized fuels oils, and the limited supplies of low-sulfur coals. These will command a premium over present fuels, and the coal industry will find washing of steam coals profitable.

These developments, however, will not provide the total requirements of low-sulfur fuels necessary to control increasing sulfur emissions, so many utilities will install facilities to remove sulfur from stack gases. By 1975 there should be several proven processes to do this. The simpler methods which produce "throw-away" by-products will be adopted by many existing plants. The more complicated processes which produce acid or elemental sulfur will be incorporated primarily in large new steam power plants.

By perhaps 1980 or 1985 sulfur emissions stemming from smelters and the combustion of fossil fuels will be under fairly good control, though total sulfur emissions will have risen substantially over those at the present time. By 1985 or 1990 there may be better ways to burn coal, as by fluidized-bed comustion in the presence of lime, which both improves boiler efficiency and eliminates sulfur from the stack gases. By 2000 the sulfur problem will be greatly lessened by the substantial switch to nuclear power.

All of this will cost a great deal of money—perhaps $500 million to $2 billion per year. But this would seem to be no great price to pay for removing a threat to health and making the U.S. a better place in which to live.

Thomas K. Sherwood, a native of Canada, has been a member of the M.I.T. faculty in the Department of Chemical Engineering since 1929, when he completed his Sc.D. degree at the Institute. He became Emeritus Professor upon reaching retirement last June, and he will soon take up an academic post at the University of California (Berkeley). This article is drawn, in part, from his experience as a member of the Committee on Air Quality Management of the National Research Council.

Senator RANDOLPH. Dr. Middleton, I am going to have provided for insertion in this record certain statements of organizations that are developing sulphur oxide control methods. I would like your subsequent comment on them because I think it would be helpful to our subcommittee. I would be interested, and I am sure the members of the subcommittee would, in receiving your best estimates on the total industry-Government expenditures that will be required to demonstrate and to develop these technologies.

(The following letter was later sent to Dr. Middleton by Senator Randolph:)

APRIL 9, 1970.

Dr. JOHN T. MIDDLETON,
Commissioner, National Air Pollution Control Administration, Department of Health, Education, and Welfare, Rockville, Md.

DEAR DR. MIDDLETON: Thank you for your excellent testimony before the Subcommittee on Air and Water Pollution on March 17, 1970, on pending legislation amending the Clean Air Act. As always, your comments were clear and concise.

During our colloquy on sulfur oxide control technologies, I mentioned an article by Professor Thomas Sherwood in the January 1970 issue of the Massachusetts Institute of Technology publication *Technology Review*. In this article a number of potential methods for controlling sulfur oxide emissions from fossil fuel energy production are mentioned. Although not mentioned by name, the list appears to include the processes under development by Bituminous Coal Research, Inc.; Chemico (Chemical Construction Corporation); Combustion Engineering, Inc.; Monsanto, Enviro-Chem Systems, Inc.; Scientific Research Instruments Corporation; Stone and Webster Ionics; Westvaco; and Wellman-Lord, Inc., to name a few.

I would appreciate your estimate of the expenditures that have been made and would be required to develop and demonstrate these sulfur oxide control methods. This estimate should include both government and industry funds. Your assistance in this regard is appreciated.

With warm regards,

Truly,

JENNINGS RANDOLPH, *Chairman.*

(Additional materials relating to foregoing colloquy appear in appendix to this day's session. See p. 211.)

Senator RANDOLPH. Can we agree, Dr. Middleton, that our discussion has centered, at least to a degree, on control technologies that can be added on the output end of new and existing facilities?

Dr. MIDDLETON. Yes, it is.

Senator RANDOLPH. There is ample evidence that technologies of control are now available at the input end—and I use, for example, coal cleaning; is that correct?

Dr. MIDDLETON. Coal cleaning is available now for taking some of the ash out, and we are at the point of developing a pilot plant to determine the economic feasibility of removing sulphur from coal on a commercial basis. This is around the corner. There is presently available no control technique at this time for that.

Senator RANDOLPH. What about gasification of coal?

Dr. MIDDLETON. Coal gasification is a very attractive way of taking even high sulphur containing coals and turning them into pipeline gas. There is a pilot demonstration of this process going on at the present time, largely under the aegis of the Department of the Interior in conjunction with a number of other organizations.

Senator RANDOLPH. Would you say it might be an effective way of controlling sulphur oxide in particular emissions?

Dr. MIDDLETON. Not only that, but it would be a particularly attractive way of assuring that low-quality coal lignites, particularly in the Middle West, could be readily available as an energy source.

Senator RANDOLPH. Well, now, we want to make sure section 104 is broad enough. I think it is, but can it cover the matter of development efforts in coal gasification? Do you think section 104 is broad enough as it is now within the law or as it is proposed to be continued in new legislation?

Dr. MIDDLETON. It presents no problem for our including it in our system, but in view of the funding difficulties, we have had to assess a different set of priorities, and knowing the Department of the Interior and others had some interest, we were happy that they were able to use some of their funds in the area of coal gasification.

But in direct response to your question, section 104 would, in fact, allow research of this kind to be undertaken.

Senator RANDOLPH. Dr. Middleton, I am sure that you and your colleagues realize that with some 35,000 or 40,000 coal miners working in the State of West Virginia, these questions are not cursory on my part. They certainly go to the point of the discussions of how the mining of coal within that industry and the uses of that coal within its marketing program can possibly be made to better meet pollution control requirements. Is that correct?

Dr. MIDDLETON. That is correct. I would extend that to say that the Department of Health, Education, and Welfare has indicated as a national policy its concern that coal be continually used as a source of the development of energy, and we are indicating ways in which it might be used in the public interest.

Senator RANDOLPH. Thank you. You mentioned coal cleaning and you say that we have come a long way with that process. Is that correct?

Dr. MIDDLETON. We have come a long way in the laboratory research side in understanding what things now need to be tried on the commercial feasibility basis. We are at the threshold of making that a pilot plant trial. So, in that way we have come a long way, but we are far short of having available commercial techniques for that purpose.

Senator RANDOLPH. Well, then, you are not sure it is an alternative, are you?

Dr. MIDDLETON. We look at coal cleaning, burning coal, and stack gas cleaning as three routes that should be made available for those who burn coal as an energy source to use to remove sulphur oxide.

Senator RANDOLPH. I am not sure that we know precisely the degree of availability of low sulphur domestic fuels. But we hear much about the setting of limits on the sulphur content of fuels and on importation of foreign oil.

I think we ought to bring these factors into this discussion today. We do have an importation problem, and we do have a problem, also, in helping to keep our domestic fuels industries viable and healthy.

I spoke of the jobs of not only coal miners but of American workers generally involved in these matters. There is the balance-of-payments problem, too. It could be adversely affected by overincreasing the importation of foreign fuel oil.

What would be your comment, if you feel you could make it?

Dr. MIDDLETON. Well, as earlier stated, the Department is officially on record as assuring that the energy resources of this country should be properly made available so that they can be used in context with the clean air policy.

In this sense, the importation of foreign oil of low sulphur is one possibility. We know they now come from Indonesia, from Libya and from Nigeria.

We know that there are domestic oil companies building desulphurization plants to take the sulphur out of both domestic and foreign crudes, but the thing that is important to point out is that the importation problems related to the distribution of oil and coal are different. And there are many places in the United States that may have difficulty in finding low sulphur containing oil.

For these and other reasons you have indicated, we emphasize the need to develop ways in which we may burn high sulphur containing coals in this country and not reject them from the market.

Senator RANDOLPH. There is a problem of balance constantly in our economy and I recognize this. There is the need, insofar as possible, as we work with other nations and use their products, to insure the strength of our own output. I am thinking of it in connection with the production and use of coal today.

Dr. MIDDLETON. Certainly in projections of the energy requirements of this country, Senator, we are going to need all of the coal and oil resources here, plus those that are presently being imported.

I would like to add, for your information, perhaps, Senator, that in developing oil quota information, the Department of the Interior has obliged as a consultant with the Department of HEW, so there is a proper liaison in these matters.

Senator RANDOLPH. Do you approve of the techniques of mangnetohydrodynamics in power production?

I am not sure whether section 104 funds could finance research in such a program. I think it would be feasible, perhaps, to research and develop and further advance this technique, if it is a technique. I am not sure, could Interior's Office of Coal Research, and possibly private and other research fund investments be used? What do you think?

Dr. MIDDLETON. There is a report, I am sure you and your staff are aware of, from the Office of Science and Technology using the expertise of the National Academy of Engineering suggesting that there be a proper pilot run of this system, MHD—which for me is much easier to say—to determine whether it has some real value in electric generation.

Since this is the use of a raw energy resource in a more efficient way, we look at this as an object of research that is primarily within the purview of the Department of the Interior and those associated with energy development rather than a project that the Department of Health, Education, and Welfare would directly join in.

Senator RANDOLPH. Thank you for that explanation. Now, this final question: Power generation, Dr. Middleton, is cerainly a prime source of air pollution; isn't it?

Dr. MIDDLETON. It is clearly a significant and large source of pollution that needs to be controlled in all places.

Senator RANDOLPH. And there are other techniques. We need to use section 104 to the fullest to research and develop air pollution control techniques to the fullest extent. Now, I want to say, Mr. Under Secretary, that it has been my privilege, personally and officially, to confer with Dr. Middleton many, many times, and this morning, as always, he brings to the consideration of this subcommittee the expertise and, also, an understanding and an awareness of the problems that confront us, and a need, where possible, not just to compromise but to be realistic in what we do.

I thank you, Dr. Middleton.

Mr. VENEMAN. Thank you.

Senator RANDOLPH. Now, I believe that while we have been talking, Senator Spong has had a conference with Senator Muskie, and he would like to make an announcement.

Senator SPONG. Yes. I would like to make a suggestion. I only have one other question of this panel.

I would suggest that we receive into the record the statements of Mr. Johnson and Dr. Cohen in their entirety, and that those Senators who have been here this morning, and any others on the committee may submit additional questions.

(Senator Muskie subsequently sent the following letter and questions to Secretary Finch. The answers will be found in the appendix to this volume, beginning p. 345.)

U.S. SENATE,
COMMITTEE ON PUBLIC WORKS,
Washington, D.C., April 8, 1970.

Hon. ROBERT H. FINCH,
Secretary,
U.S. Department of Health, Education, and Welfare,
Washington, D.C.

DEAR MR. SECRETARY: Pursuant to my conversation with Under Secretary John G. Veneman at the conclusion of the Department's testimony before the Subcommittee on Air and Water Pollution on March 17, I am forwarding a number of outstanding questions regarding the pending legislation and the activities of the National Air Pollution Control Administration.

An early response to these questions will assist the Subcommittee in concluding action on the legislation.

I appreciate your cooperation and look forward to receiving your response.

Sincerely,

EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution.

AIR QUALITY CRITERIA

(1) Since enactment of the Air Quality Act of 1967, air quality criteria have been issued for particulate matter, sulfur oxides, hydrocarbons, photochemical oxidants, and carbon monoxide.

What factors have contributed to the delay in issuing other air quality criteria, and what are the priorities and time schedules for the issuance of additional criteria?

(2) Please describe the organization and membership of the *ad hoc* committees which have participated in the development of air quality criteria?

(3) Please indicate the annual expenditures on air quality criteria related research since enactment of the Clean Air Act of 1963 in the following areas:

Nitrogen dioxide
Nitrogen dioxide and ozone
Oxidents
Particulate matter
Carbon monoxide
Behavioral toxicology
Epidemiologic studies
Vegetation effects
Effects on materials
Socioeconomic effects
Other

(4) Please justify the reported $3 million reduction for fiscal 1971 in research on health and economic effects of air pollution.

(5) What specific steps have been taken by NAPCA to coordinate health effects research with the National Institute of Environmental Health?

(6) What research has been initiated to obtain information on the long-term effects of contaminants and combinations of contaminants?

(7) What research is NAPCA conducting or supporting on carcinogenic and mutagenic effects of contaminants and combinations of contaminants?

CONTROL TECHNOLOGY DEVELOPMENT

(1) What specific contracts and grants were awarded under Section 104 for the following categories?

Control of Sulfur Oxide Pollution: Removal of sulfur from coal; removal of sulfur from fuel oil: removal of sulfur from flue gas; new process development.

Control of nitrogen oxides pollution.

Control of particulate pollution.

Control of pollution from specific industries.

Control of pollution from solid waste disposal.

Control device improvement studies.

Control of automotive emissions.

Alternatives to the internal combustion engine.

(2) How many contracts and grants have been awarded since July 1, 1969 under section 104? For what purpose? In what amounts?

(3) A five-year (fiscal 1968–1972) research and development program was developed by the Stanford Research Institute for NAPCA. What were a) the recommended total and annual expenditures for this program; b) the actual and estimated expenditures; and c) the expenditures recommended by the National Academy of Sciences?

AUTOMOTIVE EMISSION CONTROL

(1) What has been the level of funding for motor-vehicle pollution control research and development and what are the estimated expenditures for fiscal years 1971 to 1973?

(2) What specific program efforts are being made to develop alternatives to the internal combustion engine?

(3) What data is available on compliance with auto emission standards after sale by certified vehicles? Please provide this data for the record.

(4) What is the estimated effect of this failure to continue to comply with automative emission standards on projected air pollution levels of carbon monoxide, hydrocarbons, and photochemical oxidants?

(5) To what extent have States applied for the two-thirds grants for developing emission device inspection programs authorized in Sec. 209? Please indicate the States to which grants have been made and the amount of each, if any.

(6) S. 3466 would increase penalties under Sec. 205 from $1,000 to $10,000. To what extent have penalties been assessed under the existing provision? How many times? Against whom?

STANDARDS AND ENFORCEMENT

(1) What is the current status of the designation of the first 57 air quality control regions, the filing of letters of intent, and the establishment of standards and implementation plans?

(2) Why does S. 3466 provide for deletion of section 106 which provides 100 percent planning grants for interstate agencies?

(3) What factors have caused delay in the designation of air quality control regions? How many staff members are assigned to this function? To criteria development? To control technology information development?

(4) What additional regions will be designated this year?

(5) S. 3466 proposes only to enforce failure to meet air quality standards established pursuant to section 107 rather than plans for implementation of emission standards. Would this weaken the existing law?

(6) S. 3466 proposes to give the Secretary authority to establish standards with respect to emissions from classes or sources of pollution which contribute "substantially to the endangerment of public health and welfare and which can be prevented or substantially reduced." This is, in effect, national emission stand-

ards for stationary sources. This provision appears to be in conflict with other provisions of the bill which require the States, after the publication of national ambient air quality standards, to promulgate plans for implementation which will assure compliance with those air quality standards by industry or other air pollution sources. With which emission standards would a polluter comply? Would a state be authorized to enforce its emission plan if a conflict with national standards occurred?

(7) How many substances or source categories would be subject to national emission standards for both new and existing sources? What estimates of cost of compliance are available?

(8) Could you provide for the record a summary and status of Federal enforcement activities to date?

(9) Would you supply the Committee with a summary of State and local ambient air quality standards, emission standards, and compliance schedules developed under State and local law?

FUEL ADDITIVES

(1) Section 210 of the Air Quality Act of 1967 provided for the registration of fuel additives. Would you provide the Committee with a copy of the regulations proposed by the Department? Have these regulations been promulgated? If not, why not?

(2) Lacking the technical information that registration was intended to provide, what is the basis for the Administration's request for the authority to set standards for fuel composition and additives?

(3) To what extent has the Department compiled and analyzed information on the effects of fuel additives on health and welfare?

(4) Please cite for the record any additives for which standards may be promulgated.

(5) If lead is banned from gasoline, what assurances are available that other toxic additives will not be used?

PRESIDENT'S AIR QUALITY ADVISORY BOARD

(1) When has the President's Air Quality Advisory Board met?

(2) What policies has the Board reviewed or recommended, if any?

NOISE POLLUTION

(1) Is noise pollution a health problem?

(2) If a separate noise abatement agency is established, should that agency be located in the Department of Health, Education and Welfare?

PERSONNEL AND STAFFING

(1) What were NAPCA's originally projected staffing requirements to implement the Air Quality Act of 1967?

(2) What are the currently projected staffing requirements for NAPCA?

(3) How does actual staffing since enactment of the Air Quality Act of 1967 compare with these projections?

(4) In tabular form please indicate the number of persons presently employed; the number of persons needed to fully implement existing law; and the number of persons required to implement proposed legislation.

GOVERNMENTAL EXPENDITURES

(1) What were NAPCA's originally projected funding requirements under sections 104 and 309 to implement the Air Quality Act of 1967?

(2) What are the projected funding levels for NAPCA through 1975?

(3) How do the following figures for sections 104 and 309 compare: (a) authorization, (b) Departmental requested funds, (c) appropriations, (d) budget authority, and (e) actual expenditures?

(4) The Administration bill, S. 3466, provides that the authorization shall be "such sums that may be necessary" for fiscal years 1971–1973 for both Sections 104 and 309.

At what level do you expect to request appropriations for Sections 104 and 309? Please indicate the proposed allocation of the appropriation requests: low emission vehicle research, criteria development, control technology information development, regional designation, enforcement, etc.?

(5) What has been the total annual Federal-State-local funding for air pollution control since the Air Quality Act including the estimated fiscal 1970 and 1971 expenditures?

(6) Could you update individual State and local agency figures supplied the Committee in 1967?

I myself have a series of questions on fuel additives I would like to submit to you, and then we will recall the witnesses at the end of these hearings. I think all of us would be in a better position to continue in that manner at that time. Does that meet with Senator Cooper's approval?

Senator COOPER. Yes.

(The statements referred to follow:)

PREPARED STATEMENT OF CHARLES C. JOHNSON, JR., ADMINISTRATOR, ENVIRONMENTAL HEALTH SERVICE, PUBLIC HEALTH SERVICE, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Mr. Chairman and members of the Subcommittee, in the period since November 1967, the National Air Pollution Control Administration of the Environmental Health Service has made significant progress in implementing the provisions of the Clean Air Act, as amended. I am pleased to have this opportunity to review that progress with you.

To begin with, the process of planning for regional control of air pollution has been set in motion in areas involving 23 States and the District of Columbia. In the next few months, this process will be extended to the rest of the first 57 areas earmarked for designation as air quality control regions. There will then be at least a portion of an air quality control region in every State.

In designating air quality control regions, we have worked very closely with State officials. Because the factors that must be taken into account in drawing regional boundaries are also relevant to the process of adopting air quality standards and implementation plans, the involvement of State officials has given them an excellent opportunity to prepare to carry out their responsibilities under the Clean Air Act; indeed, it was for the purpose of offering State officials this opportunity that we have taken a rather deliberate and methodical approach to this task. Having accomplished our purpose, we are now in a position to accelerate the designation of regions in the months ahead.

For the regions already designated, State governments have begun adopting air quality standards and are in the process of developing implementation plans for sulfur oxides and particulate matter, for which we issued air quality criteria a year ago. In twelve cases, these air quality standards have already been submitted to us, and in one case, the Philadelphia air quality control region, the standards submitted by the States of Pennsylvania, New Jersey, and Delaware have been approved.

This week, when we issue air quality criteria for carbon monoxide, hydrocarbons, and oxidants, the air quality standard-setting process will get underway for these pollutants, as well. Early next year, we plan to issue air quality criteria for three more important types of air pollutants—nitrogen oxides, fluorides, lead, and polynuclear organic compounds. Air quality criteria for several other types of pollutants will be issued in succeeding years. In each instance, of course, their issuance, together with reports on control techniques, will trigger the standard-setting process.

The extent of public participation in State hearings on air quality standards has been one of the most gratifying and encouraging aspects of our experience thus far. A great many individual citizens and organizations have taken advantage of the opportunity to participate in such hearings. Never before in the history of the Nation's efforts to cope with the problem of air pollution has there been such widespread and well informed public involvement. And for the most part, State officials have responded quite constructively to the views expressed at these hearings.

Another very encouraging sign is the continuing expansion of air pollution control activities not only at the State level but also at local and regional levels. Over the past few years, there has been a substantial increase in budgeting and staffing for State, regional, and local programs; these trends are illustrated in two charts appended to my statement. The availability of Federal grant support and technical assistance has been a major factor in this growth. In Fiscal 1970, approximately one-fourth of the National Air Pollution Control Administration's budget was devoted to direct support of State, regional, and local air pollution control activities.

Our manpower development activities also are intended largely to support State and local air pollution control programs. Through training grants to educational institutions and fellowships to individual students, we have continued to prepare qualified personnel for careers in the air pollution field. And through our short-course training program, we are helping to upgrade the competence of personnel already employed in this field. Very recently, we took an initial step toward the creation of regional air pollution education centers. I am referring to the establishment of a consortium through which three universities in the Raleigh-Durham-Chapel Hill area in North Carolina are, in effect, pooling their air pollution research and training resources. We look forward to the creation of similar arrangements in several other areas.

Nationally, we have taken significant steps toward improved control of air pollution from motor vehicles. The national standards that were in effect for exhaust emissions of hydrocarbons and carbon monoxide for new passenger cars and light trucks in the 1968 and 1969 model years have been supplanted by more restrictive standards. Hydrocarbon and carbon monoxide standards for heavy-duty gasoline-fueled vehicles and smoke limitations for heavy-duty diesel-powered vehicles also have been placed in effect. Limitations on hydrocarbon evaporation from passenger cars and light trucks have been established for application in the 1971 model year.

On February 10, Secretary Finch announced plans for further improvements. In the 1973 model year, national standards for nitrogen oxides emissions will be placed in effect for passenger cars and light trucks. In the 1975 model year, the standards for carbon monoxide, hydrocarbons, and nitrogen oxides emissions will be substantially tightened, and limitations on particulate emissions will be placed in effect. In setting these new and more restrictive standards, we are taking maximum advantage of the emerging technical capability for moving ahead with the control of the motor vehicle pollution problem.

Naturally, the success of all air pollution control efforts, whether undertaken at the local or national level and whether aimed at stationary or mobile sources, depends on the availability of practical and effective control techniques. For many types of air pollutants and many important sources, such techniques are available. But there still are many gaps to be filled if we are to succeed in attaining and maintaining satisfactory levels of air quality.

In the area of motor vehicle pollution control, essentially pollution-free automobiles must be available in the 1980's. Whether this can be accomplished without abandoning the internal combustion engine is questionable. Accordingly, we are continuing to conduct and support research and development on emission control techniques applicable to the internal combustion engine, including techniques such as engine and fuel modification and the use of emission control devices. But at the same time, increasing emphasis is being placed on the development of alternative, low-emission engine systems. Under the President's proposed budget for Fiscal 1971, our total investment in research and development relating to motor vehicle pollution control will be substantially increased—from about $4 million to $12.9 million, some $9 million will be devoted to stimulating and supporting the development of unconventional, low-emission engines.

Insofar as stationary sources of air pollution are concerned, a major portion of our research and development program is directed toward demonstrating the technical and economic feasibility of sulfur oxides control processes applicable to electric generating plants. This activity includes processes for removing a portion of the sulfur from coal and for removing sulfur oxides from stack gases. Several promising processes are in various stages of development under the National Air Pollution Control Administration's auspices and in the private sector. Large-scale demonstration testing of the dry limestone injection and wet scrubbing process. In addition, negotiations are underway with various organizations in the private sector for joint funding of demonstrations of other promising techniques, including coal-cleaning. The objective of this activity is, of course, to insure that the Nation will not have to rely solely on the use of fuels which are naturally low in sulfur as a means of dealing with the sulfur oxides problem but, instead, will have a range of alternatives applicable to the various sizes, configurations, and locations of combustion sources of sulfur oxides pollution.

There are, of course, many other stationary source problems for which new or improved control techniques are needed. Our program includes research and development on many of these problems. A comprehensive appraisal of currently available techniques for dealing with nitrogen oxides emissions is nearing completion; this undertaking will provide a basis for planning of research and development in this area. A series of studies of the air pollution problems associated with specific industries has been undertaken. Studies of the pulp and paper, iron foundry, sulfuric acid, and secondary metals industries are underway. The primary aluminum, phosphate fertilizer, cement, and petroleum refining industries are others in which studies will be initiated. In all of these studies, the primary objective is to define needs for new or improved control techniques, so that government and industry can move ahead with needed research and development activities.

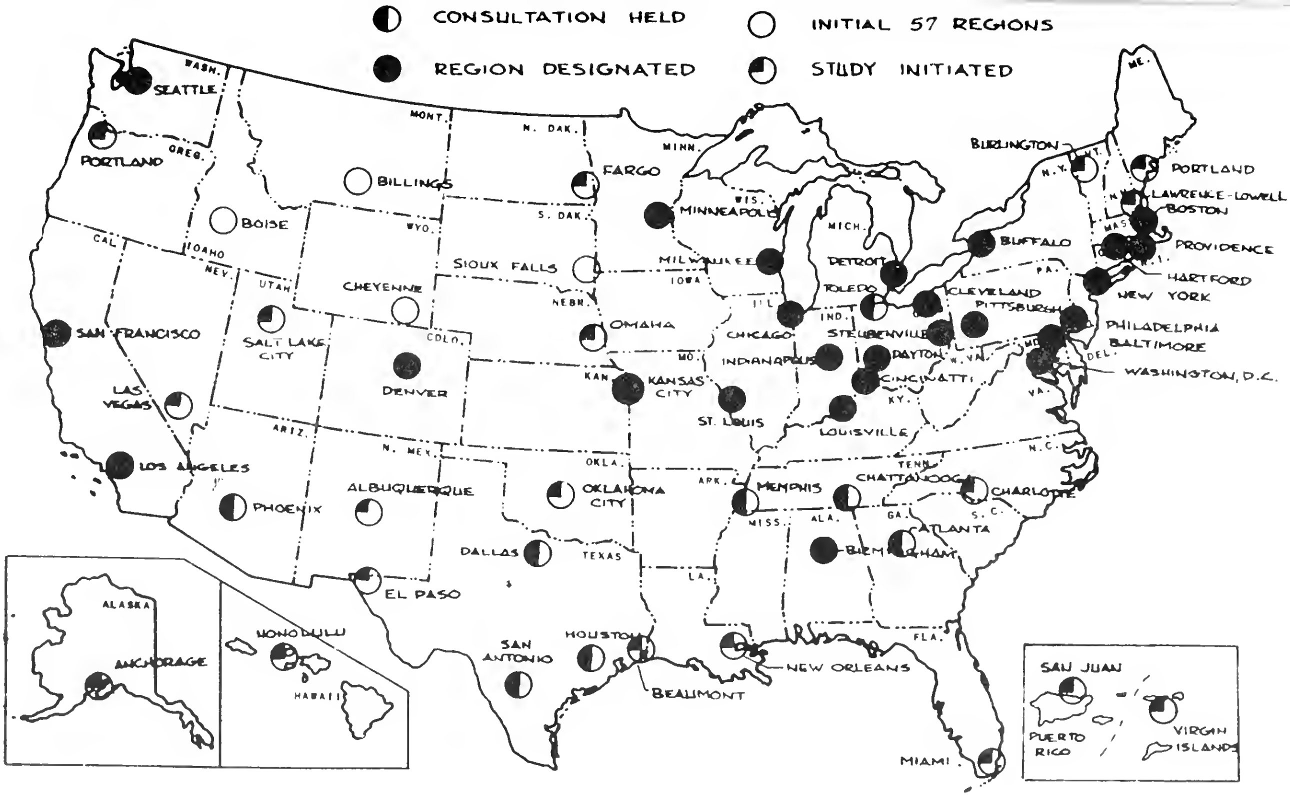
The activities I have described thus far constitute one major segment of our program, in that all of them are directed toward the objective of insuring the development and application of techniques for preventing and controlling air pollution. The other major program segment encompasses our continuing efforts to acquire an improved understanding of the nature and extent of the Nation's air pollution problem and of its impact on man and his environment.

Our program of research on the effects of air pollution is oriented toward acquiring the information needed for the development of air quality criteria. With this objective in mind, our health research activities have been broadened to provide knowledge not only about the relationship of air pollution exposure to the occurrence of chronic respiratory disease but also about human body burdens of substances present in the air, physiological and mechanical changes, and alterations in behavior and psychomotor functions.

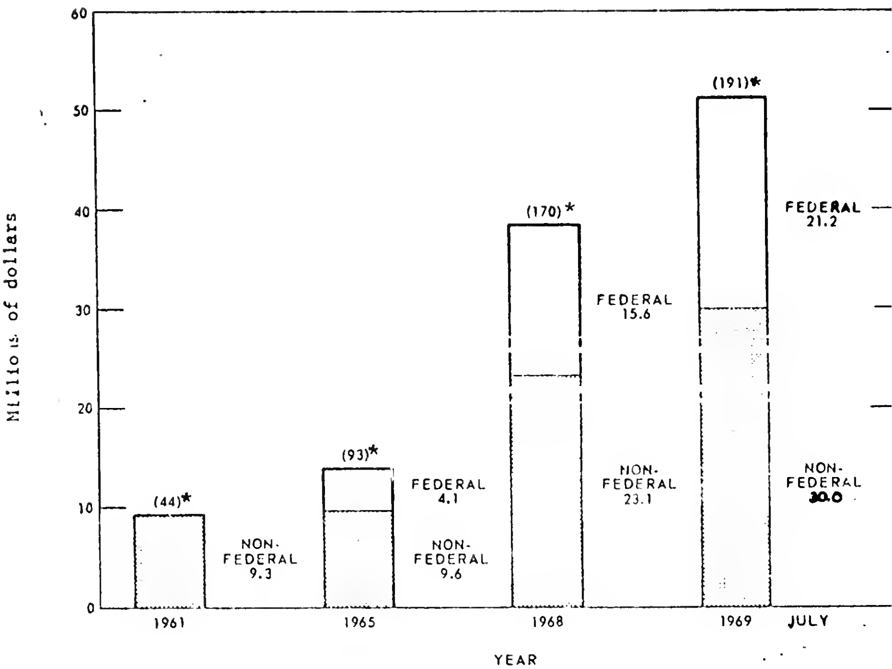
A major new effort has been initiated to observe and measure people's health in relation to air pollution exposure. I am referring to the health effects surveillance network which we are establishing in communities that have high, low, and intermediate levels of air pollution. In several such communities across the Nation, we will make regular measurements of the levels of various air pollutants and maintain records of fluctuations in selected health factors, such as the occurrence of respiratory illnesses among children and asthmatic attacks among adults.

Air quality surveillance activities are a vital part of our efforts to define the nature and extent of the Nation's air pollution problem and to assess the progress of control programs. In this area, our objective is to have an integrated Federal-State-local air monitoring system covering the entire Nation. In addition to expanding and modernizing our own air monitoring network, we are assisting State and local agencies in expanding and improving their networks and in making more efficient use of the data they gather. Furthermore, we have set up a national air data bank to facilitate the storage, retrieval, and use of air pollution data; our ultimate objective is to have all past and current air quality data stored in the bank and thus provide a base for nationwide measuring and reporting of air quality changes.

That completes my summary of our progress during the past two and one-half years. I have tried just to highlight some of the most important areas of activity. Our annual reports to the Congress under section 306 of the Clean Air Act have provided a much more detailed picture. Looking back over this period, I feel that our accomplishments have been significant; certainly, the Nation's capability of dealing with the problem of air pollution is now much closer to matching our awareness of the need for action. There can be no doubt, however, that our capability still is not adequate or that our programs of action still need to be improved and accelerated. Air pollution threatens our health and welfare and the overall quality of our environment in many direct and indirect ways. The sooner we overcome that threat, the better off we all will be.



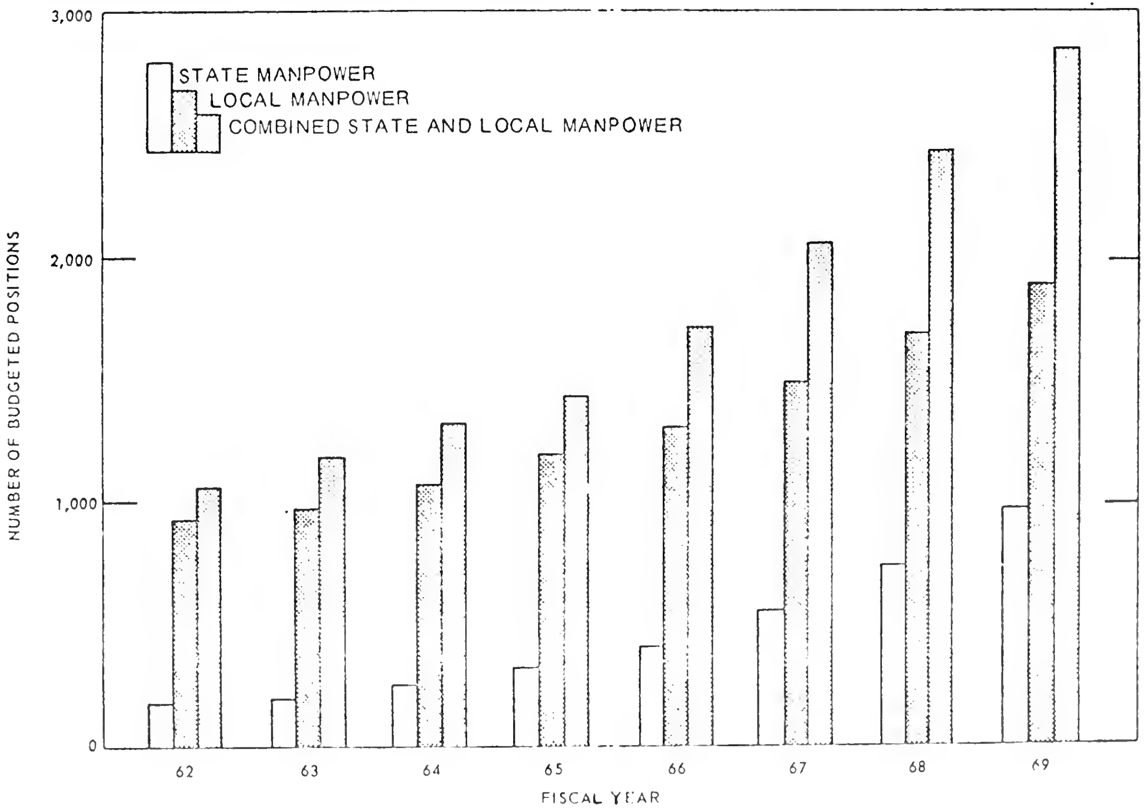
STATUS OF AQCR DESIGNATION - MARCH 10, 1970



State, local, and regional agencies air pollution control budgets.

* Number of agencies

Growth in Budgeted Positions for State and Local Agencies.



AIR QUALITY CONTROL REGION INFORMATION RELATING TO STANDARDS AND IMPLEMENTATION PLANS FOR SULFUR OXIDES AND PARTICULATE MATTER THROUGH MAR. 10, 1970

Region	Designation	State	Public hearings scheduled/held	Standards		Plans due
				Due	Submitted	
Washington, D.C.	Oct. 1, 1968	Virginia	July 14, 1969	Nov. 10, 1969	Oct. 13, 1969	May 7, 1970
		Maryland	Oct. 1, 1969	do	Feb. 3, 1970	Do.
		District of Columbia.	Oct. 24, 1969	do	Nov. 7, 1969	Do.
New York City	Nov. 20, 1968	New York	May 13, 14, 15, 1969.	do	Nov. 19, 1969	Do.
		New Jersey	Sept. 22, 1969	do	Oct. 30, 1969	Do.
		Connecticut	Aug. 12, 19, 1969	do	Nov. 7, 1969	Do.
Chicago	Dec. 4, 1968	Illinois	Aug. 5, 1969	do	Nov. 3, 1969	Do.
		Indiana	July 21; Sept. 26, 1969.	do	Nov. 10, 1969	Do.
Philadelphia	Dec. 17, 1968	Pennsylvania	Sept. 10, 1969	do	Nov. 3, 1969	Do.
		New Jersey	Sept. 22, 1969	do	Oct. 30, 1969	Do.
		Delaware	Sept. 26, 1969	do	Oct. 29, 1969	Do.
Denver	Jan. 15, 1969	Colorado	Oct. 15, 1969	do		Do.
Los Angeles	Jan. 29, 1969	California	Sept. 17; Nov. 19, 1969.	do	Dec. 15, 1969	Do.
St. Louis	Apr. 11, 1969	Missouri	Nov. 12, 1969	Jan. 6, 1970	Jan. 5, 1970	July 6, 1970
		Illinois	Aug. 12, 1969	do	Nov. 3, 1969	Do.
Boston	Apr. 12, 1969	Massachusetts	Nov. 25, 1969	Jan. 7, 1970	Jan. 15, 1970	Do.
Cincinnati	May 2, 1969	Ohio	Dec. 17, 1969	Jan. 27, 1970		July 27, 1970
		Indiana	Oct. 28, 1969	do	Feb. 25, 1970	Do.
		Kentucky	Dec. 2, 1969	do	Jan. 22, 1970	Do.
San Francisco	May 1, 1969	California	Sept. 17; Nov. 19, 1969.	Jan. 26, 1970	Dec. 15, 1969	Do.
Cleveland	May 23, 1969	Ohio	Jan. 20, 1970	Feb. 17, 1970		Aug. 17, 1970
Pittsburgh	May 1, 1969	Pennsylvania	Sept. 9, 1969	Jan. 26, 1970	Nov. 3, 1969	July 27, 1970
Buffalo	do	New York	Aug. 19, 20, 1969	do	Jan. 27, 1970	Do.
Kansas City	July 19, 1969	Missouri	Jan. 21, 1970	Apr. 15, 1970		Oct. 12, 1970
		Kansas		do		Do.
Detroit	Dec. 17, 1969	Michigan		Sept. 14, 1970		Mar. 12, 1971
Baltimore	Aug. 16, 1969	Maryland	Mar. 12, 1970	May 13, 1970		Nov. 9, 1970
Hartford-Springfield.	Oct. 3, 1969	Connecticut	Feb. 9, 16, 1970	June 30, 1970		Dec. 28, 1970
		Massachusetts	Mar. 19, 1970	do		Do.
Indianapolis	Sept. 18, 1969	Indiana	Feb. 6, 1970	Jun. 15, 1970		Dec. 14, 1970
Minneapolis-St. Paul	Aug. 16, 1969	Minneapolis		May 13, 1970		Nov. 9, 1970
Milwaukee	Sep. 18, 1969	Wisconsin		Jun. 15, 1970		Dec. 14, 1970
Providence	Dec. 6, 1969	Rhode Island		Sept. 2, 1970		Mar. 1, 9171
		Massachusetts	Mar. 18, 1970	do		Do.
Seattle-Tacoma	Oct. 25, 1969	Washington	Mar. 13, 1970	Jul. 22, 1970		Jan. 18, 1971
Louisville	Dec. 6, 1969	Kentucky		Sept. 2, 1970		Mar. 1, 1971
		Indiana		do		Do.
Dayton	Dec. 17, 1969	Ohio		Sept. 14, 1970		Mar. 12, 1971
Phoenix		Arizona	Dec. 12, 1969			
Houston	Jan. 20, 1970	Texas		Oct. 19, 1970		Apr. 15, 1971
Dallas-Fort Worth	do	do		do		Do.
San Antonio	do	do		do		Do.
Birmingham		Alabama				
Toledo		Ohio				
		Michigan				
Steubenville	Dec. 6, 1969	Ohio		Sept. 2, 1970		Mar. 1, 1971
		West Virginia		do		Do.
Chattanooga		Tennessee				
		Georgia				
Atlanta		Georgia				
Memphis		Mississippi				
		Tennessee				
		Arkansas				
Portland		Oregon				
		Washington				
Salt Lake City		Utah				
New Orleans		Louisiana				
Miami		Florida				
Oklahoma City		Oklahoma				
Omaha		Nebraska				
		Iowa				
Honolulu		Hawaii				
Beaumont-Port Arthur		Texas				
Charlotte		North Carolina				
Portland		Maine				
Albuquerque		New Mexico				
Lawrence-Lowell-Manchester.		Massachusetts				
		New Hampshire				
El Paso		Texas				
Las Vegas		Nevada				

AIR QUALITY CONTROL REGION INFORMATION RELATING TO STANDARDS AND IMPLEMENTATION PLANS FOR SULFUR OXIDES AND PARTICULATE MATTER THROUGH MAR. 10, 1970

Region	Designation	State	Public hearings scheduled/held	Standards		Plans due
				Due	Submitted	
Fargo-Moorhead		North Dakota				
		Minnesota				
Boise		Idaho				
Billings		Montana				
Sioux Falls		South Dakota				
Cheyenne		Wyoming				
Anchorage		Alaska				
Burlington		Vermont				
San Juan		Puerto Rico				
Virgin Islands						

PREPARED STATEMENT OF DR. ALEXANDER COHEN, CHIEF, NATIONAL NOISE STUDY, BUREAU OF OCCUPATIONAL HEALTH AND SAFETY, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Mr. Chairman and members of the subcommittee: I appreciate the opportunity to offer some technical comments on noise as a problem. Major intent of the noise provisions in Section II of S. 3229 is to investigate present and anticipated noise levels in our environment and their possible effects. My remarks are intended to provide a reference point for such a task. First, they will depict the nature of noise conditions presently being experienced in industry, outdoors in the community, and indoors in the home. Second, they will consider the real of alleged effects of these noise exposures on humans in light of current knowledge.

I direct your attention to the table included in my prepared testimony. Shown here are sound levels for various sources of noise encountered in different environmental situations. Such noise levels are expressed as decibels measured on the A-network of a sound-level meter, abbreviated as dBA. Noise readings in dBA are weighted in a manner designed to approximate the human ear's sensitivity to sounds of different frequency.

'A' WEIGHTED SOUND LEVELS OF SOME NOISES FOUND IN DIFFERENT ENVIRONMENTS

Overall level dBA (SPL re 0.0002 MICROBAR)	Industrial (and military)	Community (or outdoor)	Home (or indoor)
130, 120, 110 Uncomfortably loud	Armored personnel carrier (123 dB). Oxygen torch (121 dB). Scraper-loader (117 dB). Compactor (116 dB). Riveting machine (110 dB). Textile loom (106 dB).	Jet flyover at 1,000 feet (103 dB).	Rock n roll band (108–114 dB).
100, 90 Very loud	Electric furnace area (100 dB). Farm tractor (98 dB). Newspaper press (97 dB). Cockpit-prop aircraft (88 dB). Milling machine (85 dB).	Power mower (96 dB). Compressor at 20 feet (94 dB). Rock drill at 100 feet (92 dB). Motorcycles at 25 feet (90 dB). Propeller aircraft flyover at 1,000 feet (88 dBA).	Inside subway car, 35 m.p.h. (95 dB). Cockpit light aircraft (90 dB). Food blender (88 dB). Garbage disposal (80 dB). Clothes washer (78 dB).
80, 70 Moderately loud	Cotton spinning (83 dB). Lathe (81 dB). Tabulating (80 dB).	Diesel truck, 40 m.p.h. at 50 feet (84 dB). Diesel train, 40 to 50 m.p.h. at 100 feet (83 dB). Passenger car, 65 m.p.h. at 25 feet (77 dB).	Living room music (76 dB). Dishwasher (75 dB). TV-audio (70 dB). Vacuum (70 dB). Conversation (60 dB).
60, 50 Quite			
40, 30 Very quite		Near freeway-auto traffic (64 dB). Air-conditioning unit at 20 feet (60 dB). Large transformer at 200 feet (53 dB). Light traffic at 100 feet (50 dB).	
20, 10 Just audible			
0 Threshold of hearing (1,000–4,000 Hz)			

Note: Unless otherwise specified, listed sound levels are measured at typical operator-listener distances from source.

The table shows that noises in mechanized industry, as a group, have higher, more intense levels than those found outdoors in a community or indoors in a home. Furthermore, industrial operations allow for more sustained types of exposure to these higher noise levels during the typical 8-hour workday. Nonetheless, certain noises intruding in community or home environments can reach levels comparable to those noted for their noisier workplaces. Residents living under the flight-path of a nearby airport, for example, may experience the same noise levels as produced in riveting operations or around textile looms. A home power-mower generates the same noise levels as a farm tractor or newspaper press. The noise of a food blender may slightly exceed that noted in a milling machine workplace.

Fortunately, these more significant sources of community and home noise occur intermittently and perhaps infrequently which reduces the overall severity of exposure. On the other hand, some non-occupational exposures, while intermittent, may occur over longer daily periods than the usual 8-hour workday. Indeed, neighbors to major airports and busy expressways may experience intermittent noises on a round-the-clock basis. Moreover, key sources of community noise, such as those caused by transportation systems, may have wide areas of impact and affect sizeable populations. Present indications are, for example, that the supersonic transport, if permitted to fly at supersonic speeds across the United States, could produce sonic boom corridors 50-miles wide that would impact from 35 to 60 million persons per transcontinental crossing. Even without the SST booms, 130 million persons are living in urban areas throughout the U.S. which are becoming steadily noisier due to increasing crowding and traffic congestion, construction activity, and wide-scale manufacturing. Suburban areas have not been spared either. A survey of these residential areas on 1967 revealed noise levels that were from 4 to 7 decibels gerater than those noted 13 years earlier. Even more striking, the maximum levels intruding into communities in 1967 were as much as 18 decibels greater than those found before. I should point out that an increase of 3 decibels is equivalent to a doubling of acoustic energy. This 18 decibel increase means that the maximum noise energy affecting the area in which our people live has increased as much as 64 times in a 13 year period.

The environmental noise levels and exposures just noted can adversely affect man in various ways. Real or alleged effects include—

(1) Temporary and permanent hearing loss;
(2) Physical and mental disturbances;
(3) Interference with voice communication;
(4) Disruption in job performance; and
(5) Disruption of rest, relaxation, and sleep.

Permit me to elaborate on these noise-induced effects in the context of industrial and community/home exposures.

Noise-induced hearing loss is believed to be the most serious physical health hazard posed by excessive noise, and such problems are prevalent in mechanized industry. Surveys in a cross-section of manufacturing, construction, mining, farming and other occupations have found noise levels potentially harmful to hearing, and hearing studies on select worker groups exposed to such noise have shown them to have poorer hearing than those in quieter jobs (office workers). Estimates of total number of production workers experiencing noise conditions hazardous to their health range from 6,000,000 to 17,000,000, the true figure is unknown.

Recognition of noise and hearing loss problems in industry has prompted the passage of regulations to curb this health hazard. The criteria or noise limits contained in these regulations, however, still lack wide acceptance among noise experts who believe that more information will be needed to justify limits prescribed for certain types of industrial conditions. The Bureau of Occupational Safety and Health, of the Environmental Health Service is conducting field and laboratory research to provide documentation of hearing conservation criteria for a wide array of possible industrial noise exposures. Noise and hearing surveys have already been made in select steel-making, paper and wood products, printing and publications, metal products, construction and transportation occupations. At the end of June 1970, there will be a hearing data compiled on 3,000 workers exposed to noise in these industries and evaluations performed to establish safe levels of noise exposure. Other research supported by the National Institutes of Health in the Department of Health, Education and Welfare, has attempted to identify mechanisms underlying noise-induced injury to the ears and susceptibility factors.

Community and home noise exposures, owing to their generally less severe nature, do not pose the same hazard of noise-induced hearing loss as is the case in industry. Yet, it is now contended that exposures to the aggregate of noises characterizing life in a modern society—noises from mass transportation, arrays of household appliances, power tools, and hobbies and recreational activities—can cause some degree of hearing loss aside from that due to the work environment. The Bureau of Occupational Safety and Health, Environmental Health Service, has undertaken some pilot work in this area and is planning more formidable studies in FY 1971. In particular, representative noise measurements will be made in recreational activities including sport flying, drag-strip racing or cycling, and rock-and-roll music playing and rated against criteria for safe exposures to noise. Hearing of participant groups will also be tested and compared with others of comparable age having minimal noise exposure. Evidence of significant noise-induced hearing loss here will seriously complicate judgments of industrial hearing loss and pose problems in defining "normal" hearing.

Presently, there is much conjecture as to whether excessive noise conditions can cause physical or mental health disorders. That noise can trigger changes in cardiovascular, endocrine, neurologic and other physiologic functions, with correlated feelings of distress, is readily demonstrated. At issue is whether repeated noise-induced changes of this nature ultimately result in a disease process. Many noise experts believe that man's tolerance to noise is quite high and that most environmental noise conditions can be adapted to without ill effects. Yet, there are others who maintain that the stressful effects of noise, along or together with other stress factors, can eventually overwhelm man's capability for healthy adjustment with resultant physical or mental health problems. Scattered evidence for both points of view exist but in point of fact crucial, systematic studies remain to be done in this problem area.

For example, numerous studies on animals as well as humans have found physiologic changes initially induced by noise to subside with repeated or prolonged exposure to the same sound. This suggests adaption and presumably no health problem. These studies, however, have not been conducted over sufficiently long time periods to judge the possible long-term costs of this adaption to the health of the organism. In this regard, physiologic irregularities of a cariodvascular and neurologic nature have been reported in the foreign literature for workers exposed many years to high level industrial noise. Also noted in these studies is increased irritability and social problems among the workers both at the job as well as in their home situations. These results conflict, however, with other investigations involving human exposure to high level noise in the military. No unusual physical or psychiatric disturbances were found in aircraft carrier deck personnel subjected to extremely intense noise for concentrated operational periods. Reasons for the discrepant nature of these findings are not obvious. Perhaps military personnel, representing a select and conditioned group, are better able to cope with a noxious noise environment. This, of course, raises the issue of the possible stressful effects of noise on persons whose physical and mental health is already impaired. Would, for example, better noise exclusion in hospital wards hasten recovery time in the sick? A recently published study found patients' requests for pain relieving medication in a surgery recovery room to rise coincident with increased noise levels straying into this area.

Hypertension, undue nervousness, and assorted mental difficulties have been claimed by some residents living in communities subjected to intense aircraft and highway noise. These claims have not been sufficiently investigated to ascertain their validity. Indeed, only two cursory type evaluations have been made yielding conflicting results. In one, an inquiry of doctors having offices in the vicinity of London Airport revealed only one patient being treated for a mental disturbance attributed by the physician to aircraft noise exposure. A check of pharmacies in the same neighborhoods found no above-normal use of tranquilizers or drugs which might have reflected the stress of the aircraft noise disturbance. A more recent preliminary report from the same airport locale has found the number of admissions to a mental hospital from a residential area receiving intense aircraft noise to be significantly more than from a comparable demographic area not so exposed.

Clearly, the incomplete, inconsistent nature of the evidence summarized above underscores the need for comprehensive study of possible acute and chronic health effects that may be caused by long-term cumulative noise exposures on both general and special populations. One can envision investigations where the health status of groups experiencing known levels of noise will be monitored for periods of 10 or more years in length in order to fully evaluate this problem. Such work will be complex, obviously time consuming, and fraught with confounding factors. Nevertheless, resolution of the issue of physical and mental health problems posed by environmental noise will require this type of effort.

Noise not intense enough to cause hearing damage or other physiologic effects may still disrupt speech communication as well as the hearing of other desired sounds. In industry, this disruption can degrade efficiency on jobs requiring reliable communication by voice. Much is known about the masking effects of noise on speech and recommended noise limits for offices are based on these masking considerations. Inability to hear warning signals or shouts of caution in other workspaces because of high level noise can also be implicated as a factor in industrial accidents but data to indicate the significance of this problem are not available.

Noise annoyance reactions in communities also have arisen from interference with listening activities. Schools neighboring busy airports and roadways in this country have reported severe disturbances in classroom activities from intruding noises of these transportation activities. Measures of the masking effects of noise on speech are now being considered as a basis for establishing permissible outdoor noise limits in city noise ordinances.

The effects of noise on performing tasks for which voice communication is not necessary are quite variable and depend greatly on the nature of the noise condition present, the task being performed, and the attitude of the worker. The most consistent laboratory evidence for noise performance loss has been shown for those tasks requiring complete and unremitting attention to detail. Consistent with these laboratory findings, performance on jobs involving vigilance activities, such as monitoring machines and quality control inspection, show improvement with the introduction of noise control. Data coupling industrial noise conditions with accident rates, absenteeism, and employee turnover are not available. Noise may be implicated in these occupational problems but causal relationships may be difficult to demonstrate. Also, the build up of fatigue in a noisy job and its possible after-effects in off-job situations, e.g., automobile accidents in returning to one's home, have not been studied.

There is little doubt that noise can frustrate one's desire for privacy, rest, relaxation and sleep. Questionnaire surveys of communities exposed to intense air craft fly over noise have found interruption of rest relaxation and sleep to be major causes of annoyance and complaints. Presently, there is interest in developing annoyance criteria for noise based upon noise disturbances to sleep. Various considerations dictate this type of criterion development. Field studies have shown annoyance results when sleep or rest are disturbed than when other activities, e.g. listening, are interrupted. Rest and sleep presumably provide the conditions for restitution of body energy and recovery from fatigue and thus may have health significance. Disruption of sleep by noise also offers a more objective method for gauging annoyance than other procedures using subjective ratings of acceptability. However, identification of noise or sound levels capable of disrupting sleep is going to be difficult. For one thing, the amount of noise needed to awaken a slumberer varies greatly for different stages of sleep. The degree of familiarity or meaningfulness of the noise also has a significant effect upon this disturbing quality. Common experiences have shown, for example, that the city-dweller, frequently encountering high levels of outdoor and indoor noises becomes accustomed to such sounds and sleeps in their presence. The same person, vacationing in the relative quiet of the country, finds it difficult to sleep because of the cricket noises.

Still another question that has to be answered in setting noise criteria for minimizing sleep disturbances is whether the noise may adversely affect sleep even though a person is not consciously awakened. One expert in sleep research believes that noise can interfere with the dream process during sleep, without conscious awakening, and recurrent interventions of this sort may cause greater irritability, tiredness, and difficulty in concentrating during the awake hours. Work presently in progress under the supervision of the Public Health Service indicates that noise interruptions to sleep patterns over a succession of nights may cause noticeable change in measures of performance taken each day following the noise-sleep sessions.

In addition to evaluating noise effects in sleep, great efforts have been made to determine an acoustic measure that can best quantify noise annoyance and define limits for tolerable exposures. These limiting measures are essential in environmental planning, but it is well to remember that many sounds are judged annoying, not because of their acoustic properties, but because of psycho-social considerations. For example, some sounds are judged annoying because they convey distress, alarm, or have other unpleasant meanings. A Public Health Service supported survey of noise conditions in hospitals found one prevalent source of annoyance to be staff conversations in the halls. These sounds were not objectionable because of their loudness, but because of the information communicated, namely, descriptions of patients symptoms, forthcoming operations, and prognoses. To cite another case, the sounds of approaching aircraft can elicit fear, owing to a crash possibility, and such fears appear to motivate complaints of aircraft noise in neighborhoods near airports. Similarly, the screaming sirens of a patrol car, a clanging fire engine, because of the purposes attached to them, can engender annoyance out of fear. These unpleasant associations, together with numerous other social, psychologic factors, including the necessity or advantage attached to a noise source, the time of day where a given noise is heard, the listeners conditioning to noise, all complicate the use of any acoustic measures for rating noise annoyance. These considerations also make it clear that there are no practical means for freeing everyone from the annoyance problems caused by noise.

In closing, I should like to make two summary observations:

1. Noise levels and exposure conditions in communities and home environments are beginning to approach in overall severity those found in mechanized industry. Effects of noise believed specific to only high level industrial noises are beginning to emerge even in non-occupational situations. Perhaps I should point out too that my division of noise levels and effects into industrial and communities categories is somewhat artificial. In fact, hearing loss problems in industry may be aggrevated by the inability of the worker to find an off-job environment quiet enough to allow his ears to recover from the occupational noise exposure. The distress or disturbance created by community and home noises may be a carry-over from the noise encountered in the work situation.

2. There is sufficient knowledge about certain noise conditions and their effects to permit interim criteria to be established as regards hearing loss and speech interference problems. Gaps in these formulations have been recognized and research to supply needed information is in progress. On the other hand, there is comparatively little effort being directed to study possible non-aural physical and mental problems connected with excessive noise exposures. The nature of such investigations requires long-term investment of time and money with the possibility of results clouded by numerous confounding factors. Noise researchers are understandably attracted to other short-term problems with a greater potential of clean, definitive results. Nevertheless, it is this problem area that now should receive the highest priority in any on-going research program concerned with noise and health. The noise problem is most complex. I have tried to touch on the major issues. I shall be glad to amplify my remarks on the technical matters, in more detail, and to answer any questions that you or the Subcommittee may have.

Senator Spong. I have only one other question that touches on what Senator Randolph has covered. I would like to know the level that you contemplate funding the air pollution program in the fiscal year 1971, in particular regard to section 104 that Senator Randolph has been talking about and, of course, section 309, for the balance.

Mr. Veneman. The total estimate for funding, Senator Spong, is $112,118,000.

Now, I will have to ask Dr. Middleton to break out the specific sections.

Dr. Middleton. As to section 104 for 1971, we would expect to obligate $33.9 million.

Senator Spong. And the balance of the $112 million would come under section 309?

Dr. Middleton. That is right.

Senator Randolph. Senator Spong, I forgot to ask a question that I would like to ask before we recess.

Let us consider aircraft emissions of the operating airlines. They have entered into a voluntary agreement to attempt to decrease the emissions from the aircraft engines. I am not sure who would want to speak to that, but that is a voluntary agreement, isn't it?

Dr. MIDDLETON. That is correct.

Senator RANDOLPH. Now, that relates to the airlines in the United States. I must be very careful here. Does that include the foreign airlines, or is it only those airlines of the United States?

Dr. MIDDLETON. It includes the U.S. airlines, all of whom had the smoky jet manufactured by Pratt-Whitney. It doesn't include the foreign.

Senator RANDOLPH. Now, that leads me to this observation: Let us take New York City on the east and Los Angeles on the west, on our two coasts. What fraction is foreign traffic that moves into one or more airports on both the east and west coast.

Dr. MIDDLETON. This information would have to be obtained from the Department of Transportation and Federal Aviation Authority, but it was discussed in general terms in the Secretarys' conference.

They agreed at that time with the airlines that they would be able to control most of the pollution, substantial quantities of pollution, by December of 1972 from the smoky engines. The foreign aircraft were discussed at this point in the meeting, and it was determined that while they did fly planes that smoked, that the 707's would be likely phased out in 4 or 5 years or probably disappear from the international airports.

Senator RANDOLPH. Well, I commend the action of the U.S. airlines and some might have said it should have been done sooner. But certainly they have moved here on a voluntary basis on a large degree.

I don't want, however, a voluntary action as we have in the United States to be, let us say, in reverse, a discrimination against the U.S. airlines, if the foreign airlines are allowed over our airways, wherever they may be, not to do so now. Would the regulatory authority, as opposed to voluntary agreement, which didn't work for the automobile, eliminate this discrimination?

Mr. VENEMAN. Well, I indicated, also speaking to S. 3229 today, Senator, that we did not feel the vessel, the aircraft, and the agricultural vehicles are a major problem at this time, but we did feel that should they become that, that ultimately legislation should be adopted there if the voluntary effort did not materialize to produce results.

So I think it is something we have to be aware of, but I think we also have to recognize the volume by which they are, in fact, polluting the air.

Senator RANDOLPH. Thank you.

Senator SPONG. I would like to comment on Senator Randolph's last question. I join in commending the airlines for what they have done, but I think we all ought to recognize the extent of this. All they are doing is removing the smoke. Technology has not reached the point, if I understand Dr. Middleton's testimony before the Commerce Committee, where we know what we are doing with the hydrocarbons or oxides of nitrogen. My understanding is that this is causing 1 percent or less of the pollution, but I think we ought to know that getting rid of the smoke really isn't really attacking the problem, and I think that ought to be on the table at all times.

Senator Cooper?

Senator COOPER. No questions.

Senator SPONG. Speaking on behalf of the chairman, Mr. Under Secretary, I want to thank you for your appearance here today. We look forward to the further hearings and to having you with us again.

Mr. VENEMAN. I would like to express my appreciation for the cooperation you have rendered in behalf of the Secretary who has been unable to be with us.

Senator SPONG. Additional statements received relating to the appearance of the Department witnesses and their testimony here today will be included in the record at this point.

(The following statement was subsequently received:)

THE ASSOCIATION OF STATE AND TERRITORIAL HEALTH OFFICERS,
Washington, April 20, 1970.

Hon. EDMUND MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Senate Committee on Public Works, Senate Office Building, Washington, D.C.

DEAR MR. CHAIRMAN: I wish to forward for you and your Committee's consideration the views of the Association of State and Territorial Health Officers relative to amendments to the Air Pollution Control Act which you have under consideration at the present time. Please know that primary substantive contribution to this expression was furnished by the Conference of State Sanitary Engineers, ASTHO's affiliated organization whose members are responsible for the day-to-day environmental control efforts of state health agencies throughout the nation, and which subscribes to this statement.

Much remains to be accomplished in respect to the complex problems of air pollution control. That progress to date in these efforts has not been sufficient is apparent to all—to you, to us, and most importantly, to both our consituents, the American people. It is our joint constituency which suffers the ill effects of ineffective air pollution control, and whose demand for more stringent control measures are becoming a nationwide crescendo, and whose active participation in policy determinations relative to this problem is a vital key to ultimate success. It is the coordinate efforts of us all that is essential and legislation to control air pollution should be cognizant of that fact.

We are of the opinion that certain of the proposals forwarded by the Administration would not be in the best interests of this combined effort. Prominent is the call for nationally applicable ambient air quality standards. The sole justification for such a nationwide standard would be eliminating the possibility of industry bargaining one state or locality against another for selfish economic reasons. We believe that our citizens are sufficiently alert to a short-term payroll versus long-term environmental despoiling to make sound judgemental decisions relative to acceptable standards. We believe that this arrangement will make possible the most effective cooperation of the public, the state and the federal government.

For similar reasons, we believe responsibility for establishing emission standards should be a delegated state responsibility. Except for sources whose emisisons are "extremely hazardous to health" such as asbestos, war gases, pathenogenic aerosols, beryllium and cadmium where in some instances no plant should be built, establishment of standards should be done by the state agency with, once again, federal review and approval or standards promulgation in the event a state failed to establish adequate standards. Suitable differences in requirements between one locality and another could be much better accommodated resulting in desired control levels in contrast to national levels which we fear would be likely to be set at the lowest common denominator and reflect "reasonable" levels rather than "best possible" levels.

It is advocated by some that publication of air quality criteria no longer be required. We are of the opinion that such publication should be continued for important reasons. Such criteria carries considerable weight at the best judgement of the scientific community, conclusions which the public, local and state governments simply do not have the resource to derive. These data are useful and publication thereof should be continued.

In reference to certain amendments proposed by the Administration to the present Act, we would raise the following questions.

(1) Why should not the offended state be represented on the hearing board along with the offending state?

(2) Why should not air pollution control plans which are more restrictive than those of the Secretary supersede the latter?

(3) Why is the Secretary to be given authority to grant variances? The concept that compliance schedules allowed adequate time to implement standards is preferable to the variance authority.

(4) Why does the proposal eliminate the requirement for public participation in the development of air quality standards? As stated previously, we believe this involvement a cornerstone to success.

(5) What accounts for the apparent discrepancy between the President's announced intent to designate interstate air quality control regions (where not now named) and the HEW deletion of the requirement to designate air quality control regions?

(6) Should not HEW be required to forward proposed regulations to all air pollution control agencies?

(7) Should there not be the requirement that prior to Secretarial approval of a state's implementation plan determination be made that such plan will not adversely affect the ambient air quality standards of appropriate neighboring states?

It is our judgment, after study of the current situation and the proposals of the Administration, that priorities for involvement by agencies of influence are inappropriately assigned by the Administration's proposal. Specifically, we believe the roles of the Federal establishment in enforcement and in research have been inadequate. In respect to enforcement the strong cooperation and backing of HEW is essential. Since an increase in the amount of fines from $1,000 to $10,000 has been proposed, we are curious as to the number of $1,000 fines which have been assessed under the present authority. As to research, we are of the view that a much more extensive role could be assumed by the federal government. We have urged and we continue to urge increased appropriations for research activities.

We trust that these views and expressions of our judgement will be instructive of our position and of assistance to your Committee.

Yours truly,

ALFRED FRECHETTE, M.D., *President.*

Senator SPONG. We are in recess until 9:30 tomorrow morning.

(Whereupon, at 1 p.m. the subcommittee recessed, to reconvene at 9:30 a.m., Wednesday, March 18, 1970.)

(Appendix to today's hearing follows:)

APPENDIX—MARCH 17, 1970

MARCH 10, 1970.

Senator JENNINGS RANDOLPH,
Committee on Public Works,
New Senate Office Building,
Washington, D.C.

DEAR SENATOR RANDOLPH: We very much appreciated the opportunity to discuss with you the present status and technical promise of the Westvaco SO_2 Recovery Process and to hear your feelings on the urgent need to push such a process to large scale technical reality. We also went into the technical details of the process and its potential for rapid scale-up with your quite capable technical assistant, Richard Grundy. I was thus very pleased to receive your letter indicating that our process apparently had considerable potential and was badly needed to control air pollution when burning coal. The technical personnel in the National Air Pollution Control Administration for the past year have had similar feelings; but as indicated in the enclosed letter received from Mr. Margolin last month, their hands were tied until their budget was approved by Congress. Since the HEW budget was approved last week, I understand our proposal for government support of a scaled-up integrated pilot plant has now been sent to the contracting officer for negotiation. I sincerely hope and believe these negotiations will be given the needed priority to permit marked acceleration of this development.

Because of our belief in the technical feasibility of our process and the urgent necessity to have a viable solution in operation within a very few years, we have spent over two hundred thousand dollars in process development since submitting our proposal to the government at the beginning of last year. These studies have further increased our confidence in the technical and economic soundness of the process for use on existing or new boilers; and of its ability to be scaled up with existing chemical engineering technology and hardware. Since Senator Muskie has indicated that power utilities may soon be forced to put in partial, stop-gap approaches, adequate governmental funding of soundly-based, rapidly-expandable complete recovery processes could result in manyfold savings to the ultimate power consumer and taxpayer.

I will briefly recap here my description to you of the Westvaco SO_2 Recovery Process: A specially-tailored, highly-efficient granual carbon absodbent is produced in existing commercial equipment from bituminous coal. The efficient adsorbent permits the use of relatively small flue gas adsorption equipment. Similar equipment using granular carbon is currently used to recover waste solvents from air streams which are comparable in volume to the flue gas from large power boilers. The sulfur dioxide in the cooled flue gas going to the stack is continuously absorbed on fluidized carbon and reacts with residual oxygen in the flue gas to form sulfur trioxide. This sulfur trioxide reacts with water vapor in the carbon pores to form sulfuric acid which is retained at high levels within the carbon. Continuous regeneration of the carbon with complete recovery as sulfur dioxide or sulfur is achieved through progressive reaction between sulfuric acid on the carbon and hydrogen. This hydrogen is produced from coal employing the widely used producer gas unit and hydrogen requirements are significantly below such experimental recovery processes as molten carbonate. Process conditions have been optimized to prevent carbonlloss by any chemical reaction, and the minimal attrition loss with proper granular carbon in similar large scale processes appear to permit several hundred cycles with the carbon thus minimizing make-up requirements. Since this is a dry process, the expensive reheat of flue gas required in water scrubbing processes is not needed. Capital and operating costs for the process based upon semi-continuous pilot operation, which were presented to NAPCA, indicate economics as or more attractive than any other potentially competitive process currently known.

Although this process stands a good chance of satisfactorily solving sulfur dioxide pollution from power boilers, it is virtually unknown since it has been privately and confidentially developed. Our only presentations of the process have been detailed presentations on the chemistry, engineering and economics to NAPCA during the past year; and a half-day presentation this summer to the Committee on Air Quality Management of the National Research Council. This committee, specially convened by President Nixon to consider the acute problem of sulfur dioxide pollution, personally interrogated the developers of about twenty-five potential sulfur control processes and received written presentations from a number of others. Their specific evaluations were for governmental use and have not been released. The only public hint of their evaluation appears in an article by Professor Thomas K. Sherwood of Massachusetts Institute of Technology who was associate chairman of this committee. In the January 1970 issue of M.I.T.'s Technology Review a copy of which is enclosed, Professor Sherwood's article *Must We Breathe Sulfur Oxides?* discusses "Controlling Power Plant Emissions" based on his experience as a member of the committee. He states that "the technology does not now exist to effectively control SO^2 emissions, and it is coming along too late to prevent a very substantial increase in SO^2 pollution even during the next ten to fifteen years". He then describes the few widely publicized processes which have been under development during the past decade some of which are low efficiency partial treatments such as limestone injection, some have been set-back because of apparent basic process deficiencies such as in the alkalized alumina process, and some produce diluted sulfuric acid as in Monsanto's process. The only unreported process which he mentions is the Westvaco SO_2 Process but not by name or its then secret details. He says:

"Solid carbon in the form of inexpensive char has been used in Germany to pick up SO_2 from stack gas. A related process using activated carbon has been operated in a fair-sized pilot plant in this country. The carbon contacting the gases at 300°F in a fluidized bed acts as a catalyst to produce sulfuric acid, which is held by the carbon. The acid is removed from the carbon by chemical methods and the carbon is recycled. No gas reheat is required, and marketable SO_2, sulfuric acid, or elemental sulfur can be produced."

The temperature in the process is mentioned to indicate that our process can be adapted to existing power boilers since it operates on the gas being vented to the stack. A number of other precesses under consideration such as the Monsanto Process and the molten carbonate process must operate on high temperature gases and thus require high temperature precipitators and breaking into the present heat economy train.

Since making our proposal to NAPCA we have put up a mock-up of our proposed pilot installation, a picture of which is enclosed. We are not running this at room temperature with expected air flows to work out all the various mechanical and materials handling problems to expedite start up when we erect our proposed integrated pilot plant. In contacting some major engineering firms in the power utilities field to aid us in most meaningful and speedy pilot plant erection, we have been quite encouraged by their interest and the magnitudes of their scale-up from similar pilot size eqipment. Whereas earlier postulated, a prototype plant between this 18″ diameter pilot-plant and that required for a 50 megawatt boiler, it now seems it may be possible and worthwhile to make this jump in one step considering the amount of engineering technology already available in this field. This decision would partially depend upon the amount of risk capital available at the time, but your obvious determination to demand rapid progress in SO_2 recovery should prove most important in government support.

I apologize for the length of this letter, but you seemed anxious to receive additional background on our process and its relation to the field. I am also enclosing some additional literature for your possible perusal and for Richard Grundy. We appreciate your interest and I might mention that Senator Hollings and Representative Rivers, who are from Charleston, have both shown a continuing lively interest in the potential of this process. I have never asked any specific help from them as I believed the process would move on its own merits.

Sincerely,

FRANK J. BALL,
Director, Charleston Research Center.

Enclosures.

WESTVACO, *April 17, 1970.*

Representative HARLEY O. STAGGERS,
Rayburn House Office Building,
Washington, D.C.

DEAR REPRESENTATIVE STAGGERS: It was an exciting pleasure to discuss with you the critical problems that are arising so rapidly in continued combustion of available coals and of the developing plans for accelerated development of the Westvaco SO_2 recovery process as a likely solution. You asked that I thus write you a letter covering the background and the possibilities for expediting this development. I have just recently also written a letter to Senator Randolph, as chairman of the Senate Public Works Committee, covering our process; so to avoid any possible confusion, I will use some of the same language.

Although the Westvaco SO_2 recovery process stands a good chance of satisfactorily solving sulfur dioxide pollution from power boilers, it is virtually unknown since it has been privately and confidentially developed. Our only presentations of the process have been detailed presentations on the chemistry. engineering and economics to NAPCA during the past year; and a half-day presentation this summer to the Committee on Air Quality Management of the National Research Council. This committee, especially convenend by President Nixon to consider the acute problem of sulfur dioxide pollution, personally interrogated the developers of about twenty-five potential sulfur control processes and received written presentations from a number of others. Their specific evaluations were for governmental use and have not been released. The only public hint of their evaluation appears in an article by Professor Thomas K. Sherwood of Massachusetts Institute of Technology who was associate chairman of this committee. In the January 1970 issue of M.I.T.'s Technology Review, a copy of which is enclosed, Professor Sherwood's article *Must We Breathe Sulfur Oxides?* discusses "Controlling Power Plant Emissions" based on his experience as a member of the committee. He states that "the technology does not now exist to effectively control SO_2 emissions, and it is coming too late to prevent a very substantial increase in SO_2 pollution levels during the next ten to fifteen years." He then describes the few widely publicized processes which have been under development during the past decade some of which are low efficiency partial treatments such as limestone injection, some have been set back because of apparent basic process deficiencies such as in the alkalized alumina process, and some produce diluted sulfuric acid as in Monsanto's process. The only unreported process which he mentions is the Westvaco SO_2 process but not by name or its then secret details. He says:

"Solid carbon in the form of inexpensive char has been used in Germany to pick up SO_2 from stack gas. A related process using activated carbon has been operated in a fair-sized pilot plant in this country. The carbon contacting the gases at 300° F. in a fluidized bed acts as a catalyst to produce sulfuric acid, which is held by the carbon. The acid is removed from the carbon by chemical methods and the carbon is recycled. No gas reheat is required, and marketable SO_2, sulfuric acid, or elemental sulfur can be produced."

The temperature in the process is mentioned to indicate that our process is not limited to new plants but can be adapted to existing power boilers since it operates on the gas being vented to the stack. A number of other processes under consideration such as the Monsanto Process and the molten carbonate process must operate on high temperature gases and thus require high temperature precipitators and breaking into the present heat economy train.

The highly adsorptive carbon which is used in this process to trap the SO_2 from power plant stack gas was produced in large scale commercial equipment from bituminous coal. Similar specially-tailored activated carbons produced in our same plant are being used for purifying the air in the Polaris submarines and this year for preventing gasoline vapor emission from California cars. This granular carbon adsorbent, highly-efficient in adsorbing sulfur dioxide, permits the use of relatively small flue gas adsorption equipment. Similar equipment using granular carbon is currently used to recover waste solvents from air streams which are comparable in volume and rate to the flue gas from very large power boilers. The sulfur dioxide in the cooled flue gas going to the stack is continuously adsorbed on fluidized carbon and reacts on the carbon surface with residual oxygen in the flue gas to form sulfur trioxide. This sulfur trioxide reacts with water vapor in the carbon pores to form sulfuric acid which is retained at high levels within the carbon. Continuous regeneration of the carbon with complete recovery as sulfur dioxide or sulfur is then achieved in a second continuous step by progressive reaction between the sulfuric acid on the carbon and hydrogen. This hydrogen is produced from coal employing the widely used producer gas unit; and hydrogen requirements are significantly below such experimental recovery processes as molten carbonate. Process conditions have been optimized to prevent carbon loss by any chemical reaction, and the minimal attrition loss with proper granular carbon in similar large scale processes makes several hundred cycles with the carbon likely thus minimizing make-up requirements. Since this is a dry process, the expensive reheat of flue gas required in water scrubbing processes is not needed. Capital and operating costs for the process based upon semi-continuous pilot operation, which were presented in detail to NAPCA, indicate economics as or more attractive than any other potentially competitive process currently known.

Because of our belief in the technical feasibility of our process and the urgent necessity to have a viable solution for this problem in operation within a very few years, we have spent well over five hundred thousand dollars in this process development within a relatively short time. These studies have progressively increased our confidence in the technical and economic soundness of the process for use on existing or new boilers; and of its ability to be scaled up with existing chemical engineering technology and hardware. We are now running a mock-up of a portion of our proposed pilot installation, a picture of which is enclosed. The expected air and carbon flows permit working out the various mechanical and materials handling problems to expedite start up when we erect the proposed integrated pilot plant adjacent to our power boiler. In contacting some major engineering firms in the power utilities field to aid us in most meaningful and speedy pilot plant erection, we have been quite encouraged by their interest and the magnitudes of their scale-up from similar pilot size equipment. Whereas we earlier postulated, a prototype plant between this 18″ diameter pilot plant and that required for a 50 megawatt power boiler, it now seems it may be possible and worthwhile to make this jump in one step considering the amount of engineering technology already available in this field. Such plant scale decisions which might be made with our process in late 1971 assuming immediate go-ahead depend upon the ready availability of governmental or private capital willing to take the calculated risks to further telescope time requirements. Adequate encouragement, determination and funding by you and Senator Randolph as chairmen of the congressional committees directly responsible should markedly expedite the executive decisions necessary to achieve relatively rapid solution of these crises now facing the country in air pollution, utility generation and coal fuel supply.

The technical personnel in the National Air Pollution Control Administration for the past year have shown considerable interest in supporting accelerated confirmation of our process; but as indicated in the enclosed letter received from Mr. Margolin, their hands were apparently tied until their budget was approved by Congress. Nevertheless, unfortunately, fifteen months have elapsed since we proposed immediate erection of our pilot equipment with NAPCA support. By dint of a quarter of a million dollars of dedicated small scale technical effort during this time, however, we uncovered significant additional novel chemical and engineering approaches which have improved our process versatility and control. Shortly after the HEW budget was approved last month, we thus met with NAPCA personnel in Cincinnati to discuss their desire for immediate progress toward larger scale demonstrations of our process.

Our present pilot plant proposal, which has recently been discussed with NAPCA and involves less than one and a quarter million dollars in capital and operating expenses during an eighteen month effort, should be formally submitted within the next two weeks. The object of this proposal is to rapidly obtain substantiating technical and economic data on the integrated process on power plant flue gases; and to indicate the preferred chemical engineering equipment requirements for large scale use. I sincerely hope and believe that the contract decisions can be given the needed priority so we can very shortly accelerate this encouraging potential solution for the serious pollution problems facing the coal and utility industries.

Gus Brust, Al Repik and I very much appreciated and welcome your apparent interest in further expediting this development. The WESTVACO SO_2 RECOVERY PROCESS should have associated with it all the technical merit, personnel capability and prompt support to now fulfill its present promise.

Sincerely,

FRANK J. BALL, *Director.*

IONICS, INC.,
Watertown, Mass., March 16, 1970.

Senator JENNINGS RANDOLPH,
Chairman, Committee on Public Works,
Washington, D.C.

DEAR SENATOR RANDOLPH: You are currently holding hearings on extending the Air Quality Act of 1967. A key provision of this Act is Section 104, particularly as it relates to Federal support of demonstration plants on new air pollution control technology. I wish to call to your attention the Ionics/Stone & Webster process for removal of SO_2 from stack gases and append a brief description of it. We are negotiating now with NAPCA for support of a demonstration plant jointly with the utility industry. If it is possible, I feel the attached write-up should be a part of the hearing record.

Sincerely,

RUSSELL L. HADEN, Jr., *President.*

STONE & WEBSTER/IONICS PROCESS FOR SO_2 REMOVAL

The Stone & Webster-Ionics Process has undergone pilot tests at the Gannon Station of Tampa Electric Company, in Tampa, Florida, where the operation of the process as a whole and of critical components was evaluated on actual flue gas from a pulverized coal-fired boiler. The pilot plant was capable of processing about 150 to 200 CFM of fine gas which had an approximate concentration of 0.25 volume % SO_2. As a result of these tests, a process design of commercial size has been prepared and an estimate of the economic factors as a function of plant design and other parameters. For large power generating stations burning moderate to high sulfur-content coal it is believed that this process will remove up to 95% of the sulfur dioxide stream, suitable for further processing, presumably for sale as sulfuric acid. Most important of all, this abatement in air pollution in many cases should be achieved at no cost to the power station. In fact, at the present price of sulfur, the installation of this process should result in a net operating profit for the utility.

In its simplest terms, the process may be described as follows: A solution composed of sodium sulfate electrolyte (Na_2SO_4) is fed to an electrochemical cell wherein a caustic stream ($NaOH$) is produced at the cathodes and an acidic stream ($NaHSO_4$) at the anodes. The caustic (or alkaline) stream is fed into the top of an absorption tower where it is contacted counter-currently with flue gas rich in sulfur dioxide. A chemical reaction between the caustic and sulfur dioxide to produce sodium acid sulfite ($NaHSO_3$) effectively scrubs up to 95% of the sulfur dioxide out of the gas phase. The sodium acid sulfite is then fed to a heated tank where it is neutralized by the acidic stream from the electrochemical cell. The neutralization reaction results in the reformation of the sodium sulfate, which is recycled to the electrochemical cells, and the evolution of pure sulfur dioxide. The sulfur dioxide is condensed and may either be stored as a liquid or sent directly to a sulfuric acid plant.

Basically, then, sulfur dioxide is removed from flue gas and recovered through the use of only water and the electrical energy which is required to operate the cells, pumps and blowers. There is no requirement for large quantities of chemical reactants, and, most important, with this process no new waste stream results which may be a serious disposal problem in itself. This is because the process automatically purge the system of any sulfate from the absorption of SO_3 formed through the oxidation of sulfur dioxide in the absorption towers. Moreover, pure hydrogen and oxygen gas streams are useful by-products of the electrolytic cell operation.

To date, all data on the process have been obtained on laboratory and pilot plant size equipment. One of the interesting aspects of electrochemistry is that one can secure meaningful process data on a small scale. However, it is essential that there be a scale-up to production modules and demonstration of such modules in the field on a scale of sufficient magnitude to convince users of the accuracy of the economic projections and of the reliability and ease of operation of large-scale cells. These cells and their grouping in "stacks" will be similar to those now in a large-scale plant manufacturing a nylon intermediate for Monsanto's Textile Division. Scale-up, therefore, is felt to be within the state-of-the-art, but a demonstration plant is a necessary engineering step to minimize contingencies. Stone & Webster and Ionics submitted in July, 1968, a proposal to design, construct and operate such a demonstration plant for the National Air Pollution Control Administration (NAPCA) at a suitable location. In December, 1969, NAPCA was advised by the key utility in a consortium of utilities that the consortium was prepared to advance half of the necessary funds, provided NAPCA would fund the other half. None of such funds would reimburse Stone & Webster and Ionics for the monies already spent by them, which are estimated to be in excess of $750,000.

The demonstration plant will contain components of commercial size and form and will be designed to treat about 75,000 CFM of a flue gas containing 0.25% SO_2. This quantity is equivalent to that produced by a power station having an approximate capacity of 25,000 kw. It is anticipated that the demonstration plant would operate for a period of about one year in order to acquire the necessary data such as the useful life of key components and the critical operating parameters.

The key features of the process may be summarized as follows:

1. It uses simple inorganic chemistry, and it works. All technical investigators who have inspected it in detail, agree that it is technically sound.
2. It does not contribute to water or solid waste pollution in any way as so many other processes do.
3. It eliminates the air pollution of the remaining particulate matter which passes through electrostatic precipitators.
4. It probably also eliminates some of the air pollution caused by nitrogen oxides, although this must be proven on a larger scale test.
5. It is unique in that it consumes power that can be instantaneously interrupted, in quantities large enough to constitute a "*loaded* spinning reserve" useful in preventing blackouts.

GENERAL PROCESS DESCRIPTION

The Stone & Webster-Ionics Process for the removal and recovery of SO_2 from the flue gases generated by large stationary fossil fuel fired boilers involves three basic steps. These are:

1. Absorption
2. Reaction and Recovery
3. Fliud Regeneration and Oxidation Product Rejection

Absorption

The flue gas is first cooled by quenching and drawn into a tower, in which it is brought into contact with a dilute (2N) caustic solution. The flue gas enters the bottom of the tower and the fluid enters at the top. At the top of the tower, the flue gas, with most of the SO_2 removed, is reheated and sent to a stack. The caustic component of the absorbing fluid solution is converted to a sodium sulfite-sodium bisulfite mixture which contains the SO_2 removed from the flue gas.

Reaction and Recovery

The SO_2-bearing fluid can be stored because the compounds contained in the solution are stable at the temperatures and pressures of the process. This sulfite-bisulfite mix is reacted with a dilute acidic solution which is essentially sodium acid sulfate. This reaction forms sodium sulfate, SO_2 and water, and is carried out in a stripping tower. The overhead from this stripping tower is water-saturated SO_2. The water content of the SO_2 overhead gas is reduced by cooling, with the condensed water phase saturated with SO_2 being returned to the tower on an appropriate tray. The SO_2 gas then goes through a conventional counter-current drying step with concentrated sulfuric acid. Pure, dry SO_2 is recovered at this point in the process. Stripping tower bottoms is essentially a solution of sodium sulfate in water.

Since the absorption process must follow power plant load, a large buffer storage is provided after the absorber to allow the stripper and SO_2 purification and regeneration cells to function at a relatively constant rate. This liquid storage also permits the cells to be interrupted on demand, thus using off-peak power. Since this power can be made instantaneously available, it actually functions as a "loaded spinning reserve" rather than a simple off-peak load. The size of the various liquid storage tanks is a function of power plant load factor, both long and short range, but is expected to allow for shut-down of the cells for periods up to two days.

Fluid Regeneration and Oxidation Product Rejection

The sodium sulfate solution is sent to two types of electrolytic cells which are described in detail in the attached diagram. In both cells a cathode stream of sodium hydroxide (caustic) is generated. This caustic solution is the absorption tower liquid feed. In the three compartment cells the anode product is sodium sulfate. In the four compartment cells the anode product is pure dilute H_2SO_4. The anode product from the three compartment cells is the acid reactant required in the Reaction and Recovery step mentioned above. Oxygen is generated at all anodes and is recovered as a pure gas and hydrogen is generated at all cathodes and it too is recovered as a pure gas. Each can be compressed and sold, or otherwise used. However, the only value assumed in the economics is to use the hydrogen as fuel.

The critical components in the Stone & Webster-Ionics Process are these electrolytic cells wherein the spent liquid absorbent is continuously regenerated. Reference has been made above to the use of two different cell designs, a three-compartment cell and a four-compartment cell. The three-compartment cell is the basic design which converts the neutral electrolyte into two streams, one acidic and one basic. The four-compartment cell represents a further refinement in design and is the means by which excess sulfate ion is removed from the recirculating liquid electrolyte.

Excess sulfate will arise from two main sources. Any absorption process for SO_2 removal must consider the fact that a portion of the SO_2 in the flue gas may be oxidized to SO_3 in the absorption tower. In addition, an amount of SO_3 will already be present in the entering flue gas stream as a result of the combustion operation. Upon absorption, any SO_3 will show up in the electrolyte in the form of sulfate instead of the desired sulfite-bisulfite. Since sulfate ion is extremely stable (in contrast to the sulfite ion) it is not broken down in the stripper and any recovery process must provide some means of purging this amount of sulfate from the system. In other systems this is done by precipitation as calcium sulfate, gypsum, which creates water pollution and solid waste. In the Stone & Webster/Ionics process, it is removed as pure, dilute sulfuric acid, which has a value, in the four-compartment cells.

Economics

Stone & Webster has prepared detailed capital and operating cost estimates indicating that sales of recovered SO_2 not only would cover operating expenses but also would actually give the utility a return on the invested capital.

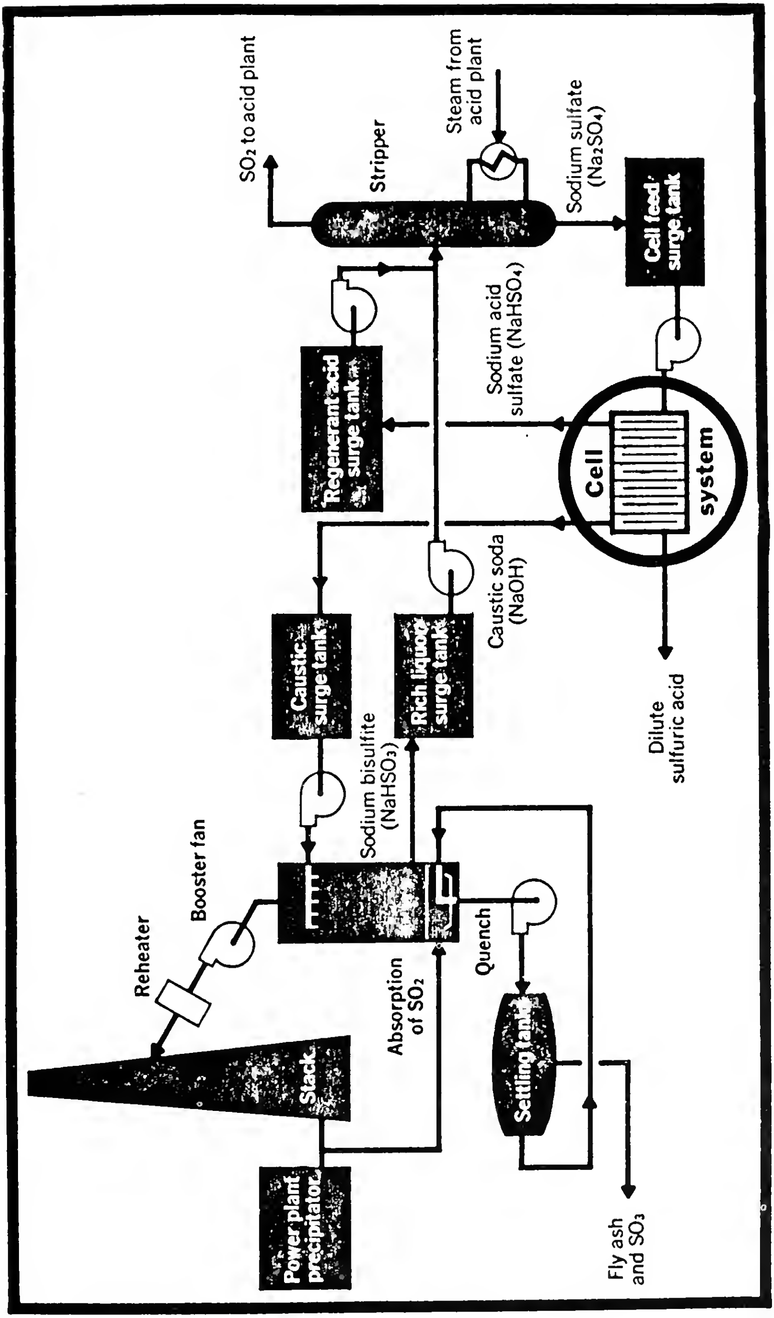
Capital cost varies with five conditions: power-plant size, number of boilers, position of existing ductwork, sulfur content of the fuel, and power-plant load factor. Operating cost is a function of energy cost, sulfur content of the fuel and SO_2 content of the effluent gas.

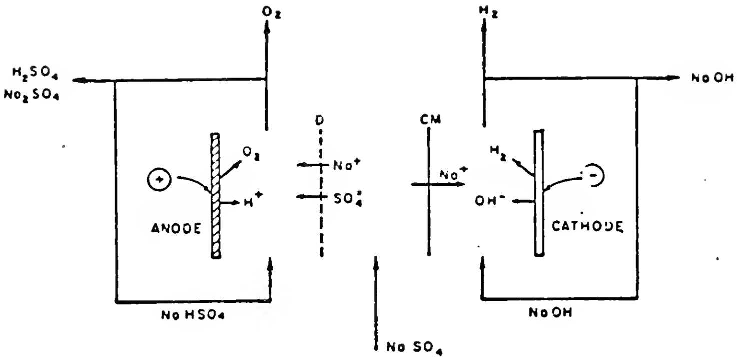
At June 1968 prices, Stone & Webster estimates a 1,200MW. electric station burning 3.5%-sulfur coal in four boilers would require an investment of $18.5 million. Ductwork, dampers, reheaters, distribution substation, sulfuric acid plant, interest during construction, initial chemical charge and initial supply of membranes, electrodes and spare parts are included.

To remove 90% of the SO_2 from the stacks, operating costs at a Mid-west location are set at $2,972,000. Income of $5,810,000 during the first year of operation would come from the sale of 340,000 tons of 99% sulfuric acid at $17/ton. No credit is taken for merchant sales of oxygen and hydrogen.

Thus, Stone & Webster predicts a 5.24% return after federal income taxes (52.8%) during the first year. Average return over the 20-year depreciation life of the plant: 9.6%.

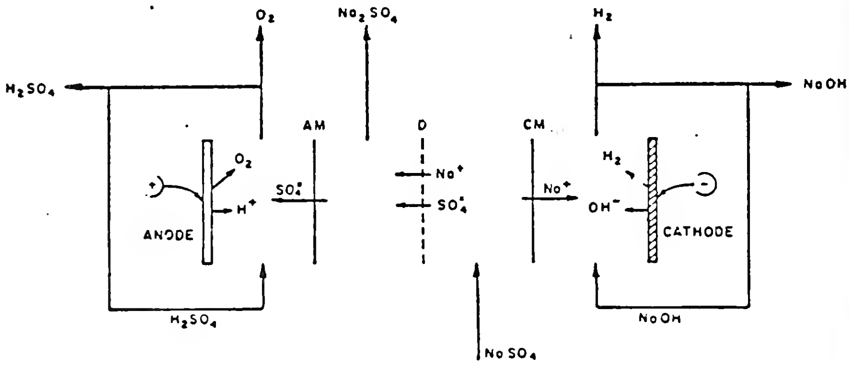
PROCESS FLOW DIAGRAM





D = Porous diaphragm
CM = Non porous cation perm-selective membrane

SCHEMATIC DIAGRAM OF 3-COMPARTMENT ELECTROLYTIC CELL



D = Porous diaphragm
CD = Non-porous cation perm-selective membrane
AM = Non-porous anion perm-selective membrane

SCHEMATIC DIAGRAM OF 4-COMPARTMENT ELECTROLYTIC CELL

MONSANTO ENVIRO-CHEM SYSTEMS INC.,
St. Louis, Mo., March 13, 1970.

HON. JENNINGS RANDOLPH,
Committee on Public Works,
Washington, D.C.

DEAR SENATOR RANDOLPH: The Air Pollution Control Department of Monstanto Enviro-Chem Systems, Inc., formerly a part of Monsanto Company, announced in October 1968 that it had available for sale a proven air pollution abatement system which would remove essentially all of the fly ash and over 90% of the sulfur dioxide from power plant stack gases. Since that time we have approached each of the major utilities in the U.S. (and a number overseas) offering guaranteed performance and assistance in marketing the by-product sulfur acid.

We have spent many millions of dollars in the past nine years developing the process and so far, fruitlessly attempting to sell a unit.

The system not only will solve a major air pollution problem but will also conserve our natural resources. It makes possible the continued use of lower cost high sulfur coal and oil both of which are available in the United States. The higher the sulfur content of the fuel, the lower the operating costs because sale of the by-product sulfuric acid produced helps to offset some of the operating expenses.

However, air pollution control will cost money. It requires a relatively large capital investment and in most cases there would be a net out-of-pocket operating cost.

It becomes a question then of what is the most practical and most economical solution to the problems.

We believe that our Cat-Ox system will be less expensive than low sulfur coal or oil in many situations.

Monsanto foresaw the probable need to control sulfur dioxide emissions. Based on its many years of experience as the world's leader in designing and building sulfuric acid plants, it built a pilot plant at the Seward Station of Pennsylvania Electric Company in 1961. Operation of this small unit proved that technology developed for production of sulfuric acid could be applied to the relatively low concentrations of sulfur dioxide in power plant stack gases.

To develop information leading to commercial reality, however, a prototype plant using commercially available equipment was required. Therefore, Monsanto and the Metropolitan Edison Company agreed to build a prototype at Portland, Pennsylvania. Portland was selected for this installation because it burns a variety of bituminous coals and is essentially a base load station. In the Cat-Ox unit at Portland, approximately 6% of the total boiler flue gas is extracted, processed and discharged through the prototype plant stack.

Ash removal is accomplished at an efficiency of about 100%. More than 90% of the sulfur dioxide present in the flue gas is oxidized and removed as sulfuric acid. The strength of the acid obtained is a function of the operating temperature of the absorption tower but averages 78%, which is a commercial grade. Operation of the prototype unit began in August, 1967, and it is presently being operated as a production unit. Over 9,000 hours of operation—equivalent to over one full year—have been successfully accomplished.

Over two million pounds of acid have been produced and sold. This acid has been used in the manufacture of plant food through the acidulation of phosphate rock.

The entire process is controlled from a small console located adjacent to the boiler control console. No additional operating manpower is required for the prototype plant. There are no unusual process control requirements. The controls for the Cat-Ox system in a new full-scale installation would be integrated among the conventional boiler controls.

While the process is foreign to operators of conventional power plants, it has been readily assimilated by the operators at Met-Ed. The system is simple and has no moving parts that are not found in a conventional power station.

As public concern increases and regulatory pressures intensify, the utilities are looking at possible alternatives to flue gas abatement systems. They are finding that the long-term viability of alternate solutions is uncertain.

For example:

> Thinking people realize that higher stacks are not a long range solution, if a solution at all.
>
> Nuclear plants cannot meet the demand due to stretch-outs in construction schedules and steeply rising capital costs. Even more fossil-fueled plants are being planned. There is also a question of the long range availability of nuclear fuels.
>
> Low sulfur content coal is in limited supply at a premium price. Natural or processed low sulfur oil already does or will command a sizable premium over coal. Most existing coal fired plants will have to be modified to burn either of the low sulfur fuels. Frequently, installation of Cat-Ox will prove less costly.
>
> Natural gas is in very limited supply.
>
> Many new plants will find it less expensive to burn high sulfur coal and utilize a Cat-Ox unit—rather than burn a low sulfur coal or oil.

Utilities eventually will be forced to adopt flue gas abatement as the most prudent course of action, yet there is a reluctance to do anything until they are forced to, particularly if control measures are going to increase the cost of electricity.

Although we have demonstrated that Cat-Ox is operable in a prototype consisting of commercially available components and we know we can scale-up and are willing to guarantee performance and to assist in marketing acid, we have been unable to sell a Cat-Ox unit. We believe this is due to lack of the legislation forcing the utilities to clean up their effluent streams.

It is difficult to generalize on the economics of an installation; however, the following tables illustrate some projected costs.

TABLE I.—CAT-OX SYSTEMS—EXISTING PLANTS BURNING 3.5 PERCENT SULFUR COAL

	Powerplant size		
	100 megawatts	250 megawatts	500 megawatts
Added capital:			
Amount (million dollars)	6	9	18
Amount (dollars per kilowatt)	60	36	36
Added operating cost (cents per million B.t.u.):			
	8	7	7
Net (after acid credit)	5	4	4
Fixed costs	15	9	9
Total costs	20	13	13
Total increase in cost of electricity (cents per kilowatt-hour)	0.19	0.13	0.12

TABLE II.—CAT-OX SYSTEMS—NEW PLANTS BURNING 3.5 PERCENT SULFUR COAL

	Powerplant size		
	250 megawatts	500 megawatts	1,000 megawatts
Added capital:			
Amount (million dollars)	10	18	32
Amounts (dollars per kilowatt)	40	36	32
Added operating cost (cents per million B.t.u.):			
Gross	4	4	3
Net (after acid credit)	1	1	1
Fixed costs	10	9	8
Total costs	11	10	9
Total increase in cost of electricity (cents per kilowatt-hour)	0.10	0.09	0.08

Thus, for control of emissions from coal burning power stations, assuming 2.0¢/kwh as the average residential rate, the homeowner could expect an increase in his electricity bill of about 6%.

Respectfully,

JOSEPH G. STITES, Jr.,
Manager, Air Pollution Control Department.

STATEMENT OF JAMES R. GARVEY, BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, FEBRUARY 25, 1970

Mr. Chairman: My name is James R. Garvey. I am President of Bituminous Coal Research, Inc., Monroeville, Pa. BCR is an affiliate of National Coal Association, Washington, D.C. A biographical summary of my qualifications is attached to my written statement.

In the almost twenty-five years I have been with the national research agency of the coal industry, I have been engaged in or directed research on coal combustion including control of pollution resulting from coal combustion. During the past ten years I have on numerous occasions appeared before Committees of Congress and other governmental agencies to testify on the "state of the art" of control of sulfur oxides.

At one such appearance, before the New Jersey State Department of Health on October 6, 1967, I said:

"With all the activity by various research organizations, we are confident that an economically attractive approach for the recovery of sulfur oxides from flue gases will be available in the next three years, give or take a year."

The purpose of my testimony here today is to bring to your attention the fact that this prediction of about two and one-half years ago was correct. We now have commercial processes available for use although their economic attractiveness may not be all we desire; the added cost for sulfur oxide control may increase the cost of electricity to residential consumers by at least three and perhaps eight percent.

There are four companies offering for sale sulfur oxide recovery systems for existing and new electric power generating plants which when applied will enable the use of high sulfur fuels with stack emissions equivalent to the burning of fuels with 0.5 percent or less sulfur. We had hoped to have the four companies offering these systems appear here individually to describe their processes, and their confidence therein, but in the interest of conserving the Committee's time, three companies have agreed for me to present a brief summary of their development and to submit their written statements on the processes for the record. These statements are attached to my statement, together with a copy of a published review of the fourth. I hope the Committee will approve the inclusion of them in the printed record of these hearings.

All four processes have some similarities and some basic differences. Because of these, one or the other may have certain advantages in application to a given power plant depending upon size, location, age and available space. But all have in common the desirable advantage of upwards of ninety percent elimination of sulfur oxide emissions. For your information I will briefly describe the processes without any attempt to favor one over the others, although the coal research agency which I represent carried out work in our laboratories on one of the approaches and contributed financially to one other.

To fully understand the technical problems involved, and to better appreciate the cost, we must keep in mind that even with a very high sulfur fuel the gases emitted from a power plant stack contain very little sulfur oxides per cubic foot—of the order of a couple of thousand parts per million. To remove the dilute quantities of sulfur oxides we must first convert them chemically to another material so a separation can be made. All four systems available do this, but in a somewhat different manner.

One system is offered by Monsanto Chemical Company a large and well-known chemical company, located in St. Louis, Missouri. Their process converts the sulfuric oxides into saleable sulfuric aicd. The principal advantage of the Monsanto process is that the chemical recovery of the sulfur values is self-sufficient; that is, no chemical reagents must be brought into the power plant. By use of a catalyst and changes in the heat exchange cycle, a disposable liquid, sulfuric acid, instead of an untouchable gas, sulfur dioxide, is produced. To reduce the idea to commercial practice has required millions of dollars and the operation of a 15,000 KW pilot plant in Eastern Pennsylvania for two and one-half years. But the necessary development work has been done and Monsanto is prepared to sell this process and guarantee performance.

The second process has been developed by Commission Engineering, Inc., whose main offices are in Windsor, Conn. Combustion Engineering is one of the leading suppliers of power boilers to the electric power industry—for both fossil and atomic fuel firing.

The Combustion Engineering approach to sulfur oxide control differs considerably from the Monsanto approach. First of all, no saleable product results. In addition, a chemical reagent must be brought in to react with the sulfur oxides—to change them into removable solids. But the end result is the same, removal of both particulates and sulfur oxides from the exit gas stream. The process has been proven feasible at a pilot installation in St. Louis and another at Lawrence, Kansas. As Combustion Engineering has pointed out in public statements, they are confident they can design and erect a recovery plant with a guaranteed sulfur removal equivalent to that of burning 0.5 percent sulfur coal and a guaranteed particulate removal of ninety-nine percent. Further, they have stated that while they will guarantee this high level of recovery, they expect to do even better.

One mid-west utility, Kansas Power and Light Company, has sufficient faith in the process that they are incorporating it into the design of a new 430 MW plant planned for operation in 1971. The decision of that Company is best expressed by an official thereof who, in discussing their pilot test of the Combustion Engineering process and their future plans, said:

"As you can appreciate, I am sure, this has not been an easy road, and there have been numerous detours, but it does look like we are going to be able to accomplish what we set out to do. Retain the clean air in Kansas, and burn coal at the same time."

The remaining two systems which are described in statements attached to my written test have not quite reached the advanced state of commercial development as that of Monsanto and Combustion Engineering. However, they are nearly there and as the statements of the companies indicate, they are confident of success in the near future.

Wellman-Lord Company, a prominent consulting firm in the phosphate fertilizer plant field, has pilot tested a sulfur oxide recovery plant at a large Maryland power station, and will start up another in New Jersey this year. Like Monsanto, this process produces a saleable product—but concentrated sulfur dioxide instead of sulfuric acid. This product can be used directly or shipped for ultimate conversion into sulfuric acid or fertilizer depending on markets in the power plant vicinity. Unlike the Monsanto process, an alkalai reagent must be introduced.

The final sulfur oxide recovery system described in the statements submitted is under development by Chemical Construction Corporation, commonly referred to in the trade as Chemico. This company is one of the oldest and largest chemical engineering firms in the world. For more than 50 years Chemico has been designing and erecting major process plant installations for the chemical, petrochemical and mineral process industries.

The Chemico sulfur oxide recovery process also produces a saleable product, elemental sulfur. But the approach is unique in that the final product is not evolved at the power plant. Recognizing that (1) electric power generating plants are not in the chemical business nor interested in getting into it, and (2) the economics of any sulfur recovery process will be primarily a function of the size of the plant which produces a final chemical product, Chemico conceives the total system as being in two parts. First, the power plant would be supplied with a chemical reagent for use in scrubbing sulfur oxides from the flue gases and, second, the used reagent would be shipped to a central processing plant for recovery of sulfur values and regeneration of the reagent for return to the power plant. Under this system, one large reagent processing plant could serve many small utilities—and even some industrial plants—in the most economic manner. As with the other three processes described, Chemico is ready to move into full scale application and eliminate sulfur oxide pollution.

The four processes which I have briefly described have been developed by industry without financial support from government. It is estimated that fifteen to twenty million dollars have been spent on them to date. A number of other companies have processes in various stages of development. In addition the National Air Pollution Control Administration of the Department of Health, Education and Welfare is researching with public funds other feasible approaches to sulfur oxide control. One of these, the use of dry alkalai additives, is currently undergoing large scale pilot test at a TVA power plant.

Gentleman, that concludes my description of what we believe are currently available commercial processes and which, in at least two cases, the manufacturer is prepared to guarantee will eliminate the so-called "SO_2 pollution problem." I have made only passing reference to cost. As the President in a recent message to Congress stated, the cost of pollution control will be high. But the processes for sulfur oxide recovery which we are calling to your attention today are less costly than other solutions which have been suggested. These include the use of natural gas and imported foreign fuels. As this Committee has acknowledged, fossil fuels must be the source of energy for our power plants for many years to come despite the expected growth in atomic power. We feel the means are available to supply the needs without sulfur pollution by use of our vast reserves of coal, most of which is high in sulfur, through the application of the processes I have described and others now under development by the National Air Pollution Control Administration of HEW.

Still to be accomplished is the application of such processes to existing and new power plants. When one considers the tremendous capital investment required for sulfur oxide control processes, the reluctance of the utility companies to apply them is understandable. We believe the Federal government could stimulate more interest by applying the available systems to government-owned power plants and by participating in the financing of installations at privately-owned plants for demonstration purposes.

JAMES R. GARVEY, PRESIDENT AND DIRECTOR OF RESEARCH, BITUMINOUS COAL RESEARCH, INC., MONROEVILLE, PA.

James R. Garvey, president and director of research of Bituminous Coal Research, Inc., and vice president, research and engineering, National Coal Association, received a Bachelor of Engineering degree in Mining from the Ohio State University in 1941. Since then, with the exception of four years during World War II when he served in the Air Force, he has been associated with the coal industry in mining and in research.

He joined Bituminous Coal Research, Inc., in 1946, as a development engineer, rising to supervising engineer, assistant director of research, director of research in 1958, and president in 1963. As president of BCR, he has the primary responsibility for the development and execution of the cooperative research program of the coal and related industries. Early in 1966, the Board of Directors of National Coal Association, of which BCR is an affiliate, elected him vice president, research and engineering. In that capacity, he assumed the management of the industry's cooperative engineering service program as well as its research.

Mr. Garvey is a member of the New York and American Academies of Science; the American Institute of Mining, Metallurgical, and Petroleum Engineers, and the American Society of Mechanical Engineers. He is also a member of the American Gas Association, International Briquetting Association, American Association for the Advancement of Science, and American Coke and Coal Chemicals Institute. He has been an active member of committees of these societies, serving as chairman of several of them.

Mr. Garvey's service to the state and federal governments has been extensive. On appointment by Governor Scranton and reappointment by Governor Shafer, he has served on a Pennsylvania Advisory Committee on Pneumoconiosis. At the federal level, he serves on the General Technical Advisory Committee to the Office of Coal Research, U.S. Department of Interior; is a member of the Environmental Pollution Panel of the U.S. Chamber of Commerce, and is a member of the National Air Quality Advisory Committee of the U.S. Department of Health, Education, and Welfare.

In addition to mining engineering, his experience includes design and development of coal-handling and coal-burning equipment for residential, commercial, and industrial markets and technical supervision of coal utilization research covering a wide scope. He holds several patents on coal-combustion equipment and is the author of many professional papers covering research and engineering application in these fields.

In 1963, Mr. Garvey received the Percy Nicholls Award. This award is presented annually by the Fuels Division, ASME, and Coal Division, AIME, for notable scientific and industrial achievement in the field of solid fuels research.

STATEMENT OF ROBERT H. QUIG, P.E., ENGINEER–UTILITY OPERATIONS, CHEMICAL CONSTRUCTION CORP.

CHEMICO AND ITS AFFILIATES

Mr. Chairman: Chemical Construction Corporation, or as it is better known—Chemico—is an architect, engineers and construction firm of large chemical complexes and pollution control systems in the U.S.A. and around the world. Chemico designed plants account for:

30% of world sulfuric acid production through 237 plants;
20% of world ammonia production through 106 installations;
25% of world urea production.

Chemico's Pollution Control Division has in operation or under construction over 1,000 systems in the chemical, oil refining, pulp and paper, smelting, steel and most recently utility industries. Chemico is affiliated as a sister organization with Ebasco Services, Inc., who are architect-engineers of utility power plants.

Chemico has associated itself with Basic Chemicals of Cleveland, Ohio, to form a joint venture company for the removal and recovery of SO_2 from stack gas as a salable product. Basic has developed numerous applications for the use of magnesium oxide in agriculture, paper processing and pollution control. The joint venture company is called Chemico-Basic and its main purpose is to promote the use of magnesium based scrubbing for SO_2 recovery in the electric utility and other pertinent industries. Since the removal and recovery of SO_2 is more than a sole desired function of the power plant operator, this joint venture company will coordinate and make arrangements for the necessary integration of the utility and chemical industries.

While Chemico is prepared to offer SO_2 recovery programs to the utility industry, it is also prepared and is now offering SO_2 control programs for the disposal of waste materials. We recognize that the decision of a utility to enter into recovery or disposal of SO_2 must be made within the framework of economical marketing of the recovered SO_2 in certain geographical areas. Scrubbing of the SO_2 from stacks utilizing low-cost calcium additives for disposal may very well be the cheapest solution in many instances.

I would like to dedicate the remainder of this statement to the recovery of SO_2 utilizing the concept of centralized recovery operations.

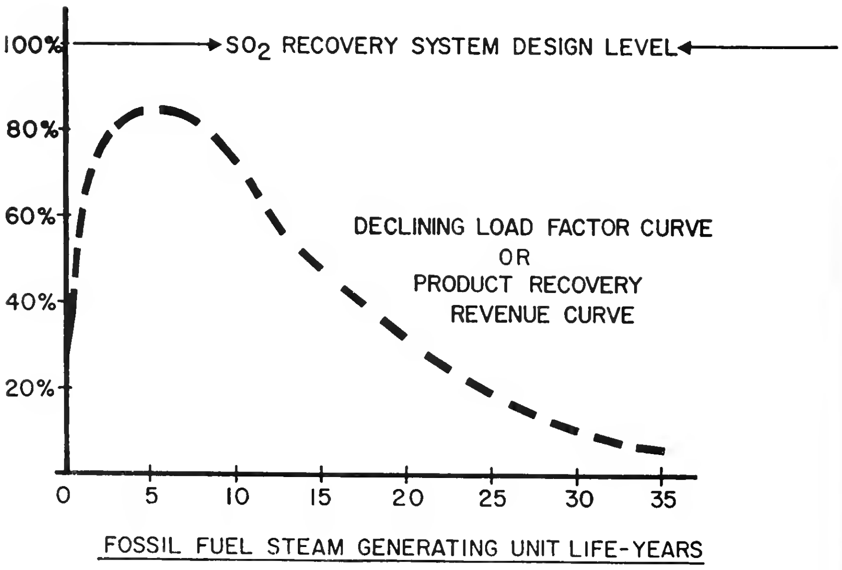
FACTORS FOR AND AGAINST SO_2 RECOVERY

The decision to recover SO_2 from stack gas will be made as an economical alternative to the potential land waste problems associated with disposal of calcium sulfite/sulfate and fly-ash materials obtained from dry and wet collection systems. This is especially true in the densely populated and heavily industrialized sections of the country where disposal areas are limited.

SO_2 recovery, while being an improvement over a disposal condition in most cases, still needs refinements itself. To date, the basic problem involved with SO_2 recovery from stack gas is that while the SO_2 is present in sufficient quantities to be considered an air pollution problem, it is not great enough from any single stack to be an efficient and economical source of sulfur.

Figure #1 illustrates this problem. The concentrations of SO_2 emitting from a stack are very small, but the gas cleaning systems required to absorb or absorb the gas must, of necessity, be constructed to handle the total gas volume of 100% boiler output. If the SO_2 recovery section of the total control system is also located between the boiler and the stack, it too must be designed for 100% ouput conditions. This creates an undesirable situation of sulfur recovery economics at each individual SO_2 emission source not only being a function of unit load factor, but also power plant size and sulfur content of fuels burned.

FIG. I - THE EFFECT OF LOAD FACTOR UPON SO_2 RECOVERY REVENUE



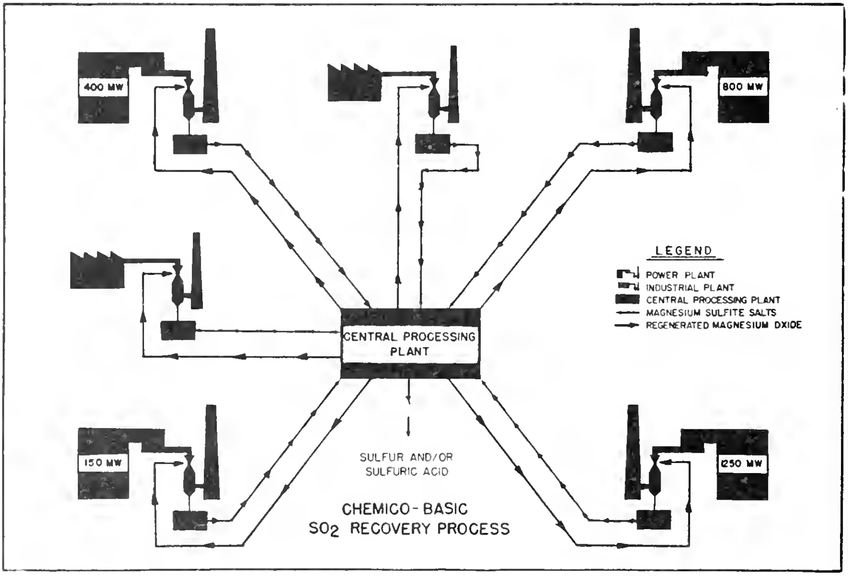
Based on past, present and estimated future performance, it is generally accepted that the average annual load factor of a fossil burning unit will assume a pattern as described in Figure #1. Thus, it is noticeable that even in the early life of the generating unit, the best annual load factor will hardly ever exceed 80%. After the seventh or eighth year of operation, the load factor will then begin to decline with an increasing rate. Assuming that the average sulfur content of the fuel remains relatively fixed and sulfur product marketing conditions do not change, the declining load factor curve will represent the diminishing product recovery revenue curve. This same problem exists in the very early life of the unit when start-up problems keep the unit off the line or forced to operate at reduced loads.

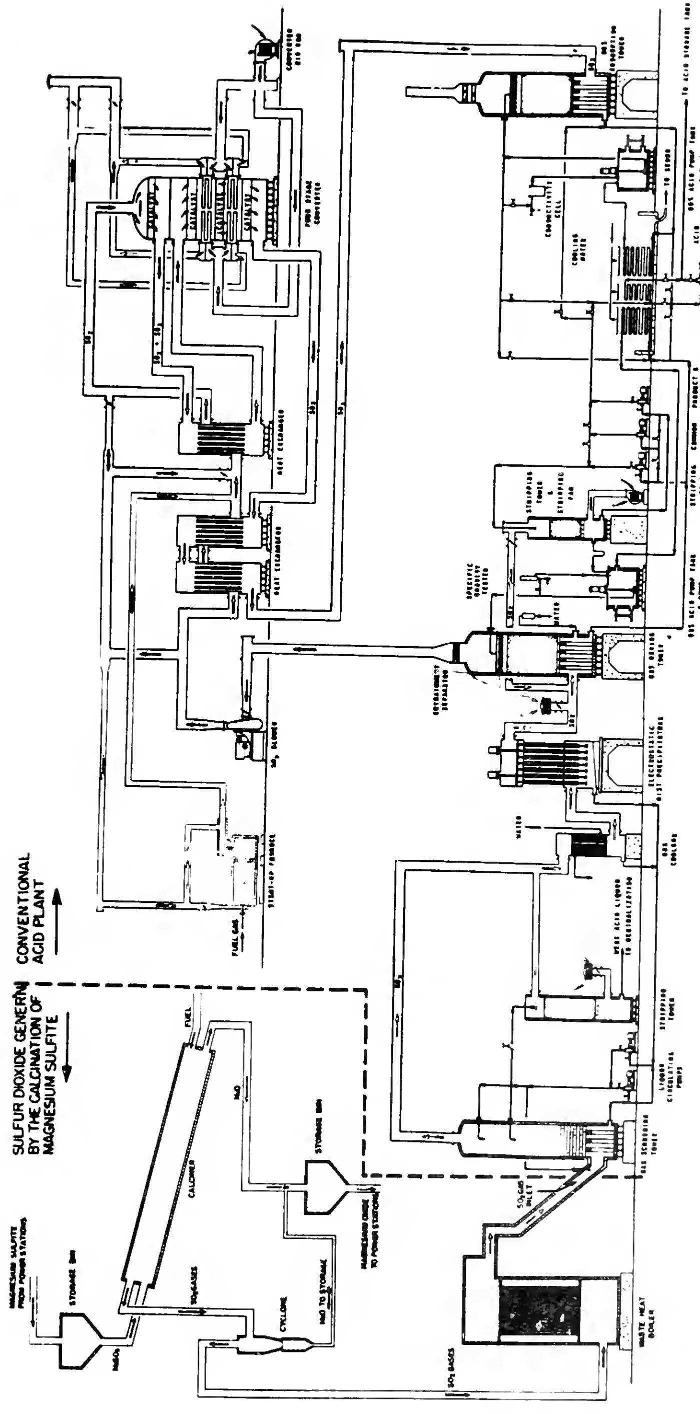
It is clear then that the impact of declining load factor plus the added complexities of a utility being in the chemical business require further thought as to the best SO_2 modus operandi for the utility. Chemico feels that, while the SO_2 removal system being designed for the gas volume associated with full load conditions cannot be avoid, the SO_2 recovery operation can be restructured so that it is a meaningful and economical source of sulfur products. The concept which we refer to is that of centralized recovery.

PROCESS FOR THE CONCEPT CENTRALIZED SO_2 RECOVERY

Chemico envisions that sulfur dioxide, efficiently removed from boiler flue gas by the application of proven scrubbing techniques, may be effectively and economically recovered at one centralized process plant. This central concept of recovery then allows many SO_2 emitters in a given geographical region to consolidate their pollution control efforts into one effective recovery operation. This is in lieu of constructing many small inefficient chemical plants at each power plant site; whose economics are, of necessity, directly related to the size and load factor of the power plant as well as the sulfur content of fuels burned. The SO_2 scrubbing system at the power plant is utilized simultaneously for over 99% removal of fly-ash.

Fig. II illustrates the concept of consolidating "captured" SO_2 emissions from many sources in a region at one centralized recovery complex. These "captured" emissions are in the form of magnesium sulfite crystals obtained from the aqueous scrubbing of flue gases using solutions of SO_2 absorbing materials such as magnesium oxide. The crystals of magnesium sulfite are then removed from the scrubbing system in an anhydrous form and forwarded to the central recovery plant. At the recovery plant, these crystals may be processed to elemental sulfur or sulfuric acid. Ultimate business and marketing evaluations will determine the best products to recover. The conversion of magnesium sulfite for recovery is accomplished by utilizing calcining or fluid bed techniques. Figure III further describes this. A concentrated but manageable SO_2 gas stream is generated for introduction into a conventional sulfuric acid plant. Essentially this is no different than the conventional processes for the recovery of sulfuric acid from metallurgical roasting plants such as copper converters or smelters. A secondary process reaction is the regeneration of the magnesium oxide for recycle back to the utility scrubbing systems at the various power plants. The SO_2 gas may also be reduced directly to elemental sulfur.


400 MW
800 MW
150 MW
1250 MW
CENTRAL PROCESSING PLANT
LEGEND
POWER PLANT
INDUSTRIAL PLANT
CENTRAL PROCESSING PLANT
MAGNESIUM SULFITE SALTS
REGENERATED MAGNESIUM OXIDE
SULFUR AND/OR SULFURIC ACID
CHEMICO - BASIC
SO2 RECOVERY PROCESS



CHEMICO CENTRAL SO_2 RECOVERY PLANT FOR SULFURIC ACID (98%)

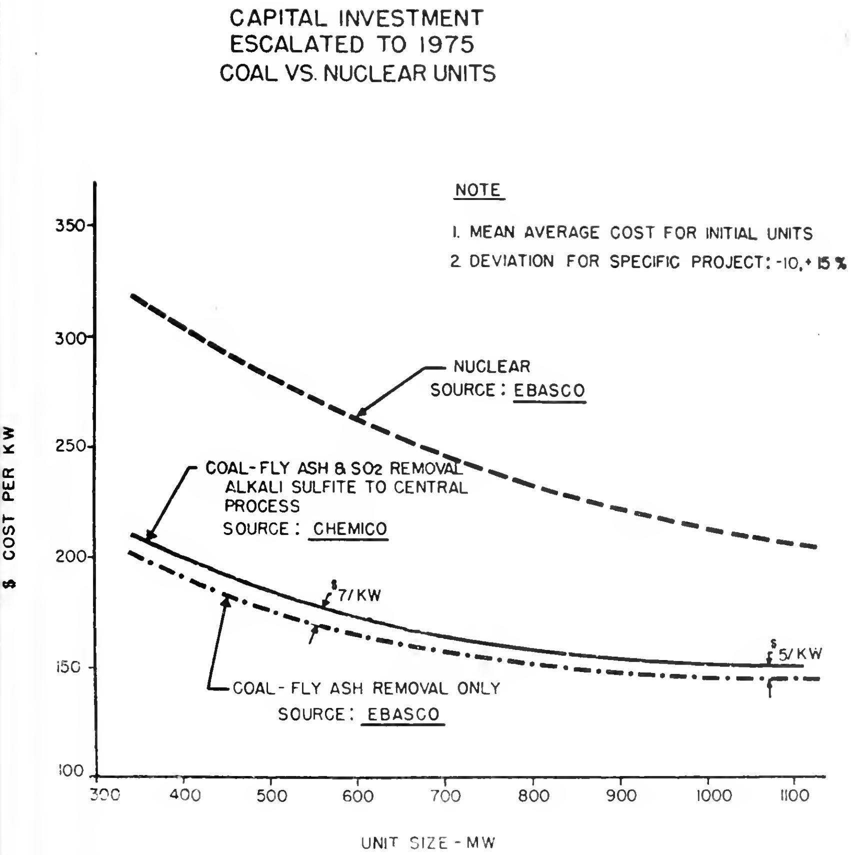
ADVANTAGES OF THE CENTRAL RECOVERY PLANT

The major advantages of a centralized sulfur recovery operation are believed to be:

1. With the exception of producing magnesium sulfite in a dried transportable condition, the capitalization and operation of chemical recovery processing is divorced from power plant activity.
2. One central process plant strategically located could provide recovery for 5000-7000 MW or more of power plant capacity. At the same time it could also provide recovery activity for smaller industrial customers who would have no hope of achieving economical sulfur recovery as an alternate to solid waste disposal. The small industrial plants would enjoy the results from economies of scale created by the large central stations.
3. Economies of scale and good process efficiency may be obtained by one large chemical complex which is sized for the SO_2 emitting from the average load factor of the system it services.
4. One large recovery plant, owned and managed by companies knowledgeable in chemical industry operations and marketing would be a formidable and competitive source of sulfur. The central plant would be able to sustain sulfur market fluctuations with greater capability than many small recovery plants could do individually.
5. Fuel suppliers as a joint venture effort with chemical producers and marketers could establish the recovery plant in return for long-term fuel contracts with utility and industrial fuel consumers.
6. Central process in concept is not foreign to utilities since they already have inter-relationships with power pooling over their transmission grid networks. Many utilities today are sharing the investment burden for new generating facilities.
7. The participating utilities as "sulfur donors" may elect, if desired, to have an equity position in the recovery plant.
8. Most important, the historical lines of conventional and economical fuel supply would not be interrupted by the pressure of SO_2 laws. Low sulfur fuels could then be diverted to very small consumers such as high-rise apartments or shopping centers.

COSTS FOR CENTRALIZED SO_2 RECOVERY

The utilities and other industrial organizations who must control SO_2 are expected to assume the capitalization and operation of the total scrubbing system for SO_2 and fly-ash removal which includes all process steps at the power plant site necessary to get the magnesium sulfite into a transportable condition. Capitalization estimates for this indicate that a range of \$5–7/kw may be expected for a new power plant and \$6–9/kw should be expected for a retrofit operation (1969 pricing basis). Operating costs including capitalization for these scrubbing systems are expected not to exceed \$1/T of coal or 25¢/bbl of oil burned. No credits are included for avoiding the use of electrostatic precipitators or the utilization of short stacks. See Figure IV for comparable figures escalated to 1975.



In return, the central recovery plant, if made large enough, say, 1000 T/day of sulfuric acid will be completely self-sustaining operation sufficient for a third party to realize a rate of return consistent with chemical industry practices. *This third party could very well be the fuel supplier.* Magnesium sulfite from the power plant scrubbing systems will be "donated" to the recovery plant in direct exchange for regenerated alkali with makeup supplied on a "free" basis.

A 1000 T/day acid plant can be "supported" by approximately 3000 MW of power plants which burn approximately 2.5% S fuel and have a system load factor of 65%. This large acid plant including off-sites would require approximately an $8,000,000 investment and can produce sulfuric acid in a cost range of $10–$12/ton.

PRIOR TESTING—WORK IN PROGRESS—FUTURE

Chemico has conducted pilot plants for fly-ash and SO_2 testing at seven different power plants and a sulfuric acid plant. The reduction of SO_2 can be guaranteed at 90% or better. Fly-ash removal can be guaranteed in excess of 99%. SO_2 recovery as a guaranteed process for yield and operating economics must still be considered elusive until prototype plants are operated—we are presently planning to build such a prototype system sized for a 150 MW generating unit. Chemico is working with a consortium of four private utilities, an international oil supplier, the National Coal Association, a leading chemcal company and the Natonal Air Pollution Control Administration to complete final plans and financing for this prototype project.

Under construction by Chemico is a large 150 MW equivalent venturi scrubbing system on an eastern utility boiler designed for fly-ash removal initially with provision for future SO_2 control, if desired.

Recently announced by the Arizona Public Service Company is APS plans for Chemico to design, engineer and construct a fly-ash now—future SO_2 scrubbing system for 575 MW.

CONCLUSION

We at Chemico conclude that work by us and the other fine organizations, Monsanto, Combustion Engineering and Wellman-Lord will enable SO_2 control to be achieved in a manner which will not upset the historic fuel consumption patterns in this country.

Much still needs to be done. A major problem is the financing of these large demonstration projects to convince and give confidence to industry that SO_2 control is economically attainable. This may and should require a reassessment of R&D priorities in federal grants, etc. SO_2 control to date, has been at the bottom of the list.

For the purpose of record, we at Chemico believe that SO_2 control is available now.

Modified SO_2 system faces new tests

Sustained operation under three types of limestone injection is goal for Combustion Engineering wet scrubber system at Kansas Power & Light's 125-Mw Lawrence 4

Operation of an air polution control system (sulfur and particulate removal) under three types of limestone injection, and sustained operation at or exceeding guarantees are objectives this fall and winter at the Lawrence Power Station of Kansas Power & Light Co. These plans were revealed recently by D. M. Miller, KPL's manager of electric production, in a status report on the wet scrubber system installed on the 125-Mw No. 4 unit at Lawrence (EW, March 4, 1968, p 35). Modifications in the system since operation began late last year will be incorporated into a similar sulfur-removal system for the station's 430-Mw No. 5 unit now under construction.

Miller first told of these minor problems encountered on initial operation with the limestone-injection wet-scrubber system: Severe vibration of the ID fan duct at reduced load levels, corrected by changing the operating mechanisms on inlet dampers originally installed "in reverse"; high pressure differential across the scrubber's marble bed and excessive ash carryover, eliminated by removing "construction dirt" from water spray nozzles immediately below affected areas; and buildup of flyash cement by eddying of moisture into the scrubber inlet duct. Ladder baffles under the marble bed in the inlet plenum and baffles and flow guides above the reheaters were installed to improve gas flow distribution. This last modification also allowed the unit to carry up to 90% of load without excessive ash carryover to the reheat coils in the scrubber. Also, temporary air soot-blowing lances below the reheat coils are used to maintain clean coils without water washing as previously planned.

A low level of effluent pH in the marble bed overflow caused advanced corrosion in the bed overflow pots, unpainted piping and scrubber tank bottom. Overflow pots and drains were replaced using PVC components, while the scrubber bottom was given a 2-in. gunite lining over a heavy bitumastic coating. Analysis of pH values throughout the scrubber clearly indicated that reactive (limestone) materials were not getting into the bed area. This was due to drop-out of heavier particles of ash and lime dust in the inlet plenum below the marble bed.

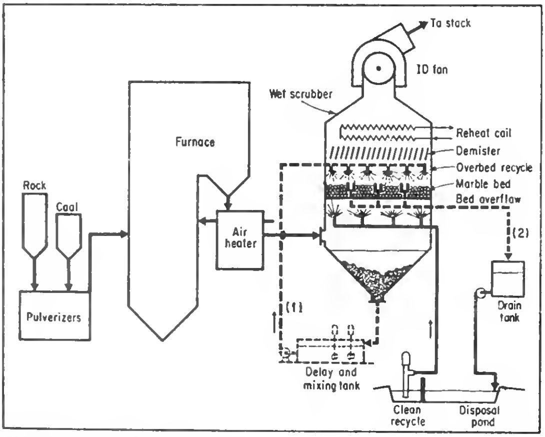
The air pollution control system on the No. 4 unit is designed to remove 99% of particulates and 83% of sulfur oxides (under conditions in accompanying table). But during initial operation the pulverizer did not reject a 1% sulfur-equivalent of pyrites from the coal-limestone mixture. Coal as fired averaged over 3% sulfur. However, concentrations of SO_2 at the scrubber inlet were equivalent to 2% sulfur coal, supporting the expected 30% reduction by furnace reaction. Conditions at the scrubber outlet averaged the equivalent of 1% sulfur coal.

Although guarantee and acceptance tests are incomplete, preliminary readings on stack discharge indicate a particulate removal exceeding 99%.

For greater removal of SO_2, a test was made of recycling the solution in the effluent tank back to the marble bed; results proved affirmative. Subsequent tests of pumping and recycling modes led to further improvement in SO_2 removal. Additionally, powdered limestone was injected at the furnace arch level (gas temperatures of 2,000 to 2,200F) for less over-burning and a more readily reactive material at the scrubber. The combination of recycling and direct injection allowed the holding of SO_2 concentration at the stack to a mean of 250 ppm during a test run of almost two days.

Based on these and other tests, it was decided by KPL in conjunction with Combustion Engineering, designer of the system, to make these changes in the handling of effluent and reactive materials:

1. Bed (or pot) overflow is piped separately from inside the scrubber to the effluent (drain) tank and then directly into the settling pond. This water has a pH of 5.8 to 6.4.
2. Spray-nozzle-reject water that falls through the plenum under the marble bed is collected in a separate delay and mixing tank, sized for about a 1-hr holding time. This water then recycles to above the marble bed where it becomes a part of the violent action of the fluidized bed.



Modifications to increase sulfur removal include (1) recycling and retention of spray reject water and (2) direct discharge of bed overthrow to disposal pond. These changes will promote reactivity between sulfur oxides and calcined limestone

From Electrical World, December 8, 1969.

The recycle solution consists of bed plate reject water and the reactive limestone and ash materials which drop directly from the flue gas stream in the inlet plenum. This recycle-detention system is expected to yield a 250-ppm further reduction in SO_2 at the stack.

Though the flue gas handling system is unchanged, KPL is installing permanent air soot blowers in the scrubber inlet to help move solid materials into the unit and to further minimize the wet-dry interface problem. Additionally, permanent air soot blowers will be installed at the reheater to keep it clean. And, unrelated to the scrubber modifications, two more air soot blowers (for a total of 9) will be installed in the furnace superheat-reheat pass to keep injected material and ash moving through the furnace. It is planned to leave 50% of the scrubber reheat surface out of service, as its effect on plume rise is not great. Remaining surface will still give a 25F reheat to keep the ID fan dry and clean.

The limestone injection system has been modified to make three methods of injection available on the 125-Mw unit:

1. Limestone and coal mixed on the belt to the bunker are pulverized and injected at all burners. This mode, planned initially, allows full-load operation of the unit, but its associated extreme calcining temperature yields the least reactive material at the wet scrubber. Also, the 1-hr detention time for the reject spray water will not result in the reactivity of all available material. Nevertheless, this mode is expected to approximate SO_2 removal guarantees.
2. Inject pulverized limestone *only* through the top burners at each corner of the boiler and coal *only* in the other burners. This method permits operation only up to 90% of full load because a pulverizer is used to grind the limestone. However, it separates the limestone feed from the main flame and thus provides more reactive material at the scrubber. It is expected that this method will meet SO_2 removal guarantees.
3. Inject limestone (pulverized independently of the unit) through separate injection nozzles at the top gas burner locations in each corner of the boiler. Nozzles will be angled to inject the limestone high into the furnace for calcining, thus minimizing overburning and providing a maximum of reactive material at the scrubber. Based on test performance, this method offers not only full-load operation but also SO_2 removal in excess of guarantee (350 ppm SO_2 in effluent gas).

For the air pollution control system being installed on the 430-Mw No. 5 unit, limestone will be pulverized in an adjacent unit. Limestone will be injected into the coolest location in the furnace as is practical to reach. Flue gas and material will follow a normal path through the furnace, i.e., from the air heater into a plenum and through six wet scrubber marble beds, the demister and reheater, and then to the ID fan and out the stack. A 25F pickup in the scrubber reheater is planned.

The bed overflow water will be separated and flow by gravity to the settling pond. Plate reject water and material collected under the marble bed will flow to detention tanks for recycling above the activated bed. It is fully expected that the system on the larger unit will be reliable, available for continuous operation, and capable of meeting SO_2 and particulate removal guarantees.

Design conditions for sulfur removal system

Coal Supply:
12,300 Btu/lb
3.4% Sulfur
12.5% Ash

Limestone injection:
13% by weight (of coal fired)

Pyrite rejection by pulverizer:
Equivalent to 1% sulfur

Furnace reaction:
20 to 30% of sulfur oxides to combine in dry furnace reaction, remainder in wet scrubber

Guarantees:
Removal of 83% of sulfur oxides and 99% of particulates

STATEMENT OF STUART WATTS, WELLMAN-LORD, INC.

Mr. Chairman, in June, 1969, Wellman-Lord presented a paper at the National Air Pollution Control Association meeting in New York City. This paper covered the economic reasons for and technical development of our potassium sulphite based SO_2 recovery system, and reported on initial results of the commercial demonstration plant for the process which is the Maryland Clean Air Project. In preparing this second report, we have for clarity recapped the June report and added the following information to bring you up to date on the status of our work.

1. A summary of results and experience on the Maryland Clean Air Plant regarding pollution control with the potassium system.
2. New information on our first full commercial plant which removes SO_2 from the sulfuric acid plant tail gas. This plant is based on our sodium sulphite system.
3. A comparison of the potassium and sodium systems and which look most promising.
4. Plans for commercialization in Japan.

Summary.—In cooperation with the utility industry and certain chemical companies, Wellman-Lord has worked on the development and commercialization of SO_2 pollution control systems for over three years. The basic technique used is absorption of the SO_2 present in stack gases in an alkali salt solution, followed by recovery of the absorbed SO_2 and continuous recycle of the solution. Development emphasis was placed on producing a salable form of sulfur as liquid SO_2, strong sulfuric acid, or element sulfur. Two technically similar absorption processes have been studied—one uses a potassium salt solution, and the other a sodium salt. Both produce SO_2 as an end product. The SO_2 can be converted to strong H_2SO_4 by standard technology, and additional investigations are underway to reduce the SO_2 to elemental sulfur or alternately produce elemental sulfur directly from the absorption process instead of SO_2. Progress to date can be summarized as follows:

1. In a joint venture with the Tampa Electric Company a one megawatt pilot plant was operated on the potassium system in April through September 1967 at their Gannon Station. Results proved the process to be chemically feasible and indicated good process economics.
2. The Maryland Clean Air Project was developed as a 25 megawatt demonstration plant for the potassium system and the plant started up in January 1969 at Baltimore Gas and Electric's Crane Station. Operating results proved decisively that this approach can remove over 90% of the SO_2, SO_3 and particulate in the flue gas and is therefore effective from a pollution control standpoint. Certain mechanical problems were encountered, particularly in the final SO_2 compression section, which limited the operating factor of the test program, but these problems were either corrected or solutions have been identified which can be employed at a future date. Based on the Baltimore operating experience an improved design for the particulate pre-scrubber is being evaluated, with the objective of removing more of the fly-ash in the pre-scrubber and less in the in-line centrifuge. The biggest disappointment was in steam economy. Low pressure steam requirements for SO_2 stripping appeared to be over twice as high as we had hoped for. Therefore, unless a solution to this problem can be developed, investment and operating costs for the potassium system will be higher than our projections from the TECO tests.
3. Early in 1968 we began preliminary studies on a sodium based absorption system. Certain advantages over potassium became apparent, particularly for small plants, and where SO_2 concentrations in the gas to be treated exceeded about 0.3 per cent. In early 1969 we evaluated both the potassium and sodium systems for reducing SO_2 emission from Olin Chemical's 700 TPD H_2SO_4 plant in Paulsboro, New Jersey. The sodium system showed significant advantages and in July 1969 we were awarded a firm price contract to install this system. Recovered SO_2 is reused in the H_2SO_4 plant and SO_2 concentration in the clean gas is guaranteed to be less than 500 ppm. Engineering design is complete and has been based on unit operation pilot tests in suppliers' laboratories . . . plant start-up is scheduled before June 1, 1970.

In summary, we can compare the design basis and operating experience of the Maryland Clean Air Plant (postassium) with the Olin Chemicals plant (sodium) and believe that the sodium design is the most economical. The experience gained at MCADP was of direct use in the Olin design and is the basis for our confidence in the sodium system. Advantages of sodium are elimination of a separate steam stripping section (reduces capital investment), lower steam usage, and a simplified over-all operation. The MCA plant has been temporarily shut down pending the results on the Olin plant. If projected performance is obtained, the sodium system will be recommended for utility application.

In addition to these projects, Wellman-Lord is evaluating two approaches for production of elemental sulfur, using the absorption process as a first step. One involves direct reduction of $K_2S_2O_5$ crystals where we have a pilot plant installed in Lakeland, and the second relates to application of provel technology for reducing SO_2 gas to sulfur. Also, negotiations are underway by our Japanese licensees (Mitsubishi and Sumitomo) to install the Wellman-Lord system which has been selected as one of three government-sponsored 150 MW demonstration units in Japan.

Abstract of Paper Presented Before National Air Pollution Control Association in New York City, June, 1969

(By Stuart G. Watt, Executive Engineer, Wellman-Lord, Inc.)

The Wellman-Lord SO_2 recovery process is based on absorption of SO_2 in potassium sulfite solution, crystallization of $K_2S_2O_5$ from this solution, and conversion of $K_2S_2O_5$ to $KHSO_3$ by dissolving the crystals in water. SO_2 is stripped from the $KHSO_3$ solution and can be used as a gas or compressed for shipment. The 3-year development program included a 1 megawatt pilot plant at Tampa Electric's Gannon Station and a 25 Megawatt demonstration plant in operation at Baltimore Gas and Electric's Crane Station. Technical and economic performance have been promising. Tests have been conducted at a metallurgical smelter and this process concept has wide application. An alternate sodium sulfite system is available. Pilot plant tests to produce elemental sulfur are in progress.

A. General Background

Wellman-Lord's basic business has been design, engineering, and construction of agricultural mining and chemical complexes and related facilities. In 1965 and 1966 we were involved in the planning stages of agricultural projects which were limited by a sulfur shortage. Although current supply/demand on sulfur shows increasing availability, we had seen price escalations of nearly 80% during the past few years. Government sources give the following quantities of sulfur potentially available from stack emissions:

Source	Sulfur (tons per year)	Percent
Coal combustion	7,014,000	61.0
Petroleum combustion	2,408,000	20.7
Other industrial (including smelting)	2,257,000	18.3
Total	11,680,000	100.0

The total sulfur consumed in seulfuric acid is about 9,000,000 tons per year, so it is apparent that an economic SO_2 recovery process could provide an effective alternate sulfur source, providing logistics are reasonable. We have mapped sulfur emission versus the H_2SO_4 use, by state, and there are many areas where emission and use are in close proximity.

Following a state of the art review of existing recovery processes, we began research in June 1966 to develop a process which would both control SO_2 pollution and recover valuable sulfur. Design objectives (and how they were achieved) were as follows:

1. *End Product.*—Should be either pure SO_2 or sulfur which have wide market acceptance, can be economically transferred over long distances, and are not tied to a single market. The Wellman-Lord process makes pure SO_2 and we have two methods in the pilot plant stages to produce elemental sulfur.
2. *Efficient Pollution Control.*—Tests to date indicate removal of over 90% of SO_2, SO_3, and fly ash leaving electrostatic precipitators (utilities).
3. *Liquid System.*—Our experience with liquid versus fluosolid systems indicates liquid is much easier to control, operate, and maintain. We, therefore, based our development on liquid scrubbing systems, which are the basis for our process.

4. *Common Chemical—Regenerative.*—Our processes are based on either KOH or NaOH as starting materials for the sulfite, which are widely available from competitive sources, and of uniform, well established quality. System regeneration is positive, in solution form, and chemical makeup is a minimum.

5. *Secondary Polution/Disposal.*—There are no solid or large liquid streams to dispose of in our process.

6. *Proven Process Equipment.*—Equipment is well proven for use in the chemical industries. The basic unit operations of absorption, crystallization, filtration, and steam stripping are involved.

7. *Variable Stack Conditions.*—The absorption process can handle varying SO_2 concentrations and gas flows because of its relatively high inherent turndown ratio.

8. *Fuel Benefits.*—Because of an economic base which favors high SO_2 production, in fuel burning units, high sulfur fuel improves economics. Similarly, when the process is used to remove SO_2 from industrial units (such as H_2SO_4 plant) where the capacity of industrial plant can be increased by permitting higher SO_2 in gas, the Wellman-Lord process can be designed to recover this higher gas strength.

B. PROCESS DESCRIPTION—POTASSIUM SYSTEM

The chemistry of SO_2 absorption in potassium salt systems has been studied for nearly 40 years with one of the basic problems being the high steam requirement to strip and recover the SO_2 from the resulting solution of potassium sulfite (K_2SO_3) and potassium bisulfite ($KHSO_3$). However, if a nearly pure solution of $KHSO_3$ could be obtained (without K_2SO_3 present), the partial pressure of SO_2 above this solution is very high and consequently the SO_2 could be stripped out with very low steam requirements. This is illustrated by the partial pressure diagram in Figure 1. Development of a simple method to obtain a pure $KHSO_3$ solution, then became one of the key points of our process. This was accomplished by developing a method to crystalize potassium pyrosulfite crystals ($K_2S_2O_5$) out of a complex potassium salt solution. The crystals are filtered and when redissolved in water give the high purity $KHSO_3$ solution required for low cost steam stripping. Our process has three basic unit operations—absorption crystallization, and steam stripping.

Absorption Section

The absorber section is comprised of a specially designed prescrubber to remove particles of fly ash, and an absorption column where the SO_2 is absorbed in the sulfite solution. Principal reactions are:

1. $2KOH + SO_2 \text{——} K_2SO_3 + H_2O$
2. $K_2SO_3 + SO_2 + H_2O \text{——} 2KHSO_3$

The prescrubber operates at low pressure drop and a water rate of less than 0.2 gpm per 1,000 cubic feet of gas treated. In utility operations, a high percentage of the SO_3 present in the gas is adsorbed on the fly ash surface and leaves with the small fly ash slurry to waste disposal. The sulfite solution absorbs over 90% of the SO_2 in the original flue gas and the gas leaves the stack at 140° F. unsaturated. The overall pressure drop across the absorber circuit is less than 8 inches of water.

Crystallization Section

The sulfite solution is cooled in a vacuum crystallizer and $K_2S_2O_5$ crystallizes out as follows:

$$2KHSO_3 \xrightarrow{\text{cool}} K_2S_2O_5 + H_2O$$

The crystals are filtered and the mother liquor is recycled to the process. The pure pyrosulfite is dissolved in H_2O to form the $KHSO_3$ for stripping.

Stripping Section

The $KHSO_3$ solution is pumped counter-currently through steam stripping columns where SO_2 vapor comes off the top of the column and the stripped solution is recycled to the absorber.

$$2KHSO_3 \xrightarrow[\Delta]{\text{steam}} K_2SO_3 + H_2O + SO_2$$

As the bisulfite is converted to sulfite, the partial pressure of SO_2 in the solution decreases very rapidly. The steam consumption for stripping is dependent on the number of stages used, but we are projecting consumption as 4 to 8 pounds per pound of SO_2. The SO_2 and steam vapor, discharged overhead from the column, are fed to a heat exchanger to condense most of the steam. Depending upon the end use for the product, the SO_2 can either be used as a gas or compressed for shipment.

C. COMMERCIAL DEVELOPMENT

The chemistry of the process described was confirmed in our laboratories in late 1966 and a program was outlined for pilot plant testing. In a joint venture with Tampa Electric Company, approximately $300,000 was allocated for construction and operation of a 1 megawatt pilot plant at their Gannon Station in Tampa, Florida. Operation began in April 1967 and was successfully concluded in September 1967. Problems with fly ash removal were recognized early in the program and a special pre-scrubber was designed to clean the gas before it contacts the solution. Basic process chemistry was demonstrated on a continuous basis and results on $K_2S_2O_5$ crystal growth were encouraging.

Successful operation at a larger scale, and on a continuous basis were necessary before any firm design could be made for a full scale utility. It was decided that a 25 megawatt unit would provide design information which could be scaled up reliably for larger power plants. The Maryland Clean Air Project was developed as a 25 megawatt demonstration plant for this process with the following participants:

The W. R. Grace Company (operates demonstration plant)
Baltimore Gas & Electric Company
Potomac Electric Power Company
Delmarva Power & Light Company
Potomac Edison Company
The Bechtel Corporation
Wellman-Lord, Inc.

The project is installed at Baltimore Gas and Electric's Crane Station in Baltimore. This $2,000,000 demonstration unit started up on schedule January 1969 and the operating and test programs conducted to date have been encouraging. Results on basic process chemistry continue to be very satisfactory and a number of design modifications have been made to improve operating factors. All unit operations have been tested through production of liquid SO_2 and optimization of the total circuit is in progress. An extensive test program in the prescrubber section has minimized problems encountered with fly ash during the start up phase, and identified methods of removing various types of fine solids depending upon their chemical composition and size distribution. Over 90% of the SO_2 has been consistently removed from the flue gas with fly ash removal as high as 98%. There have been extended test runs through production of gaseous SO_2. We are currently modifying the compression step and studying overall steam balance.

In addition to the projects at Tampa Electric's Gannon Station and Baltimore Gas and Electric's Crane Station, test work has been conducted at two other utility stations covering both fuel oil and coal fired units. These latter tests used a portable test unit of the prescrubber and absorber only. This portable unit is available for testing with other clients.

In the metallurgical area, the portable unit was tested on smelter off gases in the western United States. During a three-week test, the following results were obtained:

(a) From a 2.2% SO_2 gas stream, SO_2 recovery averaged 96%.
(b) Particulate rejection averaged 90%.

D. DEVELOPMENT STATUS

We expect to complete testing of the potassium sulfite process at the Maryland Clean Air Project within the next few months. At that time we plan to convert the demonstration unit to a sodium based circuit and continue the test program. Patents have been filed for on both processes. We are currently prepared to offer either the sodium or potassium based circuits for immediate application to small power stations, and certain industrial plants such as sulfuric acid, in those cases where SO_2 is to be used as a final product. Pending the results of continuous demonstration tests, we will be able to begin firm designs for large units by the end of 1969. We are studying two processes for production of sulfur instead of SO_2 from these systems. A pilot unit is in operation at our Lakeland office and in the first stages of testing. Feed materials for the Lakeland unit are shipped from the Maryland Clean Air Plant which permits the results to be directly related.

Summary and Acknowledgements

Following nearly 3 years of development work, the technical and economic feasibility of this approach to SO_2 recovery is being successfully demonstrated. Although there have been mechanical improvements as the program developed, basic process chemistry has been unchanged since inception. There appears to be a wide range of possible applications in the utility, industrial, and metallurgical fields as an effective pollution control system. Economics are dependent on the size of installation, the amount of SO_2 or sulfur produced, and product marketing. For medium utility stations using high sulfur fuel (or the equivalent industrial plant) we are projecting at least a breakeven cost for the operation.

Wellman-Lord is totally indebted to the utility companies who gave their full support and guidance throughout this program. Without this support and cooperation, none of the development work would have been possible. We would also like to acknowledge the financial, operating, and marketing assistance W. R. Grace and Company is providing for the Maryland Clean Air Project.

AIR POLLUTION—1970

WEDNESDAY, MARCH 18, 1970

U.S. SENATE,
SUBCOMMITTEE ON AIR AND WATER POLLUTION
OF THE COMMITTEE ON PUBLIC WORKS,
Washington, D.C.

The subcommittee met at 9:30 a.m., pursuant to recess, in room 4200, New Senate Office Building, Hon. Thomas F. Eagleton (member of the subcommittee) presiding.

Present: Senator Eagleton.

Also present: Richard B. Royce, chief clerk and staff director; Bailey Guard, assistant chief clerk, minority; Thomas C. Jorling, minority counsel; Leon G. Billings and Richard D. Grundy, professional staff members.

Senator EAGLETON. Good morning, ladies and gentlemen. The Committee on Public Works, Subcommittee on Air and Water Pollution, is now in session to continue its hearings on S. 3229, S. 3466, and S. 3546.

Our first witness this morning was to have been the Governor of Massachusetts, the Honorable Francis Sargent. Unfortunately, the Governor is ill. He will be with us at a later date, presumably tomorrow.

Our next two witnesses are from the State of West Virginia. Senator Jennings Randolph, the chairman of the full Public Works Committee, is at another committee meeting, but he will be with us later so that he can officially greet and introduce his constituents.

We will move on in his temporary absence, and call on Mr. Fred Tucker, coordinator, industrial health engineering for National Steel Corp.

STATEMENT OF FRED E. TUCKER, MANAGER, POLLUTION CONTROL AND SERVICES, NATIONAL STEEL CORP.

Mr. TUCKER. Mr. Chairman and members of the Senate Subcommittee on Air and Water Pollution:

My name is Fred E. Tucker, manager, pollution control and services, National Steel Corp.

I have appeared before this subcommittee on many occasions to present testimony for the steel industry on legislation affecting air and water quality.

I accepted with pleasure the invitation of the subcommittee of March 5 to present testimony on S. 3229, S. 3466, and S. 3546 presently being studied by your committee.

I can well remember when hearings held on this subject before this committee went virtually unnoticed. Your committee is to be commended for its foresight in anticipating national problems of air and water quality long before the press or the public shared your concern.

Legislation approved by your committee many years ago, although heard in virtual public silence, has served the Nation well and prepared it to meet today's challenge.

Your efforts have also given us in industry who support air quality control an opportunity to learn and prepare for today's challenge.

As early as 1965, the steel industry went on record supporting environmental control legislation under study by the committee. My statement today will be a positive one in support of legislation to control and improve air quality in the United States.

Although I am aware of my industry's progress in environmental control and note with pride an investment by steel companies of over $1 billion in air and water quality control equipment, I will spend little time in reflection on these accomplishments.

It should be recognized, however, that with the tremendous costs involved for the required equipment to bring about pollution control, special tax treatment should be afforded industry for this equipment.

The facts facing this committee today are that air quality in many areas of this country needs to be improved to meet public health and welfare criteria and that the people of this Nation look to Congress to provide legislation which will effect such improvement.

Quite frankly, I have not had sufficient time since invited to appear, to examine in detail the legislative proposals before your committee.

For this reason, I will limit my discussion to several basic questions embodied in these proposals and request permission to submit additional statements later for the record on more specific items in the legislation.

Senator EAGLETON. We will make a part of the record, when received, any additional material or statement you would like to submit.

Mr. TUCKER. Thank you.

The points in the legislation I will speak to today concern national air quality standards, national emission standards, penalties, class action suits, and limitations on Federal contracts.

NATIONAL AIR QUALITY STANDARDS

We support in principle the provisions of Senate bill 3466, section 107, for the establishment of National Air Quality Standards.

In 1967, our industry supported the provisions of S. 780, sponsored by this committee, and later passed as the Air Quality Act of 1967, which provided that the Secretary of HEW establish air quality criteria to be used as guides for the States to adopt air quality standards in the various air quality control regions.

This concept, although legislatively sound, may well result in utter chaos as a means of establishing air quality standards in these regions.

First, in an interstate region affecting two or more States it is necessary for these States, meeting separately in public hearings, to adopt air quality standards.

This is not only time-consuming for already overburdened State staffs, but leads to controversy between the States if disagreement occurs between standards.

Second, and perhaps most damaging, has been the appearance at most hearings of groups of well-meaning but highly emotional, overzealous and sometimes uninformed persons who seem to be playing a numbers game with air quality standards.

For example, after much responsible study by Federal scientists, a basic air quality criterion of 80 micrograms per cubic meter annual average for suspended particulates, was recommended by the Department of Health, Education, and Welfare.

Such a criterion is strict but can probably be achieved in most metropolitan areas by enactment of properly tailored and enforced State or regional emission standards as prescribed by the Air Quality Act of 1967.

Then the numbers game began with one State reducing the number to 75, then 70, and finally 65 in Cleveland, Ohio, recently following a near-riot at its air quality standards hearing.

I recently read a publicity release from a so-called Breathers Alert Lobby in another region saying "Cleveland got 65—let's go for 60."

The question is where will it all end and what will happen when regions set these standards and are then frustrated to find they cannot be met regardless of the emission controls adopted and met.

In regions with no industry and few inhabitants levels of 30 to 50 micrograms per cubic meter are common.

S. 3546 strives to close some of the gaps in standard-setting procedures but does not go far enough to solve the basic problem.

In my testimony before this committee in 1967, I said the following:

> The Clean Air Act gave HEW authority to formulate air quality criteria. This authority . . . logically belongs with a national agency. Adverse air quality that affects the health of people in Washington, D.C., will have the same effect on people living in Chicago, Charleston, Hawaii, Detroit or any other area of the United States.

Today, we hold the same opinion but in light of recent events, recommend that this legislation go one step further and give HEW authority to set air quality standards for all contaminants.

EMISSION STANDARDS

We oppose all reference to Federal emission standards for stationary sources found in section 112 of S. 3466. We are well aware that this provision is intended to apply only to sources which "contribute substantially to endangerment of the public health or welfare."

Such a limitation, however, is difficult to interpret depending as it does on a subjective definition of words such as "substantial," "endangerment," "public health," and "welfare."

We are convinced that this would lead to national emission standards for all stationary sources.

It should be pointed out that our position on national emission standards is not a protective one. Some areas of the country require more restrictive controls than others to meet a specified air quality.

Just like the automobile, the "speed limits" on air pollution source control must be adjusted to suit a specific environment.

On our new interstate highways the car is permitted to travel at 70 miles per hour, as it enters secondary roads, it is reduced to 50, and on down to 15 miles per hour in school zones. The car itself is no more or less hazardous on the superhighway than in the school zone; it hasn't changed one bit. The environment in which it is located, however, has changed, and, thus, we decrease or increase speed limits to suit the environment.

The same reasoning should apply to stationary air pollution sources. Control of the source should be dictated by the environment, not the source. Some regions of the country will require much more restrictive emission controls than others to assure a standard air quality.

For these reasons, we believe the present procedure for States in air quality control regions to supply implementation plans, including emission standards, should be continued and given a fair chance to work before we embark on new procedures for source control.

If we continue to draft and pass new legislative procedures before existing procedures have a reasonable chance to work, we will never develop workable procedures for air quality control.

To my knowledge, no regional implementation plan has been approved, let alone given a chance to work, since passage by the Congress of the 1967 Air Quality Act.

In our opinion, present provisions for regional emission standards based on the needs of that region will work; we request that you give them a chance to do so.

Section 108(i) of S. 3546 requires certification by the Secretary of new installations based on source control regulations issued by the Secretary.

From a practical point of view, we see no way in which such a provision can be implemented.

Judging by past experience, if the Secretary would do nothing more than develop air quality standards, he would have his hands full. For at least 5 years, the Secretary has had authority to issue air quality criteria. During that period he has issued only two criteria documents: One for suspended particulates and a second for sulfur oxides.

I understand, incidentally, Mr. Chairman, that three more documents were issued earlier this week.

To expect the Secretary to review and approve the thousands of new buildings, structures, or other facilities subject to air quality standards installed monthly in the United States would require staffs of trained engineers which are simply not available. Most State staffs are either prepared or getting prepared to perform this function.

State staffs should be permitted and required to certify that all new installations will met emission standards established for their regions under the Air Quality Act. Many States already require such certification.

PENALTIES

Both S. 3466 and S. 3546 provide severe penalties for failure to respond to provisions of the legislation. S. 3466 provides penalties for violation of air quality standards under section 113 but only when such violation results from failure to meet the States' or Secretary's implementation plan.

A fine of $10,000 per day seems unnecessarily severe. The procedure proposed for levying fines under S. 3466, section 113, is preferred to that found in S. 3546.

S. 3546, on the other hand, prescribes a procedure for penalties which is extremely complicated and somewhat confusing. It provides fines starting at $10,000 and 6 months in jail and progresses on up to $50,000 per day and 5 years imprisonment.

Section 4(10)(b), page 13, of the bill, provides fines up to $25,000 per day for anyone who "knowingly violates any air quality standards."

I submit that unless you have a situation involving a single pollution source, no one knowingly or unknowingly violates air quality standards.

Penalties can only be enforced on the basis of violation of implementation plans or emission standards, not air quality standards. Air quality is a measure of the sum of all sources in a region and usually cannot be identified with any single pollution source.

If such severe penalties must be assessed, then let them be based on matters which can either be proved or disproved on specific facts, not the circumstantial evidence of a violation of air quality standards.

S. 3466 offers a simple, direct penalty procedure which can be easily enforced by Federal or State control agencies.

We believe that section 4(13) of S. 3546, which provides for private civil actions, is inconsistent with the entire rationale of the other provisions of the bill and is subject to several legal objections.

Likewise, we feel that section 5 of the bill is objectionable because it fails to provide procedural safeguards and is unnecessary and inconsistent with the overall purpose of the act.

I am not qualified to comment on these points but our lawyers are preparing a legal brief which we respectfully request be subsequently submitted for the record.

Senator EAGLETON. As stated earlier, any additional material, either statistical, factual or legal, will be made part of the record.

Mr. TUCKER. Thank you.

In conclusion, Mr. Chairman, I would like to make it clear that we have no desire to discourage strong legislation for Air Quality Control.

We want controls which will provide air quality in all areas of the United States which will adequate protect the health and welfare of all the people.

Bills pending before your committee today, however, are so complicated and designed to cover so many and varied conditions that if passed, they may actually retard air quality control.

Many State agencies complain today that so much of their staff's time is devoted to hearings, testimony before commissions, and the like, that they have little time left to control pollution. I know that this problem exists for industry.

We have so many regulations and regulatory bodies to satisfy already that we sometimes have little idea whether what we are doing meets all existing requirements.

We have a Federal Air Quality Act on the books right now which hasn't even begun to be implemented, and we now consider new legislation to replace that which has not been given proper chance to work.

If for some reason you must draft new legislation, we implore you to make it direct, simple, and effective. This is one of the reasons why we propose national air quality standards. The Federal agency in HEW is competent and staffed to meet this function. It is not staffed to draft or enforce regional emission standards or to certify construction plans for new control facilities in addition to air quality standards.

Once the States are relieved of any responsibility to draft air quality standards, they are, or can be made capable to adopt and enforce regional emission standards and approve construction plans to meet these standards.

Proposals for punitive fines and public suits are extremely complicated and restrictive. As you are well aware, once our courts become clogged with legal actions of this type, actual air quality improvement can be delayed for years.

A simple provision for fines against failure to meet implementation plans seems adequate to assure completion of control facilities and their continued efficient operation.

Specifically, we propose national air quality standards, State plans for implementation, including emission standards on a State or regional basis, penalties based on violation of implementation plans, State certification of equipment, and a general simplification of procedures for air quality control.

My comments today were intended to suggest ways to simplify this procedure and not in any way to weaken or delay action. We are ready to meet our responsibility for air quality control wherever we operate steelmaking or processing plants in the United States.

Senator EAGLETON. Thank you, Mr. Tucker.

So as to clarify the record, are you speaking, sir, for your immediate employer, the National Steel Corp., or are you a spokesman for the steel industry in general?

Mr. TUCKER. I am speaking as an employee of National Steel Corp., but, as in the past, we have endeavored to get the support of this statement by other steel companies. Unfortunately, in this case, we didn't have adequate time to contact all of them.

But I can say that a major percentage of the steel industry has reviewed this statement and does support it.

Senator EAGLETON. Can I be a bit more specific? Would this statement be endorsed by United States Steel, Jones-Laughlin, Bethlehem, Republic, Kaiser, Inland?

Mr. TUCKER. Hoping that I don't leave any companies out, I have contacted United States Steel, Bethlehem, Republic Steel, Armco, Wheeling-Pittsburgh Steel, Youngstown Sheet & Tube, Jones & Laughlin, and, of course, my own company, and they do support the testimony.

Senator EAGLETON. Have you contacted Granite City Steel?

Mr. TUCKER. Not as yet, sir.

(Since giving the statement endorsement has been received from Granite City Steel.)

Senator EAGLETON. That is near my State. I am quite parochial.

Mr. TUCKER. They will be contacted tomorrow and I am reasonably sure that they will support the statement.

Senator EAGLETON. I find this curious in your statement: So often I hear from industrial spokesmen and commercial interests telling me that they want the Federal Government to keep out of various things.

For instance, you are from West Virginia. When we started on the Coal Mine Safety Act, we were told by the coal operators at first to leave it in the hands of the States, that they know how to handle these things, that they are more familiar with the problem, and that Washington is too remote to make a decision binding on West Virginia and Pennsylvania.

I am hearing now, for instance, from the insurance industry, telling me that it would be dangerous for the Federal Government to get involved in insurance; that the States are doing a bangup job in insurance; that they are really good regulators. Unfortunately, some of these companies are going under.

That is just one of those things.

Yet, in this instance, at least as far as National Air Quality Standards are concerned, industry—a significant portion of the steel industry in particular—wants the intervention of the Federal Government.

To me that is curious. Do you find that curious?

Mr. TUCKER. I can easily understand how you would find it curious, Senator. I hope that our industry is big enough to maintain a flexible policy in looking at various legislation that is presented to us.

We have, unfortunately, seen a number of delays occur in the implementation of the Air Quality Act since its passage in 1967.

We supported that act, and so we must share the blame for any delays that were built into the legislation.

We simply feel that the adoption of the air quality criteria papers presented to date as standards would speed up the implementation of air quality control.

We have invested, as an industry, roughly a half billion dollars in air quality control equipment. A large number of those installations have been made in very recent years.

We have no idea, Senator, whether they are going to meet the emission standards that will be adopted or not. If they do not meet them, then we perhaps have wasted a good deal of our limited financial resources in order to install these facilities.

We would like to get on with the work of air quality control. We would like to see the establishment of standards on air quality, and we would like to see the implementation of emission plans and schedules so we would know where we have to go.

We are getting quite confused as to what we should do where, whether we are doing what needs to be done, and we would like answers to these questions. We think those answers should be coming very shortly.

Senator EAGLETON. Let me pick up that thread from your statement. In it you say:

> Bills pending before your committee today, however, are so complicated and designed to cover so many and varied conditions that if passed, they may actually retard air quality control.

Let me submit to you this: You recommend that we scrap one of the basic premises of the 1967 act, and now in 1970 go to national air quality standards.

We are at the threshold now of the 1967 act gaining implementation. Many regions have filed their standards and many are now in the process of filing their implementation plans.

So we are on the threshold of something really being done, 3 years, albeit, after the inception of the act in 1967.

If we scrap that now and start all over again with national air quality standards, with what I deem to be the built-in delays that are in sections 107 and 108 of the administration bill, I think it will be another 18 months to 2 years before we are at the point of implementation.

I agree, in part, with that excerpt from your statement, but your basic recommendation that we go to national air quality standards will, I believe, delay us, perhaps as much as 2 years.

What do you think?

Mr. TUCKER. If there are delays built into S. 3466, and I quite honestly have not had time to study the language in detail, then I respectfully suggest that you wipe them out. We have air quality criteria documents available today. In my statement I said two, and yesterday I heard there were five, and I hear there will be nine by the end of the year.

I see no reason why these could not be immediately adopted as national air quality standards.

If we get confused about the terms national air quality standards and national air quality criteria as the testimony indicated yesterday, perhaps we should find a new word. But there is no objection on my part as an industry representative to see those criteria adopted as national standards immediately, and this would provide that all of the regions could get on with the job of adopting implementation plans and emission standards and not have to go through this time-consuming effort of hearing each and every one of these national air quality standards.

I don't think there are delays if the legislation is properly drafted. I submit that it may not be now.

Senator EAGLETON. As I read the administration bill, it repeals the provision whereby HEW promulgates the standards that you are talking about.

Mr. TUCKER. I believe it repeals the promulgation of criteria.

Senator EAGLETON. And the implementation.

Mr. TUCKER. It is simply, I think, a play on words, Senator. They would now draft, instead of criteria documents, standards documents. They mean almost exactly the same thing.

Senator EAGLETON. We went around and around on that yesterday. There is, from a semantic point of view—and I trust it is also from a philosophical point of view—a difference between a criteria and a standard.

Dr. Middleton and others were trying to articulate that benign difference. At least, they feel there is a significant difference between the two.

Do you interrelate and couple them all together; that is, criteria being the same thing as standard.

Mr. TUCKER. I do. I have read the criteria documents that have been issued to date. To me, they have enough safety factors built into them to protect the health and welfare of the public so that they could be interpreted as standards.

I agree completely with your statement that the difference is benign. I think there is a very, very slight difference between a criteria document and a standards document.

Senator EAGLETON. What level of standard do you want to see adopted nationally? Let me be more specific. Take the two levels that have already been published, and now roughly five. A few more are coming down the pike later on. Stick with any one you are familiar with.

As you know, when they publish the criteria, they say at "this" level it is dangerous to humans, and at "that" level it is not dangerous to human health, but it is dangerous to plant life.

At still another level it is not dangerous to human health and plant life but it affects environment.

I can't spell it all out, but as you know, they have varying levels. What kind of a national level do you want to see established?

Are you satisfied with one that is just good enough for human health, or do you want one which would extend beyond human health considerations?

Mr. TUCKER. I certainly would want to do a more complete job than limit our standards setting to straight human health. I don't think that HEW has done that. I respect their staff. I respect Dr. Middleton very much as an administrator and as an expert in air pollution control.

I am willing at this point to respect his judgment on what an acceptable standard for these particular contaminants would be.

I think they did an excellent job with the first two criteria documents that I studied. I am certainly not expert enough in the health effects or the welfare effects of air pollution to be very critical of them.

I am willing to accept HEW's judgment in this matter with the option, of course, as always, that we have an opportunity to comment on the papers.

Senator EAGLETON. Do you admit to the possibility that conditions can vary from region to region or area to area, atmospheric conditions, environmental conditions, humidity, and so forth?

The point I am suggesting, of course, is that if you have a national standard it might be good enough and workable in region X, but because of conditions indigenous to region or area Y it might not be satisfactory.

Is that at all possible?

Mr. TUCKER. That is very possible and one of the reasons why we recommend the establishment of State or regional emission standards.

As far as air quality standards are concerned, drafted to protect the health and welfare of the public, it really doesn't matter, Senator, whether you are in Pittsburgh or Chicago or Kansas, or where you may happen to be.

If a certain contaminant makes your eyes water, it will make them water in any one of those cities; or if it affects your health in any way, it will affect it regardless of where you are.

So I think national air quality standards should be approved, and that State or regional emission standards should be adopted to control the emissions in a particular area dependent upon environmental conditions.

Emission standards do need to be different and flexible.

Senator EAGLETON. Somewhere in your prepared statement, Mr. Tucker, you say, "For example, after much responsible study by Federal scientists, a basic air quality criterion of 80 micrograms per cubic meter annual average for suspended particles was recommended by the Department of Health, Education, and Welfare."

We are not aware of that criterion. Do you have a copy of it?

Mr. TUCKER. I do not have a copy of it with me, but that is in their suspended particulates criteria document.

Senator EAGLETON. We are just not aware of any recommendation by the Department of HEW along the specific lines you have stated in that sentence.

Mr. TUCKER. We would be happy to supply it for the record, if you would like.

Senator EAGLETON. You have spelled out on page 3 the agonies that you have had with people who want to clean up the air in Cleveland and other cities. You want to get away from that because it is a nuisance in your Department, I guess.

Do you support public participation in regional emission and implementation plans?

Mr. TUCKER. I think public participation at that point, Mr. Chairman, will be necessary. The people in these regions are going to have to decide what type emission standards they want. I heard Miami mentioned yesterday. Perhaps a city such as Miami would like to have much better air quality than anybody else to satisfy their tourist trade.

If in the judgment of the people who live in Miami they should exempt industry from that particular part of the country or exempt anything else that contributes to air pollution, that is a judgment that they should make.

I certainly do not object to them participating in that decision.

Senator EAGLETON. Let me carry you one step further. If, as you say, the public should participate in that facet of this undertaking, how does that square with your opposition to civil action, class action suits, and so forth, by the public, to enforce those very standards?

If the public is to have the right to show up at a hearing and be heard, be it in Miami or elsewhere, to participate and make suggestions on the kind of air they want in their community, and then those standards are set, why shouldn't the public have the right to follow up on that hearing and bring legal actions if they think the standards are not being enforced?

Mr. TUCKER. As I said in my statement, Senator, I am not at all qualified to talk about class action suits. I will supply more information on that. The thing that I am basically concerned about, in looking at the legislation, is we would like to see legislation that is simple and effective and can get on with the job of air quality control as soon as possible.

If we garble that legislation and confuse that legislation by a lot of extraneous requirements and provisions, I see nothing but a lot of frustration on the part of both the public and industry for many years to come as to how quickly we can implement these bills.

We would like to see this job done and done soon. I am afraid that a good deal of the language that is being suggested in the legislation will do nothing but slow it down.

Senator EAGLETON. In your prepared statement you say:

Penalties can only be enforced on the basis of violation of implementation plans or emission standards, not air quality standards. Air quality is a measure of the sum of all sources in a region and usually cannot be identified with any single pollution source.

I call your attention to the Muskie bill, S. 3546, page 5, subsection (c) and subsection (c) (4) thereof.

"Such standards and plan or revisions thereof, shall be the air quality standards applicable to such region or portions thereof if the Secretary determines that," and down to sub (4), "such plan includes emission requirements necessary to implement such standards of air quality."

So that makes the standards and the emission requirements enforceable, as I read it, under the Muskie bill.

Can you comment on those two portions of the bill in light of the statement that you make on page 7?

Mr. TUCKER. I must admit I am a little confused about this language. I tried specifically last night to read it and clarify my own position on this.

Under the existing act, for example, the Secretary sets air quality criteria. He also establishes air quality control regions.

Following 90 days, the States file a letter of intent and within 180 days they establish air quality standards. Then they have an additional 180 days to submit a plan of implementation.

Senator EAGLETON. Correct.

Mr. TUCKER. For this reason, and also even with this language which you have just read to me, which I admit ties the thing a little closer together than it did in the original act, I still think enough confusion exists that we should be quite specific in where the fines are going to be applied.

I do not believe that the language in S. 3546 is sufficiently specific to identify where you do apply the penalty to the act itself.

Senator EAGLETON. Perhaps the language should be tightened up. You are in favor of tightening it up, I take it?

Mr. TUCKER. Yes; I am.

Senator EAGLETON. Do you have objection to the imposition of substantial and significant fines for violation of standards with respect to excessive emissions?

Mr. TUCKER. I object to some of the fines that are laid out in the two pieces of legislation before us today. I think they are a little excessive. Perhaps not for some of the bigger industries, but certainly for some of the smaller industries.

I realize the language says "up to" that figure. With that in mind, I really would not prefer to take a position on the fines.

Senator EAGLETON. I think the administration bill says "up to."

Mr. TUCKER. That is right.

Senator EAGLETON. The Muskie bill doesn't have that degree of gentility.

Mr. TUCKER. I didn't realize that, sir.

It says "by a fine of not more than $25,000," which I assume to mean the same thing.

Senator EAGLETON. The Muskie bill?

Mr. TUCKER. Yes. That is on page 13. On page 14 it says "by a fine of not more than $50,000."

Senator EAGLETON. I stand corrected.

Thank you, Mr. Tucker.

Mr. TUCKER. Thank you, sir.

Senator EAGLETON. Our next witness is Dr. Benjamin Linsky, professor, air pollution control engineering, department of civil engineering, West Virginia University, Morgantown, W. Va.

STATEMENT OF BENJAMIN LINSKY, P.E., PROFESSOR IN AIR POLLUTION CONTROL ENGINEERING, DEPARTMENT OF CIVIL ENGINEERING, WEST VIRGINIA UNIVERSITY, MORGANTOWN, W. VA.

Senator EAGLETON. May I say to both Mr. Tucker, who has just left the witness table, and Professor Linsky that it is just impossible for Senator Randolph to be present in this hearing room at this time because he is involved in another very important hearing which he cannot leave. He apologizes and extends his best wishes to both of you. He hopes you understand.

Mr. LINSKY. Senator Eagleton, it is my pleasure to be before you. I hope that two of my graduates who are working in the State of Missouri have been serving you well, Mr. Auberle and Mr. Marshall.

I am professor of sanitary engineering (air pollution) at West Virginia University in the department of civil engineering.

I have been engaged full time in air pollution control engineering and control program development and administration since 1948.

From 1951 to 1956, I was head of the city of Detroit's official air and noise pollution control agency.

From 1956 to 1963, I developed and directed the official San Francisco Bay area's regional air pollution control district, covering six counties and 70 cities.

When, as an agent of social change, I was used up, I left to teach and train others who would be younger, and hopefully better, because they would receive deliberate distilled experience and selected course content regarding air pollution control engineering and program administration.

I was the 50th President of the National Air Pollution Control Administration in 1956, and a member of the U.S. Public Health Service Surgeon General's first National Advisory Committee on Community Air Pollution Control from 1957 to 1960. I now serve on the National Air Pollution Manpower Development Advisory Committee of the National Air Pollution Control Administration.

While I was in California, from 1956 to 1963, I served on almost all of the advisory committees to the State legislature and the State department of public health in drafting their motor vehicle pollution control laws and standards (limitations) for atmospheric pollutants and emissions.

I started the air pollution committee of the National Association of Counties and hold memberships in a number of other national and regional, technical and other, voluntary organizations concerned with bettering and protecting the physical environment, and especially its atmospheric environment.

I am also a member of Editorial Advisory Board of the International Journal on Atmospheric Environment.

The American Public Health Association has me serving as chairman of one of its committees on air pollution, and as a member of another of its committees on the same subject.

I serve on the air pollution measurements committee and the planning and zoning committee of the Air Pollution Control Association, National Society of Professional Engineers and vice presidency of its West Virginia Morgantown chapter; American Public Works Association and presidency of the West Virginia chapter; American Institute of Planners (affiliate membership); American Meteorology Society; American Society of Government Industrial Hygienists; American Society for Engineering Education; American Society for Public Administration; American Academy of Environmental Engineering; American Academy of Industrial Hygiene; Public Affairs Conference of West Virginia; American Academy for the Advancement of Science; Izaak Walton League of America; American Society of Planning Officials; the Civil Engineering honorary Chi Epsilon; the Engineering Society of Detroit; Engineers Club of San Francisco; San Francisco Press Club; and others.

I received my bachelor of science and master of science degrees in mechanical engineering from Wayne State University in Detroit and the University of Michigan, Ann Arbor, and have held appointments as special lecturer and teacher at the University of California, Stanford University, and Wayne State University.

I am chairman of the technical committee that has been advising the State of West Virginia and the Federal Government on its study, just being printed, of air pollution in the Kanawha Valley, Charleston.

This study has resulted in the enactment and preparation for future enactment of regional and statewide air pollution control regulations by the State of West Virginia Air Pollution Control Commission.

I also serve as an editorial consultant to the Maxwell Reprint Co., a division of Maxwell Scientific International, Inc.

Senator EAGLETON. It will show in the record that you are a nationally recognized, sanitized version of Art Carney.

Mr. LINSKY. Thank you.

The information I have prepared for you is consistent with my intent to help you restore clean air to our cities, towns, and rural countryside, while fully retaining and expanding our standards of living.

The added costs to the national economy's production, the added costs to the regulatory Government tax budgets, and the added costs to each citizen-consumer are so small that the air pollution control officials and the "aware" editors who are caught up in the bitter battles with resisting polluting industries have been reluctant to tell the general public or their elected representatives how cheap it really is to have clean air, lest they endanger their own jobs or limit their opportunities for promotion.

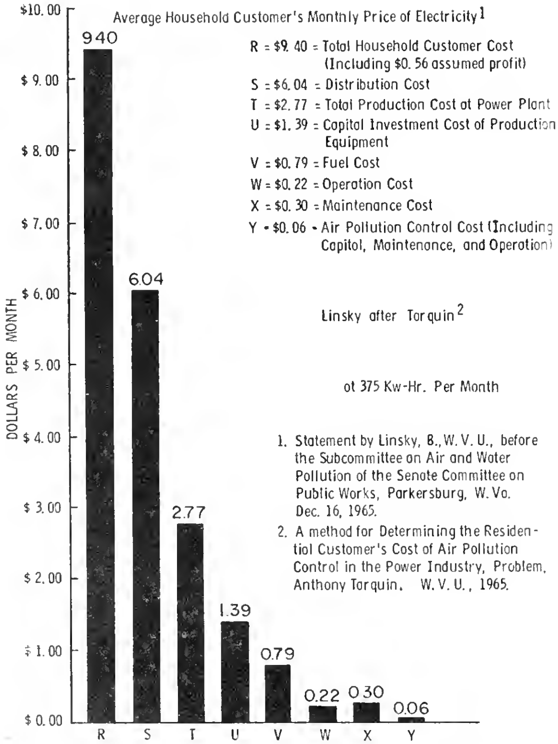
One suggested solution for the air pollution control official's dilemma might be to provide a "carry along" pension system similar to that available to city managers, or to college faculty members who are encouraged, when younger, to move in order to broaden their knowledge, and when older, to move in order to spread their wisdom in other colleges and universities.

The dilemma of the man in the middle of a public controversy who can only find employment in large organizations is obvious when he begins to plan for his future and that of his family.

As to the editors who have been hanging back—I trust that the open competition of the freedom of the press will meet this. The example of consistent failures and refusals to carry the "It only costs a few cents" story will be discussed more fully, using the two Federal reports on "Costs of Clean Air," my own 1965 report to this committee regarding cleanly produced electricity, and my 1965 report to this committee regarding the very large profit value of even 1 year's deferment in air pollution control installation.

Each year's deferment is worth about $250,000 to $300,000 for stalling the installation of $1 million of air pollution control equipment. Even so, the added retail cost is usually less than 1 percent to the consumer.

This chart, which I present here, was prepared for you and illustrates electricity production in St. Louis, Mo., with the cost as of a few years ago.



This is the air pollution control cost of the best fly ash control equipment that you could buy at that time in relation to the retail price of electricity in St. Louis of an average household.

It is about 6 cents a month.

Senator EAGLETON. I hate to interrupt, but could you explain this chart to me a little further? I am not very good with figures.

Mr. LINSKY. I will be pleased to. The $9.40 is the retail delivered price of electricity for a customer that uses about 375 kilowatt hours a month.

The $6.04 is the cost of owning and operating the distribution system, administering and metering, meter reading, and so forth.

The $2.77 is the cost of the electricity at the gates of the power plant, the so-called bus bar cost. That includes the value of the capital and everything else.

The 79 cents represents the cost of the fuel that went in to make up that $9.40 worth of electricity.

The 6 cents represented the cost of good fly ash control equipment then available.

Senator EAGLETON. On the 6-cent figure, would that be as you view it, triple X special pollution control equipment doing a really bang-up job?

Mr. LINSKY. That was only for fly ash.

In the newest report, the second HEW report of January 1970 on costs of clean air, which has just been delivered to you, I believe you will find the figure for electricity running about 40 or 50 cents now for well controlled sulfur dioxide and everything else we know how to do.

Senator EAGLETON. Let us take the high figure of 50 cents. If you add 50 cents to $9.40 could you really do a thorough job in the public interest?

Mr. LINSKY. Yes, the best job anyone could possibly think of doing at this time, or even in the next 5 years.

Senator EAGLETON. That is strictly air and has nothing to do with the picture for water pollution?

Mr. LINSKY. With regard to a powerplant's thermal pollution, that is a subject in which I am not expert, but into which I have looked sharply.

The best information I can find is that it would add about 50 cents to a family's monthly electricity bill, to get rid of thermal pollution entirely by going to dry, mechanical cooling towers.

Senator EAGLETON. That would be another 50 cents, if your figures are borne out, to do both air and water, perhaps making it $10.40.

Mr. LINSKY. Yes. This is for one of the commonly located, inherently polluting operations.

It has, in recent years, been difficult for you to meet organized pressures from large polluters who wish to walk you away from the obvious public desires for unpolluted air.

They try to focus you only upon toxic and hazardous to human health pollutants and effects.

As a professional engineer who is licensed to practice the profession of engineering because of responsibilities for health, welfare, and safety, it is proper to call for a greater safety factor whenever there is doubt or differences between specialists, as is true in the case of medical researchers into air pollution illness and toxicity.

In the criteria documents are the best statements, without a safety factor built in, of what professionals have found, have reported, and which have been considered worthwhile enough by the review committees to be included.

They do not contain safety factors beyond that.

Senator EAGLETON. Are you recommending that with whatever standard is set, by whatever method is used, that there will be an x percent safety factor because distinguished, sophisticated experts are not in precise agreement on the figures?

Mr. LINSKY. Yes. In engineering we call the safety factor and the ignorance factor the same thing between ourselves when nobody is listening.

In addition to the illness and toxicity, people resent the other malifits as much as, or more than, they fear impairment of their health.

There are at least seven other types of man-induced undesirable air pollution effects:

1. Annoyance to senses, including malodor and eye irritation.
2. Soiling of surfaces, light or dark.
3. Interference with visibility, in the absence of clean, natural fog. These hazes, when damp, are called sooner fogs, reminiscent of the land rush cheaters. They probably should be called sooner or later because they last longer, too, than if the air pollution were not there.
4. Sky darkening.
5. Injury to vegetation including reduced yields per acre.
6. Other property damage, including rubber cracking, corrosion, paint damage, and rotting fabric.
7. Interference with production, services, or social activity such as flying, outdoor sports by children and adults, precision production, commercial baking of cakes and cookies—

You can imagine how they would taste and smell if made near an uncontrolled foundry—and close eye work such as in the needle trades. Such polluting industries also chase out and keeps out modern clean industries. Varian, for example, moved about 20 miles to another city, from San Carlos to Palo Alto, Calif.

Any one of the eight types of undesirable effects of air pollution cause uninvited stresses in people who then seek, and are willing to pay for, displeasure avoidance, to the extent they think they can obtain it without economic ruin.

In the past, they have been short changed of information as to how inexpensive it is to control air pollutants—how few pennies it takes when they pay for something made in a non-air-polluting way and for non-air-polluting use.

TWO TYPES OF GOVERNMENTAL FUNCTIONS AND BUDGETS

You, as legislators, and your constituents would probably also be helped if more people understood more clearly the distinction between (1) regulatory Government functions, and (2) owning and operating governmental functions.

These two generally different types of governmental function result, as you know, in two different types of budgets, taxes, and service fees in Federal, State, and local governments.

Regulatory Government functions include police, fire prevention, building code enforcement, and air pollution control agency work.

These are different and far smaller than the owning and operating Government functions which includes public schooling, construction and operation of roads, bridges, and airports, and TVA steam powerplants, and so forth.

The operating functions resist and cause conflicts with air pollution regulatory agencies just as the regulatory agencies meet resistance and conflicts from privately owned industry polluters.

The same conflicts exist between the air pollution control agencies under the ministries of production in Communist countries, and health, as we learn from their air pollution specialists when they visit here.

The leverage of control agency budgets, at $1 per capita per year, can be several hundred dollars of control capital investment and an annualized added price of $50 per year is so far for all the things consumers buyers.

Information should be clearly provided for your use and for the public at large so they can see more easily that the regulatory work they want to see done costs only a very small addition to their tax payments, while the cleaning up of Government operations, just like the cleaning up of non-Government air polluting sources also usually adds only a very small percentage to the costs of their construction and operation.

Table 3–9, included here, gives some cost ratios with added air pollution cost per dollar of shipment shown, as a percentage of price at the plant.

(Table follows)

TABLE 3-9.—EXPECTED ANNUAL CONTROL COSTS RELATIVE TO CAPACITY AND SHIPMENTS OF INDUSTRIAL PROCESS SOURCES [1]

[1967 base; 100 metropolitan areas]

Type of source	Source totals			Cost ratios	
	Capacity (millions of units)	Value of shipments (billions of dollars)	Annual control cost (millions of dollars)	Cost per unit of annual capacity (dollars per unit)	Cost per dollar of shipment (percent)
Kraft (sulfate) pulp plants......tons..	4.1	0.4	2.5	0.61	0.63
Iron and steel plants......tons raw steel..	116.0	10.5	204.0	1.76	1.94
Gray iron foundries......tons castings [2]..	10.0	1.7	49.1	4.91	2.89
Primary nonferrous metallurgical plants.....tons [3]..	3.4	.6	23.5	6.91	3.92
Sulfuric acid plants......do....	24.4	.2	2.2	.09	1.10
Phosphate fertilizer plants......tons P_2O_5..	3.5	.4	5.5	1.57	1.39
Petroleum refineries......barrels..	2,530.0	13.5	1.4	0	.01
Asphalt batching plants.....tons paving mixture [4]..	250.0	.6	18.6	.74	3.10
Cement plants......barrels..	279.0	.6	5.7	.02	.95
Lime plants......tons..	9.6	.1	.5	.05	.50
Coal cleaning plants......do....	61.4	.3	.5	.01	.17
Petroleum products storage plants.......gallons [5]..	5,140.0	9.8	0	0	0
Grain mills......tons..	43.9	3.7	7.9	.18	.21
Grain elevators ......bushels [6]..	1,330.0	(7)	7.5	.01	(7)
Varnish plants......gallons..	52.0	.1	.8	.02	.80
Rubber plants......tires and tubes..	170.0	2.5	2.5	.01	.10
Secondary nonferrous metallurgical plants....tons..	2.4	1.4	11.9	1.96	.85

[1] Costs for controlling particulate, sulfur oxide, hydrocarbon, and cabron monoxide emissions from facilities operating in calendar year 1967. The areas are defined in app. I.
[2] Capacity is calculated assuming 1,000 operating hours per year.
[3] Tons applies to copper, lead, zinc, and aluminum smelters; for copper and lead, capacity is input material.
[4] Capacity is calculated assuming 1,000 operating hours per year.
[5] Capacity is in million gallons of gasoline storage space.
[6] Capacity is in million bushels of storage space.
[7] Not applicable.

Source: National Air Pollution Control Administration; taken in full by Linsky from "The Cost of Clean Air," 2d Report of the Secretary of Health, Education, and Welfare to the Congress of the United States in compliance with Public Law 90-148, January 1970.

This percentage cost is not for a finished product, but for a comparatively basic material, except for rubber tires and tubes. The highest ratio was for sulfuric acid plants at 3.92 percent. After the other labor and clean distribution work costs are added, the result is less than 1 percent added to consumer costs, on the average.

Senator EAGLETON. The 3.92 applies to primary nonferrous and metallurgical plants.

Mr. LINSKY. I don't know how much brass and aluminum we buy or what credit has been allowed in here for regained material.

In the nonferrous smelter industry, particularly in the brass, zinc, lead, and so forth, the recovered sulfur is a major part of the profit side of the industry.

I have a little report here that I thought might be amusing to you, perhaps a little awkward as well.

It is a 1913 report on air pollution in California by members of the Commonwealth Club, which clearly depicts and describes the recovery of sulfur from smelters as being profitable even then in some instances.

Senator EAGLETON. Looking at table 3–9, in the last column, the cost ratios are listed as cost per dollar of shipment, and you have discussed or mentioned the primary nonferrous plants, 3.92 per shipment.

What is a shipment? How big or how little?

Mr. LINSKY. That is per dollar of shipment. This is factory billing of the material.

In this case, you may have raw pulp, raw craft pulp, raw steel, castings that have not been machined or anything else done to them, tons of brass, aluminum, and so forth, tons of sulfuric acid, tons of phosphate fertilizer, where a small part of the cost goes into agriculture.

Senator EAGLETON. To put it in my layman's language, what that column indicates is that for a dollar of a shipment of these items listed in the left-hand column, it would add, as in the instance of primary nonferrous metallurgical plants almost 4 cents per dollar?

Mr. LINSKY. That is correct.

Senator EAGLETON. And for cement plants, my particular enemy——

Mr. LINSKY (continuing). It would add almost 1 cent.

Senator EAGLETON. One percent increase.

Mr. LINSKY. This kind of figure has not been widely available. It has been buried.

Senator EAGLETON. In addition to your other academic pedigrees, are you an economist of sorts?

Mr. LINSKY. Not by degree but by compulsion. I have had to learn the economics of engineering economics and production in the same way I have had to learn other kinds of specialties, just enough to know when to reach for the specialist.

Senator EAGLETON. Do you feel, for instance, that the addition of less than a penny on cement plant shipments would be found inflationary by some people?

Mr. LINSKY. I doubt it. The prices of cement seem to go up far more than that without anyone paying any attention to it.

Senator EAGLETON. I agree with you, but a lot of people find inflation in different things when they want to look for it. None of us want to be guilty of inflation. I am glad to hear you say yondon't think this is too inflationary.

Mr. LINSKY. Not only do you not have inflation, but also if that adds a penny to the cost of ordinary manufactured cement it might even operate to help in resources recovery.

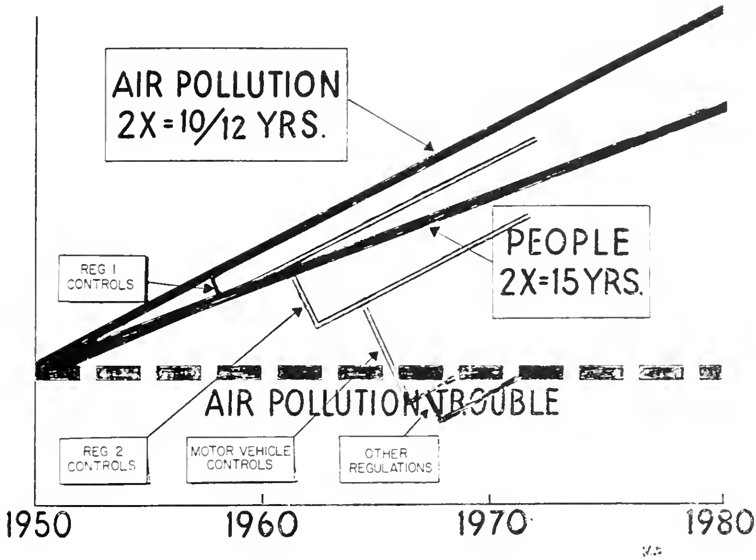
A little more fly ash might be used because that is in competition with cement for some kinds of construction. You might have an offset in reducing the cost of fly ash disposal.

Senator EAGLETON. On this table, does it take into account recycling, reuse, secondary use, and so forth?

Mr. LINSKY. The reuse factor is minor in these figures, so far as I could tell.

One of the questions I am most frequently asked is, "What should we do to clean it up once and for all?"

I worked out an answer for the League of Women Voters group in northern California in 1958 or 1959. It seems to be easier to understand and helpful to many. That is in this chart which I refer to now.



Air Pollution Potential Growth and Cut Back Concept Chart

Developed by Linsky in late 1950s while San Francisco Bay Area Air Pollution Control District chief of agency.

The idea, shown in chart form, is that our air pollution potential keeps increasing along with our general productivity per person and improved material standard of living. This leads to the understanding that the total amounts of pollutants in any area will also grow unless tighter and tighter regulatory limits are set and enforced on all those in the area. Added to this identified need for periodic added tightening is the fact the air coming into an area might contain more and more pollutants from elsewhere, below the legal threshold but, when added to the locally produced stuff adds up to trouble. This tightening will therefore need to be done at locations 50 or 100 miles away, farther too, because even very small percentages of the "potential" that are allowed to "leak" or "penetrate" add up to the locally emitted "small percentage."

In addition to all of this, it is obvious that people's goals are shifting so that after they achieve frequent 6-mile visibilities in Detroit, they wish to have frequent 12-mile visibilities, comparable to that on a gusty, windy day, infrequently.

I think the same kind of thing is happening elsewhere around the country.

By the way, it is not always clear to nonspecialists that in air pollutants and in noise control we are often dealing with trace quantities of "lost" pollutants and energy that cause significant trouble nearby and farther away.

For example, the small amount of energy that goes to make up a very troublesome noise is very hard to harness, in fact, impossible to harness and use. It only results in a little bit of heat, unusable.

But as our technology improves and as our easier, richer resources are used up or reserved for later use, more and more of these trace quantities can be transformed and recovered—but I never expect to see noise or glare energies regained.

One of the advantages of good air pollution control engineering is that it often concentrates and assembles larger quantities of wastes for possible production use.

Until quite recently, in most parts of the United States in large cities, small cities, and rural areas—and I have a report of the study of West Virginia, showing troubles county by county, even in the most rural county—the people who protested, demonstrated, and crowded the hearing halls were well organized industrial polluters who used irrational, emotional, and even hysterical language such as "ruinous costs," "it will drive industry away," "enormous costs that the public will pay in the end," "regulation for regulation's sake," "arbitrary," and so forth.

I have brought along a 12-year-old photograph showing an air pollution control officer being hung in effigy by the organized secondary materials and private refuse disposal industry.

They were trying to tell a city-county board of supervisors they should not adopt a local ordinance against open burning of rubbish and scrap metal and thus help enforce a regional law.

This was at the San Francisco City Hall, and my effigy was suspended from the yardarm of an auto wrecking company truck, as depicted in the San Francisco Chronicle. This was in 1958.

Senator EAGLETON. Is that when you moved to West Virginia?

Mr. LINSKY. No. As a matter of fact, I was able to get enough work done so that it wasn't until 1963 that I used up all my "brownie" points.

But until recently, only in a few other places had the shoe been on the other foot, with the public insisting on clean air for themselves and their children. These publicly protesting places a few years back were often not even the dirtiest.

Los Angeles, Calif., rather than Gary, Ind.; Seadade, Fla., rather than River Rouge, Mich., or Charleston, W. Va., were scenes of citizen protest.

Occasionally the housewives would picket a specific nearby powerplant or a nearby coal-drying plant, or demonstrate at a mayor's office, as in Chicago, almost 10 years ago, on in two coal mining towns.

An advertisement for Virginia Electric Power Co., appearing in the Washington Post, Wednesday, August 10, 1969, states:

The cost of living has risen 136% since 1941. The average annual unit cost of electricity has gone down 46%. If your bill is higher, it's because you're using more electricity. Six times as much as in 1941.

The legislation sponsored by your committee, the increased travel and permanent mobility of people, and the easier movement of information have let more people now know that they are entitled to unpolluted air, even though legal mechanisms are quite cubersome and complex at times.

The need for faster acting legal mechanisms, which might be found buried in some older laws—and I see they just dug up one that could operate very rapidly in Florida, an 1890 law or thereabouts—and the need for more trained people to work in public agencies and private service point to the need for added Federal, State, regional, and local budgeted positions, and added budget appropriations for specialized education and training, as well as general public and schoolchildren's education.

The added $1 or $2 or even $4 per ton for cleanly made steel and iron castings do not add much to the car payments for a new car, but people don't yet realize this, and so the steel towns and foundry neighborhoods are not cleaned up.

Similarly, the added 1 cent per gallon for nonleaded high-octane gasoline is almost lost in the 8 or 10 cents a mile overall cost for operating an automobile, even assuming only 12 miles per gallon of gasoline.

I recently ran into a 1920 paper by a civil engineer named Tribus. It was entitled "Travel Habits of Odors," and contained a statement attributed to "the first public utterance of the first State board of health in the United States, that of Massachusetts, in 1869:

> We believe that all citizens have an *inherent* (emphasis mine) "right to the enjoyment of pure and uncontaminated air and water and soil; that this right should be regarded as belonging to the whole community; and that no one should be allowed to trespass upon it by his carelessness or his avarice or even by his ignorance.

When people are asked if they would pay a few cents a month for a good air pollution control regulatory effort, and when they are asked if they would pay an added 1 percent or less for the things they buy, almost all of it resulting in increased employment for someone, the answers I have been receiving are astonishment at the low price and assurance that it is a bargain they would go for.

Various attempts to predict the future needs for trained air polluion control manpower produce different answers.

Public agency employment, at Federal, State, regional, and local level, after job descriptions, titles, and salary restructuring are arranged for, can be competitive with industrial employment of specialists only if the manpower supply is reasonably adequate.

Otherwise, the industrial higher salary incentives will be so high as to overcome even the public-minded motivation that usually permits public salaries for professional practitioners to be a little lower.

Some of the estimates of future manpower needs do not seem to take into account the full impact of the future requirement that industrial air pollution control equipment be kept up-to-date and be brought up-to-date to match ordinary changes in production processes.

It will be requiring much more stack sampling and much more frequent control equipment adjustments and revisions in the future to meet more of the control regulations in more parts of the country than now takes place.

In addition, as you probably know, a large amount of control equipment has been bought in the past without any requirement that its effectiveness be physically tested prior to the customer paying for it, or prior to a smaller, weaker control agency approving it for initial and ongoing use.

The growing role of volunteer watchdog agencies can also be expected to lead them to employ additional trained specialists, full time or as consultants, for their day-to-day or week-to-week supportive air pollution control activities.

Thus, the need for specialists at technician, professional, and research expert levels has been underestimated by all manpower studies to date, I believe.

I have become fed up with the publicly scary figures that result when the added air pollution control capital costs and annualized costs of something I buy is given an emotional aura by multiplying it by millions of buyers and then multipling that hobgoblin figure again by several years of purchases and usage.

Thus, table 33 in the 1969 "Cost of Clean Air" report shows the growth of a $1.80 to $5.80 annualized cost per motor vehicle into a $304 million cumulative national annualized cost by 1974, and an even larger $2,604 billion cumulative national capital cost by 1974.

(The table referred to follows:)

TABLE 33.—ESTIMATED COST OF MOTOR VEHICLE EMISSION CONTROL SYSTEMS, 1968–74

[National cost in millions]

	Assumed cost per car		Estimated national cost			
			Capital cost		Annualized	
	Capital cost	Annualized	Annual	Cumulative	Annual	Cumulative
1968	$18	$1.80	$180		$18	
1969	18	1.80	180	$360	18	$36
1970	36	3.60	360	720	36	72
1971	48	5.80	480	1,200	58	130
1972	48	5.80	480	1,680	58	188
1973	48	5.80	480	2,160	58	246
1974	48	5.80	480	2,640	58	304

How often have you heard either the low figure of $5.80 annualized cost per car year used from public platforms or seen it in print? Why not?

If we followed the same patterns in looking at the cumulative cost for Colonel Sanders' Kentucky Fried Chicken by 1974, for those who like to add the cost to our food budgets, I believe that figure would be startlingly large, too. About one-half billion dollars a year in Colonel Sanders Kentucky Fried Chicken sales is not very relevant to the question of whether or not you or I, as individual people want some. We have already shown they do.

Please let me repeat a small paragraph from one of my previous public statements, reprinted in one State's conservation magazine, the Delaware Conservationist, summer 1966, volume X, No. 3:

However, the best long-range or short-range self-interest of a management may lie in deferring installations. Every year of delay in a $1,000,000 nonprofitable installation may save $250,000 a year. A small part of this will buy a lot of time in studies, lobbying, etc.

Mr. LINSKY. I had a few other comments which I had not prepared ahead and worked on last night. May I proceed?

Senator EAGLETON. Yes.

Mr. LINSKY. As a tax relief or financial incentive, I know many who will say, "We will pay $5 a family per month for all open and hidden product and service charges, plus all open and hidden taxes," to reduce soiling, corrosion, including, perhaps, the Silver Bridge disaster, and so forth.

This means that new coal mines for the United States as well as for Japan will be dug fast. It will see new sulfur chemical plants grafted onto electricity plants.

We will even see wet evaporators that cause sooner fog from cooling towers replaced by dry natural draft or mechanical draft towers, such as are growing elsewhere in the world to avoid thermal pollution and air pollution.

Some people, such as my impatient wife, say:

> Why doesn't the Federal Government pay everyone to put a corrective change in 100 percent and then inspect and police them to make sure they maintain it? Also, every time he changes production there can be a government inspector or engineer around who can see to it that the air pollution controls, too, that he is fully controlled, and if the States sit on their plans and hands, to put it lightly, the Federal people can move in fast as they do when it is an AEC nuclear matter.

If the Federal Government is as serious as my wife believes the American people are, when they learn it is only a high maximum of $5 a month for all sorts of controls and modifications on everything—I will leave the conclusion of that sentence open.

With a similar sense of urgency, the last air pollution control public wave began before 1900 and was only stopped by World War I, as the scholars now appreciate.

This one has the further advantage that some added employments could be used, equal to one percent or so of the employed population, to do the work of building and maintaining control equipment.

In addition, when things boom the air pollution control engineering work can be a price increase reason for not dropping below a 40-hour week, while maintaining our pleasurable goods standard of living along with a vastly improved pleasurable outdoor air level of enjoyable living.

All it takes is guts and money plus a plan and a very few years.

Senator EAGLETON. Thank you, Professor, for both your prepared statement and the addendum thereto.

Have you had occasion to examine in any detail the three bills that are immediaitely before us?

Mr. LINSKY. I have looked at them. I have not explored them intently because I didn't know what questions were in the minds of the committee.

Senator EAGLETON. Rather than go into the bills in fine detail, let me ask you a more broadly based policy question.

In the administration bill, they recommend going, at this time, to national air quality standards. In the Muskie bill, it is an improvement upon or an extension of the basic fabric of the 1967 act.

Maybe I am oversimplifying it. Which route do you prefer or do you have a preference?

Mr. LINSKY. The national air quality standards as minimal standards would be usable and would be useful, but not as a substitute for the region, State and local standards.

It might be an additional fabric, again, for those States and regions that sit on their plans and hands.

Senator EAGLETON. Under Secretary Veneman said yesterday he viewed them as minimum standards, that the States and regions would be free to improve them.

Do you run this risk: If you set a national standard that is theoretically tolerable, don't you run the risk that that standard, perforce, becomes the nationwide standard?

That is, a local region says, "Well, if that is good enough for the whole country, if it is good enough for New York and Los Angeles, why should we here in St. Louis and Kansas City worry about it?"

Mr. LINSKY. For standards, can I substitute the word "limitations"? Then I don't get confused with good or better or tighter or looser.

I think it has been well demonstrated that area-wide legal limits are not always good enough for locals by the local's own viewpoints.

The previous witness was complaining that these recommendations— and they are rather broad, kind of fuzzy recommendations that you couldn't label as recommendations—were pointed at without a safety factor, that the localities have been going tighter for their own good reasons.

Senator EAGLETON. I agree with you and Mr. Tucker who testified before.

For instance, he stated that basic air quality criterion of 80 micrograms per cubic meter annual average—well, he said was recommended by HEW. We don't know that.

Assuming it has been, it is his position that it is a good nationwide standard and that Cleveland, Ohio, and Chicago and Charleston are futzing around with it.

Mr. LINSKY. This is almost irreligious. If I want to live in a community that is cleaner. I don't know why I couldn't have a tighter living standard and tighter limits on my neighborhood just as I do in zoning, and neither do you.

If you want to live in a cleaner area than is accepted as a result of bargaining at the national level, and, frankly, that is what it is——

Senator EAGLETON. It is even more than that. Is it not only what people think they ought to have locally, which I think is very important, but also isn't it a scientific fact that regions do vary in terms of atmosphere, humidity, climate control, so that conditions are not identical in all 50 States?

Mr. LINSKY. The major differences with regard to the outdoor air dirtiness limitations, if you are calling these air quality standards, are dust and fog. Any measurements of air pollutants that are done well will take into account such factors as sunshine that convert material A to material B while it is in the air.

So the only backgrounds that you have that may be troublesome and different will be dust and natural fog. Those two differences are important.

The citation of areas that are sparsely settled that have high backgrounds might very well be from a desert area.

Senator EAGLETON. On page 4 of your prepared statement, you list seven other types of undesirable air pollution effects.

How would national standards apply to those seven others? Are those seven others variable from one district or one region to another, or would you say they are constant factors in all districts or regions and, therefore, susceptible to a national standard?

Mr. LINSKY. The background conditions that are different are certainly No. 3, which is the interference with visibility because of the presence of fog, damp air, and soiling, where you may have the desert kinds of dust.

Senator EAGLETON. Do I take it, then, the others would be constant factors? I don't know whether that is a term of art.

Mr. LINSKY. I think reasonably, yes. You have a little more rubber cracking out on the west coast because of more extended sunshine.

Senator EAGLETON. I now have three questions which I would like to propound to you from Senator Randolph. He sent them over to us and asked that we direct these three questions to you.

In your prepared statement you refer to cumbersome and complex enforcement provisions in existing air pollution laws.

Could you specify particular legal roadblocks in these statutes and suggest how they might be overcome?

Mr. LINSKY. I would sit down and work them out for any particular State and locality since each State's laws, as you know, are so different. Even within the States the home rule cities, home rule counties, have specific provisions.

So other than a totally uniform federal system, which is apparently not contemplated, it would have to work out those specific roadblocks case by case.

Senator EAGLETON. You are correct. There is an enormous variance in State laws, municipal ordinances, and so forth. So passing that, just viewing it in terms of Federal legislation and Federal regulations, what comment would you make?

Mr. LINSKY. I think national emission standards would have value. National emission limits have real value, again as floors beyond which local operations could go tighter when and if they wish unless it becomes the policy of the Congress and of the Federal Government that a British system be used, such as the British Alkali Act, as "the best practicable means" to be utilized, coupled with exclusion as an area approaches its air quality legal limits.

Such exclusion is being practiced practically here and there around the country, generally not advertised. The only place that I know of that was loudly advertised was in Los Angeles County where they said "no new fossil-fuel-fired powerplants in our county."

Senator EAGLETON. Describe for me how you would set up a national emission standard, say for the steel industry. You call it a floor or a limit.

Mr. LINSKY. The best, well-used equipment would be prescribed. Numbers would be set up that would match the best well-used control equipment for the process.

Beyond that, since you have a land space factor and a general limit location factor—well, let me put it this way: The best, cleanest steel mill in the country does not belong next to the State capitol building or a school because of spills, upsets, and some not yet controlled operations in which adequate engineering has not been done, such as the coke oven charging.

So you would need a combination of the emission limits and a hard caution prior to location of location factors that are inherent, sensitivities to neighboring land uses.

Senator EAGLETON. Would you support the basic concept, then, that by Federal legislation we should require all new plants, steel, automotive, lead plants, and so forth, at the time of construction to have as part of their process the then best available pollution control equipment?

Mr. LINSKY. Yes, with an additional proviso, that its location be appropriately governed so that it isn't in an area that is either crowded with other pollutants already being produced, with some margin for growth by that plant itself, and with a sensitivity of nearby neighbors.

Senator EAGLETON. How would you handle this plant site certification business? Should this be done by the Federal Government, the State Government, county, or municipality?

Who would certify the propriety of a plant being located on a certain plot of land?

Mr. LINSKY. I wish I had a good answer for that one, but the political scene is changing, and if the public interest continues to develop as it has been, then I think it might be safely left to a local or a State operation.

If it doesn't, then it is going to require, shall we say, a Federal overview and review. There is no reason why the location should not require a Federal overview to make certain that an error has not been made or that undue pressure has not been placed by those who want to grow their department stores and grow their subdivision with new employees.

Senator EAGLETON. Senator Randolph's second question: In your statement you said you have participated in the preparation of air pollution control regulations for the State of West Virginia.

Could you provide these for the record?

Mr. LINSKY. Yes. The regulations to which contributed, although not all of my suggestions were accepted, are numbers I through VI, as well as the proposed regulation VII. The State law was rewritten in part as a result of my advice to the State's agency staff and members of the State legislature at their request.

(The documents furnished follow:)

Air Pollution Control Law
OF
West Virginia

Issued by

WEST VIRGINIA AIR POLLUTION CONTROL COMMISSION

Reprinted from Michie's West Virginia Code and
1967 Cumulative Supplement

THE MICHIE COMPANY
CHARLOTTESVILLE, VA.
1967

Air Pollution Control Law of West Virginia

CHAPTER 16.

PUBLIC HEALTH.

ARTICLE 20.

AIR POLLUTION CONTROL.

Sec.
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§ 16-20-1. Declaration of policy and purpose.

It is hereby declared to be the public policy of this State and the purpose of this article to achieve and maintain such levels of air quality as will protect human health and safety, and to the greatest degree practicable, prevent injury to plant and animal life and property, foster the comfort and convenience of the people, promote the economic and social development of this State and facilitate the enjoyment of the natural attractions of this State.

To these ends it is the purpose of this article to provide for a coordinated state-wide program of air pollution prevention, abatement and control; to facilitate cooperation across jurisdictional lines in dealing with problems of air pollution not confined within single jurisdictions; and to provide a framework within which all values may be balanced in the public interest. (1961, c. 63; 1963, c. 76; 1967, c. 13.)

Effect of amendment of 1967. — The amendment rewrote this section.

§ 16-20-2. Definitions.

The terms used in this article are defined as follows:

The term "person" shall mean any and all persons, natural or artificial, including any municipal, public or private corporation organized or existing under the laws of this or any other state or country, and any firm, partnership or association of whatever nature.

The term "commission" shall mean the air pollution control commission, and the term "commissioner" shall mean a member of said commission.

The term "air pollutants" shall mean solids, liquids or gases which, if discharged into the air, will result in a statutory air pollution.

The term "discharge" shall refer to the release, escape or emission of air pollutants into the air.

The term "statutory air pollution" shall mean and be limited to the discharge into the air by the act of man of substances (liquid, solid, gaseous, organic or inorganic) in a locality, manner and amount as to be injurious to human health or welfare, animal or plant life, or property, or which would interfere with the enjoyment of life or property.

The term "director" shall mean the director of the West Virginia air pollution control commission appointed as hereinafter provided. (1961, c. 63; 1967, c. 13.)

Effect of amendment of 1967. — The amendment made changes in the definitions of "commission," "discharge" and "statutory air pollution," and added the definition of "director."

§ 16-20-3. Causing statutory pollution unlawful; article not to provide persons with additional legal remedies.

For the purposes of this article and subject to all of the provisions hereof, it shall be unlawful for any person to cause a statutory air pollution as herein defined: Provided, however, that nothing contained in this article shall be construed to provide any person with a legal remedy or basis for damages or other relief not otherwise available to such person immediately prior to enactment of this article [June 6, 1961]. (1961, c. 63.)

§ 16-20-4. Air pollution control commission—Composition; appointment and terms of members; vacancies; compensation and expenses of members; organization and personnel; appointment of director; records; meetings.

The "air pollution control commission," heretofore created, shall continue in existence as an agency of the State but on and after the effective date of this act [June 9, 1967] shall consist of seven members, including the State director of health and the commissioner of agriculture, who shall be members ex officio, and five other members to be appointed by the governor with the advice and consent of the senate, two of whom shall be representative of industries engaged in business in this State, and three of whom shall be representative of the public at large. The three appointed members of the commission in office on the effective date of this act shall, unless sooner removed, continue to serve until their terms expire and until their successors have been appointed and have qualified. On or before June fifteen, one thousand nine hundred sixty-seven, the governor shall appoint one member to serve until June thirty, one thousand nine hundred seventy, and one member to serve until June thirty, one thousand nine hundred seventy-one, or until their successors have been appointed and have qualified. As the terms of the three appointed members of the commission in office on the effective date of this act expire and as the terms of the two members to be appointed by the governor on or before June fifteen, one thousand nine hundred sixty-seven, expire, members shall be appointed for overlapping terms of five years, so that one term expires each year, or until their successors have been appointed and have qualified. Any vacancy in the office of an appointed member of the commission shall be filled by appointment by the governor for the unexpired term of the appointed member whose office shall be vacant.

The ex officio members of the commission shall receive no salary or remuneration for their services as such but they shall be reimbursed, out of moneys appropriated for such purpose, for all reasonable and necessary expenses actually incurred in the discharge of their duties as such.

As compensation for his services on the commission, each appointed member shall receive, out of moneys appropriated for such purpose, the sum of fifty dollars for each day or substantial portion thereof that he is actually engaged in the work of the commission. Each member shall also be entitled to be reimbursed, out of moneys appropriated for such purpose, for any reasonable and necessary expenses actually incurred in the discharge of his duties as a member of the commission.

At its first meeting the commission shall elect from its membership a chairman, and at the first meeting in each fiscal year thereafter the commission shall elect from its membership a chairman to act during such fiscal year. At similar times the commission shall appoint a secretary, who need not be a member of the commission. The commission shall appoint and employ a director and such personnel as may be required, whose duties shall be defined by the commission and whose compensation, to be fixed by the commission, shall be paid out of the State treasury, upon the requisition of the commission, from moneys appropriated for such purposes.

The commission may establish rules for the regulation of its affairs and the conduct of all proceedings before it. All proceedings of the commission shall be entered in a permanently bound record book, properly indexed, and the same shall be carefully preserved. Copies of orders entered by the commission, as well as copies of papers or documents filed with it, or the records of proceedings before the commission, shall be attested by the secretary of the commission. The commission shall meet at such times and places as may be agreed upon by the commissioners, or upon the call of the chairman of the commission or any two commissioners, all of which meetings shall be general meetings for the consideration of any and all matters which may properly come before the commission. (1961, c. 63; 1967, c. 13.)

Effect of amendment of 1967. — The amendment rewrote this section.

§ 16–20–5. Same—Powers and duties; legal services; rules and regulations; public hearings.

The commission is hereby authorized and empowered:

(1) To develop ways and means for the regulation and control of pollution of the air of the State;

(2) To advise, consult and cooperate with other agencies of the State, political subdivisions of the State, other states, agencies of the federal government, industries, and with affected groups in furtherance of the declared purposes of this article;

(3) To encourage and conduct such studies and research relating to air pollution and its control and abatement as the commission may deem advisable and necessary;

(4) To adopt and to promulgate reasonable regulations, not inconsistent with the provisions of this article, relating to the control of air pollution: Provided, that no rule or regulation of the commission shall specify the design of equipment, type of construction, or particular method which a person shall use to reduce the discharge of air pollutants, nor shall any such rule or regulation apply to any aspect of an employer-employee relationship;

(5) To enter orders requiring compliance with the provisions of this article and the regulations lawfully promulgated hereunder;

(6) To consider complaints, subpoena witnesses, administer oaths, make investigations, and hold hearings relevant to the promulgation of regulations and the entry of compliance orders hereunder;

(7) To encourage voluntary cooperation by municipalities, counties, industries and others in preserving the purity of the air within the State;

(8) To employ personnel, including specialists and consultants, purchase materials and supplies, and enter into contracts necessary, incident or convenient to the accomplishment of the purposes of this article;

(9) To enter at reasonable times upon any private or public property for the purpose of investigating an alleged statutory air pollution: Provided, however, that no such investigation shall extend to information relating to secret processes or methods of manufacturing or production;

(10) Upon reasonable evidence of a violation of this article, which presents an imminent and serious hazard to public health, to give notice to the public or to that portion of the public which is in danger by any and all appropriate means;

(11) To cooperate with, receive and expend money from the federal government and other sources;

(12) To represent the State in any and all matters pertaining to plans, procedures and negotiations for interstate compacts in relation to the control of air pollution; and

(13) To appoint technical advisory councils from such areas of the State as it may determine. Each such council so appointed shall consist of not more than five members for each area so designated, at least two of whom shall be truly representative of industries operating within such area, and may advise and consult with the commission about all matters pertaining to the regulation, control and abatement of air pollution within such area.

The attorney general and his assistants and the prosecuting attorneys of the several counties shall render to the commission without additional compensation such legal services as the commission may require of them to enforce the provisions of this article.

No rule or regulation of the commission pertaining to the control, reduction or abatement of air pollution shall become effective until after at least one public hearing thereon shall have been held by the commission within the State. Notice to the public of the time and place of any such hearing shall be given by the commission at least thirty days prior to the scheduled date of such hearing by advertisement published as a Class II legal advertisement in compliance with the provisions of article three [§ 59-3-1 et seq.], chapter fifty-nine of this Code, and the publication area for such publication shall be the county wherein such hearing is to be held. Full opportunity to be heard shall be accorded to all persons in attendance and any person, whether or not in attendance at such hearing, may submit in writing his views with respect to any such rule or regulation to the commission within thirty days after such hearing. After such thirty-day period, no views or comments shall be received in writing or otherwise, unless formally solicited by the commission. The proceedings at the hearing before the commission shall be recorded by mechanical means or otherwise as may be prescribed by the commission. Such record of proceedings need not be transcribed unless requested by an interested party, in which event the prevailing rates for such transcripts will be required from such interested party. (1961, c. 63; 1963, c. 76; 1967, c. 105.)

Effect of amendment of 1967. — The amendment, effective May 1, 1967, made changes in the last paragraph with regard to publication of notice, added the fourth sentence thereof, and deleted a former last sentence thereof which formerly provided that the commission might solicit comments in writing from parties affected or interested in proposed rules and regulations.

§ 16-20-6. Issuance of cease and desist orders by director; service; appeals to commission; hearings, subpoenas, etc.; orders and findings of commission.

If, from any investigation made by him or from any complaint filed with him, the director shall be of the opinion that a person is violating the provisions of this article, or any rules and regulations promulgated pursuant thereto, he shall make and enter an order directing such person to cease and desist such activity. The director shall fix a reasonable time in such order by which such activity must stop or be prevented. The order shall contain the findings of fact upon which the director determined to make and enter such order.

The director shall cause a copy of any such order to be served upon such person by registered or certified mail or by any proper law enforcement officer.

Any person upon whom a copy of such final order has been served may appeal such order to the air pollution control commission in the manner hereinafter provided. The person so appealing shall be known as the appellant and the director shall be known as the appellee. Such appeal shall be perfected by filing a notice of appeal, on the form prescribed by the commission for such purpose, with the commission within fifteen days after the date upon which the appellant received a copy of the order. The notice of appeal shall set forth the order complained of and the grounds upon which the appeal is based. The filing of such notice of appeal shall stay the effect of the order complained of until final determination thereof is made by the commission. A copy of the notice of appeal shall be filed by the commission with the director within eight days after the notice of appeal is filed with the commission.

Within seven days after receipt of his copy of the notice of appeal, the director shall prepare and certify to the commission a complete record of the proceedings out of which the appeal arises, including all documents and correspondence in the director's file relating to the matter in question. The commission shall hear the appeal de novo, and evidence may be offered on behalf of the appellant and appellee.

All of the pertinent provisions of article five [§ 29A-5-1 et seq.], chapter twenty-nine-A of this Code shall apply to and govern the hearing on appeal authorized by the provisions of this section and the administrative procedures in connection with and following such hearing, with like effect as if the provisions of said article five were set forth in extenso in this section, except that any such appeal hearing shall be held in the county wherein the alleged statutory air pollution complained of originated.

Any such appeal hearing shall be conducted by a quorum of the commission. For the purpose of conducting any such appeal hearing, any member of the commission and the secretary thereof shall have the power and authority to issue subpoenas and subpoenas duces tecum in the name of the commission, in accordance with the provisions of section one [§ 29A-5-1], article five, chapter twenty-nine-A of this Code. All subpoenas and subpoenas duces tecum shall be issued and served within the time and for the fees and shall be enforced, as specified in section one, article five of said chapter twenty-nine-A, and all of the said section one provisions dealing with subpoenas and subpoenas duces tecum shall apply to subpoenas and subpoenas duces tecum issued for the purpose of an appeal hearing hereunder.

Any such hearing shall be held within twenty days after the date upon which the commission received the timely notice of appeal, unless there is a postponement or continuance. The commission may postpone or continue any hearing on its own motion, or upon application of the appellant or the appellee for good cause shown. The director shall be represented at any such hearing by the attorney general or his assistants. At any such hearing the appellant may represent himself or be represented by an attorney at law admitted to practice before any circuit court of this State.

After such hearing and consideration of all of the testimony, evidence and record in the case, the commission shall make and enter an order affirming, modifying or vacating the order of the director, or shall make and enter such order as the director should have entered.

Such order shall be accompanied by findings of fact and conclusions of law as specified in section three [§ 29A-5-3], article five, chapter twenty-nine-A of this Code, and a copy of such order and accompanying findings and conclusions shall be served upon the appellant, and his attorney of record, if any, and upon the appellee in person or by registered or certified mail. The order of the commission shall be final unless vacated or modified upon judicial review thereof in accordance with the provisions of section seven [§ 16-20-7] of this article. (1961, c. 63; 1963, c. 76; 1967, c. 13.)

Effect of amendment of 1967. — The amendment rewrote this section.

§ 16–20–7. Appeals from orders of commission.

Any person whose interest shall have been substantially affected by an order of the commission may appeal from such order or decision by filing with the commission a written notice of appeal. Such notice shall be filed within thirty days from the date notice of the order or decision of the commission was given to such person, and shall be signed by him or his attorney. Within thirty days from the receipt of the notice of appeal, the commission shall prepare and forward to the appellant or his attorney a copy of a full transcript of the proceedings, together with a copy of the order or decision of the commission and a copy of the notice of appeal, and at the same time shall file a transcript of the proceedings before the commission and the other documents mentioned above with the clerk of the circuit court herein designated. All documents shall be duly certified by the secretary of the commission. The court shall thereafter have complete jurisdiction of the matter.

The appeal shall be taken to the circuit court of the county wherein the alleged statutory air pollution complained of originated. The circuit court to which any such appeal shall have been taken, or the judge thereof, shall fix a time for the hearing of the appeal and shall, after such hearing, without a jury, by order entered of record, affirm, modify or set aside in whole or in part the order of the commission. The said court shall make findings of fact and conclusions of law based upon the transcript of the proceedings before the commission and upon any additional evidence adduced before said court, the right to adduce such additional evidence being hereby reserved to the commission or to any person substantially affected by the order of the commission. In the event the circuit court shall affirm or modify the commission's order that a statutory air pollution exists under the provisions of this article, the order of the court shall specify that such pollution shall be corrected within a reasonable period of time to be fixed therein. The commission or any person whose interests shall have been substantially affected by the final order of the circuit court may appeal to the supreme court of appeals in the manner prescribed by law.

An appeal to a circuit court or to the supreme court of appeals shall serve to stay the order of the commission or circuit court, as the case may be, pending final determination thereof. (1961, c. 63.)

§ 16–20–8. Penalties; recovery and disposition; duties of prosecuting attorneys.

Any person who shall fail or refuse to comply with any final order made and entered hereunder to correct a statutory air pollution within the time fixed by such order, or any extension of time granted by the commission, shall be subject to a penalty of not more than one thousand dollars for each day that such failure or refusal continues after such time has expired, which penalty may be recovered in a civil action brought by the commission in the name of the State of West Virginia in the circuit court of any county wherein such person resides or is engaged in the activity complained of. The amount of the penalty shall be fixed by the court without a jury. The amount of any such penalties collected by the commission shall be deposited in the general fund of the State treasury according to law. Upon a request in writing from the commission, it shall be the duty of the prosecuting attorney of the county in which any such action for penalties accruing under this section may be brought to institute and prosecute all such actions on behalf of the commission.

For the purpose of this section, violations on separate days shall be considered separate offenses. (1961, c. 63; 1967, c. 13.)

Effect of amendment of 1967. — The amendment rewrote this section.

§ 16–20–9. Applications for injunctive relief.

In addition to the remedy provided for in section eight [§ 16-20-8] of this article and in the absence of reasonable progress toward correction of the statutory air pollution, the commission may request the prosecuting attorney of the county in which the person resides or is engaged in the activity complained of to apply to the circuit court of such county for an injunction to restrain all violations of any final order entered pursuant to section six [§ 16-20-6] of this article. (1961, c. 63; 1967, c. 13.)

Effect of amendment of 1967. — The amendment inserted "person" in lieu of "defendant" and deleted "of the commission" which formerly appeared following the words "final order."

§ 16–20–10. Emergencies.

Whenever air pollution conditions in any area of the State become such as, in the opinion of the commission, to create an emergency and to require immediate action for the protection of the public health, the commission may, with the written approval of the governor, so find and enter such order as it deems necessary to reduce or prevent the emission of air pollutants substantially contributing to such conditions. In any such order the commission shall also fix a time, not later than twenty-four hours thereafter, and place for a hearing to be held before it for the purpose of investigating and determining the factors causing or contributing to such conditions. A true copy of any such order shall be served upon persons whose interests are directly prejudiced thereby in the same manner as a summons in a civil action may be served, and a true copy of such order shall also be posted on the front door of the courthouse of the county in which the alleged conditions originated. All persons whose interests are prejudiced or affected in any manner by any such order shall have the right to appear in person or by counsel at the hearing and to present evidence relevant to the subject of the hearing. Within twenty-four hours after completion of the hearing the commission shall affirm, modify or set aside said order in accordance and consistent with the evidence adduced. Any person aggrieved by such action of the commission may thereafter apply by petition to the circuit court of the county for a review of the commission's action. The circuit court shall forthwith fix a time for hearing de novo upon the petition and shall, after such hearing, by order entered of record, affirm, modify or set aside in whole or in part the order and action of the commission. Any person whose interests shall have been substantially affected by the final order of the circuit court may appeal the same to the supreme court of appeals in the manner prescribed by law. (1961, c. 63.)

§ 16–20–11. Powers reserved to State board of health, local health boards and political subdivisions; conflicting statutes repealed.

Nothing in this article shall affect or limit the powers or duties heretofore conferred by the provisions of this chapter upon the State board of health, county health boards, county health officers, municipal health boards, municipal health officers, combined boards of health or any other health agency or political subdivision of this State except insofar as such powers and duties might otherwise be hereafter deemed to apply to the control, reduction or abatement of air pollution. All existing statutes or parts of statutes are, to the extent of their inconsistencies with the provisions of this article and to the extent that they might otherwise be deemed to apply to the control, reduction or abatement of air pollution, hereby repealed: Provided, however, that no ordinance heretofore adopted by any municipality relating to the control, reduction or abatement of air pollution shall be deemed repealed by this article. (1961, c. 63.)

§ 16–20–12. Severability.

The provisions of this article are severable and if any provision, section or part thereof shall be held invalid, unconstitutional or inapplicable to any person or circumstance, such invalidity, unconstitutionality or inapplicability shall not affect or impair any of the remaining provisions, sections or parts of the article or their application to him or to other persons and circumstances. It is hereby declared to be the legislative intent that this article would have been adopted if such invalid or unconstitutional provision, section or part had not been included therein. (1961, c. 63.)

§ 16–20–13. Effective date of rules and regulations.

The rules and regulations promulgated pursuant to the provisions of this article shall be of no effect until one year after the effective date of this article [one year after June 6, 1961]. (1961, c. 63.)

WEST VIRGINIA ADMINISTRATIVE REGULATIONS
Air Pollution Control Commission

Chapter 16-20
Series I
(1965)

Subject: To Prevent and Control Air Pollution from Coal Refuse Disposal Areas.

Section 1. Definitions.

1.01. "Air Pollution" - The term 'statutory air pollution' shall have the meaning ascribed to it in section two of chapter sixteen, article twenty of the code of West Virginia, 1931, as amended.

1.02. "Coal Refuse." - Any combination of carbonaceous waste with rock, shale, culm, boney, slate, clay, and related materials associated with or near a coal seam, which are either brought above ground or otherwise removed from the mine in the process of mining coal, or which are separated from coal during the cleaning or preparation operations, provided, however, that coal refuse shall not mean overburden from strip-mining operations or incombustible materials from mine shafts and mine tunnels.

1.03. "Coal Refuse Pile" - Any deposit of coal refuse on the surface which is intended as a permanent disposal of or long-term storage of such material. Continuous deposits of coal refuse and deposits which are not separated shall be considered a single coal refuse pile.

1.04. "Coal Refuse Disposal Area" - Any area or plot of land which is used as a place for dumping, storage, or disposal of coal refuse. A coal refuse pile must be contained in a single coal refuse disposal area; however, a coal refuse disposal area may contain two (2) or more coal refuse piles if the area is so designated.

1.05 "Operate" - The act of disposing, depositing or dumping of coal refuse upon a coal refuse disposal area or of physically altering the coal refuse disposal area, except by removal of ashes, red dog, or other material from a burned-out coal refuse pile.

Other words and phrases used in this regulation, unless otherwise indicated, shall have the meaning ascribed to them in section two of chapter sixteen, article twenty of the code of West Virginia, 1931, as amended.

Section 2. Registration.

2.01 Within ninety (90) days after the effective date of this regulation all persons operating coal refuse disposal areas within the State on the effective date of this regulation shall have registered with the Commission on forms to be made available by the Commission, the name of the person, company or corporation operating the disposal area, the address, location, county, ownership (lessee and lessor), the principal officer of the company, or the manager of the mine, and any other such reasonable information as is needed.

2.02 After the effective date of this regulation all persons who intend to establish coal refuse disposal areas shall register with the Commission, on forms made available by the Commission, the name of the person, company or corporation that will operate the disposal area, the address, location, county, ownership (lessee and lessor), the principal officer of the company or the manager of the mine and other such reasonable information as is needed.

2.03 Notification in writing is to be given to the Commission when the operation of a coal refuse area is to be permanently discontinued.

2.04 Notification in writing is to be given to the Commission within thirty (30) days after the ownership or operation of a coal refuse disposal area changes.

2.05 It shall be unlawful for any person to operate a coal refuse disposal area unless such area has been registered.

Section 3. Standards.

In order to prevent and control air pollution from coal refuse disposal areas, the operation of coal refuse disposal areas shall be conducted in accordance with the standards established by this Section.

3.01 Coal refuse is not to be deposited on any coal refuse disposal area unless the coal refuse is deposited in such a manner as to minimize the possibility of ignition of the coal refuse.

3.02 Coal refuse disposal areas shall not be so located with respect to mine openings, tipples, or other mine buildings, unprotected coal outcrops or steam lines, that these external factors will contribute to the ignition of the coal refuse on such coal refuse disposal areas.

3.03 Vegetation and combustible materials shall not be left on the ground at the site where a coal refuse pile is to be established, unless it is rendered inert before coal refuse is deposited on such site.

3.04 Coal refuse shall not be dumped or deposited on a coal refuse pile known to be burning, except for the purpose of controlling the fire or where the additional coal refuse will not tend to ignite or where such dumping will not result in statutory air pollution.

3.05 Materials with low ignition points used in the production or preparation of coal, including but not limited to wood, brattice cloth, waste paper, rags, oil and grease, shall not be deposited on any coal refuse disposal area or in such proximity as will reasonably contribute to the ignition of a coal refuse disposal area.

3.06 Garbage, trash, household refuse, and like materials shall not be deposited on or near any coal refuse disposal area.

3.07 The deliberate ignition of a coal refuse disposal area or the ignition of any materials on such an area by any person or persons is prohibited.

Section 4. Burning Coal Refuse Disposal Areas.

Each burning coal refuse disposal area which allegedly causes air pollution shall be investigated by the Commission.

4.01 Each coal refuse disposal area which causes air pollution shall be considered on an individual basis by the Commission. Consistent with the declaration of policy and purpose set forth in section one of chapter sixteen, article twenty of the code of West Virginia, 1931, as amended, as well as the established facts and circumstances of the particular case, the Commission shall determine and may order after a proper hearing the effectuation of those air pollution control measures which are adequate for each such coal refuse disposal area.

4.02 With respect to all burning coal refuse disposal areas, the person responsible for such coal refuse disposal areas or the land on which such coal refuse disposal areas are located shall use due diligence to control air pollution from such coal refuse disposal areas. Consistent with the declaration of policy and purpose set forth in section one of chapter sixteen, article twenty of the code of

West Virginia, 1931, as amended, the Commission shall determine what constitutes due diligence with respect to each such burning coal refuse disposal area. When a study of any burning coal refuse disposal area by the Commission establishes that air pollution exists or may be created, the person responsible for such coal refuse disposal area or the land on which such coal refuse disposal area is located shall submit to the Commission a report setting forth satisfactory methods and procedures to eliminate, prevent, or reduce such air pollution. The report shall be submitted within such time as the Commission shall specify. The report for the elimination, prevention or reduction of air pollution shall contain sufficient information, including completion dates, to establish that such program can be executed with due diligence. If such report is not submitted as requested or if the Commission determines that the methods and procedures set forth in such report are not adequate to reasonably control such air pollution, then a hearing will be held pursuant to the procedures established by Code 16-20-6.

Section 5. Effective Date.

Regulation I shall become effective on the 1st day of January, 1964.

The foregoing is a true and correct copy of the West Virginia Air Pollution Control Commission Regulation I as adopted on the 15th day of November, 1963.

Carl G. Beard, II
Secretary
West Virginia Air Pollution Control Commission

WEST VIRGINIA ADMINISTRATIVE REGULATIONS
Air Pollution Control Commission

Chapter 16-20
Series II
(1966)

Subject: Regulation II - To Prevent and Control Air Pollution From Combustion of Fuel in Indirect Heat Exchangers.

Section 1. Scope of This Regulation.

1.01. The effective area of this regulation will be the Kanawha Valley air basin starting at the junction of the Gauley and New Rivers and terminating at the center of the Winfield Locks and extending a distance of three (3) statute miles, measured horizontally, with no reference to terrain, on each side of the center line of the Kanawha River.

Section 2. Definitions.

2.01. "Air Pollution", 'statutory air pollution' shall have the meaning ascribed to it in Section Two of Chapter Sixteen, Article Twenty of the Code of West Virginia, 1931, as amended.

2.02. "Commission' shall mean the West Virginia Air Pollution Control Commission.

2.03. "Person' shall mean any and all persons, natural or artificial, including any municipal, public or private corporation organized or existing under the laws of this or any other state or county, and any firm, partnership or association of whatever nature.

2.04. "Fuel Burning Equipment" shall mean and include any furnace, boiler apparatus, device, mechanism, stack or structure used in the process of burning fuel, or other combustible material for the primary purpose of producing heat or power by indirect heat transfer.

2.05. "Fuel" shall mean a fuel such as anthracite, or semi-anthracite, bituminous or sub-bituminous coal, lignite, or coke breeze, which is fired in fuel burning equipment as a solid. When gas, liquids or any products or by-products of a manufacturing process are substituted for or used in conjunction with any of the above fuels, the same regulation will apply.

2.06. "Fly Ash" shall mean particles of gas-borne matter arising from the combustion of fuel as defined by definition 2.05.

2.07. "Smoke" shall mean small gas-borne and air-borne particles arising from a process of combustion in sufficient number to be visible.

2.08. "Ringelmann Smoke Chart" shall be the Ringelmann's Scale for Grading the Density of Smoke published by the U.S. Bureau of Mines as information circular 7718, August, 1955, or any chart, recorder, indicator, device which is a standardized method for the measurement of smoke density which is approved by the Commission as the equivalent of said Ringelmann's Scale.

2.09. "Pulverized Fuel Burning Equipment" - Fuel burning equipment in which is burned fuel which has been pulverized so that at least 90 percent will pass through a 100 mesh U.S. standard sieve.

2.10. "New Equipment" -

(a) All fuel burning equipment installed after the adoption of this regulation.

(b) Existing equipment will be reclassified as new equipment when modifications or changes amounting to 30% of the replacement cost of the entire steam generating unit (but not including air pollution control equipment) are made in any 12-month period, or when any changes are made in the combustion equipment which significantly alters the combustion characteristics. Prior to making such changes, a written notice of intent, including scheduled completion dates, must be filed with the Commission. After completion, a report must be submitted to the Commission for their consideration and decision as to whether the characteristics have been changed sufficiently to justify a reclassification. This report must be submitted within 45 days after the completion of the modifications or changes.

Other words and phrases used in this regulation, unless otherwise indicated, shall have the meaning ascribed to them in Section Two of Chapter Sixteen, Article Twenty of the Code of West Virginia, 1931, as amended.

Section 3. <u>Emissions of Smoke and/or Fly Ash Prohibited and Standards of Measurement.</u>

3.01. New Fuel Burning Equipment.

No person shall cause, suffer, allow or permit emission of smoke and/or fly ash into the open air from any fuel burning equipment which is:

(a) As dark or darker in shade or appearance as that designated as No. 1 on the Ringelmann Smoke Chart.

3.02. Existing Fuel Burning Equipment.

No person shall cause, suffer, allow or permit emission of smoke and/or fly ash into the open air from any fuel burning equipment which is:

(a) As dark or darker in shade or appearance as that designated as No. 2 on the Ringelmann Smoke Chart.

3.03. The Provisions of Sub-sections 3.01 and 3.02 of this Section Shall Not Apply To:

(a) Smoke and/or fly ash emitted during the building of a new fire, the shade or appearance of which is less than No. 3 of the Ringelmann Smoke Chart for a period or periods aggregating no more than 8 minutes in any hour.

(b) Smoke and/or fly ash emitted during the cleaning of a fire box or soot blowing the shade or appearance of which is less than No. 3 of the Ringelmann Smoke Chart for a period or periods aggregating no more than 8 minutes per boiler for any 8 hour period.

3.04. The equivalent opacity of those Ringelmann numbers in (a) of sub-section 3.01 and sub-section 3.02 and (a) and (b) of sub-section 3.03 of this section shall be used as a guide in the enforcement of Section 4 of this regulation.

Section 4. Control and Prohibition of Fly Ash.

No person shall cause, suffer, allow or permit fly ash caused by the combustion of fuel to be discharged from any stack or chimney into the open air in excess of the quantity set forth in the following table:

4.01. Existing Fuel Burning Equipment - (In existence on the effective date of this regulation).

Heat Input In Million British Thermal Units Per Hour	Maximum Allowable Emissions of Fly Ash in Pounds Per Million British Thermal Units Input Per Hour
10	0.75
20	0.64
30	0.58
40	0.54
50	0.51
70	0.47
100	0.43
200	0.37
300	0.33
400	0.31
500	0.30
700	0.27
1000 & above	0.25

4.02. New Fuel Burning Equipment -

Heat Input In Million British Thermal Units Per Hour	Maximum Allowable Emission Of Fly Ash In Pounds Per Million British Thermal Units Input Per Hour
10	0.56
20	0.48
30	0.43
40	0.40
50	0.38
70	0.35
100	0.33
200	0.28
300	0.25
400	0.23
500	0.22
700	0.20
1000 & above	0.19

For a heat content between any two consecutive heat contents stated in this table, the fly ash limitation shall be as determined by interpolation. For the purposes hereof, the heat input shall be the aggregate heat content, based on the higher heating value, of all fuels whose products of combustion pass through such stack or chimney. This is defined as follows:

(a) When two or more fuel-burning units are connected to a single stack, the combined heat input of all units connected to the stack shall be used to determine the allowable emission from the stack.

(b) When the discharge from a single unit of combustion equipment is discharged to the open air through two or more stacks, the total heat input to the combustion equipment shall be used to determine the allowable emission from the unit of combustion equipment.

(c) No person shall circumvent this regulation by adding additional stacks to existing fuel burning equipment.

4.03. The Commission shall give consideration to the use of "super-high" dispersion stacks in addition to the emission limitations detailed in this section of the regulation. For the purposes of this regulation, a "super-high" stack is defined as one having sufficient height and/or exit velocity to assure piercing of inversion layers.

Section 5. Registration.

5.01. Persons burning fuel, whose products of combustion are discharged into the open air from a stack or chimney, shall register with the West Virginia Air Pollution Control Commission information for each stack or chimney relating to place, type of fuel burned, heat in fuel burned, quantity of fuel burned per hour, description of combustion equipment, period of operation, height and size of outlet, and description of dust-removal equipment, on forms provided for that purpose by the Commission.

5.02. Such information shall be submitted to the West Virginia Air Pollution Control Commission in the case of existing installations within 45 days from the effective date of this regulation and in the case of new or altered installations, within 30 days after being placed in service. From time to time, additional reports concerning these items may be requested by the Commission.

Section 6. Reports.

6.01. At such reasonable times as the Commission may require, the owner of fuel burning equipment may be requested to conduct or have conducted stack tests to determine the dust loading in flue gas when the Commission has reason to believe that this regulation is being violated. Such tests shall be conducted in such manner as the Commission may specify and be filed on the forms and in the manner acceptable to the Commission. The Commission may at its option witness or conduct such stack tests.

6.02. The operators of fuel burning equipment shall submit data on the fuel used in such equipment. Such data shall be reported in the manner the Commission may specify not to exceed one report per month. Such reports must be filed within 15 days of the end of the established reporting period and will include, but not necessarily be limited to content such as ash, sulfur, moisture, volatile matter, quantities, British Thermal Units value, etc., but not including fuel price.

6.03. When products or by-products of a manufacturing process are used as a fuel, the British Thermal Units value, sulfur, metals, volatile halogens, and ash content of such materials, as well as the quantities used shall be reported.

Section 7. Variance.

7.01. Where emission sources in existence prior to the adoption of this regulation do not meet the particulate matter emission limitations noted above, then an acceptable program to meet the emission limitations shall be developed and offered to the Commission by the person owning the equipment causing the emission. This program shall be submitted upon the request of and within such time as shall be fixed by the Commission, and after said program has been approved by the Commission, the owner of the equipment causing the emission shall not be in violation of this regulation so long as the program is observed.

7.02. Due to unavoidable malfunctions of equipment, emissions exceeding those provided for in this regulation may be permitted by the Commission for periods not to exceed 10 days upon specific application to the Commission. Such application shall be made within 24 hours of the malfunction or within such other time period as the Commission may specify. In cases of major equipment failure, additional time periods may be granted by the Commission provided a corrective program has been submitted by the operator and approved by the Commission.

Section 8. Exemptions.

8.01. All residential fuel burning equipment as well as fuel burning equipment used solely for heating apartment buildings up to and including six (6) apartments, shall be exempt from this regulation.

8.02. All fuel burning equipment having a heat input under 10 million British Thermal Units per hour will be exempt from Section 4 and Section 5 of this regulation.

Section 9. Effective Date.

Regulation II shall become effective April 4, 1966.

The foregoing is a true and correct copy of the West Virginia Air Pollution Control Commission Regulation II as adopted on the 17th day of February, 1966.

Carl G. Beard II

Carl G. Beard, II
Secretary
West Virginia Air Pollution Control Commission

WEST VIRGINIA ADMINISTRATIVE REGULATIONS
Air Pollution Control Commission

Chapter 16-20
Series III
(1966)

Subject: Regulation III - To Prevent and Control Air Pollution From the Operation of Hot Mix Asphalt Plants.

Section 1. Definitions.

1.01. "Air Pollution", 'statutory air pollution' shall have the meaning ascribed to it in Section Two of Chapter Sixteen, Article Twenty of the Code of West Virginia, as amended.

1.02. "Commission" shall mean the West Virginia Air Pollution Control Commission.

1.03. "Person" shall mean any and all persons, natural or artificial, including any municipal, public or private corporation organized or existing under the law of this or any other state or county and any firm, partnership, or association of whatever nature.

1.04. "Fuel Burning Equipment" shall mean and include any chamber, apparatus, device, mechanism, stack or structure used in the process of burning fuel or other combustible material for the primary purpose of producing heat for direct heat transfer as applied to an asphaltic hot mix plant excluding internal combustion engines.

1.05. "Fuel" shall mean a fuel such as gas or liquid fuel which is fired in fuel burning equipment. When solid fuels are substituted for or used in conjunction with either of the above fuels, the same regulation will apply.

1.06. "Plant" shall mean an 'asphaltic hot mix plant' which shall mean and include all the equipment utilized in the manufacture of asphaltic hot mix concrete, such as burner, drier, elevators, screens, mixer, weighing equipment, bins, air pollution control equipment, etc.

1.07. "Air Pollution Control Equipment" is defined as:

(a) Primary collection - That equipment such as cyclones or multicyclones incorporated for the collection of fine particulate material generated and emitted principally from the drying operation and from which all collected material may or may not be reinjected into the main aggregate flow.

(b) Secondary collection - That equipment such as multi-cyclones, scrubbers, bag filters, and electrostatic percipitators incorporated for the collection of that particulate material not collected by the primary collection equipment and from which such collected material may or may not be reinjected into the main aggregate flow.

1.08. "Smoke" shall mean small gasborne and airborne particles arising from a process of combustion in sufficient numbers to be visible.

1.09. "Ringelmann Smoke Chart" shall be the Ringelmann's Scale for Grading the Density of Smoke published by the U. S. Bureau of Mines as information circular 7718, August, 1955, or any chart, recorder, indicator, or device which is a standardized method for the measurement of smoke density which is approved by the Commission as the equivalent of said Ringelmann Scale.

1.10. "New Equipment" shall mean all asphaltic hot mix plants installed after the effective date of this regulation.

1.11. "Fugitive Dust" shall mean any and all particulate matter generated by the operation of an asphalt mix plant which, if not confined, would be emitted directly to the atmosphere from points other than the stack outlet.

1.12. "Fugitive Dust Control System" shall mean any equipment or method used to confine, collect, and dispose of fugitive dust, including hoods, bins, duct work, fans, air pollution control equipment, etc.

Other words and phrases used in this Regulation, unless otherwise indicated, shall have the meaning ascribed to them in Section Two of Chapter Sixteen, Article Twenty of the Code of West Virginia, 1931, as amended.

Section 2. Emission of Smoke Prohibited and Standards of Measurement.

2.01. No person shall cause, suffer, allow or permit emission of smoke into the open air from any fuel burning equipment which is as dark or darker in shade or appearance as that designated as No. 1 on the Ringelmann Smoke Chart.

2.02. The provisions of Sub-Section 2.01 of this Section shall not apply to smoke emitted during the starting operation the shade or appearance of which is less than No. 3 of the Ringelmann Smoke Chart for a period or periods aggregating no more than 4 minutes per start-up.

2.03. The equivalent opacity of those Ringelmann numbers in Sub-Section 2.01 and Sub-Section 2.02 of this Section shall be used as a guide in the enforcement of Section 3 of this Regulation.

Section 3. Control and Prohibition of Particulate Emission.

3.01. No person shall cause, suffer, allow or permit particulate emission from a plant into the open air in excess of the quantity as listed in the following table:

Aggregate Process Rate Pounds Per Hour	Stack Emission Rate Pounds Per Hour
10,000	10
20,000	16
30,000	22
40,000	28
50,000	31
100,000	33
200,000	37
300,000	40
400,000	43
500,000	47
600,000 & above	50

For a process weight between any two consecutive process weights stated in this table, the emission limitation shall be determined by interpolation.

3.02. In the case of more than one stack to a hot mix asphalt plant, the emission limitation of Sub-Section 3.01 of this Section will be based on the total emission from all stacks.

3.03. No person shall cause, suffer, allow or permit a plant to operate that is not equipped with a fugitive dust control system. This system shall be operated and maintained in such a manner as to prevent the emission of particulate material from any point other than the stack outlet.

3.04. The owner or operator of the plant shall maintain dust control of the plant premises and plant owned, leased, or controlled access roads by paving, oil treatment, or other suitable measures. Good operating practices shall be observed in relation to stockpiling, screen changing, and general maintenance to prevent dust generation and atmospheric entrainment. Good operating practices, including water spraying or other suitable measures, shall be employed to minimize dust generation and atmospheric entrainment when hot bins are pulled.

Section 4. Registration.

4.01. Within thirty (30) days after the effective date of this regulation, all persons operating asphalt mix plants within the state shall have registered with the Commission on forms to be made available by the Commission, the name of the person, company or corporation operating the plant, the address, location, county, ownership (lessee & lessor), the principal officer of the company, and any other such reasonable information as the Commission may require including but not necessarily limited to capacity of the plant, type of fuel used, plant operating schedule, description of rotary drier, height and size of stack and description of dust control equipment.

4.02. When such plants are modified by changes in burner design, heating fuel, fan capacity, drier design, air pollution control equipment, or like changes which significantly effect the emission characteristics of the plants then they shall be re-registered with the Commission defining those changes within thirty (30) days after being placed in operation.

Section 5. Permits.

5.01. Plants in existence on the effective date of this regulation will be granted a temporary operating permit. These permits will be valid for as long as the Commission shall designate. When control programs are completed that meet the requirements of this regulation, these temporary permits will be replaced with annual operating permits.

5.02. Plants in existence on the effective date of this regulation will be granted an operating permit provided they meet and maintain the requirements as set forth in this regulation. These permits will be valid for one calendar year and must be renewed annually. Any plant failing to maintain these requirements shall, at the discretion of the Commission, have their operating permit revoked.

5.03. When permits are revoked, the Commission will consider reissuing permits when such changes as necessary to meet the requirements of this regulation are made by the owner or operator of the plants.

5.04. Ten (10) days prior to the operation of a new or relocated plant, application must be made to the Commission for a permit. Such application shall be made on forms to be made available by the Commission and in the manner acceptable to the Commission. Plants that meet the requirements of this regulation will be issued an annual permit for operation by the Commission.

5.05. Plants operating without a permit will be in violation of this regulation.

Section 6. Reports.

6.01. When the Commission has reason to believe that the provisions of this regulation are being violated, the owner of the plant shall permit the Commission to conduct such stack tests as necessary to determine the dust loading in the exhaust gases. The operator will provide all the sampling connections and sampling ports to be located in such manner as the Commission may require, power for test equipment and the required safety equipment such as the necessary scaffolding, railings, ladders, etc., to comply with generally accepted good safety practices.

6.02. At such time as the Commission may request, the operator of the plant will submit data on type, sizing, and quantity of the aggregate used and the hours of operation.

Section 7. Variance.

7.01. Where plants in existence prior to the adoption of this regulation do not meet the particulate matter emission limitations noted above, then an acceptable control program to meet the emission limitations shall be developed and offered to the Commission by the person owning the plant causing the emission. This control program shall be submitted upon the request of and within such time as shall be fixed by the Commission, and after said program has been approved by the Commission, the owner or operator of the equipment causing the emission shall not be in violation of this regulation so long as the program is observed.

7.02. Due to unavoidable malfunctions of equipment, emissions exceeding those provided for in this regulation may be permitted by the Commission for periods not to exceed 2 days upon specific application to the Commission. Such application shall be made within 24 hours of the malfunction or within such other time period as the Commission may specify. When parts are not available for repair the Commission may grant an extension of time for a period longer than 2 days, but not to exceed 10 days.

Section 8. Effective Date.

Regulation III shall become effective October 1, 1966.

The foregoing is a true and correct copy of the West Virginia Air Pollution Control Commission Regulation III as adopted on the 22nd day of August, 1966.

Carl G. Beard, II

Carl G. Beard, II
Secretary
West Virginia Air Pollution Control Commission

WEST VIRGINIA ADMINISTRATIVE REGULATIONS
Air Pollution Control Commission

Chapter 16-20
Series IV
(1967)

Subject: Regulation IV - To Prevent and Control the Discharge of Air Pollutants Into the Open Air Which Causes or Contributes to an Objectionable Odor or Odors.

Section 1. Definitions.

1.01. "Air Pollutants" shall mean solids, liquids, or gases which, if discharged into the air, will result in a statutory air pollution.

1.02. "Air Pollution", 'statutory air pollution' shall have the meaning ascribed to it in Chapter Sixteen, Article Twenty, Section Two of the Code of West Virginia, as amended.

1.03. "Commission" shall mean the West Virginia Air Pollution Control Commission.

1.04. "Person" shall mean any and all persons, natural or artificial, including any municipal, public or private corporation organized or existing under the laws of this or any other state or county, and any firm, partnership, or association of whatever nature.

1.05. "Odor" shall mean a sensation resulting from stimulation of the human sense of smell.

1.06. "Objectionable Odor" - In addition to odors generally recognized as being objectionable, an odor shall be deemed objectionable when in the opinion of a duly authorized representative of the Air Pollution Control Commission, based upon his investigations or his investigations and complaints, such odor is objectionable.

1.07. "Duly Authorized Representative" shall mean the Director or such other agent or employee of the Commission who by virtue of special training and/or experience is qualified to make determinations relative to this regulation.

Other words and phrases used in this Regulation, unless otherwise indicated, shall have the meaning ascribed to them in Chapter Sixteen, Article Twenty, Section Two of the Code of West Virginia, 1931, as amended.

Section 2. Objectionable Odor Prohibited.

2.01. No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor at any location occupied by the public.

2.02. The Barnebey-Cheney Scentometer or any other instrument, device, or technique designated by the Commission may be used as a guide in the enforcement of the regulation and may be used in the determination of the objectionability of an odor.

Section 3. Accidental and Other Infrequent Emissions, Reporting.

3.01. Accidental and other infrequent discharges which cause or contribute to objectionable odors will be considered on an individual basis and shall be reported by the person responsible therefor to the Commission in the manner to be prescribed by the Commission.

Section 4. Notice of Violation.

4.01. No person shall be considered in violation of this regulation unless notified that he is discharging an air pollutant or air pollutants which causes or contributes to an objectionable odor.

4.02. Notification as herein required shall be by registered or certified letter of notice sent to the person at his last known address which notice shall set forth the nature of the violation and require such person to submit a control program within such reasonable time as the Commission shall specify.

4.03. The provisions of this section shall not apply to persons operating a control program approved pursuant to Section 5 of this regulation.

Section 5. Variance.

5.01. When a process or operation results in the discharge of an air pollutant or pollutants which causes or contributes to an objectionable odor, an acceptable control program shall be developed and offered to the Commission by the person responsible for the discharge of such air pollutant or pollutants. This control program shall be submitted in the manner prescribed by the Commission and within such time as shall be fixed by the Commission. If such a control program has been approved by the Commission by the issuance of a variance, the person responsible for said discharge shall not be considered to be in violation of this regulation in connection with said discharge so long as the program is observed.

5.02. The Director may permit, under emergency circumstances, the discharge of air pollutants which causes or contributes to an objectionable odor under specific conditions for specific time periods. Any person who desires such a variance shall make application to the Director in the manner to be prescribed by the Director.

Section 6. Exemptions.

6.01. This regulation shall not apply to the following sources of objectionable odor until such time as feasible control methods are developed:

(a) Internal combustion engines.

(b) Normal and necessary operations associated with the production of agricultural products grown on the premises or livestock, dogs, cats, and poultry grown on the premises.

Section 7. Effective Date.

Regulation IV shall become effective October 1, 1967.

The foregoing is a true and correct copy of the West Virginia Air Pollution Control Commission Regulation IV as adopted on the 17th day of August, 1967.

Carl G. Beard, II

Carl G. Beard, II
Secretary
West Virginia Air Pollution Control Commission.

WEST VIRGINIA ADMINISTRATIVE REGULATIONS
Air Pollution Control Commission

Chapter 16-20
Series V
(1968)

Subject: Regulation V - To Prevent and Control Air Pollution From the Operation of Coal Preparation Plants and Coal Handling Operations.

Section 1. Definitions.

1.01. "Air Pollution", 'statutory air pollution' shall have the meaning ascribed to it in Chapter Sixteen, Article Twenty, Section Two of the Code of West Virginia, as amended.

1.02. "Commission" shall mean the West Virginia Air Pollution Control Commission.

1.03. "Person" shall mean any and all persons, natural or artificial, including any municipal, public or private corporation organized or existing under the law of this or any other state or county and any firm, partnership, or association of whatever nature.

1.04. "Handling Operation" shall mean and include but not be limited to all coal grinding, crushing, picking, screening, conveying, storing, and stockpiling operations associated with the transport, production, or preparation of coal or coal refuse, excluding coal washing, drying, or air separation operations.

1.05. "Coal Preparation" shall mean and include but not be limited to all coal washing, drying or air separation operations used for the purpose of preparing the product for marketing.

1.06. "Plant" shall mean and include all equipment and grounds utilized in an integral complex for coal preparation and associated handling.

1.07. "Fuel" shall mean a fuel such as a solid, gaseous or liquid fuel which is fired in fuel burning equipment.

1.08. "Fuel Burning Equipment" shall mean and include any chamber, apparatus, device, mechanism, stack or structure used in the process of burning fuel for the primary purpose of producing heat for a thermal drier.

1.09. "Thermal Drier" shall mean a device using fuel burning equipment for the primary purpose of reducing the moisture content of coal.

1.10. "Air Table" shall mean a device using a gaseous separating media for the primary purpose of improving the product quality.

1.11. "Air Pollution Control Equipment" shall mean any equipment used for collecting gasborne particulate matter for the purpose of preventing or reducing particulate emissions into the open air.

1.12. "Standard Cubic Foot" - One cubic foot of dry gas, measured at standard conditions of 60°F and 29.92 inches of mercury column.

1.13. "Stack" - For the purpose of this Regulation shall mean but not be limited to any duct, control equipment exhaust, or similar apparatus, which vents gases containing particulate matter into the open air.

1.14. "Particulate Matter" shall mean any material except uncombined water, that exists in a finely divided form as a liquid or solid.

1.15. "Smoke" shall mean small gasborne and airborne particles emitted from a stack in sufficient numbers to be visible.

1.16. "Ringelmann Smoke Chart" - Shall be the Ringelmann's Scale for Grading the Density of Smoke published by the U. S. Bureau of Mines as information circular 7718, August, 1955, or any chart, recorder, indicator, device, or method which is a standardized method for the measurement of smoke density which is approved by the Commission as the equivalent of said Ringelmann Scale.

1.17. "Fugitive Dust" - Shall mean any and all particulate matter generated, which, if not confined, would be emitted directly into the open air from points other than a stack outlet.

1.18. "Fugitive Dust Control System" - Shall mean any equipment or method used to confine, collect, and dispose of fugitive dust, including but not limited to hoods, bins, duct work, fans, and air pollution control equipment.

Other words and phrases used in this Regulation, unless otherwise indicated, shall have the meaning ascribed to them in Chapter Sixteen, Article Twenty, Section Two of the Code of West Virginia, 1931, as amended.

Section 2. Emission of Smoke Prohibited and Standards of Measurement.

2.01. No person shall cause, suffer, allow or permit emission of smoke into the open air from any stack which is as dark or darker in shade or appearance as that designated as No. 1 on the Ringelmann Smoke Chart.

2.02. The provisions of Sub-Section 2.01 of this Section shall not apply to smoke, the shade or appearance of which is less than No. 3 on the Ringelmann Smoke Chart for a period or periods aggregating no more than 5 minutes in any 60-minute period during operation.

2.03. The provisions of Sub-Section 2.01 and 2.02 of this Section shall not apply to smoke, the shade or appearance of which is less than No. 3 on the Ringelmann Smoke Chart for a period of up to 8 minutes in any operating day for the purposes of building a fire of operating quality in the fuel burning equipment of a thermal drier.

2.04. The equivalent opacity of those Ringelmann numbers in Sub-Section 2.01 and Sub-Section 2.02 of this Section shall be used as a guide in the enforcement of Section 3 and Section 4 of this Regulation.

2.05. No person shall cause, suffer, allow or permit emission of smoke into the open air from any fugitive dust control system which is as dark or darker in shade or appearance as that designated as No. 1 on the Ringelmann Smoke Chart or the equivalent opacity of this Ringelmann number.

Section 3. <u>Control and Prohibition of Particulate Emissions From Coal Thermal Drying Operations of a Coal Preparation Plant.</u>

No person shall cause, suffer, allow or permit particulate matter to be vented into the open air from any thermal drier exhaust in excess of the following limitations:

3.01. Until September 2, 1971, thermal driers installed on or before March 1, 1970, shall not emit more than 0.15 grains of particulate matter per standard cubic foot of exhaust gas.

3.02. After September 1, 1971, thermal driers installed on or before March 1, 1970, shall not exceed the emission limitations of the following table:

Total Plant Volumetric Flow Rate (Standard Cubic Feet Per Minute)	Maximum Allowable Particulate Loading Per Drier (Grains Per Standard Cubic Foot)
120,000 or less	0.12
172,000	0.11
245,000	0.10
351,000	0.09
500,000 & above	0.08

3.03. Thermal driers installed after March 1, 1970, shall not exceed the emission limitations of the following table:

Total Plant Volumetric Flow Rate (Standard Cubic Feet Per Minute)	Maximum Allowable Particulate Loading Per Drier (Grains Per Standard Cubic Foot)
75,000 or less	0.10
111,000	0.09
163,000	0.08
240,000 & above	0.07

3.04. For the volumetric flow rate between any two consecutive volumetric flow rates stated in Sub-Section 3.02 and Sub-Section 3.03, limitations shall be as determined by linear interpolation. For the purpose hereof, the total volumetric flow rate shall be the total standard cubic feet of dry gas passed through all thermal driers at one plant location. This value shall be determined by methods which are acceptable to the Commission.

3.05. When modifications are made to plants after March 1, 1970, that result in a significant increase in the total gas volume passing through a thermal drier, said drier(s) will be subject to the emission limitations of Sub-Section 3.03 even though such modifications do not include the installation of a new thermal drier(s).

3.06. No person shall circumvent this Regulation by adding additional gas to any drier exhaust or group of drier exhausts for the purpose of reducing the grain loading.

3.07. No person shall cause, suffer, allow or permit the exhaust gases from a thermal drier to be vented into the open air at an altitude of less than 80 feet above the foundation grade of the structure containing the drier or less than 10 feet above the top of said structure or any adjacent structure, whichever is greater.

In determining the desirable height of the above stack, due consideration shall be given to the local topography, meteorology, the location of nearby dwellings and public roads, and the stack emission rate.

3.08. Any stack venting thermal drier exhaust gases into the open air shall contain flow straightening devices or a vertical run of sufficient length to establish flow patterns consistent with acceptable stack sampling procedures.

Section 4. Control and Prohibition of Particulate Emissions From an Air Table Operation of a Coal Preparation Plant.

4.01. No person shall cause, suffer, allow or permit particulate matter to be vented into the open air from any air table exhaust in excess of 0.05 grains per standard cubic foot of exhaust gases.

4.02. No person shall circumvent this Regulation by adding additional gas to any air table exhaust or group of air table exhausts for the purpose of reducing the grain loading.

4.03. Any stack venting air table exhaust gases into the open air shall contain flow straightening devices or a vertical run of sufficient length to establish flow patterns consisten with acceptable stack sampling procedures.

Section 5. Control and Prohibition of Fugitive Dust Emissions From Coal Handling Operations and Preparation Plants.

5.01. No person shall cause, suffer, allow or permit a plant or handling operation to operate that is not equipped with a fugitive dust control system. This system shall be operated and maintained in such a manner as to minimize the emission of particulate matter into the open air.

5.02. The owner or operator of the plant or handling operation shall maintain dust control of the premises and owned, leased, or controlled access roads by paving, or other suitable measures. Good operating practices shall be observed in relation to stockpiling, car loading, breaking, screening, and general maintenance to minimize dust generation and atmospheric entrainment.

Section 6. Registration.

6.01. Within thirty (30) days after the effective date of this Regulation, all persons owning and/or operating coal preparation plants within the State shall have registered with the Commission on forms to be made available by the Commission, the name of the person, company or corporation operating the plant, the address, location, county, ownership (lessee & lessor), the principal officer of the company, and any other such reasonable information as the Commission may require, including, but not necessarily limited to, capacity of the plant, type of fuel used, plant operating schedule, description and capacities of thermal driers and air tables, height and size of stacks and air pollution control equipment.

6.02. Persons operating registered plants which are to be modified by changes in fuel burning equipment, fuel, fan capacity, drier design, air pollution control equipment, air tables, stacks or like changes which could significantly affect the emission characteristics of the plants shall file with the Commission those proposed changes not less than thirty (30) days before such changes are made.

6.03. Within thirty (30) days after the completion of the modifications as filed under Sub-Section 6.02, the operator shall register such changes with the Commission on forms to be made available by the Commission.

6.04. Not later than sixty (60) days prior to operation, new plants shall be registered by the owner and/or operator of such plants. Such registration shall be made on forms to be made available by the Commission and will include the name of the person, company, or ownership (lessee & lessor), the principal officer of the company, and any other such reasonable information as the Commission may require including, but not necessarily limited to, data on the capacity of the plant, type of fuel to be used, description and capacities of thermal driers and air tables, height and size of stacks and description of air pollution control equipment.

Section 7. Permits.

7.01. Plants in existence on the effective date of this Regulation will be granted temporary operating permits subject to compliance with Sub-Section 6.01. These permits will be valid for as long as the Commission shall designate. When it is determined by the Commission that a plant meets the requirements of this Regulation, the temporary permit will be replaced with an operating permit.

7.02. Any plant failing to maintain the requirements of this Regulation shall, at the discretion of the Commission, have the permit revoked.

7.03. When permits are revoked, the Commission will reissue permits when such changes as necessary to meet the requirements of this Regulation are made.

7.04. New plants will be granted temporary operating permits provided they comply with Sub-Section 6.04.

7.05. Subject to the provisions of Sub-Section 6.01, plants operating without a permit will be in violation of this Regulation.

7.06. The possession of a permit by any person shall in no way relieve the holder thereof of his obligation to comply with the provisions of this Regulation.

Section 8. Reports and Testing.

8.01. At such reasonable times as the Director may designate, the operator of a coal preparation plant may be required to conduct or have conducted stack tests to determine the dust loading in exhaust gases when the Director has reason to believe that the stack emission limitation is being violated. Such tests shall be conducted in such manner as the Director may specify and be filed on forms, and in a manner, acceptable to the Director. The Director, or his duly authorized representative, may at his option witness or conduct such stack tests. Should the Director exercise his option to conduct such tests, the operator will provide all the necessary sampling connections and sampling ports to be located in such manner as the Director may require, power for test equipment, and the required safety equipment such as scaffolding, railings, ladders, etc., to comply with generally accepted good safety practices.

8.02. The Director, or his duly authorized representative, may conduct such other tests as he may deem necessary to evaluate air pollution emissions other than those noted in Sub-Section 8.01.

Section 9. Variance.

9.01. If a plant operating under a temporary permit does not meet the requirements of this Regulation, the operator of the plant shall develop and submit to the Commission an acceptable control program to meet these requirements. This control program shall be submitted upon the request of and within such time as shall be fixed by the Commission, and after said program has been approved by the Commission, the owner or operator of the plant will not be in violation of this Regulation as long as said program is observed.

9.02. Due to unavoidable malfunctions of equipment or non-availability of repair parts, emissions exceeding those provided for in this Regulation may be permitted by the Commission upon specific application to the Commission. Such application shall be made within 24 hours of the malfunction or within such other time period as the Commission may specify.

Section 10. Effective Date.

Regulation V shall become effective September 1, 1968.

The foregoing is a true and correct copy of the West Virginia Air Pollution Control Commission Regulation V as adopted on the 11th day of July, 1968.

Carl G. Beard, II

Carl G. Beard, II
Secretary
West Virginia Air Pollution Control Commission

WEST VIRGINIA ADMINISTRATIVE REGULATIONS
Air Pollution Control Commission

Chapter 16-20
Series VI
(1969)

Subject: Regulation VI - To Prevent and Control Air Pollution From Combustion of Refuse.

Section 1. Intent and Purpose.

1.01. Neither compliance with the provisions of this Regulation nor the absence of specific language to cover particular situations constitutes approval or implies consent or condonement of any emission which is released in any locality in such manner or amount as to cause or contribute to undesirable levels of air contaminants. Neither does it exempt nor excuse anyone from complying with other applicable laws, ordinances, regulations or orders of governmental entities having jurisdiction.

1.02. All persons engaged in any form of combustion of refuse shall give careful consideration to the effects of the resultant emissions on the air quality of the area(s) affected by such burning. Important considerations include but are not limited to the location and time of burning, the type of material being burned and the potential emissions and the prevailing meteorological conditions. Persons failing to give due consideration to these factors will be in violation of this Regulation.

1.03. It is the intent of the Commission that all incorporated areas and other local governmental entities prohibit open burning and develop alternative methods for disposal of waste material. If such action is not taken in any air basin, air quality control region or other such areas as the Commission may designate, then such action may be taken by the Commission to insure compliance with air quality standards.

Section 2. Definitions.

2.01. "Air Pollution", 'statutory air pollution' shall have the meaning ascribed to it in Chapter Sixteen, Article Twenty, Section Two, of the Code of West Virginia, as amended.

2.02. "Commission" shall mean the West Virginia Air Pollution Control Commission.

2.03. "Person" shall mean any and all persons, natural or artificial, including any municipal, public or private corporation organized or existing under the law of this or any other state or county, and any firm, partnership or association of whatever nature.

2.04. "Particulate Matter" shall mean any material, except uncombined water, that exists in a finely divided form as a liquid or solid.

2.05. "Smoke" shall mean small gasborne and airborne particles emitted as the result of the combustion of refuse in sufficient numbers to be visible.

2.06. "Ringelmann Smoke Chart" shall mean the Ringelmann's Scale for Grading the Density of Smoke, published by the U. S. Bureau of Mines, or any chart, recorder, indicator, device or method which is a standardized method for the measurement of smoke density and is approved by the Commission as the equivalent of said Ringelmann Chart.

2.07. "Air Pollution Control Equipment" shall mean any equipment used for collecting or converting gasborne particulate or gaseous materials for the purpose of preventing or reducing emission of these materials into the open air.

2.08. "Incineration" shall mean the destruction of combustible refuse by burning in a furnace designed for that purpose. For the purposes of this Regulation, the destruction of any combustible liquid or gaseous material by burning in a flare/ flare stack shall be considered incineration.

2.09. "Incinerator" shall mean any device used to accomplish incineration.

2.10. "Flare", 'flare stack' shall mean and include a combustion source normally comprised of but not limited to a length of stack or pipe which has an attached burner mechanism designed to destroy liquid or gaseous material with an open or semi-enclosed flame.

2.11. "Open Burning" shall mean the combustion of refuse whereby the gaseous products of combustion are not conveyed through man-made means from one point to another and are discharged directly to the open air.

2.12. "Refuse" shall mean the useless and/or unwanted or discarded solid, liquid and/or gaseous waste materials resulting from community, commercial, industrial or citizen activities.

2.13. "Construction and Demolition Wastes" shall mean combustible waste building materials and rubble resulting from construction, remodeling, repair and demolition operations on houses, commercial buildings, pavements and other structures.

2.14. "Incinerator Capacity" shall be the manufacturer's or designer's guaranteed maximum charging rate or such other rate as may be determined by the Director in accordance with good engineering practices. In case of conflict the determination by the Director shall govern. For the purposes of this Regulation the total of the capacities of all furnaces within one system shall be considered as the "incinerator capacity".

Other words and phrases used in this Regulation, unless otherwise indicated, shall have the meaning ascribed to them in Chapter Sixteen, Article Twenty, Section Two, of the Code of West Virginia, 1931, as amended.

Section 3. Open Burning Prohibited.

3.01. General Provisions

The open burning of refuse for the purpose of volume reduction, elimination or product recovery by any person, firm, corporation, association or public agency is prohibited except for the following exemptions:

(a) Vegetation grown on the premises of a home or farm, provided that there is compliance with the provisions of Sub-Section 1.02, and the health, safety, comfort and property of persons are protected from the effects of such burning.

(b) Fires set for the purpose of bona fide instruction and training of public and industrial employees in the methods of fighting fires, provided that approval to conduct such burning is received from the Director or his duly authorized representative.

(c) Open burning of construction and demolition wastes, provided that all the following conditions are met:

(1) There is no practical alternate method for the disposal of the material to be burned;

(2) The health, safety, comfort and property of persons are protected from the effects of such burning;

(3) Such burning shall not be conducted for salvage purposes; and,

(4) In non-rural areas approval to conduct such burning is received from the Director or his duly authorized representative.

(d) Backyard open burning for the reduction of refuse produced on the premises as long as the amount does not exceed that weight normally produced by the everyday living habits of one (1) family, until such families are serviced by a municipal or private refuse collection service.

3.02. The exemptions listed in Sub-Section 3.01 are subject to the following stipulation:

Upon notification by the Director, no person shall cause, suffer, allow or permit any form of open burning during existing or predicted periods of atmospheric stagnation. Notification shall be made by such means as the Director may deem necessary and feasible.

Section 4. <u>Emission Standards for Incinerators and Incineration.</u>

4.01. Unless authorized by the Commission, no person shall cause, suffer, allow or permit particulate matter to be discharged from an incinerator into the open air in excess of the quantity determined by use of the following formula:

Emissions (lb/hr) = F x Incinerator Capacity (tons/hr)

where the Factor, F, is as indicated in Table I below:

Table I: Factor, F, for Determining Maximum Allowable Particulate Emissions

	Incinerator Capacity	F Factor
A.	200 lbs/hr or less	8.25
B.	More than 200 lbs/hr but less than 15,000 lbs/hr	5.43
C.	15,000 lbs/hr or greater	2.72

4.02. Emission of Visible Particulate Matter

No person shall cause, suffer, allow or permit emission of smoke into the atmosphere from any incinerator which is as dark or darker in shade or appearance than that designated as No. 1 on the Ringelmann Smoke Chart or the equivalent opacity of this Ringelmann number.

4.03. The provisions of Sub-Section 4.02 shall not apply to smoke, the shade or appearance of which is less than No. 2 on the Ringelmann Smoke Chart or the equivalent opacity of this Ringelmann number, for a period or periods aggregating no more than eight (8) minutes per start-up, or six (6) minutes in any 60-minute period for stoking operations.

4.04. No person shall cause, suffer, allow or permit the emission of particles of unburned or partially burned refuse or ash from any incinerator which are large enough to be individually distinguished in the open air.

4.05. Incinerators, including all associated equipment and grounds, shall be designed, operated and maintained so as to prevent the emission of objectionable odors.

4.06. Incineration of Residues and Hazardous Materials

Persons responsible for the incineration of hazardous materials such as insecticides, empty insecticide containers, toxic materials, certain chemical residues, explosives, used bandages and other medical wastes, pathological wastes, human and animal remains and other like materials shall give the utmost care and consideration to the potential harmful effects of the emissions resulting from such activities. Evaluation of these facilities as to adequacy, efficiency and emission potential will be made on an individual basis by the Commission working in conjunction with other appropriate governmental agencies.

Section 5. <u>Registration.</u>

5.01. Registration of Existing Incinerators

Within sixty (60) days after the effective date of this Regulation, all persons owning, operating or constructing incinerators within the State shall register with the Commission on forms to be made available by the Commission. The Director may require any such reasonable information as he may specify.

5.02. Registration of New Incinerators

New incinerators shall be considered duly registered when the owner and/or operator thereof has received from the Director written approval of the plans and specifications submitted, pursuant to the requirements of Section 6.

5.03. Registration of Incinerator Modifications

When incinerators are to be modified by changes in charging method, auxiliary fuel, air pollution control equipment or like changes which significantly affect the emission characteristics of the incinerator, such proposed changes shall be registered with the Commission no later than thirty (30) days prior to their being made.

Section 6. New Incinerator Plan Review.

Plans and specifications for proposed incinerators are to be submitted to the Director at least sixty (60) days prior to construction for review and approval. These plans and specifications shall include any such reasonable information as the Director may specify.

Section 7. Reports and Testing.

7.01. At such reasonable times as the Director may designate, the operator of an incinerator may be required to conduct or have conducted stack tests to determine the dust loading in exhaust gases, when the Director has reason to believe that the stack emission limitation is being violated. Such tests shall be conducted in such manner as the Director may specify and be filed on forms and in a manner acceptable to the Director. The Director, or his duly authorized representative, may at his option witness or conduct such stack tests. Should the Director exercise his option to conduct such tests, the operator will provide all the necessary sampling connections and sampling ports to be located in such manner as the Director may require, power for test equipment and the required safety equipment such as scaffolding, railings and ladders to comply with generally accepted good safety practices.

7.02. The Director, or his duly authorized representative, may conduct such other tests as he may deem necessary to evaluate air pollution emissions other than those noted above.

Section 8. Variances.

8.01. If it can be demonstrated to the Commission that the disposal of certain materials by any method other than burning leads to ground water contamination, then the person responsible for the disposal of such materials shall submit to the Commission within sixty (60) days a program leading to the construction of a suitable incinerator. If such program is accepted by the Commission, the person shall not be in violation as long as the program is observed.

8.02. Due to unavoidable malfunctions of equipment and/or non-availability of repair parts, emissions exceeding those provided for in this Regulation may be permitted by the Director. Application for such variance shall be made within 24 hours of the malfunction or within such time period as the Director may specify. These variances shall be valid for such time periods as the Director may specify.

8.03. Control Program Variance

The owner or operator of an incinerator or an open burning operation in existence on the effective date of this Regulation that does not meet the Regulation requirements shall submit a control program to the Commission. This program shall be submitted upon the request of and within such time as shall be fixed by the Commission, and after said program has been approved by the Commission, the owner or operator of such incinerator or open burning operation shall not be in violation of this Regulation so long as the program is observed.

Section 9. Effective Date.

Regulation VI shall become effective September 1, 1969.

The foregoing is a true and correct copy of the West Virginia Air Pollution Control Commission Regulation VI as adopted on the 22nd day of July, 1969.

Carl G. Beard, II

Carl G. Beard, II
Secretary
West Virginia Air Pollution Control
Commission

WEST VIRGINIA ADMINISTRATIVE REGULATIONS

AIR POLLUTION CONTROL COMMISSION

REGULATION VII

"To Prevent and Control Particulate Air Pollution From Manufacturing Process Operations."

Public hearing will be held on this Regulation Thursday, April 9, at 10:00 a.m., House of Delegates Chamber, State Capitol Building, Charleston, West Virginia.

PROPOSED REGULATIONS

PROPOSED REGULATIONS

PROPOSED REGULATION

WEST VIRGINIA ADMINISTRATIVE REGULATIONS

AIR POLLUTION CONTROL COMMISSION

Subject: REGULATION VII - To Prevent and Control Particulate Air Pollution From Manufacturing Process Operations.

Section 1. Definitions.

1.01. "Air Pollution", 'statutory air pollution' shall have the meaning ascribed to it in Section Two of Chapter Sixteen, Article Twenty of the Code of West Virginia, as amended.

1.02. "Commission" shall mean the West Virginia Air Pollution Control Commission.

1.03. "Person" shall mean any and all persons, natural or artificial, including any municipal, public or private corporation organized or existing under the law of this or any other state or county and any firm, partnership, or association of whatever nature.

1.04. "Particulate Matter" shall mean any material, except uncombined water, that exists in a finely divided form as a liquid or solid.

1.05. "Smoke" shall mean small gasborne and airborne particulate matter emitted from a stack or other aperture in sufficient numbers to be visible.

1.06. "Ringelmann Smoke Chart" shall be the Ringelmann's Scale for Grading the Density of Smoke published by the U. S. Bureau of Mines or any chart, recorder, indicator, or device which is a standardized method for the measurement of smoke density which is approved by the Commission as the equivalent of said Ringelmann Scale.

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1.07. "Fugitive Dust" shall mean any and all particulate matter generated by any manufacturing process which, if not confined, would be emitted directly into the open air from points other than a stack outlet.

1.08. "Fugitive Dust Control System" shall mean any equipment or method used to confine, collect, and dispose of fugitive dust, including, but not limited to, hoods, bins, duct work, fans, and air pollution control equipment.

1.09. "Fuel" - Shall mean any form of combustible matter that is used as a source of heat - solid, liquid, vapor, or gas.

1.10. "Air Pollution Control Equipment" shall mean any equipment used for collecting or converting smoke and/or particulate matter for the purpose of preventing or reducing emission of these materials into the open air.

1.11. "Standard Conditions" - Shall mean for the purposes of this Regulation a temperature of 60°F and a pressure of 29.92 inches of mercury column.

1.12. "Stack" - Shall mean for the purposes of this Regulation, bu not be limited to, any duct, control equipment exhaust, or similar apparatus, which is designed to vent gases containing particulate matter into the open air.

1.13. "Plant" - Shall mean and include all equipment, grounds, source operations, and any manufacturing process(es) utilized in an integral complex.

1.14. "Manufacturing Process' - Shall mean any action, operation or treatment embracing chemical, industrial, or manufacturing efforts, and employing, for example, heat treating furnaces,

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by-product coke plants, core-baking ovens, mixing kettles, cupolas, blast furnaces, open hearth furnaces, heating and reheating furnaces, puddling furnaces, sintering plants, electric steel furnaces, ferrous and non-ferrous foundries, kilns, stills, driers, crushers, grinders, roasters, and equipment used in connection therewith, and all other methods or forms of manufacturing or processing that may emit smoke, particulate matter, or gaseous matter.

1.15. "Process Weight" - Shall mean that total weight of all materials introduced into a source operation, excluding solid, liquid, and gaseous fuels used solely as fuels, and excluding air introduced for purposes of combustion.

1.16. "Process Weight Rate" - Shall mean a rate established as follows:

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

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

Where the nature of any process or operation or the design of any equipment is such as to permit more than one interpretation of this definition, the interpretation that results in the minimum value for allowable emission shall apply.

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1.17. "Physical Change" - Shall mean for the purposes of this Regulation, any change in a substance which does not change the properties of the substance. Such changes include but are not limited to crushing, grinding, drying, change of state and sizing.

1.18. "Chemical Change" - Shall mean for the purposes of this Regulation, any change in a substance which does change the properties of the substance and by which a new substance is formed.

1.19. "Source Operation" - Shall mean the last operation in a manufacturing process preceding the emission of air contaminant which operation (a) results in the separation of the air contaminant from the process materials or in the conversion of the process materials into air contaminants; and (b) is not an air pollution abatement operation.

1.20. "A Duplicate Source Operation" - Shall mean any combination of two or more individual source operations of any size that have the same nomenclature, either formerly adopted and/or commonly sanctioned by usage such as but not limited to two or more rotary driers, basic oxygen furnaces, or electric arc furnaces contained in the same plant.

1.21. "Source Operation Type" -shall mean a categorization established as follows:

(a) Type 'a' - Shall mean any manufacturing process source operation in which materials of any origin undergo physical changes and/or calcination except as noted in Type 'c' below.

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(b) Type 'b' - Shall mean any metallurgical manufacturing process source operation.

(c) Type 'c' - Shall mean any existing wet cement manufacturing process source operation which is used for the primary purpose of calcination.

(d) Type 'd' - Shall mean any manufacturing process source operation in which materials of any origin undergo a chemical change (except calcination).

Where the nature of any process or operation or the design of any equipment is such as to permit more than one interpretation of source operation type, the interpretation of the Commission shall apply.

Other words and phrases used in this Regulation, unless otherwise indicated, shall have the meaning ascribed to them in Section Two of Chapter Sixteen, Article Twenty of the Code of West Virginia, as amended.

Section 2. Emission of Smoke Prohibited and Standards of Measurements.

2.01. No person shall cause, suffer, allow or permit emission of smoke into the open air from any process source operation which is darker in shade or appearance than that designated as No. 1 on the Ringelmann Smoke Chart or the equivalent opacity of this Ringelmann number, except as noted in Sub-Sections 2.02, 2.03, and 2.04.

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2.02. The provisions of Sub-Section 2.01 of this Section shall not apply to smoke emitted from any process source operation which is less than No. 2 on the Ringelmann Smoke Chart or the equivalent opacity of this Ringelmann number for any period or periods aggregating no more than five (5) minutes of any sixty (60) minute period.

2.03. The provisions of Sub-Sections 2.01 and 2.02 of this Section shall not apply to smoke emitted during the charging or pushing operation of a by-product coke production facility the shade or appearance of which is no darker than No. 2 on the Ringelmann Smoke Chart or the equivalent opacity of this Ringelmann number for a period or periods aggregating no more than 30 seconds per charge or push.

2.04. No person shall cause, suffer, allow or permit emission of smoke into the open air from any enclosed storage structure associated with any manufacturing process.

Section 3. Control and Prohibition of Particulate Emissions by Weight From Manufacturing Process Source Operations.

3.01. No person shall cause, suffer, allow or permit particulate matter to be vented into the open air from any type source operation or duplicate source operation, or from all air pollution control equipment installed on any type source operation or duplicate source operation in excess of the quantity specified under the appropriate source operation type in the following table:

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Operating Source Operation or Total Duplicate Source Operation Process Weight Rate in Pounds Per Hour[1]	Maximum Allowable Total Stack Emission Rate in Pounds Per Hour For The Appropriate Process Weight and Source Operation Type[1]			
	Type 'a'	Type 'b'	Type 'c'	Type 'd'[2]
0	0	0	0	0
2,500	3	3	9	0.22
5,000	5	5	13	1.39
10,000	10	10	19	1.84
20,000	16	16	26	4.00
30,000	22	22	32	6.15
40,000	28	28	36	8.31
50,000	31	31	40	10.46
100,000	33	33	54	21.24
200,000	37	37	70	21.24
300,000	40	40	80	21.24
400,000	43	46	88	21.24
500,000	47	53	94	21.24
600,000	50	62	99	21.24
700,000	50	71	99	21.24
800,000	50	79	99	21.24
900,000	50	88	99	21.24
1,800,000 and above	50	176	99	21.24

[1] For a process weight between any two consecutive process weights stated in this table, the emission limitation shall be determined by linear interpolation.

[2] Type 'd' source operation stack emission rates do not apply to MINERAL ACIDS. See Sub-Section 3.02.

3.02. Mineral acids shall not be released from any Type 'd' source operation or duplicate source operation or from all air pollution control equipment installed on any Type 'd' source operation or duplicate source operation in excess of the quantity given in the following table:

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Mineral Acid	Allowable Stack Gas Concentration in Milligrams Per Dry Cubic Meter at Standard Conditions from Source Operations or Duplicate Source Operations in Existence on the Effective Date of this Regulation	Allowable Stack Gas Concentration in Milligrams Per Dry Cubic Meter at Standard Conditions from Source Operations or Duplicate Source Operations Installed After the Effective Date of this Regulation
Sulfuric Acid Mist	70	35
Nitric Acid Mist and/or Vapor	140	70
Hydrochloric Acid Mist and/or Vapor	420	210
Phosphoric Acid Mist and/or Vapor	6	3

3.03. Where more than one source operation or combinations thereof, which are part of a duplicate source operation, are vented through separate stacks, the allowable stack emission rates for the separate stacks shall be determined by the following formula:

$$R_s = R_t \frac{W_s}{W_t}$$

Where: R_s is the allowable stack emission rate for the separate stack venting the source operations in question

R_t is the total allowable emission rate for the duplicate source operation

W_s is the operating process weight rate for the source operation(s) vented through the separate stack

W_t is the total operating process weight rate for the duplicate source operation

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3.04. The provisions of this Section shall not apply to the coking of coal.

3.05. For a period of ____ years, provisions of this Section shall not apply to process source operations existing on the effective date of this Regulation with process weights of ____ lbs/hr or more, provided that the following requirements are met and maintained:

(1) The actual pollutant emissions from such process source operations do not exceed the allowable emissions specified in Sub-Sections 3.01 and 3.02, by more than 20 percent; and

(2) Smoke emitted into the open air from any such process source operation is not as dark or darker in shade or appearance than that designated as No. 1 on the Ringelmann Smoke Chart or the equivalent opacity of this Ringelmann number.

3.06 Any stack serving any process source operation or air pollution control equipment on any process source operation shall contain flow straightening devices or a vertical run of sufficient length to establish flow patterns consistent with acceptable stack sampling procedures.

3.07. Potential Hazardous Material Emissions

Persons responsible for manufacturing process source operations from which hazardous particulate material may be emitted such as but not limited to lead, arsenic, beryllium, and other such materials shall give the utmost

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care and consideration to the potential harmful effects of the emissions resulting from such activities. Evaluations of these facilities as to adequacy, efficiency and emission potential will be made on an individual basis by the Commission working in conjunction with other appropriate governmental agencies.

Section 4. Control of Fugitive Dust.

4.01. No person shall cause, suffer, allow or permit any manufacturing process to operate that is not equipped with a fugitive dust control system. This system shall be operated and maintained in such a manner as to minimize the emission of fugitive dust.

4.02. The owner or operator of a plant shall maintain dust control of the plant premises and plant owned, leased, or controlled access roads by paving, oil treatment, or other suitable measures. Good operating practices shall be observed in relation to stockpiling and general maintenance to prevent dust generation and atmospheric entrainment.

Section 5. Registration

5.01. Within thirty (30) days after the effective date of this Regulation all persons owning and/or operating existing manufacturing process source operations shall have registered such source operations with the Commission. The information required for registration shall be determined by the Director, and shall be provided in the manner specified by the Director.

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5.02. The owner and/or operator of manufacturing process source operations that are under construction or on which construction is initiated within thirty (30) days after the effective date of this Regulation shall register such process sources within this thirty (30) day period.

5.03. After __________ the owner and/or operator shall register new process source operations with the Director at least thirty (30) days prior to construction.

5.04. Persons owning and/or operating registered manufacturing process source operations which are to be modified by changes which could significantly affect the emission characteristics of the source operations shall register with the Director those proposed changes not less than thirty (30) days before such changes are made.

Section 6. Reports and Testing.

6.01. At such reasonable times as the Director may designate, the operator of any manufacturing process source operation may be required to conduct or have conducted stack tests to determine the dust loading in exhaust gases when the Director has reason to believe that the stack emission limitation(s) is/are being violated. Such tests shall be conducted in such manner as the Director may specify and be filed on forms and in a manner acceptable to the Director. The Director, or his duly authorized representative, may at his option witness or conduct such stack tests. Should the Director exercise his option to conduct such tests, the operator will provide all the necessary sampling connections and sampling ports to be located in such manner as the Director may require, power for test equipment, and the required safety equipment such as scaffolding, railings, and ladders to comply with generally accepted good safety practices.

6.02. The Director, or his duly authorized representative, may conduct such other tests as he may deem necessary to evaluate air pollution emissions other than those noted in Sections 2 and 3.

Section 7. Variance.

7.01. In the event that process equipment or operations in existence prior to the adoption of this Regulation do not meet the emission limitations, an acceptable program shall be developed and offered to the Commission by the person responsible for the installation. This program shall be submitted upon the request of and within such time as shall be fixed by the Commission. Once this program has been approved by the Commission, the owner, and/or operator of such installation shall not be in violation of this Regulation so long as the approved or amended program is observed.

7.02. Due to unavoidable malfunction of equipment, emissions exceeding those provided for in this Regulation may be permitted by the Commission for periods not to exceed 10 days upon specific application to the Commission. Such application shall be made within 24 hours of the malfunction. In

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cases of major equipment failure, additional time periods may be granted by the Commission provided a corrective program has been submitted by the owner or operator and approved by the Commission.

Section 8. Exemptions.

8.01. Provisions of this Regulation shall not apply to particulate emissions regulated by Regulations II, III, V, and VI, or to internal combustion engines, aircraft, and air entrained particulate matter from public or private carriers.

Section 9. Effective Date

Regulation VII shall become effective ____________________________.

Senator EAGLETON. Senator Randolph's third question:

You are a member of the Manpower Development Advisory Committee of the National Air Pollution Control Administration.

You have stated that there is a need for specialists at all levels, technicians, professional, and research expert.

You have also stated that all manpower studies to date underestimate this need.

Please supply the committee with an evaluation of the specific manpower needs to implement the air quality programs at a Federal, State, and local level.

Mr. LINSKY. I will do my best. It will be to some extent a paraphrase of a manpower study which is being completed by the Federal Government.

I will supply additional information as it has come to me.

Senator EAGLETON. I will add onto that question, if it is possible, that we should be supplied with not only what the manpower needs or shortages are, but also any recommendations you might have as to how those needs or shortages could be corrected.

Mr. LINSKY. Right.

Senator EAGLETON. Finally, and this is in the nature of policy and I won't try to pin you down to any one particular cause or any one particular bill, but generally what value, if any, do you see in having public participation in this pollution process, whether it be establishing standards, setting hearings, limitation plan hearings, criteria?

Do you view with dismay or with encouragement the participation of the public at these various levels of decision?

Mr. LINSKY. I guess I can sum it up by saying thank God, at last.

Senator EAGLETON. Would you please make it abundantly clear for the printed record.

(The information subsequently furnished follows:)

MANPOWER QUESTIONS ANSWERED

At present, it is estimated that about 20,000 man-years are being employed in major industries with air pollution troubles.

Federal, state and local positions for control agencies are estimated to be about 4,000 at present.

This 5 to 1 ratio is about the ratio one would expect to be continued when the public agencies double or triple their staffs to 8,000, 10,000, or 12,000. The industry manpower, directly employed and also those working for consultants will probably increase to 40,000, 50,000, or 60,000 man years to do the actual control and corrective work that is reviewed and spurred by the control agencies.

On-the-job or after-hours training of people hired for such work will fill some unknown percentage of these needs—perhaps 30% overall. These people as well as their "trainers" and the rest of the people who are needed will be educated and trained before they start on their specialty jobs.

Technicians can be trained in two (2) year community colleges and in commercial trade schools, such as those who turn out many electronics technicians.

Others will need special courses during their regular four (4) year college courses with summer school special courses to accelerate the manpower supply work.

Still others, including the true practicing professionals, the teachers and professors, and the research specialists who will help uncover new knowledge to do more, easier, must receive graduate training with financial support.

The present system of direct Federal support training can be enlarged. In addition, a "pool" of trained manpower can be arranged for, as it has been in the past for air pollution control and other programs. The Federal government can take the initiative of directly employing newly trained people and placing them with public control agencies until the State or local agency can work out its personnel procedures, especially the merit civil service procedures that are established, properly, to assure that only fully qualified persons are employed in career specialist positions.

Mr. LINSKY. For the printed record, I fully support the heaviest participation and, therefore, learning and knowledge by nonprofessionals in the decision-setting process for air pollution control.

Senator EAGLETON. And would that include even participation of the public in the enforcement mechanism?

Mr. LINSKY. Yes: and let me elaborate, if I may. The public has always participated in the enforcement, both at official and at unofficial needle levels.

I will illustrate that by saying there tend to be three reasons why you don't get a complaint in an official control agency.

One is that everything is fine, there is no need for a complaint.

Second, a feeling of helplessness, "Why fight city hall? Why tell him? There will be nothing done anyway."

And the third, "There is no need to tell him. He is doing extremely well and I can help him by applying some direct pressure and grapevine support."

The citizen activity was illustrated in Los Angeles when they passed their ban on open burning in backyard incinerators at homes. This was in 1957. The agency had planned and had thought and had hired a lot of inspectors and supervisors to do that extra policing.

In the view of some of us professionals, they were not going to need these people. In fact, they would be able to reduce their existing staff because the citizens would police each other in an informal, across-the-fence, needling basis. Once having put their own stake in the game, as having stopped something by having their little backyard incinerator sitting out as a flower pot, they were now in a position to say, "How about Joe? Let's clean him up, too. How is he getting away with it?"

They served as volunteer reporters and enforcers.

Senator EAGLETON. Thank you very much, Professor.

The "Lynch Linsky" picture will be made part of the record.

(The following photograph, taken by Joe Rosenthal, March 6, 1958, appeared in the San Francisco Chronicle:)

Senator EAGLETON. That concludes this morning's hearings of the subcommittee.

There will be hearings tomorrow on the same subject matter commencing at 9:30 a.m.

(Whereupon, at 11:10 a.m. the subcommittee recessed, to reconvene at 9:30 a.m., Thursday, March 19, 1970.)

[Appendix to Part 1 follows]

APPENDIX—Part 1

The materials which follow are answers supplied by the Department of Health, Education, and Welfare to questions supplied by the subcommittee through Chairman Muskie. (See p. 193 for reference.)

AIR QUALITY CRITERIA

Question 1. Since enactment of the Air Quality Act of 1967, air quality criteria have been issued for particulate matter, sulfur oxides, hydrocarbons, photochemical oxidants, and carbon monoxide. What factors have contributed to the delay in issuing other air quality criteria and what are the priorities and time schedules for issuance of additional criteria?

Answer. The National Air Pollution Control Administration's schedule for the issuance of air quality criteria is based on a number of factors, including the relative magnitude and extent of emissions of the various air pollutants, the availability of methods of measuring emissions and ambient air levels, and the adequacy of existing scientific data on health and welfare effects. Thus, the air quality criteria documents already issued cover five pollutants which account for a major share of community air pollution problems and which have been the subjects of extensive research over a period of several years. The following schedule reflects current planning for the issuance of additional air quality criteria documents:

Pollutants:	*Year*
Fluorides, lead, nitrogen oxides, and polynuclear organics	1971
Asbestos, beryllium, chlorine gas, hydrogen chloride, and odors	1972
Arsenic, cadmium, copper, manganese, nickel, vanadium, and zinc	1973
Barium, boron, chromium, mercury, and selenium	1974
Pesticides and radioactive substances	1975

Air quality criteria for nitrogen oxides originally had been scheduled for issuance in 1970; issuance was postponed for 1 year because of the need for additional data on the health effects of nitrogen oxides and on the quantitative relationship between nitrogen oxides and photochemical oxidants in the ambient air. This postponement has been the only significant departure from earlier scheduling of the issuance of air quality criteria documents.

Question 2. Please describe the organization and membership of the ad hoc committees which have participated in the development of air quality criteria.

Answer. There has been substantial participation in the development of air quality criteria by non-Government scientists as well as by Government scientists from agencies other than the National Air Pollution Control Administration. The National Air Quality Criteria Advisory Committee participates on a continuing basis in the development of air quality criteria documents. A great many non-Government experts who are not members of the Advisory Committee also participate as contributors to, and reviewers of, specific portions of criteria documents; generally, they participate as individual consultants rather than as members of committees. In addition, organizations such as the State of California Department of Public Health have been involved in air quality criteria development under contract with the National Air Pollution Control Administration. A complete list of Advisory Committee members, Federal agency representatives, and non-Government scientists who have participated in this work appears in each air quality criteria document.

Question 3. Please indicate the annual expenditures on air quality criteria related research since enactment of the Clean Air Act of 1963 in the following areas:

Nitrogen dioxide.
Nitrogen dioxide and ozone.
Oxidants.
Particulate matter.
Carbon monoxide.
Behavioral toxicology.
Epidemiologic studies.
Vegetation effects.
Effects on materials.
Socioeconomic effects.
Other.

Answer. The initial response to this question contained data for the National Air Pollution Control Administration's in-house and contract research on the effects of various types and combinations of air pollutants. The following tables provide corresponding information on NAPCA's research grants program.

EXPENDITURES FOR AIR QUALITY CRITERIA RELATED RESEARCH NAPCA RESEARCH GRANTS

Type of research	Particulates	SOx	CO	NOx	Oxidants	Other pollutants [1]	Pollutants in combination	Total
Fiscal Year 1965								
Behavioral toxicology						$51,775		$51,775
Other toxicology	$46,599	$19,141				13,104		78,844
Epidemiology						366,605		366,605
Clinical	94,468	213,435	$30,556	$30,316	$22,304	257,219		648,298
Vegetation	40,646	108,392		91,902	85,458	263,470		589,868
Materials								
Socioeconomic						118,017		118,017
Total	181,713	340,968	30,556	122,218	107,762	1,070,190		1,583,407
Fiscal Year 1970								
Behavioral toxicology								
Other toxicology	75,787				22,558			98,345
Epidemiology						86,412	$27,099	113,511
Clinical	1,831	109,300	51,981	261,546		168,861		593,519
Vegetation	35,134	220,955		86,319	49,585	490,023	40,392	922,408
Materials		1;555					31,019	32,574
Socioeconomic								
Total	112,752	331,810	51,981	347,865	72,143	745,296	98,510	1,760,357
FISCAL YEAR 1969								
Behavioral toxicology	8,706					384		9,090
Other toxicology	70,219				37,154	36,913		144,286
Epidemiology						77,055		77,055
Clinical	92,122	102,906	39,069	374,569		176,434		785,100
Vegetation	29,293	96,060		72,296	118,193	431,377	68,543	815,762
Materials		11,719				20,640	25,399	57,758
Socioeconomic						92,169		92,169
Total	200,340	210,685	39,069	446,865	155,347	834,972	93,942	1,981,220

EXPENDITURES FOR AIR QUALITY CRITERIA RELATED RESEARCH NAPCA RESEARCH GRANTS—Continued

Type of research	Particulates	SOx	CO	NOx	Oxidants	Other pollutants [1]	Pollutants in combination	Total
FISCAL YEAR 1968								
Behavioral toxicology						$40,892		$40,892
Other toxicology	$108,791					12,500	$19,254	140,545
Epidemiology						113,731		113,731
Clinical	111,157	$124,942	$51,716	$312,081		117,055		716,951
Vegetation	45,081	101,226		149,717	$150,846	482,567	19,509	948,946
Materials		21,206			19,339	26,160	54,410	121,115
Socioeconomic						19,509	17,906	37,415
Total	265,029	247,374	51,716	461,798	170,185	812,414	111,079	2,119,595
FISCAL YEAR 1967								
Behavioral toxicology						60,481		60,481
Other toxicology	58,154					17,531	18,664	94,349
Epidemiology						239,295		239,295
Clinical	118,280	203,481	6,052	212,427		177,337	10,000	727,577
Vegetation	36,158	147,744		108,961	129,904	479,706		902,473
Materials		22,455			13,928	26,160	10,080	72,623
Socioeconomic						69,230	16,275	85,405
Total	212,592	373,680	6,052	321,388	143,832	1,069,740	55,019	2,182,303
FISCAL YEAR 1966								
Behavioral toxicology						53,556		53,556
Other toxicology	48,790	24,490				8,560		81,840
Epidemiology						132,000		132,000
Clinical	182,884	226,346	45,207	29,746	18,834	223,680		726,697
Vegetation	31,329	37,801		95,456	97,341	305,504		567,431
Materials					14,405	34,560		48,965
Socioeconomic		37,560				25,689		63,249
Total	263,003	326,197	45,207	125,202	130,580	783,549		1,673,738

[1] Expenditures for projects which involved studies of the effects of more than 1 pollutant but not their combined effects are included under other pollutants.

Question 4. Please justify the reported $3 million reduction for fiscal 1971 in research on health and economic effects of air pollution.

Answer. No such reduction is contemplated. The following figures show amounts budgeted for these activities in fiscal 1970 and 1971:

	1970	1971
Division of Health Effects Research	$3,977,000	3,977,000
Division of Economic Effects Research	2,082,000	2,085,000

Question 5. What specific steps have been taken by the National Air Pollution Control Administration to coordinate health effects research with the National Institute of Environmental Health Sciences?

Answer. The National Air Pollution Control Administration (NAPCA) has maintained active liaison with the National Institute of Environmental Health Sciences (NIEHS) ever since the latter organization was created. NAPCA and NIEHS annually exchange project-planning information in order to eliminate duplication of effort. All air quality criteria documents and NAPCA research position papers are sent to NIEHS for review. NAPCA's Office of Research Grants maintains contact with NIEHS relative to the review of research grant applications. In June 1969, when NIEHS held a planning conference in Corvallis, Oreg., NAPCA was represented by the Director of Bureau of Criteria and Standards and the Director of the Division of Health Effects Research. NAPCA is regularly represented by the Director of the Bureau of Criteria and Standards at meetings of the Environmental Health Sciences Advisory Committee, the primary advisory group for NIEHS. In December 1969, NAPCA and NIEHS held a joint information exchange meeting in order to reinforce coordination of research of mutual interest to the two organizations. In addition, NAPCA has submitted to NIEHS a list of projects concerning the health effects of air pollution which NAPCA is unable to initiate at this time but which would be appropriate to the mission of NIEHS. Finally, on the working level, there is continuing informal coordination between NAPCA and NIEHS scientists concerning research of mutual interests.

Question 6. What research has been initiated to obtain information on the long-term effects of contaminants and combinations of contaminants?

Answer. NAPCA's health effects research program includes many projects designed to identify the effects of long-term exposure to low levels of air pollutants and combinations of pollutants. These projects include both laboratory and field studies.

The following is a list of current field studies; it should be noted that field studies generally reflect the effects of combinations of pollutants, because, even though one pollutant may predominate in the study area, others will be present.

1. The relationship between nitrogen oxides and acute and chronic respiratory disease.
2. The presence of polychlorinated biphenyl compounds in human plasma and ambient air in two cities.
3. The relationship between air pollution in the area of residence of persons in Chicago and chronic respiratory disease.
4. The relationship between trace metals in hair, blood, and urine among military recruits categorized by air pollution levels at residence prior to recruitment.
5. Health effects of exposure to lead, arsenic, and cadmium.
6. Blood pressure, cholesterol, and cadmium relationships in families highly exposed to cadmium.
7. Lead and mercury threshold studies for hematological effects.
8. Trace metal patterns and polychlorinated biphenyl residues in hair, blood, urine, bone, and soft tissue, as related to chronic obstructive lung disease, lung cancer, stroke, and myocardial infarction.
9. Lead exposure study in seven cities to determine if there has been an increase in the body burden of lead since the three-city study was completed in 1962.
10. Trace metals in the sputum in patients with chronic respiratory disease.
11. The relationship between occupation and residence histories of lung cancer decedents to determine if a relationship exists with air pollution.
12. Health effects surveillance studies.

Laboratory studies include a study of the effects of chronic exposure to raw or irradiated automobile exhaust, sulfur oxides, nitrogen oxides, or combinations of these materials: relationship of nitrogen oxides to occurrence of emphysema in primates; effect of long-term exposure to sulfur dioxide and particulate matter in varying concentrations on animal pulmonary function; the immunological and biochemical characterization of lung surfactant with regard to chronic respiratory disease and air pollution; and a review of research data relating chronic, low-level carbon monoxide exposure to altered cellular metabolism and resultant decrements in human physical and behavioral performance.

Question 7. What research is NAPCA conducting or supporting on carcinogenic and mutagenic effects of contaminants and combinations of contaminants?

I. INTRODUCTION

Answer.—It would appear from epidemiological data that there is a strong possibility that air pollutants are contributing to the incidence of cancer, notably of the bronchial-pulmonary variety.

The preponderance of lung cancer in urban, as compared to rural. areas is well documented; furthermore, it is equally well known that a number of specific carcinogens and many substances capable of enhancing carcinogenic effects are present in urban air at many times their concentrations in rural air.

Accordingly, it is appropriate that biological research be conducted, as part of NAPCA's air quality criteria development program, to determine the role that air pollutants may be playing in the occurrence of cancer of the lung and related anatomical regions. The task of determining the contributions of air pollutants as direct inducers, co-factors, or passive carriers requires studes of quantitative inhalation models in whole animals and other biological systems. Some of the possibilities by which air pollutants might induce cancer are listed below.

1. Specific carcinogenic effect of polycyclic hydrocarbons.
2. Cocarcinogenic effect of irritant gases, such as sulfur dioxide, ozone, et cetera, in conjunction with polycyclic hydrocarbons or other carcinogens.
3. Enhancing effect of particulate material, such as fly ash, on which carcinogens from the air or other sources might be absorbed. Such particulate material consists of carbon, silica, iron, etc.
4. Specific biological effects on anticarcinogenic induced enzyme systems produced through organo complexes from trace metals; e.g., effect of nickel on benzopyrene hydroxylase.
5. Specific additive effect of a given carcinogen from the air superimposed on similar carcinogen from industrial or personal source; e.g., BAP (benz-a-pyrene) from cigarette smoke and BAP from air.
6. Specific carcinogen from air reacting with carrier from other source; e.g., BAP from community air pollution reacting with asbestos from an industrial source.
7. Interaction of carcinogenic air pollutants with tumor-inducing viruses.

II. CURRENT STATUS OF RESEARCH

A. General

Considerable information is already on hand from the work of Sawicki and others on the chemistry of hydrocarbon carcinogens contained in polluted air and Hueper and others on biological evaluation of hydrocarbons through skin painting and percutaneous application to adult mice with whole organic extract and various subfractions. Epstein's work with paramecia, supported by NAPCA, has shown that presumptively carcinogenic activity resides in a number of specific fractions of air extract and that crude organic fractions from various cities differ markedly in effect. It is of interest that where material from the same cities was used, Epstein, through subcutaneous injection of newborn mice, and Hueper et al. through percutaneous and subcutaneous inoculation of adult mice, obtained comparable quantitative results. Studies currently are being conducted to evaluate the related potency of various hydrocarbon subfractions in neonatal mice.

The influence of particulate matter in conjunction with hydrocarbon carcinogens, as demonstrated by Pylev for a combination of carbon. DMBA (dimethylbenzanthracene), and BAP, and by Saffiotti et al. for a combination of hematite and BAP, has been of great interest. The latter has been an extremely successful model and would appear to hold the greatest promise of any developed so far for adaptability to an inhalation system.

The enhancing effect of irritant gases recently has been demonstrated by the work of Laskin et al. with respect to sulfur dioxide and BAP inhalation.

Preliminary work reported by Dixon et al. suggests that trace metals alter the activity of benzopyrene hydroxylase enzyme, and Gross has shown that nickel apparently potentiates the activity of asbestos in eliciting lung tumors in animals. Also, retrospective epidemiologic data strongly support the view that an interaction occurs between fibers and tobacco smoke, with smokers having 82 times the risk of nonsmokers.

Currently, NAPCA scientists are carrying on research in which massive amounts of benzene soluble extracts of particulate matter are being accumulated for direct operations in biologic carcinogenicity studies. This material is now being incorporated with particulate material of the proper size for airway deposition of aerosols in inhalation studies. Direct tracheal instillation of this and other particulate material, in the manner of Saffiotti and Shubik, will commence shortly for the purpose of obtaining detailed background information before inhalation work is attempted. This material also will be tested in conjunction with BAP and certain other pure chemical material likely to be biologically active in this system, that is, trace metals. Studies will be carried out on such matters as toxicity to the macrophage, alteration of lysozomal enzyme activity, elicitation of hyperplasia, metaplasia, or malignant transformation in *in vitro* systems.

In preliminary work in intact animals, particulate material containing hydrocarbon carcinogens will be intratracheally instilled into hamsters and inoculated into other appropriate biological systems. The animals will be examined for evidence of precancerous changes as well as for eventual development of definitive tumors.

In the meantime, work will be underway on the physical aspects of aerosol production and characterization and on basic animal exposure for the purpose of studying deposition, clearance, and so forth before exposure of animals to carcinogenic agents by ventilation is begun.

After preliminary work is completed, aerosol exposure to actual carcinogens will commence.

B. Specific research

1. Contracts

(*a*) A contract (CPA 22–69–21) was let last year and is continuing this year to provide realistic material for biological testing in the direct operations portion of this program. This consists of the following phases:

Phase 1. Procurement of massive amounts of airborne particulate matter and extraction of the crude organic or benzene soluble portions.

Phase 2. Preparation of particles incorporating hematice, nickel, or other metallic substances with (*a*) crude organic extract in suitable form for eventual aerosolization or other use in animals, and (*b*) benzopyrene.

Phase 3. Fractitionation and subfractionation of another portion of the crude organic extract for specific biologic carcinogenicity testing.

The first phase of this contract is now completed, and the contractor is ready to supply material. Exploratory work is underway on the second phase, and materials will be ready shortly. Phase 3 will be started soon and should be finished during the current fiscal year.

(*b*) Now underway, under a NAPCA contract (PH 86–66–169), is a project to determine the carcinogenicity and mutagenicity of specific fractions of crude organic extract derived from airborne particular matter. Specific fractions will be tested for carcinogenicity: subcutaneous injection of newborn mice will be used as the experimental system. Specific fractions will be injected into pregnant mice to determine mutagenicity by observing the occurrence of dominant lethal genes. Examination for evidence of mutations in mold culture will also be undertaken.

2. Direct operations

The work will consist of two phases which will proceed simultaneously: Program of tumorigenesis in animals and program to detect the influence of various air pollutants on lung defensive systems against carcinogens.

Phase 1. Cancer induction phase

This work will begin with a study of the Saffiotti and Shubik model for the production of lung cancer in hamsters through the use of various combinations of pure chemical and pollutant material collected from the air. The objectives of this study are:

(*a*) Determine if BAP may be replaced by materials collected from the air.

(*b*) Determine if hematite may be replaced by airborne particulate matter.

(*c*) Determine if the model can be enhanced by airborne cofactors, that is, nickel.

(*d*) Determine if airborne organic material may be additive to BAP.

This work will require repeated intertracheal instillation of carcinogenic and additive material into a large number of hamsters. It will form the basis for inhalation work, which will follow.

Animals that have received carcinogens and respective controls will be sacrificed at various times for study of pathology, macrophage function, RNA, DNA turnover, and so forth. The remaining animals will be reserved and held for approximately 1 year, at which time they will be sacrificed and subjected to detailed search for the presence of tumors and classification of the histologic type.

Phase 2. Defensive mechanisms phase

This work will involve studies of the behavior of known carcinogens within the lung and in vitro and the influence of various cofactors. In vivo and in vitro studies of alveolar macrophages will be carried out to assay their handling of BAP by means of phagocytosis, transport, and detoxification. The influence of exposure to hematite, trace metals, airborne particulate matter, and air pollutant gases on the ability of macrophages to handle BAP will be determined. The in vivo portion of this work will consist of exposure and study of hamsters.

Search for alteration of number, phagocytic ability, lysosomal enzyme activity, and so forth, of alveolar macrophages will be pursued by washout methods. The retention and movement of BAP, as influenced by hematite, nickel, and other cofactors, will be studied by radiolabel BAP by means of pulmonary lavage, whole lung studies, and so forth. Efforts will be made to identify methods of studying how suppression of macrophage formation by colchicine or immune reaction affects the handling of hydrocarbon carcinogens. The influence of exposure of hamsters to pollutant gases will be studied through the use of the above system. In vitro studies employing surviving cultures of rabbit macrophages in giant roller tubes will be carried out. Induction of benzopyrene hydroxylase and its alteration by various cofactors, notably nickel, will be studied: Exposure of the surviving tissue culture cells to various air pollutant gases to determine the influence of these factors on enzyme induction will also be carried out in roller tubes.

3. Collaborative program

The Ministry of the Interior, Federal Republic of Germany, has asked the United States to collaborate in developing a German cancer research program under the auspices of the pending United States-German natural resources program.

In addition, there is a cooperative Public Law 480 project (No. 05-301-3) with the State Institute of Hygiene, Department of Communal Hygiene, Poland, entitled "Estimation and effects of carcinogenic material in airborne particulate matter collected in 10 selected cities in Poland."

CONTROL TECHNOLOGY DEVELOPMENT

Question 1. What specific contracts and grants were awarded under section 104 for the following categories?

Control of sulfur oxides pollution:

Removal of sulfur from coal.

Removal of sulfur from fuel oil.

Removal of sulfur from flue gas.

New process development.

Control of nitrogen oxides pollution.

Control of particulate pollution.

Control of pollution from specific industries.

Control of pollution from solid waste disposal.

Control device improvement studies.

Control of automotive emissions.

Alternatives to the internal combustion engine.

Answer. Attached is a list of contracts and interagency transfers under section 104 through June 30, 1969. No grants were awarded under section 104 during this period.

With regard to both this question and the next one, it should be noted that NAPCA is not supporting research and development relating to removal of sulfur from fuel oil, since adequate technology for this purpose already exists. It should also be noted that research and development activities relating to control of air pollution from solid waste disposal are conducted primarily under the Solid Waste Disposal Act rather than under the Clean Air Act.

NAPCA CONTRACTS UNDER SEC. 104 (THROUGH JUNE 30, 1969)

I. CONTROL OF SULFUR OXIDE POLLUTION

Name of firm	Title of project	Amount
A. REMOVAL OF SULFUR FROM COAL		
Battelle Memorial Institute	Fuel availability-cost model study	$143,280
Bituminous Coal Research	Evaluation of coal cleaning methods and techniques for removal of pyritic sulfur from fine size coal.	47,333
General Technologies Corp	Solvent-refined coal cost study	38,272
University of Illinois	Sampling and evaluation of coal mines in Illinois by the Illinois Geological Survey.	73,595
Interagency transfers:		
Bureau of Mines	Removal of pyrite from coal by tabling	46,000
Do	Removal of pyrite from coal in a Humphrey Spiral	50,000
Do	Occurrence and removal of pyritic sulfur from American coals	125,000
Do	Availability of low-sulfur coals	340,000
B. REMOVAL OF SULFUR FROM FUEL OIL		

NAPCA CONTRACTS UNDER SEC. 104 (THROUGH JUNE 30, 1969)—Continued

Name of firm	Title of project	Amount
C. REMOVAL OF SULFUR FROM FLUE GAS		
Aerojet-General	Applicability of aqueous solutions for the development of new processes for removing sulfur dioxide from flue gases.	$184,765
Allied Chemical	Applicability of reduction to sulfur techniques to the development of new processes for removing sulfur dioxide from flue gases.	231,000
Babcock & Wilcox	Aqueous slurry scrubbing of sulfur dioxide from flue gases	257,900
Battelle Memorial Institute	Study of reaction kinetics of limestone-dolomite with sulfur dioxide in a dispersed solid contactor.	128,080
Bechtel Corp	Prototype study of limestone scrubbers for SO2 dust removal systems.	891,145
Ford Motor Corp	Applicability of inorganic solids other than oxides to the development of new processes for removing SO from flue gases.	116,125
Mine safety	Applicability of inorganic liquids to the development of new processes for removing sulfur dioxide from flue gases.	147,121
North American Rockwell Corp	Development of molten carbonate process for removal of sulfur dioxide from powerplant stack gases.	484,248
Peabody Coal	Moving grate furnace study of limestone for control of sulfur oxides.	8,676
Radian Corp	Theoretical description of the limestone injection-wet scrubbing process for SO_2 removal.	81,519
Research-Cottrell, Inc	Particulates collection study–Tennessee Valley Authority dry limestone tests.	67,200
Stone & Webster	Development of the Stone & Webster ionics sulfur dioxide removal and recovery process.	23,000
TRW Corp	Applicability of organic solids to the development of new techniques for removing oxides of sulfur from flue gases.	58,888
University of Illinois	Study of petrographic and mineralogical characteristics of carbonate rocks related to sulfur oxide sorption in flue gases.	69,320
West Virginia University	Experimental investigation of the penetration and dispersion phenomena in the limestone injection method.	31,033
Interagency Transfers:		
Tennessee Valley Authority	Effect of physical properties of limestone, dolomite, and their derivatives on the kinetics of reaction with SO_2.	100,000
Do	Unit full-scale evaluation-dry limestone injection process for SO_2 removal from powerplant stack gases.	700,000
Do	Conceptual design and cost study of sulfur oxide removal from powerplant stack gas.	225,000
Do	Pilot plant study of ammonia scrubbing of powerplant stack gases.	138,000
Bureau of Mines	Evaluation of processes for removal of SO2 from flue gas	10,000
Do	Regenerative kinetics of alkalized alumina	40,000
Do	Mechanisms and kinetics of alkalized alumina process for SO2 removal.	30,000
Do	Study of sorption of SO_2 from smelter gases by alkalized alumina.	100,000
Do	Preparation of an improved catalyst for alkalized alumina	35,000
Do	Process development for sulfur dioxide removal from flue gas	300,000
Do	Evaluation of metal oxides as sorbents for SO2 in powerplant flue gases.	40,000
Oak Ridge National Laboratory	Studies and causes of comminution of alkalized alumina	29,000
D. NEW PROCESS DEVELOPMENT		
Aerojet General	Systems evaluation of refuse as a low sulfur fuel	344,970
Chemical Construction	High sulfur combuster study	216,601
United Aircraft	Technological and economic feasibility study of advanced power cycles and methods of producing nonpolluting duels.	292,654
Interagency transfers:		
Argonne National Laboratories	Reduction of atmospheric pollution by application of fluidized bed combustion.	267,000
Office of Coal Research Pope, Evans, Robbins.	Characterization and control of air pollutants from an industrial fluidized-bed combustion unit.	62,500
E. OTHER		
General technology	Infrared spectroscopic study of gas solid interactions	51,879
Walden Research	Systematic study of air pollution from fossil-fuel combustion equipment.	241,906
Interagency transfers:		
Brookhaven National Laboratory	Atmospheric sulfur pollutions	150,000
Oak Ridge National Laboratory	Elevated plume study	20,000
Tennessee Valley Authority	White pine ramets for large power plants emissions study	9,000
Tennessee Valley Authority	Full-scale field study of inversion break-up at large powerplants.	30,000

NAPCA CONTRACTS UNDER SEC. 104 (THROUGH JUNE 30, 1969)—Continued

II. CONTROL OF NITROGEN OXIDES POLLUTION

Name of firm	Title of project	Amount
Esso Research & Engineering	Systems study of nitrogen oxides control methods for stationary sources.	$28,584

III. CONTROL OF PARTICULATE POLLUTION

Midwest Research Institute	Particulate pollutant system study	$249,500
Southern Research	Electrostatic precipitator systems study	289,277
Walter C. McCrone	Standard manual methods for particulate measurements for fossil-fuel combustion sources.	203,000

IV. CONTROL OF POLLUTION FROM SPECIFIC INDUSTRIES

Batelle Memorial Institute	Systems analysis study of the integrated iron and steel industry.	$75,790
Chemical Construction	Engineering analysis of emissions control technology for sulfuric acid manufacturing process.	69,660
A. T. Kearney, Co	System analysis of emissions and emissions control in the iron foundry industry.	264,356
A. C. McKee	Systems analysis study of the smelting industry	12,100
Stanford Research Institute	Photochemical reactivities of organic solvents	94,760
Stanford Research Institute	Feasibility study of new SO^2 control process applied to smelter and other low emission sources.	35,000

V. CONTROL OF POLLUTION FROM SOLID WASTE DISPOSAL

VI. CONTROL DEVICE IMPROVEMENT STUDIES

Belco Pollution Control	Pulsed power supply for electrostatic precipitators	$20,255
Interagency transfers: Atomic Energy Commission: Oak Ridge National Laboratory.	Technology to control air pollution from stationary sources	120,000

VII. CONTROL OF AUTOMOTIVE EMISSIONS

Automotive Research Association	Engine deterioration and exhaust emissions	$39,07
The Marquardt Co	Continuous flow combustion systems study	96,683
The Dow Chemical Co	Effects of fuel additives on characteristics of emissions in auto exhaust.	104,000
Esso Research and Engineering Co	Control of NOx in auto exhaust	98,180
General Research Corp	Model study of characteristics of photochemical reaction in Los Angeles basin.	56,485
International Telephone & Telegraph Research Institute.	Development of particulate emission control techniques for spark ignition engines.	96,058
Illinois Institute of Technology	Chemical species in diesel engine exhaust and exhaust odors.	33,000
Arthur D. Little, Inc	Diesel odor composition and identification	33,263
Olson Laboratories, Inc	Emissions from 2-cycle IC engines	9,980
Consolidated Engineering Technology Corp	Substitute fuels (methanol)	42,269
Scott Research Laboratories, Inc	Passenger car refueling losses	15,856
Federal Aviation Administration	Visual appearance of jet aircraft smoke and test cell measurements.	20,000
Scott Research Laboratories, Inc	Exhaust emissions from reciprocating aircraft powerplants	89,650
Stanford Research Institute	Catalytic control of exhaust emissions from Otto cycle engines.	45,340
Systems Development Corp	5-city survey	13,990
TRW, Inc	Surveillance, inspection, maintenance procedures	245,534
Interagency transfers:		
Atomic Energy Commission	AEC-NAPCA cooperative study of gas-aerosol interactions	5,000
Bureau of Mines	Characteristics of photochemical reactivity of vehicular emissions.	165,000
Do	Composition, smoke, and odor of diesel combustion products.	160,000
Do	Interactions between fuel composition and vehicle emissions	139,000
National Aeronautics and Space Administration.	Development of thermal reactors for control of hydrocarbon and carbon monoxide in motor vehicle exhaust.	300,000
Do	Power information center support (2 years)	50,000
U.S. Army Tank Automotive Command	Analysis of exhaust emissions from diesel cycle engines	11,000
Do	Technical feasibility of controlling motor vehicle emissions by use of the Ford stratified charge process.	57,000

VIII. ALTERNATIVES TO THE INTERNAL COMBUSTION ENGINE

Thermo-Electron Corp	Conceptual design of Rankine cycle propulsion system	$174,173
Atomic Energy Commission: Argonne National Laboratory.	Status of high-energy battery developments	50,000

NAPCA CONTRACTS UNDER SEC. 104 (THROUGH JUNE 30, 1969)—Continued

IX. Other

Name of firm	Title of project	Amount
Battelle Memorial Institute	Combustion research study	$157,600
Ernst & Ernst	Analytic studies in air pollution control	71,510
Massachusetts Institute of Technology	Research and development engineering services	105,370
Research Triangle Institute	Ozone chemiluminescent study	103,278
Thermo-Systems, Inc	Development of a transducer for continuous measurement of aerosol mass concentration of air pollution aerosols using a quartz-crystal oscillator.	46,363
TRW, Inc	Systems analysis program	390,200
Walden Research	Standard chemical methods for sampling and analysis of gaseous pollutants from the combustion of fossil fuels.	198,330
Interagency Transfers:		
Atomic Energy Commission: Argonne National Laboratory.	Chicago air pollution system model	150,000
Bureau of Mines	Pollution by chlorine in coal, and flame characteristics causing air pollution.	50,000

Question 2. How many contracts and grants have been awarded since July 1, 1969, under section 104? For what purpose? In what amounts?

Answer. Attached is a list of contracts, interagency transfers, and grants under section 104 since July 1, 1969. To show the purposes, the projects are classified under the same headings used in the preceding question. It should be emphasized that the list includes only contracts, grants, and interagency transfers actually awarded through May 7, 1970. As of that date, many other contracts were in various stages of development; included among them were several relating to the development of alternatives to the internal combustion engine.

NAPCA CONTRACTS AND INTERAGENCY TRANSFERS UNDER SECTION 104 (JULY 1, 1969, THROUGH MAY 7, 1970)

Name of firm	Title of project	Amount
I. CONTROL OF SULFUR OXIDE POLLUTION		
A. Removal of sulfer from coal:		
Bituminous Coal Research, Inc	An evaluation of coal cleaning methods and techniques for removal of pyritic sulfur from fine size coal.	$40,000
Harvard University	Computer mapping of coal reserves by sulfer level	69,858
Interagency transfers:		
Bureau of Mines	Availability of low-sulfur fuels	400,000
U.S. Air Force, Hanson Field, Mass	A system engineering study of deep-cleaned coal	140,000
Bureau of Mines	Coal cleaning projects	485,000
B. Removal of sulfur from fuel oil:		
C. Removal of sulfur from flue gas:		
Radian Corp	A study of the limestone injection wet scrubbing process	141,415
TRW, Inc	Holographic determination of injected limestone distribution in unit of the Shawnee Powerplant.	84,500
Tyco Laboratories, Inc	Feasibility of oxidizing SO_2 in powerplant flue gases to sulfuric acid.	64,966
Interagency Transfers		
Tennessee Valley Authority	Full scale evaluation of the dry limestone injection process	840,000
Do	Pilot plant study of ammonia scrubbing of powerplant stack gases.	350,000
Bureau of Mines	Evaluation of metal oxides as sorbents for SO_2 in powerplant flue gases.	100,000
D. New process development:		
Pope, Evans & Robbins	Characterization and control of air pollutants from a fluidized-bed combustion unit.	245,450
Westinghouse Electric Corp	Evaluation of the fluidized-bed combustion process	344,487
Interagency Transfers		
Atomic Energy Commission Argonne National Laboratory	Study of fluidized-bed combustion	33,000
Bureau of Mines	Fluidized-bed combustion as a means of reducing air pollution.	205,000
Office of Coal Research	Characterization and control of air pollutants from a fluidized-bed combustion unit.	20,500

NAPCA CONTRACTS AND INTERAGENCY TRANSFERS UNDER SECTION 104 (JULY 1, 1969, THROUGH MAY 7, 1970)—Continued

Name of firm	Title of project	Amount
E. Other:		
Scientific Research Instruments	Sulfur behavior and sequestering of sulfur compounds during coal carbonization, gasification, and combustion.	$164,330
General Technologies Corp	Infrared spectroscopic study of gas-solid interactions	36,000
Interagency transfers:		
Environmental Science Services Administration.	Meteorological support to the large power plant effluent study at Indiana, Pa.	200,000
Tennessee Valley Authority	Conceptual design and economic evaluation studies of SO_2 control processes.	225,000
Do	Full scale field study of inversion breakup at large power plants	40,000
II. CONTROL OF NITROGEN OXIDE POLLUTION		
Esso Research and Engineering Co	Systems study of nitrogen oxides control methods for stationary sources.	53,534
III. CONTROL OF PARTICULATE POLLUTION		
Thermo-Systems, Inc	Continuous particulate monitors for fossil fuel combustion sources.	194,500
IV. CONTROL OF POLLUTION FROM SPECIFIC INDUSTRIES		
A. T. Kearney & Co	Systems analysis of emissions and emissions control in the iron foundry industry.	5,000
Stanford Research Institute	Feasibility study of new SO_2 control process applied to smelter and other low emission sources.	2,408
V. CONTROL OF POLLUTION FROM SOLID WASTE DISPOSAL		
VI. CONTROL DEVICE, TECHNIQUE EVALUATION SYSTEM IMPROVEMENT STUDIES		
VII. CONTROL OF AUTOMOTIVE EMISSIONS		
Optimizer Control Corp	Optimizer ignition control system	23,000
North American Rockwell Corp	Development of particulate emission control techniques for spark-ignition engines.	31,355
Southwest Research Institute	Investigation of diesel powered vehicle odor and smoke	104,024
Battelle Memorial Institute	A laboratory study of the influence of fuel atomization, vaporization, and mixing processes in pollutant emissions from motor vehicle powerplants.	79,000
Charles G. Roberts & Son	Evaluation of Charles G. Roberts emissions control system	14,677
Olson Laboratories, Inc	Study of emissions from 2-cycle internal combustion engine	961
Automotive Research Assoc. Inc	Study of relationship of engine deterioration to exhaust emissions.	9,791
Systems Development Corp	Conduct a survey of driving patterns in 5 cities relative to auto air pollution.	36,480
Interagency transfers:		
Commerce Technical Advisory Board	Panel on automotive fuels and air pollution—Costs of eliminating lead from gasoline.	13,400
U.S. Army Tank Automotive Command	Exhaust emission evaluation of a Ford combustion process engine.	50,000
Atomic Energy Commission Argonne National Laboratory.	The fate of CO in the atmosphere	40,000
Bureau of Mines	Products of combustion of distillate fuels for motive power	185,000
Bureau of Mines	Interaction between fuel compositions and engine factors influencing exhaust emissions.	145,000
Federal Aviation Administration	Reduction of nitrogren oxides emissions from aircraft	50,000
VIII. ALTERNATIVES TO THE INTERNAL COMBUSTION ENGINE		
Interagency transfers: Atomic Energy Commission Argonne Nat'l Laboratory.	Status of high energy battery developments	50,000
IX. OTHER		
Travelers Research Corp	A study of indoor-outdoor air pollutant relationships	12,063
Scott Research Laboratories, Inc	Atmospheric reaction studies in the Los Angeles Basin	75,617
Research Triangle Institute	Chemi uminescent ozone meter for continuous air monitoring project.	23,640
Barringer Research Ltd	Test program of optical measurements of SO_2 and NO_2	24,000
Louisiana State University	A specific method for the determination of ozone in the atmosphere.	1,430
California Department of Health	Performance evaluation procedures for continuous atmospheric analyzer	60,011
Copley International Corp	Studies to assess the social and economic impact of odors, national survey of the odor problem	9,567
Southwest Research Institute	Development and implementation of an operational system for evaluating and collaboratively testing methods recommended for air pollution measurements	241,900

NAPCA CONTRACTS AND INTERAGENCY TRANSFERS UNDER SECTION 104 (JULY 1, 1969, THROUGH MAY 7, 1970)—Continued

Name of firm	Title of project	Amount
Ernst & Ernst	Analytic studies in air pollution	$31,425
Interagency transfers:		
Bureau of Mines	Characteristics and photochemical reactivity of fuel components and combustion products	180,000
National Bureau of Standards	Study of the feasibility of the use of permeation tubes for gas analyses standards	12,000
Environmental Science Services Administration	Spectroscopic characteristics of pollution gases	60,000
Agricultural Research Service	Development of bioassay methods to measure effects of air pollution on vegetation	20,000
Forest Service	Air pollution effects on forest trees of the eastern United States	25,000

NAPCA survey and demonstration grants under section 104, July 1, 1969 through May 8, 1970

I. Control of sulfur oxide polluton:
  A. Removal of sulfur from coal:
    New Mexico Institute of Mining and Technology — $40,966
      "Extent and availability of low-sulfur coal."
    Utah geological and mining survey — 88,500
      "Extent and availability of low-sulfur coal."

Question 3. A 5-year (fiscal 1968–72) research and development program was developed by the Stanford Research Institute for NAPCA. What were: (a) the recommended total and annual expenditures for this program; (b) the actual and estimated expenditures; and (c) the expenditures recommended by the National Academy of Sciences?

Answer. The 5-year plan cited in the question is for research and development relating to the prevention and control of sulfur oxides pollution from stationary sources. It was developed by the Stanford Research Institute under a contract with the National Air Pollution Control Administration and was completed in April 1968. The contractor did not make any recommendations as to expenditures; rather, the purpose of the contract was to assemble all available information on Federal agencies' plans for research and development relating directly and indirectly to the prevention and control of sulfur oxides pollution. In addition to the National Air Pollution Control Administration, the agencies included in the contractor's survey were the Bureau of Mines and Office of Coal Research of the Department of the Interior, Tennessee Valley Authority, Federal Power Commission, and Environmental Science Services Administration of the Department of Commerce.

The projected total of expenditures by Federal agencies during fiscal 1968–72 was $392,544,000. Annual totals were as follows:

Fiscal year:	*Amount*
1968	$26,587,000
1969	88,293,000
1970	100,466,000
1971	93,634,000
1972	83,564,000

Estimated Federal expenditures are as follows:

Fiscal year:	Amount
1968	$24,050,000
1969	26,100,000
1970	32,000,000
1971	(1)
1972	(1)

[1] Not available.

The National Academy of Sciences (National Academy of Engineering) did not recommend a level of expenditures.

AUTOMOTIVE EMISSION CONTROL

Question 1. What has been the level of funding for motor vehicle pollution control research and development and what are the estimated expenditures for fiscal years 1971 to 1973?

Answer. The following table shows actual obligations in fiscal 1968 and 1969 and estimated obligations for fiscal 1970–73. The figure for fiscal 1970 is based on actual appropriations, while that for fiscal 1971 is based on the budget estimate to the Congress. Estimates for fiscal 1972 and 1973 are derived from long-range planning allocations (as explained in response from long-range planning allocations (as explained in response to question 2 on governmental expenditures).

Fiscal year:	*Amount*
1968	$1,500,000
1969	3,490,000
1970	7,021,000
1971	13,800,000
1972	20,500,000
1973	26,400,000

The above figures include estimated obligations not only for research and development but also for the clean car incentive program (described in response to next question).

Question 2. What specific program efforts are being made to develop alternatives to the internal combustion engine?

Answer. The National Air Pollution Control Administration has developed a 6-year plan for Federal research and development relating to the prevention and control of motor vehicle pollution. A brief description of the plan is attached. The following table shows estimated fiscal 1970–71 funding of the National Air Pollution Control Administration's activities relating to the development of alternatives to the internal combustion engine. Estimated funding of the clean car incentive program also is shown in the table; a description of this program is attached.

	Fiscal years 1970	Fiscal years 1971
I. Research and development:		
A. Rankine cycle engines:		
1. First-generation prototype organic fluid reciprocating powerplant: Phases II and III	$420,000	$800,000
2. Rankine water-based reciprocating powerplant		800,000
3. Rankine organic turbine		800,000
4. Other, including supporting components research (includes synthesis of alternative working fluids)	800,000	200,000
B. Hybrid power systems:		
1. Heat engine/flywhee	160,000	500,000
2. Heat engine/battery	225,000	800,000
C. Turbine power systems (emissions and materials development research)	185,000	700,000
D. Supporting combustion studies	359,000	600,000
E. Electrical power systems (high-temperature alkali metal batteries)	250,000	600,000
F. Program direction and program planning studies	101,000	200,000
Total research and development	2,500,000	6,000,000
II. Clean-car incentive program	250,000	4,800,000
Total	2,750,000	10,800,000

National Air Pollution Control Administration Motor Vehicle Research and Development Plan*

The National Air Pollution Control Administration (NAPCA) has developed a 6-year plan (fiscal 1970–75) for Federal research and development relating to the prevention and control of motor vehicle pollution. Included in the plan are the current and projected future motor vehicle research and development activities of NAPCA and several other Federal agencies, including the Department of Transportation, Defense, and the Interior, the General Services Administration, the National Aeronautics and Space Administration, and the Atomic Energy Commission.

Totally, Federal expenditures of $89.1 million are contemplated; of this sum, at least $7.8 million would be in funding by agencies other than NAPCA.

Expenditures by agencies other than NAPCA actually may be greater than $7.8 million, since the plan, in its current form, reflects the Department of Transportation's projected activities only through fiscal 1970; information on future activities has not been made available to NAPCA.

There are three major elements to the plan: Research and development relating to control of emissions from conventional motor vehicles; development of unconventional, low-pollution motor vehicles; and necessary supporting research. Following is a brief description of each element; figures in parentheses indicate projected Federal expenditures during the fiscal 1970–75 period:

1. Conventional motor vehicles ($25.5 million).—Research and development aimed at providing new and improved techniques for controlling emissions of hydrocarbons, carbon monoxide, nitrogen oxides, and particulate matter (including lead) from gasoline-fueled engines; and nitrogen oxides, smoke, and odors from diesel engines. Work relating to abatement of aircraft emissions also is included.

2. Unconventional motor vehicles ($45.4 million).—Efforts to develop commercially acceptable, low-emission alternatives to the internal combustion engine. The major emphasis will be in the area of heat engines, particularly the Rankine-cycle (steam) engine, but also including the Brayton-cycle (gas turbine) and Stirling-cycle engine. Also included will be efforts to develop prototypes of electrical engines and to explore the potential of hybrid systems (combinations of two engine systems).

3. Supporting research ($18.2 million).—This encompasses research in areas that have a bearing on motor vehicle pollution and its prevention and control. Among them are atmospheric chemistry, development of needed instrumentation and sampling techniques, transportation planning and urban design in relation to air quality, and fundamental combustion research.

Clean Car Incentive Program

The Department of Health, Education, and Welfare has estimated that passenger cars capable of meeting the following emission goals

*This is a plan developed by NAPCA; it is being reviewed by the Council on Environmental Quality.

must be available by 1980 if the Nation is to make continued progress in abating the problem of motor vehicle pollution:

	Grams per mile
Hydrocarbons	0.25
Carbon monoxide	4.7
Nitrogen oxides	0.4
Particulate matter	0.03

If passenger cars propelled by internal combustion engines cannot meet these goals, alternative propulsion systems will have to be available. Translating such new technology from the design and prototype stages into practical application is likely to take some years. Accordingly, the necessary research and development must get underway immediately.

The Federal clean air incentive program is intended to stimulate private-sector efforts in this field. To the extent that motor vehicles developed through this program are purchased in quantity by governmental agencies, such procurement could be expected to stimulate and lead to mass production.

In addition to being capable of meeting the above exhaust emission goals, cars must also meet performance, safety, durability, reliability, maintenance, and servicing specifications in order to be eligible for entry into the clean car program.

The program is designed in three phases intended to provide graduated financial incentives to private developers and to permit selection of those low-pollution passenger cars most likely to be suitable for general use:

1. Prototype phase. The developer of a vehicle submits technical data to the National Air Pollution Control Administration (NAPCA). NAPCA will evaluate the data and, if testing of the vehicle seems warranted, will undertake such testing.
2. Demonstration phase. NAPCA will purchase 10 models of the vehicle for testing in various climates and under various operating conditions for at least 6 months.
3. Fleet testing. Substantial numbers of the vehicle would be tested for 1 to 2 years under actual operating conditions. To be eligible for fleet testing, a vehicle must be, in all respects, a passenger car suitable for the uses ordinarily made of such cars.

Question 3. What data is available on compliance with auto emission standards after sale by certified vehicles? Please provide this data for the record.

Answer. Data on the question of whether motor vehicles in the hands of the public meet the Federal standards that were applicable to them at the time of their original sale have been developed through the National Air Pollution Control Administration's studies of rental car fleets and the National Air Pollution Control Administration's supported studies by the California Air Resources Board.

The first surveillance data on cars subject to the Federal standards, from the California surveillance program, were reported in the summer of 1968. Since the cars were less than a year old, their 50,000-mile emission rates had to be extrapolated from measurements of their low mileage rates. (Department of Health, Education, and Welfare regulations provide that the average emissions of test vehicles at 50,000 miles must be within the standards with normal maintenance.) The calculations showed that, on the average, the cars complied with the

Federal hydrocarbon and carbon monoxide emission standards. A comparison of these data on 1968 vehicles with data on 1966–67 vehicles equipped to meet the same standards in California showed that the emission control performance of the 1968 vehicles was considerably improved over that of the 1966–67 vehicles.

Subsequent reports from the California surveillance program indicated that, through the spring of 1969, average emissions from 1968 vehicles, again extrapolated to 50,000 miles were slightly higher than the Federal standard for hydrocarbons and at or below the standard for carbon monoxide. By the winter of 1969, these surveillance data indicated that, on the average, hydrocarbon emissions of 1968 cars extrapolated to 50,000 miles were running about 20-percent above the standard, and carbon monoxide emissions were about 8 percent above the standard. Reports received in 1970 show hydrocarbon emissions exceeding the standard by 25 percent and carbon monoxide by about 10 percent, again extrapolated to 50,000 miles.

The results of the California surveillance program have been published regularly in the California Air Resources Board Bulletin, and a status report was published in the Journal of the Air Pollution Control Association in April 1969. The published data confirms the statement made in the JAPCA report that "emsision tests on thousands of vehicles with exhaust controls in public use indicate that both emission levels and deterioration are higher than on the proving ground."

The rental car study was initiated by the National Air Pollution Control Administration in the spring of 1968 with two rental car companies in Los Angeles and two companies in Detroit agreeing to periodically furnish 1968 and 1969 model cars for testing. This study was scheduled to run from March 1968 through November 1969. A tabulation of the data collected from March 1968 through April 1969 was completed in August 1969. Based upon the incomplete data then available, slightly more than one-half of the cars tested failed to meet the Federal exhaust standards for hydrocarbon and carbon monoxide emissions. A preliminary analysis of more complete data from the study, prepared in November 1969 (copy attached), shows that, on the average, hydrocarbon emissions from a sample population of 431 domestic cars were running about equal to the Federal standard, and carbon monoxide emissions were slightly lower than the Federal standard at mileage accumulations from 3,500 to 26,000 miles.

The more complete data confirm that slightly more than one-half of the cars tested failed to meet either the hydrocarbon or the carbon monoxide standard. For one model, more than 80 percent of the cars tested failed one or more tests. Due to the small number of cars, these emission data were not extrapolated to 50,000 miles; however, on the basis of the California data one would expect that the emissions would tend to increase to some extent with increased mileage accumulations. The rental car data are undergoing further analysis to attempt to determine the factors that contributed to the observed emission levels.

The apparent failure of many individual cars to meet the Federal standards under conditions of actual use is a matter of great concern to the Department of Health, Education, and Welfare. Current procedures call for testing of prototype vehicles representative of a class of engine-transmission-control system combinations and the issuance of a certificate of conformity with the standards to cover all vehicles within that class, of substantially the same construction, manufactured throughout the model year.

There are three possible reasons for cars in use failing to perform at the level of the prototype or test vehicles:

1. The durability test procedures prescribed in the regulations may be inadequate to test the true durability characteristics of emission control system;
2. The prototype or test cars may receive special handling or not be truly representative of the production model cars which are deemed to be of substantially the same construction; or
3. Operating and maintenance practices in the hands of the public may cause deterioration in the performance of the vehicle's control system.

The remedies to the potential causes for failure of cars to perform as expected are both administrative and legislative. The National Air Pollution Control Administration is now in the process of developing, for publication in the Federal Register, a revised test procedure to be followed by the manufacturers in submitting 1972 model year automobiles for certification. These revised procedures will (*a*) measure the actual mass of pollution emitted from each test car rather than calculate it; (*b*) better reflect urban driving habits; (*c*) require that each test car meet the applicable standard; (*d*) revise the durability test procedure to more accurately reflect actual operating conditions; and (*e*) require the manufacturer to make available to the National Air Pollution Control Administration test cars to be under the control of the Federal Government in accumulating the requisite mileage. These procedural revisions will reduce the present degree of uncertainty as to whether prototype cars themselves can meet the 50,000-mile emission standards.

Since each certificate of conformity issued to the manufacturer under section 206(a) of the act may be issued "upon such terms * * * as (the Secretary) may provide," it is arguable that the certificate could be conditioned so as to require that production vehicles covered by the certificate be tested at time of manufacture for compliance with the emission standards, and that their noncompliance result in revocation of the certificate and/or other sanctions. Section 206(b), however, extends a presumption of conformity with the standards to every vehicle "* * * which is in all material respects substantially the same construction as the (certified) test vehicle * * *." This language makes questionable the conditioning of a certificate upon the performance of production vehicles insofar as they qualify as being "substantially the same" as the prototypes tested.

The Congress has been asked to clarify the Department of Health, Education, and Welfare's authority by amending section 206 to expressly authorize revocation of certificates of conformity if production vehicles do not meet the Federal standards. We have also requested that the Department of Health, Education, and Welfare be explicitly authorized to test, or require manufacturers to test, vehicles at the end of production lines.

Interim Report—Rental Car Surveillance Program, March 1968 to November 1969, by Division of Motor Vehicle Pollution Control, Bureau of Abatement and Control, National Air Pollution Control Administration

THE RENTAL CAR EXHAUST EMISSION SURVILLANCE PROGRAM

Introduction

This is an interim report on the rental car motor vehicle exhaust emission surveillance program conducted by the Inspection and Surveillance Branch of the Division of Motor Vehicle Pollution Control.

As of November 12, 1969, 600 exhaust emission tests representing 26 different engine-transmission combinations have been performed at the Los Angeles, Calif., and Ypsilanti, Mich., test facilities. The purpose of these tests is to provide background information necessary to efficiently plan surveillance programs on privately owned vehicles and to give the DMVPC some indication of whether or not vehicles in general use are emitting pollutants at a higher level than that at which they were certified to meet.

Vehicles for this program were obtained from the Hertz and Airways rental companies in Los Angeles and Hertz and Avis in Detroit. When interpreting data from these vehicles it must be kept in mind that these vehicles generally differ from normal owner-driven vehicles by the care which they are driven, the maintenance they receive, and the type and rate of mileage accumulated. Since the effects of these parameters on motor vehicle emissions are not known with certainty, one should avoid unqualified generalization of these data to vehicles driven by the motoring public at large. Nonetheless, the data generated by this program provides important information on the effectiveness of air pollution control devices operating in vehicles driven under conditions quite different than those under which certification vehicles are driven.

II. Program operation

This program was initiated in March of 1968 and is scheduled to end in December of 1969. A final report, including a detailed evaluation of this program, will be issued in the spring of 1970. At the onset of the program it was intended to start with a basic fleet of 138 1968-model vehicles would be retested at 3,000- to 4,000-mile intervals throughout the life of the various contracts. These vehicles were chosen so as to represent many of the high-production vehicles sold in the United States.

Within a short period of time, however, it was found that the rental companies could not deliver the vehicles at the required intervals for repetitive testing. In addition, policy changes at the rental companies resulted in the retention of most rental vehicles for less than 1 year of operation, thereby eliminating any possibility of obtaining large samples of vehicles with more than 20,000 accumulated miles. Hence it was necessary to reorganize the program to reflect nonrepetitive testing of vehicles and the inclusion of low milage, 1969-model vehicles in the test fleet.

All vehicles, except Volkswagens, were equipped with automatic transmissions and all vehicles except Cadillacs had engine modification emission control systems. The Cadillacs used an air injection emission control system.

All vehicles were tested by the standard Federal seven-mode, seven-cycle cold start test procedure as described in the Federal Register, volume 31, No. 51, part II, paragraph 85.70–85.83, inclusive. In addition, if it was found that a vehicle was not within the manufacturer's specifications by ±75 r.p.m. or ±2° basic timing, these items were reset to specifications and the vehicle was hot cycle tested (two additional seven-mode cycles) for hydrocarbons (HC), carbon monoxide (CO), and carbon dioxide (CO_2). The purpose of these additional cycles was to ascertain the effect, if any, of minor engine adjustment on vehicle exhaust emissions. Analysis of these data will appear in the final report on the contract rental program.

For data analysis purposes all test results for a manufacturer were grouped and analyzed by engine displacement, even if the same displacement was used in a variety of body styles. Hence, all tests on Ford Motor Co. 302 c.i.d. engine were lumped together even though the last fleet for this engine included a mix of Mercury Cougars, Ford Galaxies, and Ford Mustangs. Similarly, data on Chrysler Motor Corp.'s 318 c.i.d. engine was obtained by testing both Plymouths and Dodges.

All engines of a given displacement used in this study constituted a homogeneous population in that only one version of a given engine displacement was tested. Hence, even though Ford Motor Co.'s 390 c.i.d. engine comes in both a two barrel and a four barrel carbureted version, all test data are from the two barrel model (see table 1).

The only exception to the rule whereby all data for a given manufacturer is segregated by displacement, occurred in the analysis of data from General Motors Corp.'s 350 c.i.d. engine. The 350 c.i.d. engines used by GM's Buick, Chevrolet, Oldsmobile, and Pontiac divisions were significantly dissimilar in design so as to warrant a separate analysis for each of the division's engines.

Except for the Chevrolet 327 c.i.d. engine, 1969 versions of the engines tested differ little from 1968 versions of the same displacement. Hence, except for the Chevrolet 327 c.i.d. engine, data from 1968 and 1969 vehicles were combined.

III Test results

Test results are grouped and analyzed by engine displacement, as explained above. Of the 26 engine displacements included in the test program, only 12 contain data from 15 or more complete exhaust emission tests. Data from the remaining 14 engine displacement groups will not be treated in this interim report, but will be included in the final reports of the 1968–69 rental vehicle surveillance program. These 14 displacements are listed in appendix A.

A summary of test results is given in table I for those 12 engine displacement groups which contain data from 15 or more exhaust emission tests. This table includes all tests performed on vehicles of a given displacement regardless of accumulated mileage.

A similar analysis of data is given in table II, but all tests performed on vehicles with less than 3,500 accumulated miles have been eliminated. This was done for two reasons. First, because low mileage tests tend to bias a data sample, as explained earlier. Second, because low mileage tests were performed on vehicles from some displacement groups, but not others. Hence, their elimination tends to normalize the average odometer readings for each engine displacement group, making comparisons of emission data between displacement groups more meaningful.

For convenience in data presentation, the column headings in tables I and II are abbreviated and explained below.

Column A "Engine": This column gives the manufacturer and the cubic inch displacement of the engine tested. In the case of General Motors Corp., engines are listed by automotive divisions within the General Motors family. If more than one version of an engine displacement is manufactured, the carburetion and compression ratio of the version tested is listed.

Column B "No. of Cars Tested": This column gives the number of vehicles of each displacement tested. Each car was tested once only.

Column C "Avg. Odo." This column lists the average odometer reading for vehicles of a given displacement at the time of test.

Columns D and E "Avg. of Min. 3 Odo." and "Avg. of Max. 3 Odo.": These columns give the averages of the three lowest and three highest test odometer readings for vehicles of a given displacement. This gives information as to the mileage range of vehicles tested.

Column F "Avg. Emissions": This column displays the average seven-cycle composite emissions for HC and CO.

Column G "95 percent Conf. Interval": This column lists the 95-percent confidence interval for the "average emissions" given in column F.

Column H "Percent Vehicles Failing HC, CO, Both, Either": This column gives the percentage of test vehicles failing the Federal emission standards for HC, CO, both HC and CO, and either HC or CO.

Table III is a listing of the sales figures for the 12 different engines listed in tables I and II. These figures were taken from the various manufacturers' applications for certification and show the projected new car engine sales of all engines which are similar to those tested in the rental car program. An engine is considered similar to a rental car test engine if its displacement, carburetion, compression ratio, and emission control system are identical to that of the corresponding engine in the test program. As can be seen from the totals at the bottom of table III, these 12 engines represent approximately 40 percent of new engine sales in this country during the 1968 and 1969 model years. The 14 engines listed in appendix A of this report represent an additional 10 percent of engine sales, bringing to slightly over 50 percent the percentage of new car sales represented in this test program.

An explanation of the column headings used in table III is as follows:

Column marked "Sales": This column gives the projected new car sales of engines similar to the engine specified in the column marked "Engine".

Column marked "Percent Manufacture Sales": This column lists the approximate percentage of the manufacturer's total engine production represented by the engine given in the left hand column. The manufacturer's total engine production includes all engines for which Federal certification was requested.

Column marked "Percent Total National Sales": This column gives the approximate percentage of new car engine sales in this country represented by the engines used in the test program. The national new car engine sales includes the sales figures of both foreign and domestic engines.

IV. Conclusions

As mentioned in the introduction to this interim report, the purpose of this program was to gather information on the effectiveness of air pollution control devices operating on vehicles driven under conditions quite different than those under which certification vehicles are driven. For these data the following conclusions can be drawn:

(1) Many vehicles in rental car fleet type of operation are producing exhaust emissions at a higher level than that which they were certified to meet.

(2) Average levels of exhaust emission vary considerably not only between engines produced by different automotive manufacturers, but between different engines produced by the same manufacturer.

APPENDIX A.—ENGINE-DISPLACEMENT GROUPS WITH LESS THAN 15 TESTS AS OF NOV. 12, 1969

Manufacturer	Engine cubic-inch displacement	Number of tests
Ford Motor Co	200	11
Chevrolet	230	5
American Motors Corp	343	12
Chevrolet	350	4
Oldsmobile	350	4
Ford Motor Co	351	13
Chrysler Corp	383	7
Ford Motor Co	428	4
Do	429	8
Chrysler Corp	440	3
Oldsmobile	455	8
Ford Motor Co	460	8
Do	462	5
Cadillac	472	8

TABLE I.—DATA SUMMARY—ALL DISPLACEMENT GROUPS WITH 15 OR MORE TESTS

Engine	Number of cars tested	Average odometer	Average of minimum 3 odometer readings	Average of maximum odometer readings	Average emissions		95 percent conf. interval		Percent vehicles failing			
					HC (p.p.m.)	CO (percent)	HC (p.p.m.)	CO (percent)	HC	CO	Both	Either
	(B)	(C)	(D)	(E)	(F)		(G)		(H)			
AMC, 290 c.i.d., 2 bbl., 9.0 c.r.	32	5,133	263	10,709	213	1.13	±11	±0.13	0	13	0	13
Chrysler Motor Corp., 225 c.i.d., 1 bbl.	18	12,280	4,272	19,334	203	1.49	±14	±0.27	6	39	6	39
Chrysler Motor Corp., 318 c.i.d., 2 bbl., 9.2 c.r.	49	4,991	34	14,265	230	1.09	±13	±0.16	12	10	4	18
Ford Motor Co., 289 c.i.d., 2 bbl., 8.1 c.r.	45	10,994	4,050	21,397	319	1.39	±38	±0.27	62	22	20	64
Ford Motor Co., 302 c.i.d., 2 bbl., 9.5 c.r.	110	8,953	940	21,821	305	1.19	±19	±0.15	58	19	19	58
Ford Motor Co., 390 c.i.d., 2 bbl, 9.5 c.r.	116	7,979	34	24,199	227	1.08	±20	±0.19	16	16	7	25
Chevrolet, 307 c.i.d., 2 bbl. 9.0 c.r.	44	9,944	1,088	20,311	331	1.48	±50	±0.17	64	50	43	71
Chevrolet, 327 (1968), 4 bbl., 10.0 c.r.	48	16,960	6,525	25,991	289	1.76	±21	±0.18	42	58	29	71
Chevrolet, 327 (1969), 2 bbl., 9.0 c.r.	52	5,326	44	21,822	229	1.52	±14	±0.14	10	46	4	52
Pontiac, 350 c.i.d., 2 bbl.	25	9,631	486	17,187	218	1.55	±18	±0.25	16	56	8	64
Pontiac, 400 c.i.d., 4 bbl.	23	6,492	1,550	12,042	176	1.46	±15	±0.19	0	48	0	48
Volkswagen, 91.6 c.i.d.	31	9,152	53	15,150	371	2.17	±39	±0.49	32	16	16	32

TABLE II.—DATA SUMMARY—ALL DISPLACEMENT GROUPS WITH 15 OR MORE TESTS, TESTS ON VEHICLES WITH LESS THAN 3,500 MILES ELIMINATED

Engine	Number of cars tested	Average odometer	Average of minimum 3 odometer readings	Average of maximum 3 odometer readings	Average emissions		95 percent conf. interval		Percent vehicles failing		Both	Either
					HC (p.p.m.)	CO (percent)	HC (p.p.m.)	CO (percent)	HC	CO		
	(B)	(C)	(D)	(E)	(F)		(G)		(H)			
AMC, 290 c.i.d	24	6, 157	3, 690	10, 709	218	1. 12	±11	±0. 14	0	8	0	8
Chrysler Motor Corp., 225 c.i.d., 1 bbl	17	12, 922	6, 739	19, 334	203	1. 48	±15	±0. 23	6	35	6	38
Chrysler Motor Corp., 318 c.i.d	28	8, 125	3, 661	14, 265	240	1. 18	±21	±0. 28	18	14	7	25
Ford Motor Co., 289 c.i.d., 2 bbl., 9.2 c.r	44	11, 191	4, 902	21, 397	323	1. 40	±38	±0. 28	62	23	20	65
Ford Motor Co., 302 c i.d., 2 bbl., 9.5 c.r	95	10, 038	3, 827	21, 821	314	1. 23	±21	±0. 18	63	20	20	63
Ford Motor Co., 390 c.i.d., 2 bbl., 9.5 c.r	70	12, 479	4, 384	24, 199	251	1. 31	±31	±0. 29	24	23	11	36
Chevrolet, 307 c.i.d., 2 bbl., 9.0 c.r	33	12, 560	5, 616	20, 311	366	1. 53	±62	±0. 21	82	52	52	82
Chevrolet, 327 (1968), 4 bbl., 10.0 c.r	48	16, 960	6, 525	25, 991	289	1. 76	±21	±0. 18	42	58	29	71
Chevorlet, 327 (1969), 4 bbl., 9.0 c.r	31	7, 965	3, 817	21, 882	250	1. 52	±17	±0. 17	16	42	6	52
Pontiac, 350 c.i.d. 2 bbl	20	11, 620	6, 576	17, 187	217	1. 63	±19	±0. 27	15	60	10	65
Pontiac, 400 c.i.d. 4 bbl	21	7, 060	3, 703	12, 042	175	1. 50	±15	±0. 18	0	48	0	48
Volkswagen, 91.6 c.i.d	26	10, 877	5, 531	15, 150	393	2. 20	±41	±0. 58	38	19	15	42

TABLE III.—DOMESTIC SALES OF ENGINES LISTED IN TABLES I AND II

Engine	1968 model year: Sales	1968: Percent manufacturers sales	1968: Percent total national sales	1969 model year: Sales	1969: Percent manufacturers sales	1969: Percent total national sales
AMC; 298 CID	34,000	12	0.3	60,000	20	0.6
Chrysler Corp.:						
318 CID	419,000	24	3.8	554,000	26	5.6
225 CID	364,000	21	3.3	281,300	25	3.9
General Motors:						
Chevrolet, 307 CID	947,700	18	8.7	250,000	5	2.5
Chevrolet, 327 CID (1968	320,400	6	2.9	(1)	(1)	(1)
Chevrolet, 327 CID (1969)[1]	(1)	(1)	(1)	550,000	12	5.6
Pontiac 350 CID	161,100	3.1	1.5	189,000	4.1	1.9
Pontiac 400 CID	278,900	5.3	2.6	154,000	3.4	1.6
Ford Motor Co.:						
289 CID	335,453	12	3.1	(1)	(1)	(1)
302 CID	554,000	19	5.1	796,800	30	8.1
390 CID	493,112	17	4.5	491,800	18	5.0
Volkswagen, 91.6 CID	329,000	73	3.0	369,000	75	3.7
Total			38.6			38.5

[1] Not manufactured.

Question 4. What is the estimated effect of this failure to continue to comply with automotive emission standards on projected air pollution levels of carbon monoxide, hydrocarbons, and photochemical oxidants?

Answer. Starting in 1968 the Federal Government established limits for the carbon monoxide and hydrocarbons emitted from motor vehicles. The long-term goal of these emission standards, which apply to new motor vehicles, is to restrict and reduce the magnitude of such emissions. The overall purpose of this program is to provide the Nation's citizens with an air quality which will be satisfactory for the protection of the Nation's health and welfare.

The present mechanism for determining whether new motor vehicles will meet the standards is a prototype motor vehicle emission and durability testing program. After 50,000 miles, the average prototype vehicle must conform to the Federal emission standards applicable to each model year. In 1968 and 1969 the exhaust emission standards required a 72-percent reduction in hydrocarbons and a 56-percent reduction in carbon monoxide. In 1970, the standards called for further reductions. Additional reductions are required by the 1975 proposed standards and by the 1980 goals proposed by the Department of Health, Education, and Welfare.

Given a knowledge of the emission rates for uncontrolled vehicles and for the controlled prototype fleets, plus the predicted growth in number of vehicles, it becomes possible to project the effects of the Federal mobile emission standard program on total national exhaust emissions of hydrocarbons and carbon monoxide. Air quality is a complex function of total emissions; therefore, changes in total emission values may be assumed to be representative of the changes in air quality in large metropolitan regions.

The effect of each phase of the Federal mobile emission control program is illustrated by the curves labeled A in the accompanying figures. Three cases are considered. Figures I and II represent the projected effect of imposition of the 1968 and 1970 exhaust emission standards. Figures III and IV show the additional effect of the 1975 proposed standards, while figures V and VI show the additional expected effect of the 1980 proposed goals. The curves labeled "A" thus represent the relative changes in expected air quality, as projected from present and proposed Federal emission standards for exhust emissions of carbon monoxide and hydrocarbons and from test data on prototype vehicles. The 1990 values of curve A in figures V and VI appear at this time to represent acceptable air quality goals consistent with present knowledge of health and welfare effects.

For some time, it has been apparent that a discrepancy exists between the average emission rates of the prototype fleet and the average emission rates of the production fleet in the hands of the public. Although the prototype fleet meets the Federal standards at 50,000 miles, emissions from the production fleet, extrapolated to 50,000 miles, exceed the Federal standards. A considerable quantity of information relative to the emission rates of the production fleet has been generated by the California Air Resources Board (CARB). Calculations using the CARB averaged and sales-weighted data result in the curves labeled B in the attached figures. The differences between curves A and B represent the effect of noncompliance of the production fleet. The production fleet data indicate that air quality in 1985 will be 25 percent higher in hydrocarbons and 13 percent higher in carbon monoxide than it would have been if there were no discrepancy in emission rates. Oxidant concentrations are approximately a direct function of hydrocarbon concentrations, as indicated in the "Air Quality Criteria for Hydrocarbons." Thus, the oxidant levels in 1985 will also be approximately 25 percent higher. This analysis is based on data gathered from 1968 and 1969 model year cars. To the extent that production fleet performance can be made to approximate prototype emissions more closely, in 1970 and later model years, the discrepancies in the projected curves can be reduced.

Figure I. Projected effects of 1968 and 1970 Federal Emission Standards on total U.S. Hydrocarbon Emissions from Light Duty Vehicle Exhaust

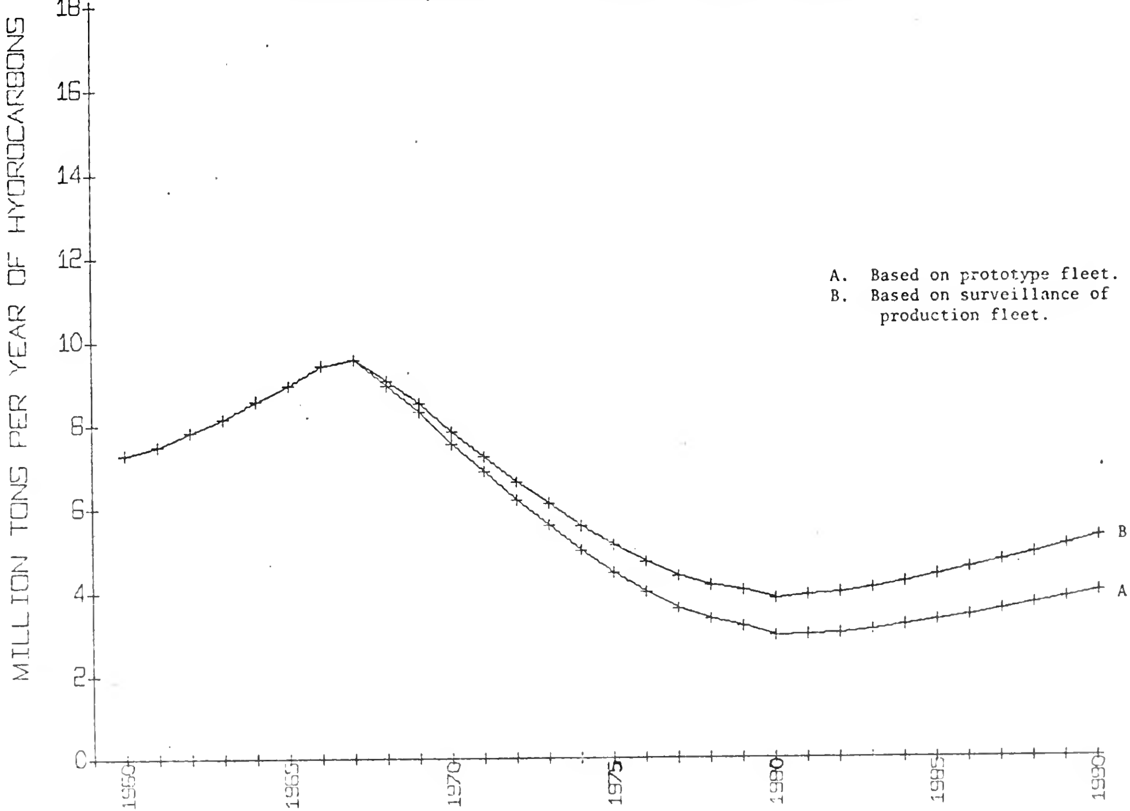


Figure II. Projected effects of 1968 and 1970 Federal Emission Standards on total U.S. Carbon Monoxide Emissions from Light Duty Vehicle Exhaust

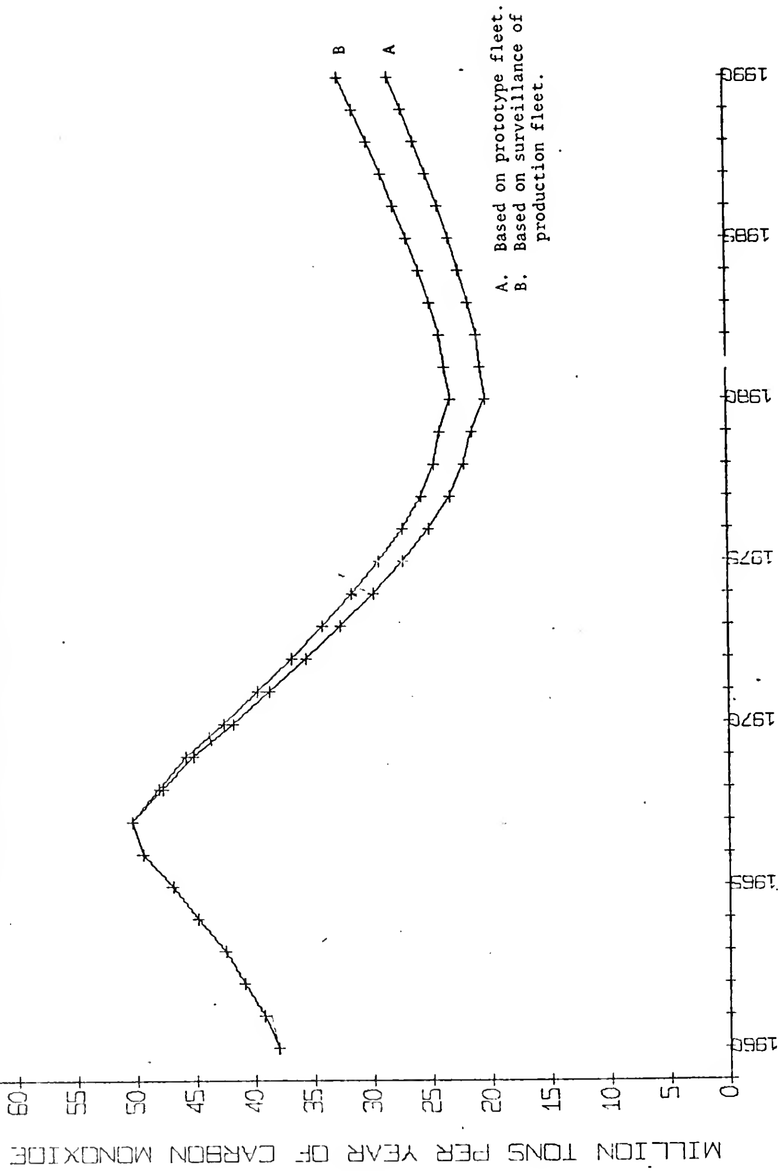


Figure III. Projected effects of 1968 and 1970 Federal Emission Standards and proposed 1975 standards on total U.S. Hydrocarbon Emissions from Light Duty Vehicle Exhaust.

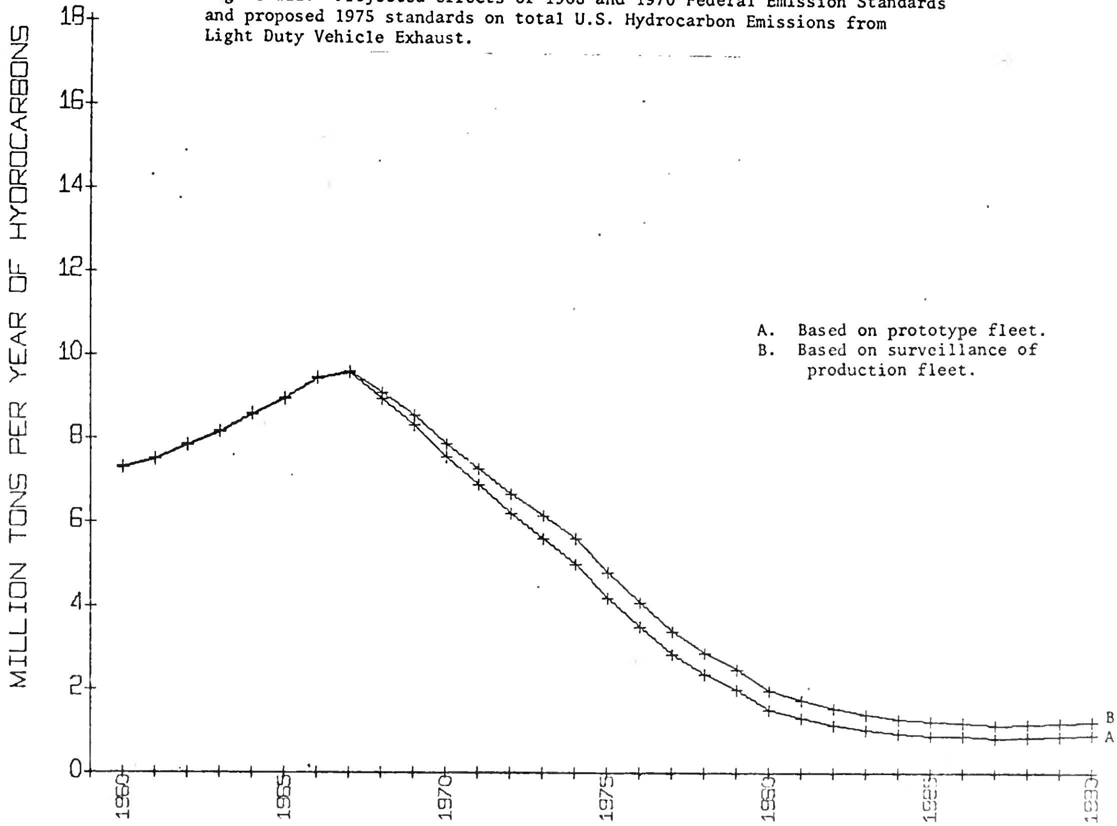


Figure IV. Projected effects of 1968 and 1970 Federal Emission Standards and proposed 1975 standards on total U.S. Carbon Monoxide Emissions from Light Duty Vehicle Exhaust.

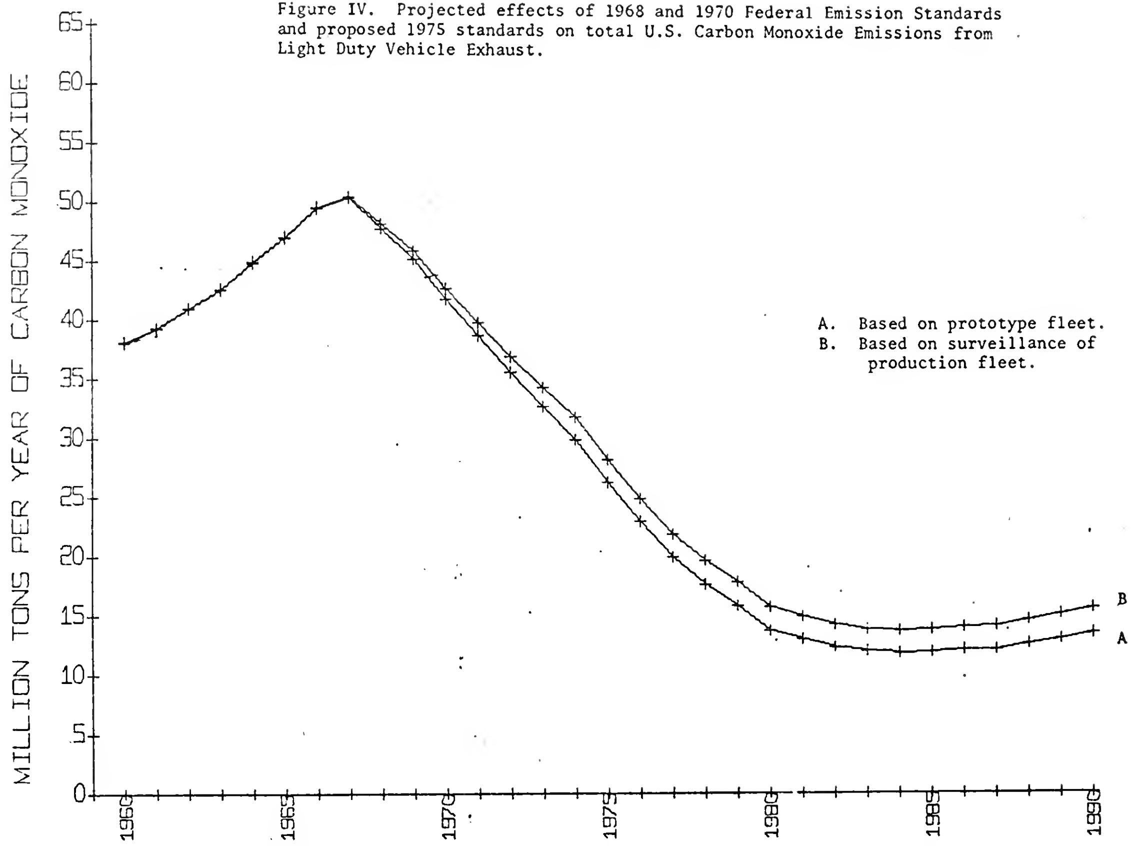


Figure V. Projected effects of 1968 and 1970 Federal Emission Standards, proposed 1975 standards, and the 1980 Goals on total U.S. Hydrocarbon Emissions from Light Duty Vehicle Exhaust.

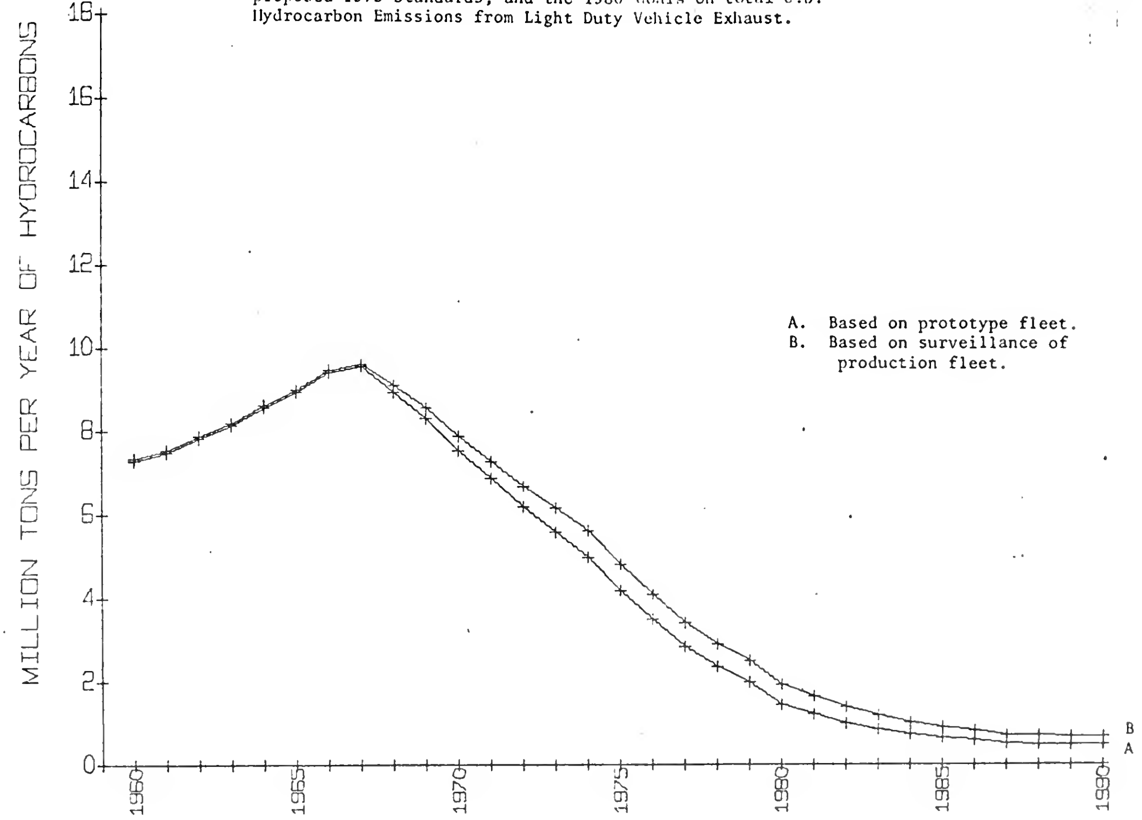
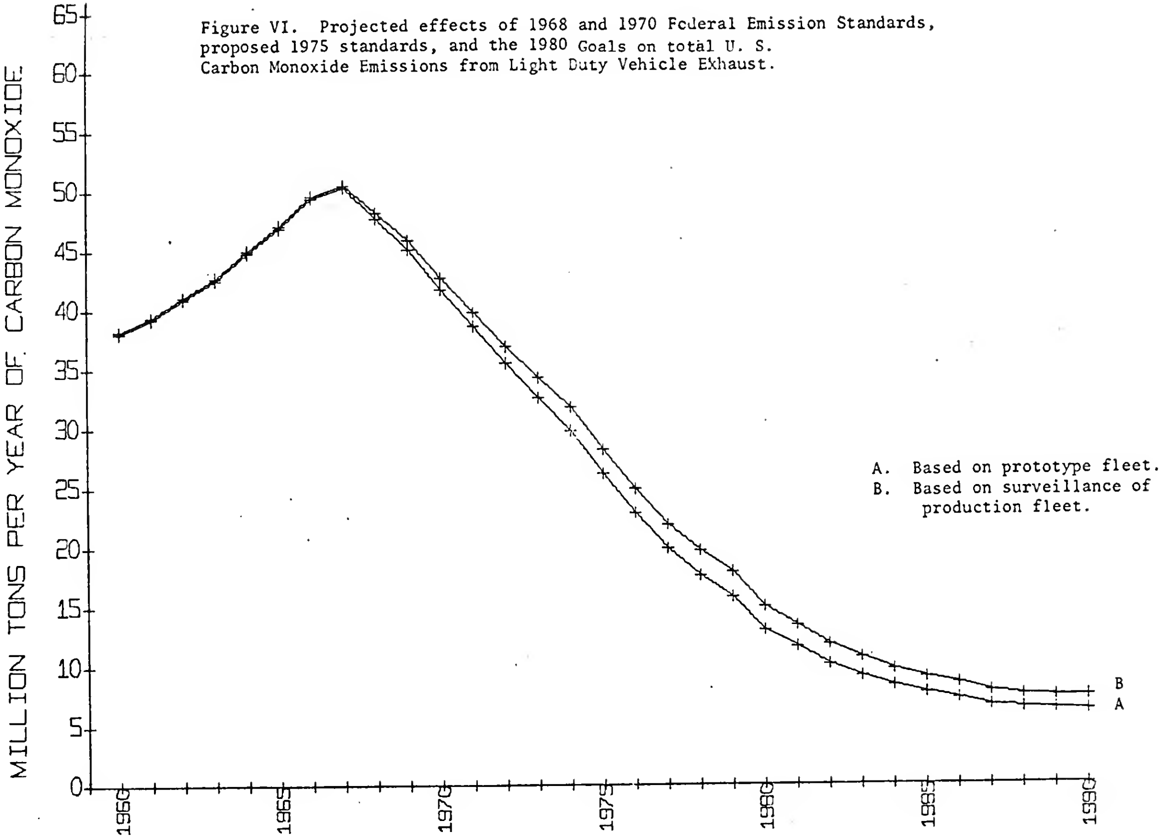


Figure VI. Projected effects of 1968 and 1970 Federal Emission Standards, proposed 1975 standards, and the 1980 Goals on total U. S. Carbon Monoxide Emissions from Light Duty Vehicle Exhaust.



Question 5. To what extent have States applied for the two-thirds grants for developing emission dévice inspection programs authorized in section 209? Please indicate the States to which grants have been made and the amount of each, if any?

Answer. No applications for grants under section 209 have been submitted. Under other provisions of the Clean Air Act, a demonstration grant has been made to the State of New Jersey to support the development of emission testing procedures suitable for inspection programs. Attached is a description of this project and a summary of the progress to date.

DEMONSTRATION PROJECT

Project title.—New Jersey Motor Vehicle Emission Inspection Project.

Agency.—State of New Jersey, Department of Public Health, Division of Clean Air and Water (Richard J. Sullivan, Director).

Grant data.—Federal funds provided, $813,581.

Grant No.	Period	Budget		
		Federal	Local	Total
67A-3301D	Dec. 6, 1966 to July 31, 1967	$235,300	$78,434	$313,734
68B-3301D	Aug. 1, 1967 to June 30, 1968	174,000	58,012	232,012
68B-3301D	July 1, 1968 to June 30, 1970	404,281	139,513	543,794
Total		813,581	275,959	1,089,540

PROJECT ELEMENTS

(1) Evaluation of the feasibility of enforcing motor vehicle pollution control requirements by tests at the established State motor vehicle safety inspection stations.

(2) The procurement and evaluation of low-cost meters and smoke guides for on-the-road measurement of smoke from diesel-powered vehicles.

(3) Development of an exhaust emission testing procedure and testing system for rapid emission tests in a safety lane.

(4) The installation and testing in six pilot locations in New Jersey motor vehicle inspection lanes and also in the State's motor vehicle laboratory, of a prototype system developed under this project for the purpose of demonstrating the practicability of the system under actual operational conditions, and to develop data for the establishment of legal standards.

(5) The construction of a mobile unit equipped with a prototype system to demonstrate its use at schools for mechanics, to test vehicles at automobile dealer showrooms and for related educational and surveillance purposes.

(6) Evaluation of the effectiveness of engine maintenance procedures recommended by the automotive service industry on vehicles which fail to meet hypothetical New Jersey standards when tested in the pilot safety inspection lanes. Results will be measured on effectiveness of work performed at (*a*) diagnostic tune-up centers, (*b*) new car dealers and (*c*) routine service stations and garages.

PROGRESS

(1) Testing cycle and equipment to perform inspection lane testing have been developed. The test takes 90 seconds. During the coming year, results of this quick test will be compared with results of seven-mode cycle test currently used to determine compliance with Federal standards.

(2) A diagnostic clinic has been constructed anl will be operational later this month. Motorists whose vehicles fail the 90-second test will be invited to have their vehicles adjusted and retested. Results will assist the State in determining whether to develop courses on emission control systems for auto mechanics throughout the State.

Question 6. S. 3466 would increase penalties under section 205 from $1,000 to $10,000. To what extent have penalties been assessed under the existing provisions? How many times? Against whom?

Answer. Thus far, no penalties have been assessed under section 205. In one case, however, a permanent injunction was obtained to prevent illegal importation of new motor vehicles. This case, *United States of America* v. *Felix A. Chapa. d/b/a Arlington Cars*, was successfully concluded in November 1969 in the U.S. District Court for the Eastern District of Virginia.

STANDARDS AND ENFORCEMENT

Question 1. What is the current status of the designation of the first 57 air quality control regions, the filing of letters of intent, and the establishment of standards and implementation plans?

Answer. The attached table summarizes the status of these activities.

NAPCA AIR QUALITY CONTROL REGION INFORMATION RELATING TO STANDARDS FOR SULFUR OXIDES AND PARTICULATE MATTER—BIMONTHLY SUMMARY, APR. 30, 1970

Region	Boundaries proposed	Consultation	Designation	State	Letter of intent: Due	Letter of intent: Dated	Public hearings scheduled/held
Washington, D.C.	July 31, 1968	Aug. 22, 1968	Oct. 19, 68	Virginia	May 12, 1969	May 8, 1969	July 14, 1969.
				Maryland	do	May 12, 1969	Oct. 1, 1969; Jan. 23, 1970.
				District of Columbia	do	do	Oct. 24, 1969.
New York City	Aug. 30, 1968	Sept. 30, 1968	Nov. 20, 1968	New York	do	Mar. 11, 1969	May 13–15, 1969.
				New Jersey	do	May 10, 1969	Sept. 22, 1969.
				Connecticut	do	Apr. 11, 1969	Aug. 12–19, 1969.
Chicago	Sept. 28, 1968	Oct. 21, 1968	Dec. 4, 1968	Illinois	do	May 9, 1969	Aug. 5, 1969.
				Indiana	do	do	July 21; Sept. 27, 1969.
Philadelphia	Oct. 4, 1968	Oct. 28, 1968	Dec. 17, 1968	Pennsylvania	do	Mar. 12, 1969	Sept. 10, 1969.
				New Jersey	do	May 10, 1969	Sept. 22, 1969.
				Delaware	do	Mar. 21, 1969	Sept. 26, 1969.
Denver	Nov. 9, 1968	Nov. 26, 1969	Jan. 15, 1969	Colorado	do	May 7, 1969	Oct. 15, 1969.
Los Angeles	Nov. 23, 1968	Dec. 10, 1968	Jan. 29, 1969	California	do	do	Sept. 17; Nov. 19, 1969.
St. Louis	Dec. 21, 1968	Jan. 14, 1969	Apr. 11, 1969	Missouri	July 10, 1969	May 6, 1969	Nov. 12, 1969.
				Illinois	do	June 17, 1969	Aug. 12, 1969.
Boston	Dec. 24, 1968	Jan. 17, 1969	Apr. 12, 1969	Massachusetts	July 11, 1969	May 20, 1969	Nov. 25, 1969.
Cincinnati	Jan. 10, 1969	Jan. 27, 1969	May 2, 1969	Ohio	July 31, 1969	July 28, 1969	Dec 17, 1969.
				Indiana	do	July 14, 1969	Oct. 28, 1969.
				Kentucky	do	May 7, 1969	Dec. 2, 1969.
San Francisco	Jan. 10, 1969	Jan. 31, 1969	May 1, 1969	California	July 30, 1969	May 9, 1969	Sept. 17, 1969; Nov. 19, 1969.
Cleveland	Feb. 12, 1969	Feb. 26, 1969	May 23, 1969	Ohio	Aug. 21, 1969	Aug. 21, 1969	Jan. 20, 1970.
Pittsburgh	do	Feb. 27, 1969	May 1, 1969	Pennsylvania	July 30, 1969	June 10, 1969	Sept. 9, 1969.
Buffalo	do	Feb. 28, 1969	do	New York	do	May 13, 1969	Aug. 19–20, 1969.
Kansas City	Mar. 26, 1969	Apr. 11, 1969	July 19, 1969	Missouri	Oct. 17, 1969	July 29, 1969	Jan. 21, 1970.
				Kansas	do	Sept. 30, 1969	Mar. 24, 1970.
Detroit	Oct. 16, 1969	Nov. 3, 1969	Dec. 17, 1969	Michigan	Mar. 17, 1970	Feb. 10, 1970	
Baltimore	May 7, 1969	May 23, 1969	Aug. 16, 1969	Maryland	Nov. 14, 1969	Oct. 10, 1969	Mar. 12, 1970.
Hartford-Springfield	Apr. 16, 1969	Apr. 29, 1969	Oct. 3, 1969	Connecticut	Jan. 2, 1960	Oct. 3, 1969	Feb. 9–16, 1970.
				Massachusetts	do	Nov. 24, 1969	Mar. 19, 1970.
Indianapolis	May 23, 1969	June 10, 1969	Sept. 18, 1969	Indiana	Dec 17, 1969	Oct. 21, 1969	Feb. 6, 1970.
Minn.-St. Paul	May 7, 1969	May 21, 1969	Aug. 16, 1969	Minnesota	Nov. 14, 1969	Sept. 9, 1969	Mar. 25, 1970.
Milwaukee	July 8, 1969	July 21, 1969	Sept. 18, 1969	Wisconsin	Dec. 17, 1969	Oct. 17, 1969	May 19, 1970.
Providence	July 12, 1969	July 29, 1969	Dec. 6, 1969	Rhode Island	Mar. 6, 1970	Jan. 31, 1970	
				Massachusetts	do	Jan. 15, 1970	Mar. 18, 1970.
Seattle-Tacoma	July 23, 1969	Aug. 5, 1969	Oct. 25, 1969	Washington	Jan. 23, 1970	Nov. 17, 1969	Mar. 13, 1970; Apr. 17, 1970.
Louisville	Oct. 7, 1969	Oct. 17, 1969	Dec. 6, 1969	Kentucky	Mar. 6, 1970	Dec. 15, 1969	
				Indiana	do	Dec. 12, 1969	
Dayton	Oct. 2, 1969	Oct. 16, 1969	Dec. 17, 1969	Ohio	Mar. 17, 1970	Mar. 17, 1970	
Phoenix	Oct. 11, 1969	Oct. 21, 1969	Apr. 24, 1970	Arizona	July 23, 1970		Dec. 12, 1969.

NACPA AIR QUALITY CONTROL REGION INFORMATION RELATING TO STANDARDS FOR SULFUR OXIDES AND PARTICULATE MATTER—BIMONTHLY SUMMARY, APR. 30, 1970—Continued

Region	Boundaries proposed	Consultation	Designation	State	Letter of intent: Due	Letter of intent: Dated	Public hearings scheduled/held
Houston	Oct. 28, 1969	Nov. 10, 1969	Jan. 20, 1970	Texas	Apr. 20, 1970	Feb. 12, 1970	
Dallas-Fort Worth	Oct. 29, 1969	Nov. 12, 1969	Jan. 20, 1970	do	do	do	
San Antonio	Oct. 30, 1969	Nov. 14, 1969	Jan. 20, 1970	do	do	do	
Birmingham	Dec. 9, 1969	Dec. 17, 1969	Mar. 7, 1970	Alabama			
Toledo	do	Dec. 19, 1969		Ohio	July 16, 1970		
			Apr. 17, 1970	Michigan	do		
Steubenville	Aug. 13, 1969	Aug. 27, 1969	Dec. 6, 1969	Ohio	Mar. 6, 1970	Mar. 6, 1970	
				West Virginia	do	Feb. 5, 1970	
Chattanooga	Dec. 9, 1969	Dec. 18, 1969		Tennessee	July 9, 1970	Apr. 17, 1970	
			Apr. 10, 1970	Georgia	do		
Atlanta	Feb. 3, 1970	Feb. 13, 1970	Apr. 29, 1970	Georgia	July 28, 1970		
				Mississippi	do		
Memphis	Jan. 17, 1970	Jan. 28, 9170	do	Tennessee	do		
				Arkansas	do		
Portland	Apr. 10, 1970	Apr. 21, 1970		Oregon			
				Washington			
Beaumont-Port Arthur	May 5, 1970	May 15, 1970		Texas			
New Orleans				Louisiana			
Miami	Mar. 21, 1970	Mar. 31, 1970		Florida			
Oklahoma	Mar. 19, 1970	Mar. 26, 1970		Oklahoma			
Omaha	Apr. 8, 1970	Apr. 17, 1970		Nebraska			
				Iowa			
Honolulu				Hawaii			
Salt Lake City	Apr. 21, 1970	May 1, 1970					
Charlotte				North Carolina			
Portland				Maine			
Albuquerque				New Mexico			
Lawrence				Massachusetts			
Lowell-Manchester				New Hampshire			
El Paso				Texas			
Las Vegas				Nevada			
Fargo				North Dakota			
Moorhead				Minnesota			
Boise				Idaho			
Billings				Montana			
Sioux Falls				South Dakota			
Cheyenne				Wyoming			
Anchorage				Alaska			
Burlington	Mar. 19, 1970	Mar. 30, 1970		Vermont			
				New York			
San Juan				Puerto Rico			
Virgin Islands	Mar. 10, 1970	Mar. 20, 1970					

Region	Standards: Due	Standards: Submitted	Standards: HEW "approval"	Implementation plans: Due	Implementation plans: Submitted	Implementation plans: HEW "approval",
Washington, D.C.	Nov. 10, 1969	Oct. 13, 1969		May 7, 1970		
	do	Feb. 3, 1970		do		
	do	Nov. 7, 1969		do		
New York City	do	Nov. 19, 1969		do		
	do	Oct. 30, 1969		do		
	do	Nov. 7, 1969		do		
Chicago	do	Nov. 3, 1969	Mar. 27, 1970	do		
	do	Nov. 10, 1969	do	do		
Philadelphia	do	Nov. 3, 1969	Feb. 25, 1970	do		
	do	Oct. 30, 1969	do	do		
	do	Oct. 29, 1969	do	do		
Denver	do			do		
Los Angeles	do	Dec. 15, 1969		do		
St. Louis	Jan. 6, 1970	Jan. 5, 1970		do		
	do	Nov. 3, 969		July 6, 1970		
Boston	Jan. 7, 1970	Jan. 15, 1970		do		
Cincinnati	Jan. 27, 1970	Mar. 17, 1970		July 27, 1970		
	do	Feb. 25, 1970		do		
	do	Jan. 22, 1970		do		
San Francisco	Jan. 26, 1970	Dec. 15, 1969		do		
Cleveland	Feb. 17, 1970	Mar. 17, 1970		Aug. 17, 1970		
Pittsburgh	Jan. 26, 1970	Nov. 3, 1969	Mar. 22, 1970	July 27, 1970		
Buffalo	do	Jan. 27, 1970		do		
Kansas City	Apr. 15, 1970	Mar. 30, 1970		Oct. 12, 1970		
	do	Apr. 14, 1970		do		
Detroit	Sep. 14, 1970			Mar. 12, 1970		
Baltimore	May 13, 1970			Nov. 9, 1970		
Hartford-Springfield	June 30, 1970			Dec. 28, 1970		
	do			do		
Indianapolis	June 15, 1970			Dec. 14, 1970		
Minneapolis-St. Paul	May 13, 1970			Nov. 9, 1970		
Milwaukee	June 15, 1970			Dec. 14, 1970		
Providence	Sept. 2, 1970			Mar. 1, 1971		
	do			do		
Seattle-Tacoma	July 22, 1970			Jan. 18, 1971		
Louisville	Sept. 12, 1970			Mar. 1, 1971		
	do			do		
Dayton	Sept. 14, 1970			Mar. 12, 1971		
Phoenix	Jan. 19, 1971			July 19, 1971		

Region	Standards: Due	Standards: Submitted	Standards: HEW "approval"	Implementation plans: Due	Implementation plans: Submitted	Implementation plans: HEW "approval"
Houston	Oct. 19, 1970			Apr. 15, 1971		
Dallas-Fort Worth	do			do		
San Antonio	do			do		
Birmingham						
Toledo	Jan. 12, 1971			July 12, 1971		
	do			do		
Steubenville	Sept. 2, 1970			Mar. 1, 1971		
	do			do		
Chattanooga	Jan. 5, 1971			July 6, 1971		
	do			do		
Atlanta	Jan. 25, 1971			July 19, 1971		
	do			do		
Memphis	do			do		
	do			do		
Portland						
Beaumont-Port Arthur						
New Orleans						
Miami						
Oklahoma City						
Omaha						
Honolulu						
Salt Lake City						
Charlotte						
Portland						
Albuquerque						
Lawrence						
Lowell-Manchester						
El Paso						
Las Vegas						
Fargo-Moorhead						
Boise						
Billings						
Sioux Falls						
Cheyenne						
Anchorage						
Burlington						
San Juan						
Virgin Islands						

Source: Office of Education and Information.

Question 2. Why does S. 3466 provide for deletion of section 106, which provides 100-percent planning grants for interstate agencies?

Answer. Of the 34 air quality control regions designated thus far, 14 encompass parts of two or more States. Nonetheless, the National Air Pollution Control Administration has received no applications for interstate planning grants under section 106. It should be noted that repeal of section 106 would not preclude States from forming or designating interstate agencies for the purpose of coordinating the planning of air quality control programs or from receiving Federal grant support for the activities of such agencies. Section 105 authorizes awarding of grants to interstate agencies covering up to three-fourths of the cost of planning regional air quality control programs. The requirement that the grantee agency pay a portion of the cost is applied to all other air pollution control programs grants awarded under the Clean Air Act and has been found to be a highly effective means of stimulating State, and local involvement in air pollution control activities.

Question 3. What factors have caused delay in the desgination of air quality control regions? How many staff members are assigned to this function? To criteria devleopment? To control technology information development?

Answer. Under the Clean Air Act, as amended in November 1967, State governments are expected to adopt air quality standards and implementation plans for air quality control regions. An implementation plan must be based on, and provide for, the degree of air quality improvement needed to attain and maintain the desired air quality standards. As of November 1967, few States had had any experience with this approach. For the most part, measures taken to prevent and control air pollution had been designed simply to reduce visible emissions or abate obvious nuisances.

The procedure to be followed by the States under the Clean Air Act requires knowledge of existing levels of air pollutants, detailed information on sources and emissions, and data on meteorological conditions affecting the diffusion and transport of pollutants in the air. In November 1967, few States had such information in sufficient detail to provide a basis for planning air quality control programs for air quality control regions. Since similar information is needed in determining boundaries of air quality control regions, it was considered necessary and desirable to employ the regional designation process as a means of familiarizing State officials with the concept of implementing air quality standards and with the mechanics of this approach. Accordingly, the National Air Pollution Control Administration has assembled and published a report containing relevant data on each area prior to its designation as an air quality control region. As part of the process of developing each report, an inventory of area and point-source emissions was compiled, demographic data were assembled, and meteorological data were obtained and employed as input to a mathematical model for predicting pollutant concentrations. Throughout this process, National Air Pollution Control Administration worked closely with State agencies.

As experience with this process has been gained, designation of regions has been accelerated. In the first 2 years following enactment of the November 1967 amendments to the Clean Air Act, 18 regions were designated. By the end of the summer of this year, designation will have been completed in the other 39 areas included in the first 57 earmarked for designation. At that point, there will be at least a portion of an air quality control region in every State. In addition, the National Air Pollution Control Administration has announced plans for the designation of an additional 34 air quality control regions—all interstate—by the end of the summer. The fact that all States will have had some experience with the process and will be capable of participating in the work involved in it accounts, in large measure, for the feasibility of this accelerated schedule. If the Congress should enact legislation calling for continued designation of air quality control regions, there will be a further acceleration of the process.

Eight NAPCA staff members are directly involved in the process of designating air quality control regions. These personnel are responsible for assembling needed data, delineating proposed regional boundaries, arranging and holding consultations with State and local officials, and preparing official notifications of the designation of air quality control regions. Many other NAPCA staff members also are involved in this work. For example, the Division of Air Quality and Emission Data generates and evaluates most of the needed technical data. Personnel in all of NAPCA's regional offices are involved in obtaining available data from State and local agencies and in consultations with State and local officials. In addition, two contractors are assisting NAPCA in assembling and evaluating technical data.

Seven NAPCA staff members are directly involved in the preparation of air quality criteria documents. A great many other staff members, plus consultants and contractors, also contribute to the development of air quality criteria. All of the economic and health effects research conducted and supported by NAPCA's Bureau of Criteria and Standards is directly related to the development of air quality criteria. More than 100 non-Government scientists and several contractors participate in preparing and reviewing air quality criteria documents.

On an annual basis, about 12 man-years of NAPCA staff effort are directly involved in preparation of reports on control technology. A substantial additional effort is involved in reviewing drafts of such reports on control technology. This figure does not include staff effort involved in reviewing drafts of all or parts of such reports. In addition to NAPCA staff, many non-Government experts and several contractors also are involved in preparing and reviewing these reports.

Question 4. What additional regions will be designated this year?

Answer. At least 91 air quality control regions will have been designated by the end of calendar year 1970. They include the 57 listed in the table provided in response to question 1 on standards and enforcement and the 34 listed in the attached news release:

Commissioner John T. Middleton of the National Air Pollution Control Administration today named an additional 34 interstate air quality control regions that will be designated by the end of this summer, bringing the total regions by that time to 91.

Under 1967 amendments to the Clean Air Act, designation of regions is a fundamental step in triggering action by State governments, which are responsible under the act for adopting and enforcing standards to control air pollution on a regional basis.

"Previously," Commissioner Middleton said, "we selected 57 areas to be designated. These included the largest and most polluted urban communities in the country. and included at least one community in each of the 50 States. Now that most of the States have had the experience of operating the machinery of the Clean Air Act. we can accelerate the designation process, and as the President indicated in his February 10 message to the Congress, we will focus our efforts on interstate regions."

Proposed boundaries for the first 21 of the interstate regions will be published in the Federal Register within 45 days. Each involves States that have already gone through the original designation process at least once. Boundaries for each of the remaining 13 will be proposed after all the States involved have gone through the process.

Central cities of the 21 air quality control regions to be designated first are:

1. Allentown-Bethlehem-Easton, Pa.—Phillipsburg, N.J.
2. Binghamton, N.Y.—Pennsylvania.
3. Bristol, Va.—Johnson City—Kingsport, Tenn.
4. Columbus, Ga.—Phenix City, Ala.
5. Cumberland, Md.—Keyser, W. Va.
6. Duluth, Minn.—Superior, Wis.
7. Erie, Pa.—Ashtabula, Ohio.
8. Evansville, Ind.—Owensboro-Henderson, Ky.
9. Florence, Ala.—Mississippi—Tennessee.
10. Fort Smith, Ark.—Oklahoma.
11. Hunting, W. Va.—Ashland, Ky.—Portsmouth-Ironton, Ohio.
12. Joplin, Mo.—Miami, Okla.
13. La Crosse, Wis.—Winona, Minn.
14. Menominee-Escanaba, Mich.—Marinette, Wis.
15. Mobile, Ala.—Pensacola, Fla.—Biloxi-Gulfport, Miss.
16. Paducah, Ky.—Metropolis, Ill.
17. Parkersburg, W. Va.—Marietta, Ohio.
18. Rockford, Ill.—Janesville-Beloit, Wis.
19. Sequatchie River Valley, Ala.—Tennessee.
20. South Bend-Elkhart, Ind.—Benton Harbor, Mich.
21. Youngstown-Warren, Ohio—Sharon, Pa.

Central cities of the 13 air quality control regions to be designated later are:

1. Augusta, Ga.—Aiken, S.C.
2. Berlin, N.H.—Rumford, Maine.
3. Davenport, Iowa—Rock Island-Moline, Ill.
4. Douglas, Ariz.—Lordsburg, N. Mex.
5. Dubuque, Iowa—Illinois—Wisconsin.
6. Keokuk, Iowa—Missouri—Illinois.
7. Lewiston-Moscow, Idaho—Clarkston-Pullman, Wash.
8. Norfolk, Va.—Elizabeth City, N.C.
9. Savannah, Ga.—Beaufort, S.C.
10. Shreveport, La.—Texarkana, Tex.—Arkansas.
11. Sioux City, Iowa—Nebraska.
12. Spokane, Wash.—Coeur d'Alene, Idaho.
13. Vicksburg, Miss.—Tallulah, La.

States are responsible for setting air quality standards for any portion of their territory that is included in an air quality control region. They are also responsible for developing and carrying out plans for implementation and enforcement of the standards.

Provisions of the Clean Air Act call for States to begin such action after the Department of Health, Education, and Welfare publishes air quality criteria describing the adverse effects of air pollutants and information on techniques for controlling the sources of those pollutants.

Air quality criteria and control techniques information for sulfur oxides and particulate matter were issued to the States on February 11, 1969. Those for carbon monoxide, hydrocarbons, and photochemical oxidant were issued on March 19, 1970.

Once criteria and control techniques information for a pollutant are issued, States have 90 days to signify their intent to set air quality standards for that pollutant for areas included in air quality control regions. They then have 180 days to hold public hearings and adopt standards, and another 180 days to adopt plans for implementation and enforcement of the standards. The standards and plans must be submitted to the Department of Health, Education, and Welfare for review and approval.

Question 5. S. 3466 proposes only to enforce failure to meet air quality standards established pursuant to section 107 rather than plans for implementation of emission standards. Would this weaken existing law?

Answer. No, S. 3466 would not weaken existing law and in some respects would strengthen it.

Under the existing section 108(c)(4), Federal enforcement action is contingent upon a finding that "the ambient air quality of any air quality control region or portion thereof is below the air quality standards established under this subsection" and that "such lowered air quality results from the failure of a State to take reasonable action to enforce such standards."

S. 3466 would make Federal action contingent upon a finding that the ambient air quality in any State or the area under the jurisdiction of any interstate air pollution control agency fails to meet the air quality standards established pursuant to section 107 or that there is a violation of federally established emission standards under new section 112, and that such failure or violation results from the failure of a State or interstate agency to carry out its approved enforcement plan or the plan provided for it by the Secretary.

Thus, S. 3466 provides for enforcement of Federal emission standards and for enforcement of emission or other source restrictions designed to achieve national air quality standards in any case where a State is not enforcing its plan.

Furthermore, under S. 3466, Federal enforcement action could be initiated not just in cases of interstate air pollution but in all instances of failure to meet air quality or emission standards. This change would substantially broaden Federal enforcement powers.

Question 6. S. 3466 proposes to give the Secretary authority to establish standards with respect to emissions from classes or sources of pollution which contribute "substantially to the endangerment of public health and welfare and which can be prevented or substantially reduced." This is, in effect, national emission standards for stationary sources. This provision appears to be in conflict with other provisions of the bill which require the States, after the publication of national ambient air quality standards, to promulgate plans for implementation which will assure compliance with those air quality standards by industry or other air pollution sources. With which emission standards would a polluter comply? Would a State be authorized to enforce its emission plan if a conflict with national standards occurred?

Answer. S. 3466 would authorize application of national emission standards only to new stationary sources which would contribute substantially to endangerment of public health or welfare, with the exception that such emission standards could be applied to existing stationary sources in the case of emissions which are extremely hazardous to health.

If there were a conflict between National and State standards applicable to such sources, the more restrictive standards would apply. In accordance with the policy statements contained in the Clean Air Act, States clearly would have the right to adopt and enforce emission standards more restrictive than those established by the Federal Government.

Question 7. How many substances or source categories would be subject to national emission standards for both new and existing sources? What estimates of cost of compliance are available?

Answer. With respect to new stationary sources, the following categories would be the first to receive attention: Electric generating plants, iron and steel mills, primary metals plants, cement mills, petroleum refineries, and kraft pulp mills. Estimates of the cost of complying with emission limitations similar to those that might be established under S. 3466 are included in the "Report to the Congress on the Need for National Emission Standards."

With respect to emissions which are extremely hazardous to health, national standards could be applied to both new and existing sources. The following pollutants are candidates for such standards: Polynuclear organic particulate matter, asbestos, radioactive materials, pesticides, cadmium, arsenic, lead, manganese, beryllium, chromium, nickel, lead, biological aerosols, chlorine-hydrochloric acid, and aeroallergens. Cost estimates have not been developed.

Question 8. Could you provide for the record a summary and status of Federal enforcement activities to date?

Answer. The following is a summary of air pollution abatement proceedings initiated under section 108 of the Clean Air Act, as amended:

(*a*) Bishop, Md.-Selbyville, Del.

At the request of the State of Delaware, an abatement conference was held in November 1965. It concerned odors emanating from a rendering plant in Bishop and affecting health and welfare in Selbyville, about 1½ miles from the plant.

Because the ensuing recommendations for odor abatement were not implemented by the Bishop Processing Co., a hearing was held in May 1967. The hearing board recommended specific measures to abate the problem.

Because these measures were not taken, the Secretary of Health, Education, and Welfare asked the Attorney General to bring suit against the company. A suit was brought in U.S. district court and was settled by a consent decree signed on November 1, 1968. The decree provided that plant operations would cease if further complaints were received from Delaware.

Following receipt of continued complaints from persons in the Selbyville area, action was taken to enforce the consent decree. After evidence to support enforcement was provided, the district court ordered the company to cease operations. The fourth circuit court of appeals subsequently upheld the order. The case now has been appealed to the U.S. Supreme Court, which has not made a decision as yet on whether it will review the case.

(*b*) Ticonderoga, N.Y.-Shoreham, Vt.

At the request of the State of Vermont, an abatement conference was held in November 1965. Participants in the conference found that offensive odors and other pollutants from the International Paper Co.'s pulp mill in Ticonderoga were adversely affecting the health and welfare of persons in the Shoreham area. Following the conference, recommendations were made in regard to abatement of odors and particulate emissions.

Equipment has been installed in general accordance with the abatement techniques discussed at the conference. Nevertheless, odor complaints have persisted. There is evidence that some of the plant's facilities are being operated at production rates in excess of their intended capacity, thus negating, to some extent, the effect of the control equipment installed after the abatement conference was held. In addition, it is suspected that liquid and solid wastes discharged into Lake Champlain in the past may now be contributing to the occurrence of odors.

A new 500-ton-per-day pulp mill is now being built; it is scheduled to replace the old one by 1971. The design of the new plant appears to include air pollution control equipment and techniques for virtually every emission source. If rated capacities are not exceeded, odors and particulate emissions should be well below those associated with the existing plant.

(*c*) New York-New Jersey Metropolitan Area

Abatement conferences were held in January 1967 and January 1968. They covered New York City and three other counties in New York State and nine counties in northern New Jersey. The first conference dealt with sulfur oxides and carbon monoxide. The second one dealt with particulate matter. The recommendations pertained mainly to source categories rather than individual sources.

Both States have made vigorous efforts to implement the recommendations arising from the first conference. Because the requisite fuels were not available, however, the recommendations relating to the sulfur content of fuels could not be implemented by the original target dates. They will be implemented by next year. The recommended interim limit has been achieved and has produced a 40-percent reduction in sulfur oxides emissions.

The State of New Jersey's limitations on the sulfur content of fuels are somewhat more stringent than is necessary to implement the recommendations.

Action on a recommendation regarding industrial process sources of sulfur oxides has resulted in a reduction of about 50 percent in sulfur oxides emissions from sulfuric acid plants and similar facilities. Nearly all such sources in the area are located in New Jersey.

The recommendations arising from the second conference did not require as much State action as did those from the first conference. Many of the requisite emission control regulations for stationary sources had already been adopted by State and local agencies in the area. There have been some improvements in the control of particulate emissions from fuel burning and manufacturing, but incineration still is a large source of particulate emissions in the area.

All 17 counties in the abatement area, plus most of Fairfield County in Connecticut, are included in an air quality control region designated in November 1968. Provisions for further control of particulate emissions from incinerators and other sources are expected to be included in implementation plans due to be submitted in May 1970.

(*d*) Kansas City, Kans.-Kansas City, Mo.

Abatement conferences were held in January 1967 and April 1968. The first conference was concerned with particulate emissions affecting visibility at two airports in the area; the recommendations were directed at sources in the immediate vicinity of the airports, with particular emphasis on 20 industrial plants and a burning refuse dump. The second conference dealt with the overall air pollution problem in the Kansas City metropolitan area; recommendations were of a more general nature and were directed at all categories of particulate emission sources.

Equipment to reduce particulate emissions has been installed at many industrial sources in the area and at electric generating plants. In several instances, inefficient coal burning equipment has been replaced by facilities using natural gas or fuel oil. Emissions from solid waste disposal operations have been reduced through the elimination of backyard incinerators in many communities in the area and improvements in sanitary landfill operations. Most open burning at dumps and salvage operations has been eliminated.

Of the 21 sources covered by recommendations arising from the first conference, six are in complete compliance. Another has moved from the area included in the first conference. Ten others have made significant improvements but have not achieved full compliance, as yet. At the other four progress thus far has been slower than recommended, but the firms involved have developed plans for controlling particulate emissions in the near future.

(*e*) Clarkston, Wash.-Lewiston, Idaho

An abatement conference was held in March 1967. It was found that the pulp mill owned by Potlatch Forests, Inc., in Lewiston was the major source of malodorous hydrogen sulfide gases and particulate pollutants adversely affecting health and welfare in the area. It was recommended that the company abate the emissions by instituting appropriate control procedures and installing necessary air pollution control equipment. It was also recommended that open burning be eliminated in the area and that teepee burners and other inefficient, single-chamber incinerators either be eliminated or improved.

Though the plant has reduced particulate emissions by about 75 percent and malodorous sulfur emissions by about 50 percent, both problems still persist in the area. At a March 1970 meeting with officials of the National Air Pollution Control Administration and State and local agencies, Potlatch Forests officials described further improvements to be made in their operations. These improvements are expected to control 90 to 98 percent of the odorous sulfur compounds now being discharged to the atmosphere. Under the present schedule, the changes will be completed from 1972 through 1975.

Except for the elimination of open burning at one refuse dump, there have been no appreciable reductions in pollution from sources other than the pulp mill.

Lewiston and Clarkston are to be included in an interstate air quality control region to be designated later this year.

(*f*) Parkersburg, W. Va.-Marietta, Ohio

An abatement conference was first convened in March 1967. It was concerned with sulfur oxides and particulates; odorous chlorine compounds, and eye irritants also were considered in later proceedings. It was found that much of the sulfur oxides and particulate pollution in the area was being released from a single facility of the Union Carbide Corp. Recommendations for abatement of sulfur oxides and particulate emissions were prepared by the conference participants but were not officially issued because the State of Ohio proposed to supply additional information pertinent to the conference.

The conference was reconvened on October 30, 1969, to permit the conference participants to present new data. Recommendations issued in March 1970 called for reductions in emissions of particulate matter and chlorine. Recommendations regarding sulfur oxides emission were deferred until reports from Union Carbide Corp. were obtained under the authority of section 108(j) of the Clean Air Act.

Information requested from the Union Carbide Corp. was received, and the conference was reconvened March 31, 1970, to consider recommendations for the control of sulfur oxide emissions. The earlier recommendations were amended to provide for limiting sulfur emissions from the powerplant boilers operated by the Union Carbide Corp.

(*g*) Powell County (Garrison), Mont.

An abatement conference was held in August 1967. It concerned fluoride emissions from a plant which processes phosphate rock to produce animal food supplement. The single recommendation was that the Rocky Mountain Phosphate Co. be closed until proper abatement devices for control of fluoride emissions were installed.

The plant was closed within the month following the conference. In October 1967, operations were resumed, but the temporary fluoride scrubber that had been installed later proved unsatisfactory. In the spring of 1968, the plant ceased all operations to install a new fluoride scrubber similar to equipment successfully used in the Florida phosphate industry.

Stack tests performed by the National Air Pollution Control Administration in March 1969, indicated the fluoride collection efficiency of the scrubber to be around 99 percent. Other measurements made at the time of the stack test showed marginally acceptable fluoride levels were reached in ambient air and vegetation one-quarter mile from the plant.

In late 1969, the fluoride content of grasses in the area increased dramatically, far above the State standard of 35 parts per million in forage fed to livestock. On January 16, 1970, the State board of health requested the plant to cease operation under the terms of a prior agreement until the board could evaluate proposed changes in the system. The plant reopened on March 3, 1970, without the approval of the board and State attorney general's office.

The attorney general's office asked the State supreme court either to close the plant until the board could evaluate changes made to reduce pollution or to overrule the district court order preventing the attorney general from taking immediate legal action without a hearing. The State supreme court ruled the argument presented was "insufficient" to grant the request, thereby permitting the plant to continue operation.

The State department of health will continue surveillance of the plant operations and evaluate the effect of improvements in the control system. If State standards are exceeded, the board plans to invoke injunction procedures against the plant. The company has installed a second fluoride scrubber at the phosphate plant to serve a kiln which had been idle. The company plans to operate both kilns in the near future.

(*h*) National Capital Metropolitan Area

An abatement conference was held in December 1968. It dealt with general classifications of pollution sources rather than specific sources. It was recommended that the States of Maryland and Virginia and the District of Columbia promulgate and enforce regulations that would achieve areawide reductions in sulfur oxides and particulate emissions. The State of Maryland and the District of Columbia have followed most of the recommendations. The State of Virginia has not enacted specific regulations for the area; however, several Virginia communities in the area have enacted regulations consistent with the recommendations.

The recommended sulfur oxides emission limitation (equivalent to the use of fuel containing no more than 1 percent sulfur) was achieved by July 1, 1969, in much of the area. Additional sulfur oxides reductions resulted from fuel switches to natural gas and distillate oil. The overall reduction in sulfur oxides emissions since the abatement conference was held is estimated at 40 percent.

At four of the six powerplants in the area, sulfur dioxide and particulate emissions have been lowered by switching to coal and fuel oil of 1 percent sulfur content or less. Three of these plants now burn some oil (one burns only oil) whereas they all burned nothing but coal prior to the conference. In accordance with the recommendations, stack desulfurization processes are being developed to handle the two outlying powerplants, which are fired with coal. This effort is scheduled to culminate in full-scale desulfurization facilities for the two plants by 1973.

The largest single source of particulate pollution in the area, the Kenilworth dump, was closed in 1968. Further reductions in air pollution from solid wastes burning are to be achieved through stringent emission restrictions for incinerators. According to the present timetable for compliance, these reductions are to be realized by 1972.

(*i*) Ironton, Ohio-Ashland, Ky.-Huntington, W. Va.

An abatement conference was held in July 1968. It was concerned with interstate air pollution, more than 80 percent of which was attributed to 19 large industrial sources in the area. The recommendations issued in March 1969 pertained mainly to the control of particulate emissions from fuel combustion, industrial processes, solid wastes disposal, and coke manufacturing operations in the area.

Responsibility for implementing the recommendations is shared jointly by the States of Ohio, Kentucky, and West Virginia. Control recommendations dealing with fuel burning at stationary sources, coke manufacturing, and industrial processes were to be implemented no later than July 1, 1970.

The State of Kentucky has submitted reports indicating that sources in the State are making reasonable progress toward implementing the recommendations. West Virginia officials have informally reported that progress is being made toward compliance with the recommendations at several major sources. Ohio officials have not made specific reports of progress toward implementing the recommendations. The Ohio Air Pollution Control Board has scheduled a public hearing for April 29, 1970, to consider ambient air quality standards for the two counties comprising the Ohio portion of the abatement area as a prerequisite to establishing emission standards.

(*j*) New Cumberland, W. Va.-Knox Township, Ohio

An abatement conference was held in July 1969 in regard to sulfur oxides and particulate pollution from the Ohio Edison powerplant at Toronto, Ohio. Emissions from the plant were found to be adversely affecting the health and welfare of residents of the New Cumberland area. Recommendations issued in August 1969 included the following schedule for control of emissions from the Toronto powerplant: By July 1, 1970, emissions of particulates from the three largest boilers were to be controlled to 99 percent and vented through a tall stack; and emissions from the eight older boilers were to be stringently restricted by certain dates, depending on the control option selected, the latest date being December 31, 1970.

The Ohio Edison Co. has submitted plans and specifications for particulate emissions control devices for the three large boilers. The company claims that use of the older boilers is necessary in 1970 and 1971 to maintain the reliability of its system, but that control of emissions or conversion to cleaner fuels is not economically feasible. The company proposes to use the eight older boilers only to meet peakloads, which would mean that they would be operated less than 10 percent of the time. The company further proposes to retire the eight older boilers from service no later than December 1971. These proposals are being studied by the National Air Pollution Control Administration and the air pollution control agencies of the two States.

Question 9. Would you supply the committee with a summary of State and local ambient air quality standards, emission standards, and compliance schedules developed under State and local law?

Answer. Emission standards and/or regulations applicable to all or some sources of particulate matter have been adopted by more than half the States and a great many local and regional air pollution control agencies. Specifically, 28 States have adopted such standards for industrial process sources and fuel combustion sources. Thirty States have adopted emission or design standards applicable to incinerators. At the local and regional levels, 97 agencies have adopted particulate emission standards for industrial process sources, 120 have adopted particulate emission standards for fuel combustion sources, and 107 have adopted emission or design standards for incinerators. The attached copies of "A Compilation of Selected Air Pollution Emission Control Regulations and Ordinances" (Public Health Service Publication No. 999—AP—43; retained in subcommittee files) and "Trends in Air Pollution Control Regulations" summarize the salient features of the principal types of particulate emission standards and contain examples of particulate standards currently in effect.

To date, relatively few air pollution control agencies have adopted emission standards or regulations applicable to gaseous pollutants. Six States and 20 local and regional agencies have adopted standards or regulations applicable to sulfur oxides emissions from fuel combustion sources. These standards and regulations generally impose limitations on the sulfur content of fuels but allow the use of stack-gas desulfurization equipment if it will achieve an equivalent degree of sulfur oxides control. The attachments summarize and give examples of the principal types of sulfur oxides standards and regulations adopted by State and local agencies. A complete listing of all such standards and regulations is being prepared and will be supplied to the committee. The attachments also summarize and give examples of State and local emission standards and regulations applicable to several other types of gaseous pollutants.

With respect to compliance schedules, State and local agencies invariably specify compliance dates in connection with standards and regulations applicable to sulfur oxides emissions from fuel combustion sources. In many places, limitations on the sulfur content of fuels are already in effect; in the District of Columbia, for example, a limitation of 1 percent took effect in July 1969. In some places, progressively more stringent limitations will take effect on specified future dates; in New Jersey, for example, a 1-percent limitation on the sulfur content of bituminous coal took effect in May 1968, and a limitation of 0.2 percent has been adopted to take effect in October 1971. The listing of sulfur oxides regulations now being prepared (as mentioned above) will show compliance schedules.

More often than not, emission standards and regulations for other types of air pollutants are not associated with any broadly applicable compliance schedules. As a rule, such standards take effect immediately upon adoption. New facilities built after the date of adoption generally are required to be designed and equipped to comply with the applicable standards. Sources already in existence generally are given varying periods of time to achieve compliance; the time allowed usually depends largely on the economic and technological problems associated with compliance. In cases where emission standards and regulations do include specific compliance schedules, the time allowed generally ranges from 6 months to 3 years. It should be noted, however, that most State and local agencies can grant variances from compliance schedules established either by regulation or by agreement with the affected parties.

In regard to ambient air quality standards, the attached tables list those standards adopted or proposed by State governments as of May 15, 1970, for application in air quality control region and those adopted by State or local governments for application in other areas (some of which are due to be designated as air quality control regions). For the latter areas, the tables show air quality standards based on the most meaningful measurements of air pollutant levels; thus, air quality standards for suspended particulate matter are listed, but air quality standards based on measurements of settleable particulate matter (dustfall) are not shown, since the latter are not as meaningful an index of air pollution and are not as widely employed. For air quality control regions, sulfur dioxide and suspended particulate matter are the only pollutants for which air quality standards have been officially adopted; in accordance with the timetable set forth in the Clean Air Act, as amended, air quality standards for carbon monoxide, hydrocarbons, and oxidants for some 30 regions are due to be adopted by December 24, 1970 (9 months following the issuance of air quality criteria for these pollutants).

Trends in Air Pollution Control Regulations

(By Terry L. Stumph and Robert L. Duprey, Division of Control Agency Development)

ABSTRACT

This paper analyzes recent trends in air-pollution-control regulations adopted by State and local agencies. Many of the regulations were evaluated by personnel of the Division of Control Agency Development of the National Air Pollution Control Administration, and written comments were sent to the agencies to assist them in developing sound regulations.

The emphasis of discussion is on concepts of control regulations rather than on specific emission limits. Trends in control regulations have been toward preventing air pollution through required application of known control techniques. Outmoded concentration emission standards are rapidly being replaced by those that limit total mass-emission rate. Allowable emission rates usually vary according to the size of the source.

Control of all visible emission is being accepted as necessary to any control program. Particulate matter from fuel-burning equipment is being controlled to a high degree; emission standards for sulfur oxides from fuel combustion are anticipated in the near future. Incinerator emission standards are relatively undeveloped, due to the lack of knowledge about the performance of high-efficiency dust collectors on these sources. Control of many types of process industries presents a challenge in the design of equitable emission standards. The familiar process-weight-rate regulation is rapidly becoming the standard for limiting particulate matter from this source category. The potential-emission-rate concept shows promise for certain source types and pollutants. Odor regulations have mainly involved ambient air measurements using the human sense of smell.

Key words:

- Emission standard.
- Equivalent opacity.
- Process weight.
- Potential-emission rate.
- Odors.

INTRODUCTION

Conservation or degradation? Prevention or action based only on proven adverse effects? Stringent emission control or use of atmospheric dilution? These are the options confronting State and local governments in developing air-pollution-control regulations. The prospects of an increasing air pollution problem, growing public demand for action, and the general failure of conciliation, persuasion, and voluntary control have resulted in the need for and growing tendency toward Government regulation.

Federal stimulatory program grants have accelerated the progress of this activity at the State and local levels. In order to receive maintenance-grant suport, an agency must be able to prevent and control air pollution from all sources under its jurisdiction.[1] Federal abatement actions under the Clean Air Act have also stimulated State and local regulatory actions. With the advent of the requirements of the Air Quality Act of 1967, further advances can be expected on a regional basis in the designated air-quality-control regions.

What, then, are the trends in modern air-pollution-control regulations? The consensus has clearly been in favor of air pollution prevention, air resource conservation, and increasingly stringent emission control regulations. Most emission control standards adopted in recent years by state and local agencies have been based on maximum application of modern control technology rather than on atmospheric dispersion. Some reasons for this tendency include:

1. Realization that future demands on atmospheric resources are not easy to predict, which indicates the necessity for a present policy of conservation.
2. Inability of most States and local agencies to develop sophisticated air-resource-management programs.
3. Necessity for concentrating limited agency resources on solving immediate pollution problems.
4. Need for regulations the emission limits of which are readily known by source owners and agency personnel, especially for design of new collection systems.
5. Desire of most agency personnel for regulations that can be readily and directly applied to the numerous sources found in most urban areas, without extensive monitoring and data collection.
6. Realization that emissions from multiple sources are practically untraceable after discharge into a common air envelope.

This paper attempts to analyze the particular control regulations that have evolved from State and local agencies over the years. Speculation about future trends will be limited to immediate extensions of typical current regulations, without discussing the larger questions and potential approaches associated with more sophisticated air-management programs.

CONCEPTS OF EMISSION STANDARDS

Early concepts

Early emission standards limited the concentration of pollutants in the effluent gas stream in such terms as pounds per thousand

[1] Federal Register, vol. 32, No. 104, May 30, 1967.

pounds, grains per standard cubic foot, parts per million, and micrograms per standard cubic meter. Concentrations based on pollutants mass per unit gas volume vary with temperature and pressure so correction to standard temperature and pressure is necessary, usually 60° F. and 14.7 pounds per square inch absolute. To prevent circumvention of standards by diluting pollutants with large quantities of air, concentration standards have to be standardized. This is usually accomplished by correcting flue-gas volumes to a percentage of the theoretical quantity of air required for complete combustion of fuel. Because early emission standards were primarily intended for coal-burning boiler plants, pollutant concentrations were corrected to 50 percent excess air which, for most bituminous coals, results in a carbon dioxide concentration of approximately 12 percent in the dry flue gas. Unfortunately, emission standards of this type have the following deficiencies:

1. Pollutant concentration, by itself, does not indicate total pollutant discharge, because flue-gas volumes vary considerably.
2. An emission standard specifying a single concentration requires essentially the same degree of control for large and small sources, whereas large sources emit more pollutants and are usually capable of purchasing and operating more efficient collectors.
3. Standardization with respect to percent excess air is meaningful only for pure combustion processes where no other materials are contacted by the fuel or its combustion products.

The first emission standards were derived for coal-fired equipment, but were occasionally applied to incinerators and industrial processes. Emission limits applied to coal-fired equipment were not related to the emission rates of incinerators and industrial processes, and standardization for excess combustion air raised special problems for each.

Correction of incinerator effluents to 50-percent excess air is not as simple as for coal combustion, because combustion of different wastes with 50 percent excess air produces different quantities of carbon dioxide. The specific quantity produced for each waste should be known in order to make a valid correction to 50 percent excess air. Because waste properties vary considerably, incinerator effluents are usually corrected to 12 percent carbon dioxide in the dry flue gas, without the contribution of auxiliary fuel. This value of 12 percent carbon dioxide is not related to any specific waste but is simply a convenient reference condition for allowable dilution. The correction procedure is not affected by the selection of specific emission limits for various types of waste. It can be affected, however, by the use of wet collectors because water can absorb a significant quantity of the carbon dioxide produced by incineration.

Despite these difficulties, pure combustion effluents can theoretically be standardized for excess combustion air so that concentration standards can be applied. However, such standards are not applicable to industrial operations that involve various combinations of combustion, chemical, and physical processes. A cement plant discharges large quantities of carbon dioxide from the thermal decomposition of limestone. The charging of limestone into foundry cupolas also results in discharge of carbon dioxide. Some drying operations use hot air that has been heated indirectly and, thus, contains no gaseous combustion products. For these and other industrial processes, determination of percent of excess combustion air becomes meaningless. Resultant flue-gas volumes cannot be effectively standardized, and circumvention of a concentration standard by dilution with outside air cannot be detected or prevented.

Some operations, such as foundry cupolas, infiltrate large quantities of air for cooling purposes, during certain portions of the melting cycle. McIlvaine [2] gives data that illustrate how deceptive pollutant concentrations can be. With minimum infiltration, pollutant concentration was 0.19 grain per standard cubic foot. With greatly increased infiltration, the concentration was reduced to 0.05 grain per standard cubic foot with no reduction in mass-emission rate. Therefore, low effluent concentrations do not necessarily indicate low emission rates, especially for industrial processes that normally use large quantities of dilution air (for example, foundry cupolas and basic oxygen furnaces).

Collection-efficiency standards are similar to concentration standards in that they (1) do not directly limit total emissions, (2) usually specify a single degree of control regardless of source size, and (3) are subject to circumvention. Regarding the last point, collection efficiency is determined by measuring pollutant flow rate both before and after the collector. The efficiency of many types of collectors increases with the quantity of material passing through them because of the attendant increase in particle size. Some methods of increasing pollutant flow rate include recirculating collected solids and entrainment of larger particles from the process by increasing gas-flow rates. Although these practices often increase collection efficiency, they are usually acocmpanied by increased emission rates.

New concepts

The deficiencies associated with concentration and collection-efficiency standards have led to development of more meaningful standards that restrict total emission rate in units such as in pounds per hour. This type of standard eliminates the possibiilty of circumvention and directly limits total pollutant discharge to the atmosphere. Another feature of newer standards is that sources with large potential for pollution are being more strictly controlled because they (1) usually contribute a greater pollution load to the atmosphere and (2) can usually afford and maintain more expensive and efficient control devices, due to economics of size. Parameters that reflect source size are also approximate measures of pollution potential. Thus, emission limits for fuel-burning equipment usually vary on the basis of total heat input in millions of B.t.u. per hour, whereas some incinerator standards are based on the total weight of refuse charged in pounds per hour. Industrial processes include many types of operations, making it more difficult to select a single parameter tot indicate pollution potential. Many emission standards for industrial processes vary with process-weight rate; others vary with potential-emission rate. Whenever an emission standard applies to a specific industry, any convenient measure of source size usually correlates with pollution potential.

[2] McIlvaine, Robert W., "Air Pollution Equipment for Foundry Cupolas," Journal of the Air Pollution Control Association, vol. 17, No. 8, August 1967.

There have been complaints about the difficulty of accurately determining various size parameters, especially for operations that do not employ calibrated feeding devices. This difficulty, however, also applies to the older concentration standards. To equitably apply a concentration standard, the unit must be operated at its design capacity during compliance testing. Otherwise, many operations might be able to comply by operating at less than design capacity.

There has been inconsistency in the application of total mass-emission-rate standards to multiple equipment units existing in a plant. Some regulations apply to the total plant capacity; others apply to individual units. The latter condition presents an opportunity to circumvent the intent of the regulation by constructing several small units rather than a single large one. This temptation should not exist. A source should have to meet a fixed emission limit dependent only upon the total capacity of all "like" units (for example, boilers, cement kilns, driers, and recovery furnaces) in the plant.

VISIBLE EMISSION REGULATIONS

Since the introduction of the Ringelmann chart in 1890, the regulation of black smoke plumes caused by poor combustion has been widely accepted. In 1948 the health and safety code of California was amended to include the "equivalent opacity concept," which extended the Ringelmann chart for application to a visible plume of any color, which obscures the view of an observer to the same degree as black smoke. This concept has now spread to numerous jurisdictions throughout the Nation including most of the major urban areas. Its legality has been upheld in the courts.[3]

Equivalent opacity regulations are especially useful for maintaining surveillance of a large number of source installations without having to sample the source. Enforcement of the regulation assures continuous maintenance and proper operation of equipment. Despite its usefulness, a number of technical questions have arisen concerning the validity of equivalent opacity. Foremost among these is the question concerning the benefits to be gained by control of nonblack visible emissions.

The visibility of a plume is more a function of the size of entrained particulate matter than of the total weight. Particles in the size range of 0.1 to 1 micron have the optimum effect in scattering light. A high collection efficiency by weight of particulate matter may still allow an offensive visible plume due to the remaining presence of many submicron particles. Such particles remain suspended in the atmosphere for long periods of time and, during inversions, accumulate to cause severe visibility reduction and soiling of buildings and materials. These small particles are also inhaled by man and can be retained in the lower respiratory tract. Visible plumes are offensive from an esthetic standpoint and, in some cases, are direct hazards to ground and air transportation.[4]

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[3] 62 Wash. 2d. 834 P 2d. 859 (1963) cert. den. 377 U.S. 906. 84 S. Ct. 1166. 12 L. Ed. 2d. 177 (1964); 102 Cal. App. 2d. Supp. 925. 226 P 2d. 587 (1951); 137 Cal. App. 2d. Supp. 859. 291. 2d. 587 (1955) Cert. den. 351 U.S. 990 76 S. Ct. 1046. 100 L. Ed. 1503 (1955).

[4] "Air Quality Criteria for Particulate Matter," NAPCA Publication No. A.P. 49, January 1969.

Because mass-emission standards are unrelated to particle size, they are not always effective in eliminating visible plumes. The use of standards involving visible emissions is the only practical means for controlling submicron particles until measurement techniques and emission standards that limit the number of discharged particles according to size are developed.

A second technical question concerns the reproducibility of reading equivalent opacity of plumes. Common objections are that opacity varies with the position of the observer relative to the sun, atmospheric lighting, and background. These sources of error also apply to observation of black plumes, but even the strongest opponents of pollution control have accepted the desirability of controlling smoke emissions. Observers can be taught to compensate for these variables to a reasonable degree of accuracy. With smoke school training, an observer is required to reproduce his reading of opacity usually within 10 percent of actual plume transmittance before he is certified.[5] This is believed to compare favorably with the accuracy of many other sampling and analytical procedures routinely used in the field of air pollution control.

A third question concerns the method for complying with equivalent opacity as compared to the usual method for complying with smoke regulations. When smoke is the offending agent, control can be achieved by improved combustion efficiency. When plume visibility is due to the emission of fine fly ash from fuel combustion or to fumes from metallurgical processes, control must then be achieved by use of collection equipment. Collection of submicron particles requires highly efficient devices such as baghouses, high-energy scrubbers, and high-efficiency electrostatic precipitators. Collection sufficient for compliance with mass-emission-rate standards may not be sufficient for compliance with equivalent capacity standards.

Mass concentration can be related to plume transmittance for specific particle sizes and types, and plume thickness. Conner[6] demonstrated a close correlation between plume transmittance and mass concentration for oil particles by calculation and measurement. Other relationships have been published for different types of particles and sources.[7] [8]

Equipment manufacturers make use of such existing data, however limited, to design control equipment to opacity requirements. This practice has, by necessity, depended primarily on the vendor's experience with similar installations on specific source types rather than on theoretical relationships. Correlation of particle size and concentration data with plume visibility for additional sources is needed to aid designers in eliminating offensively visible plumes.

Many new industrial plants install equipment for purposes of eliminating all visible plumes, even if not required to do so. Such action constitutes good public relations, and plant managers realize their chances of being singled out for complaints and source sampling are greatly diminished if their plumes are invisible.

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[5] Rom, J. J. "Reading Visible Emission," Training Course Manual, National Air Pollution Control Administration, Durham, N.C., April 1968.

[6] Conner, W. D. and Hodkinson, J. R. "Optical Properties and Visual Effects of Smoke-Stack Plumes," NAPCA Publication No. AP–30, 1967.

[7] Stern, A. C., ch. 51, p. 706, Air Pollution Standards, "Air Pollution," vol. III, 2d ed. Academic Press, New York, 1968.

[8] Air Pollution Manual, pt. II, Control Equipment, ch. 2, AIHA, Detroit 1968.

Until recently, most visible emission standards have been less than No. 2 Ringelmann or its equivalent opacity. The present trend of new regulations is to require all incinerators and new sources of all types to meet No. 1 Ringelmann or its equivalent opacity. A few areas require all sources to meet No. 1 Ringelmann. Some areas prohibit all visible discharges from automobiles except for short periods of time. The trend appears to be toward prohibition of all unnecessary visible emissions and, ultimately, toward elimination of all visible emissions.

CONTROL OF PARTICULATE EMISSIONS FROM FUEL-BURNING EQUIPMENT

No source of particulate matter has been more extensively regulated than coal-fired heating and powerplants. The reason is obvious: coal is the major fuel used for generating heat and electric power in most of the major urban areas. Coal contains considerable ash—from 10 to 20 percent—most of which is discharged as air contaminants unless collection equipment is employed.

Until recent years, most particulate-matter emission standards were based on a 1949 American Society of Mechanical Engineers (ASME) model code, which limits emissions to 0.85 pound of dust per thousand pounds of flue gas, corrected to 50 percent excess air. The collection-efficiency requirements vary from about 50 to 85 percent, depending on the type of equipment used to burn coal with 10 percent ash and 13,000 B.t.u. per pound. Even the largest powerplants can meet the standard using mechanical collectors.

ASME issued a new model in 1966 entitled "Recommended Guide for the Control of Dust Emission—Combustion for Indirect Heat Exchangers" commonly known as ASME standard APS–1. The new ASME model limits the mass-emission rate of particulate matter rather than the in-stack concentration used in the 1949 model. This new model requires a varying degree of control dependent on plant size and stack height. ASME standard APS–1 has had only limited acceptance by State and local air pollution control agencies perhaps due to the following limitations:

1. It is based on meteorological dispersion equations applicable only to single source emissions located on essentially flat terrain. Maximum allowable ground level concentrations are based on the "critical wind speed" with no consideration for inversion and possible fumigation conditions. Obviously, these assumed conditions do not exist in urban areas nor in areas where irregular terrain or adjacent buildings negate the theoretical benefits of dispersion.
2. Allowable mass-emission rate is dependent on the stack height. Increased stack height can be used to meet the standard in lieu of emission control, although there is no minimum stack-height requirement.
3. The use of a taller stack does not reduce the total quantity of pollutants discharged but merely disperses the effluent over a wider area, perhaps degrading the air elsewhere.
4. The control requirements of the standard are generally lenient compared to other modern regulations and to the degree of con-

trol now being applied to new fuel-burning installations.[9] The standard can be restrictive for a plant with a large number of short stacks. However, the trend is to build large plants with a single tall stack, principally for dispersing sulfur dioxide emissions. Any unit burning pulverized coal with 10 percent ash and 13,000 B.t.u. per pound can comply with the most stringent ASME provision with a collection efficiency of only 87 percent merely by erecting a tall stack. For example, a 500-megawatt plant with a 700-foot stack can comply with an 87-percent efficient collector.

Most urban areas, many States, and the Federal Government (Federal facilities) use what is commonly known as the sliding scale concept to regulate particulate-matter emissions from fuel-burning equipment. Figure 1 illustrates three of the more restrictive standards that are currently in use. The first such standard was adopted by New York City in 1964. It was based on the lowest line of an ASME proposed model [10] that was later replaced by ASME Standard APS–1.

It is common practice to compare collector performance using collection efficiency rather than total pollutant-emission rate. Keeping with this practice, collection-efficiency requirements for each of the three standards are presented in table 1 for various types and sizes of equipment, based on coal with an average heat content of 13,000 B.t.u. per pound and an ash content of 10 percent. The efficiency requirements of a sliding scale standard increase with increasing size of the installation and also with increasing emission potential of the source. In view of the number of new source installations being designed with control equipment having collection efficiencies greater than 99 percent,[9 11 12] it seems clear that these standards are attainable with currently available control technology. There is some justification for more restrictive standards, at least for new installations, since the emission standards shown have not yet reached the limits of technical feasibility and are, perhaps, unnecessarily lenient for installations greater than 10,000 million B.t.u. per hour. Plants with even greater capacities are being designed.

CONTROL OF SULFUR OXIDE EMISSIONS FROM FUEL-BURNING EQUIPMENT

Combustion of high-sulfur coal and residual fuel oil is the principal source of sulfur oxides in most areas of the Nation.[13] Present atmospheric levels of sulfur oxides and potential increases in emissions have led to considerable recent activity in adopting control regulations. Use of low-sulfur fuels (natural or cleaned) and/or flue-gas desulfurization are potential means of reducing sulfur oxide emissions, other than elimination of the source.

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[9] Moore, W. W., "Reduction in Ambient Air Concentrations of Flyash—Present and Future Prospects," proceedings, Third National Conference on Air Pollution, Washington, D.C., Dec. 12–14, 1966.

[10] Schueneman, J. J. "Air Pollution From Use of Fuel—Current Status and Future of Particulate Emission Control." National Engineer, March 1965.

[11] Stern, A. C. "The Regulation of Air Pollution From Power Plants in the United States," presented at International Symposium on Emission Regulations, Essen, Germany, March 1966.

[12] Engelbrecht, H. L., "Electrostatic Precipitators in Thermal Power Stations Using Low-Grade Coal," presented at 28th Annual Meeting of American Power Conference, Illinois Institute of Technology, April 1966.

[13] Control Techniques for Sulfur Oxide Air Pollutants, NAPCA Publication No. AP 52, January 1969.

The first attempt at regulation involved the 1937 St. Louis law that required washing of high-sulfur coals. Los Angeles County (which uses no coal) has limited the sulfur content of liquid and gaseous fuels since 1958. The stated aim of the Los Angeles County Air Pollution Control District is to eliminate the use of fossil fuels in powerplants and to have an adequate supply of natural gas for other fuel consumers. Since 1964, several cities and States, and the Federal Government (Federal facilities in New York, Chicago, and Philadelphia) have adopted regulations governing the sulfur content of fuels. Regulations of maximum allowable sulfur content usually carry an alternative provision whereby any fuel may be used if flue-gas desulfurization can be shown to result in an equivalent or lower rate of sulfur oxide emissions, as measured in pounds of sulfur oxides per million B.t.u. The "emission standard" is obtained by direct conversion from sulfur content of fuel and is based on air quality considerations. An excellent discussion on the development of sulfur oxide regulations has been published by High and Megonnell.[14]

Regulation of sulfur oxides from small multiple sources will probably continue to be based on sulfur content of fuel, because this is easily enforced by regulation of the importation, distribution, and sale of high-sulfur fuels. Emission testing of numerous small sources is not feasible. However, establishment of emission standards for large industrial sources and steam-electric powerplants is likely and desirable when economical flue-gas desulfurization techniques become available. The emission standards could be formulated so that they require the maximum use of those techniques. They can also be based on needed reduction in sulfur oxide emissions, recognizing that this could require either more or less control than is technically feasible. If more control is needed, other alternatives such as fuel substitution would have to be considered. Emission standards for sulfur oxides would logically be stated in the same units as those shown in figure 1 for particulate matter. The "size" of the installation to be regulated by use of emission standards could perhaps begin at $1{,}000 \times 10^6$ B.t.u. per hour. The control-efficiency requirements of the emission standard would logically increase with the size of the installation, for the same reasons discussed in reference to particulate-matter restrictions. A similar standard based on potential-emission rate could be developed to reflect the same considerations as those used in developing a standard based on plant size. Either method should be suitable since potential-emission rate and installation size are easily determined for fuel-burning installations.

PROCESS EQUIPMENT REGULATION

About 20 years ago, the Los Angeles County Air Pollution Control District (LACAPCD) developed the so-called process-weight regulation, which restricted total particulate-matter emission rates from industrial processes as a function of the process-weight rate. Process weight is, generally, the total weight of all materials, except gases, introduced into a process. This approach removed dilution as a factor

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[14] High, M. and Megonnell, W., "Development of Regulations for Sulfur Oxide Emissions," Presented at 61st Annual Meeting of Air Pollution Control Association, paper No. 68–40, June 1968.

in meeting emission standards and assured increasingly strict control of larger source operations.

The Los Angeles County process-weight regulation was derived after a thorough study of the many metallurgical industries located there. Well-controlled and well-operated plants served as the basis for determining the degree of control that was technically and economically feasible. The application of this regulation also demonstrated that many types of industries, regardless of the specific nature of their products, can comply with the emission limits. The maximum allowable emission limit was set at 40 pounds per hour.

In 1959, the Bay Area Air Pollution Control District in San Francisco (BAAPCD) developed still another process-weight regulation based on well-controlled process industries found there. They included some of the larger mineral-based operations not found in Los Angeles County. Consequently, the bay area regulation is comparable to the Los Angeles County regulation in the lower range, but allowable emissions increase at a reduced rate above 40 pounds per hours with increasing size of operation. This regulation is perhaps more reasonable for a wider range of source types than the Los Angeles County regulation and, therefore, has been more widely accepted. Other control agencies have also developed process-weight regulations, but these regulations have had limited acceptance.

The LACAPCD and BAAPCD process-weight regulations are compared graphically in figure 2, which also shows a large number of actual source operations that have complied with the bay area regulation. These sources are identified in table 2. The first 11 sources were ones used to construct the original bay area regulation.[15] Figure 2 demonstrates that a wide variety of source types can comply with this regulation, some with relative ease. Indeed, the standard is not restrictive for some source types, such as asphalt plants. Many additional industrial process operations could be shown on this graph by plotting source-test data for other well-controlled plants. Some sources, however, have difficulty in meeting the bay area regulation because of relatively difficult technical problems that can result in economic hardship. Examples of these are wet-process cement kilns and jobbing cupolas.

Control regulations for industrial gaseous emissions have in the past been mainly limited to sulfur oxides. These regulations have consisted of a mixture of emission standards and property-line concentration standards. Emission standards for sulfur dioxide are relatively unrefined, consisting of specified effluent concentration based on measured performance of well-designed and well-operated contact sulfuric acid plants. The standard of 2,000 parts per million has been enforced for over 20 years in Los Angeles for all sources. St. Louis applied this standard to existing sources in 1966 and required new plants to limit sulfur dioxide emissions to 500 parts per million based upon reported performance of European sulfuric acid plants using the double-contact process. St. Louis has emission standards established for sulfur trioxide or sulfuric acid mist based upon studies of sulfuric acid plants.

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[15] Unpublished report, "Restrictions on Particulate Emissions Based on Process Weight." Bay Area Air Pollution Control District, 1959.

Sulfur oxide emission standards similar to those adopted in St. Louis have been adopted by many other control agencies. They leave much to be desired because they (1) originated from studies on a single-source category and hence have questionable applicability to other major sources of sulfur oxides (for example, smelters and petroleum refineries) and (2) limit pollutant concentration rather than mass-emission rate and, thus, are subject to circumvention by dilution.

The generalized process-weight regulation has been used for many years. Its insensitivity to certain industries has recently led to development of a few specialized process-weight regulations. West Virginia adopted one specifically for asphalt plants which is slightly more restrictive than the bay area regulation. New York State adopted a special standard for a certain category of existing ferrous foundries. This standard is slightly less restrictive than the bay area regulation and is intended to give an economic break to the owners of these small, noncontinuous operations.

The States of Pennsylvania and New York have developed regulations, the emission limits of which vary with the pollution potential of the source. The Pennsylvania regulation, shown in figure 3, limits the mass rate of emission in pounds per hour as a function of potential-emission rate, also in pounds per hour. The regulation contains several sets of emission limits, applicable to different areas of the State. It is designed to require greater collection efficiency for those operations that would otherwise discharge large quantities of pollutants. This type of regulation appears readily adaptable to sources, the uncontrolled emission rates of which are easily determined. Many operations that discharge sulfur oxides through the processing of sulfur-bearing raw materials meet this condition. Sulfur oxide emissions from primary smelters and sulfuric acid plants, among others, could be restricted according to potential-emission rate, which, in these cases, is a direct function of the total weight of sulfur fed into the operations. The same is true for some industries that process materials containing fluorides. Sulfur oxides and particulate matter from fuel-burning equipment also lend themselves to determination of potential-emission rate.

The Pennsylvania regulation presents some difficulty when applied to the many industrial operations discharging particulate matter, because the uncontrolled emission rates bear no direct relationship to quantity of feed material but, rather, depend upon the amount of material entrained in the exhaust gases during a particular operation. Potential-emission rate, in these instances, would be determined by sampling the uncontrolled effluent gases, and source compliance would be determined by measuring collector efficiency. This requires twice the normal amount of source sampling and presents some opportunity for the source owner to manipulate the quantity of material entrained in the effluent gases. There is also the problem of assuring that tests are run at normal conditions, probably requiring establishment of normal process-weight rate or production rate. An alternative approach would be to assign potential-emission rates to these problem sources through use of preestablished emission factors. Because an emission factor ideally represents the average measured emission rate from a number of similar installations (for example, basic oxygen furnaces), the use of such factors is a logical and equitable substitute for determining potential-emission rate for each individual source.

Allowable emissions according to the bay area regulation and the most stringent provision of Pennsylvania's potential-emission-rate regulation are compared with actual emission rates measured on some selected industrial sources. These data appear in table 3. Potential-emission rates have been calculated, using published emission factors.[16] This comparison does not indicate the relative merits of each type of regulation, but it does indicate the relative stringency of the specific emission limits contained in each one. Based upon these few examples, it appears that the Pennsylvania regulation (class D) is comparable to the bay area regulation for sources with small pollution potential, but less restrictive for sources with large potential-emission rates. The bay area regulation appears to be quite stringent for sources with a combination of large process-weight rate and large emission factors (for example, cement plants). It is noticeably lenient for sources with small emission factors such as asphalt plants.

There is likely to be a continuing need for generalized regulations that apply to a variety of industrial sources. These might be based either on process-weight rate or on potential-emission rate. The use of one type rather than the other for an individual source might depend upon the relative ease with which necessary measurements can be made.

In areas containing a significant number of similar industry types, there may be a need for tailored regulations that apply to a single source category (for example, foundry cupolas) and more nearly reflect attainable emission rates for that particular source. Generalized regulations for process industries apply to many types of operations and are usually inadequate for a certain few source types, being either very lenient or very stringent. Tailored regulations for these particular sources might also be based either on process-weight or potential-emission rate, depending upon the nature of the specific source operation.

INCINERATOR REGULATIONS

The numerous small incinerators found in most urban areas cause many localized nuisances through discharge of smoke, odors, and fly ash. If enough incinerators are present, the discharged pollutants may constitute a significant portion of the total community emissions. Control of incinerator emissions and elimination of nuisance complaints has been accomplished by the use of incinerator design and emission standards, and elimination of certain types of incinerators.

Control agencies have long recognized that incinerators must burn refuse as completely as possible to minimize pollutant discharge. Well-designed, multiple-chamber incinerators are considered necessary by most authorities to achieve satisfactory combustion. Therefore, many agencies ban single-chamber incinerators and specify acceptable designs for construction of multiple-chamber incinerators. The most frequently used design standards are those adopted by the Los Angeles County Air Pollution Control District and those recommended by the Incinerator Institute of America. The LACAPCD standards are quite

[16] Duprey, Robert L., "Compilations of Air Pollutant Emission Factors," NAPCA Publication No. AP-42, 1968.

rigid and are generally considered to produce a more efficient combustion device. Because Incinerator Institute of America standards are more flexible and allow considerable variation in actual design, some incinerators built in accordance with these standards may be inefficient combustion devices. Although some designers resent being told how to design incinerators, this is the only feasible method of controlling the numerous domestic and commercial incinerators existing in most major urban areas. It would be impossible to sample each one in order to determine compliance with emission standards. Large municipal and industrial incinerators are more suitable to direct control through source testing and enforcement of emission standards.

Emission standards specific for incinerators are relatively new and are undergoing revision. Los Angeles County has for many years enforced a concentration standard of 0.3 grain per standard dry cubic foot, corrected to 12 percent carbon dioxide, without the contribution of auxiliary fuel. This was a level felt to be attainable with well-designed, multiple-chamber incinerators, without control equipment. In 1966, the Federal Government applied this standard to its incinerators smaller than 200 pounds per hour and required larger units to meet a standard of 0.2 grain per standard dry cubic foot. The latter value was found to be attainable [17] with installation of certain low-efficiency wet collectors, operating at pressure drops of about 0.5 inch of water. These particular standards have been adopted by many other control agencies in the past few years. The State of New Jersey requires that incinerators with capacities greater than 2,000 pounds per hour meet a standard of 0.1 grain per standard dry cubic foot, and smaller ones a standard of 0.2 grain per standard dry cubic foot.

In 1967, New York City and New York State developed standards that restrict mass emission rate in pounds per hour as a function of increasing incinerator size, as determined by total weight-rate of refuse charged in pounds per hour. This is more logical than concentration standards, which are somewhat difficult to standardize for for percent of carbon dioxide, if auxiliary fuel is used or if a wet collector is employed. Furthermore. it is more meaningful to restrict mass emission rate than to restrict effluent concentration.

The standards for Federal facilities (0.3 and 0.2 gain per standard dry cubic foot) have been converted to equivalent mass emission rates on the basis of selected normal refuse. These converted standards, the basis for conversion, and the New York City and New York State regulations are shown in figure 4. The dotted lines for Federal facilities represent constant emission concentrations and, hence, require about the same degree of collection efficiency for all incinerators with capacities above and below 200 pounds per hour, respectively. Any line parallel to these lines (e.g., New York State's existing units) also represents a single concentration and constant collection efficiency for all sizes. This is less than ideal for reasons already discussed. Larger units discharge more pollutants and are better suited to installation of the more efficient collectors.

Lines B (New York State's new units) and C (New York City) have decreasing slopes with increasing weight of refuse charged. These

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[17] Sableski et al., "Development of Incineration Guidelines for Federal Facilities," presented at the annual meeting of the Air Pollution Control Association, June 1968.

two standards require increasingly greater control for large units. The technical basis for constructing lines B and C is not known to the authors, and so no evaluation can be made as to their current technical feasibility. It is generally agreed, however, that most municipal-type incinerators are presently undercontrolled, considering the current availability of high-efficiency collectors for particulate matter. Perhaps these standards will require upgrading of collection equipment on such incinerators. More will be known about technical feasibility of lines B and C after tests have been made on those municipal incinerators currently being equipped with electrostatic precipitators and high-energy scrubbers. Once these tests are completed, it should be possible to construct a new standard based on the best available control equipment.

Because of the large number of small incinerators existing in most large cties, control of individual sources is expected to be accomplished primarily through application of incinerator design standards. Emission standards shown on figure 4 will serve mainly as a basis for evaluating various incinerator designs. Incinerators with capacities greater than 1,000 pounds per hour should be few enough in number so that compliance with the emission standards through source testing can be required.

Even well-designed incinerators, especially the smaller ones, can cause odors and other nuisance conditions if improperly operated. For this reason, some agencies are considering the gradual elimination of certain types and sizes of incinerators. The most efficient procedure for incinerating urban refuse would appear to be one whereby refuse is collected and incinerated at central points in municipal-type incinerators. In this manner, the most efficient collectors can be installed, and proper operation can be assured by hiring and training full-time operators. These measures are not feasible for onsite incineration as now practiced in many urban areas.

Because different waste materials have different emission factors, it might be advantageous to apply different emission standards to different types of incinerators. Junk automobile incinerators emit little particulate matter in comparison to total weight charged, therefore, the standards in figure 4 might be too lenient. Other unusual wastes might also require specific emission limits, if suitable application of control technology is to be assured.

ODOR REGULATIONS

Odors constitute the most perplexing and often the most objectionable air pollution problems. They are caused by a variety of substances, many of which are detectable at trace concentrations below one part per billion. There are many cases in which odorous substances cannot be detected by normal chemical analysis, but are detectable by the sense of smell. The human nose is, by necessity, the present standard for determining odor intensity in the ambient air and in source effluents.

It is no simple matter to trace an odor to its source, especially if multiple odor sources are located in close proximity. Existing odor control regulations consist of a variety of partially successful measures, including:

1. Nuisance-type restrictions based on ambient air detection of odors.
2. Process restrictions for certain known odor-producing sources.
3. Control equipment requirements, for specific source operations.

The three categories of regulations either specify techniques that are likely to reduce odorous emissions or declare that such emissions must not cause objectionable conditions. Most odor regulations are directed at measurement of odors in the ambient air. After this is done, there remains the problem of tracing the odor to its source and then specifying adequate control techniques. This approach is somewhat justified because human response to ambient odor must be the ultimate criterion of acceptable odorous emissions.

Early ambient air standards for odors considered of applying the nuisance prohibition without attempting to evaluate odor intensity. Because this approach is entirely complainant oriented, control officials felt the need for a tool by which odors can be evaluated and abated before nuisance conditions develop. St. Louis adopted a regulation that allows a panel of observers to evaluate odor intensity of ambient air samples when such samples are diluted with specified quantities of odor-free air. If odors can be detected after the specified dilution has occurred, the odors are deemed objectionable. What happens thereafter is not predictable because the offending odors may originate from many sources, or may be untraceable. Such approaches to odor control are both technically and legally difficult.

Another procedure for evaluating odor in the ambient air has been proposed by Huey.[18] This technique makes use of a mechanical dilution device, which simplifies the task of assigning numerical strengths to detectable odors. He also suggests a regulation by which a single observer, rather than a panel of observers, determines the objectionability of ambient odors. Both this and the St. Louis regulation are concerned with evaluating ambient odors and differ only in the mechanics of such determinations. Neither offers a method for abating such odors at the source.

Odor-control regulations, in the form of process restrictions and control equipment specifications, have been applied to certain known odor-producing operations. Los Angeles, St. Louis, and many other agencies require that effluents from animal-matter reduction be incinerated at a temperature of 1,200° F. for at least 0.3 second. These are minimum design standards for an afterburner. Other process restrictions and control requirements seek simply to prevent unnecessary discharge of odors. Examples of these are restrictions on practices in the Kraft pulping industry and operation requirements for animal feedlots.

Los Angeles County Air Pollution Control District has developed a quantative odor-measurement technique, based on American Society for Testing Materials Method D 1391–57, that can be applied at the source. Odor concentration is expressed in odor units per standard cubic foot of flue gas. An odor unit is the quantity of odorous sub-

[18] Huey, N. A., "Ambient Odor Evaluation," paper presented at annual meeting of the Air Pollution Control Association, June 1968.

stances that, when completely dispersed in 1 cubic foot of odor-free air, produces a threshold odor response by 50 percent of an odor panel. Determination of odor units requires dilution of a sample of odor-bearing air with odor-free air to the threshold of detection by 50 percent of a panel of observers. Odor concentration, in odor units per standard cubic foot of gas, can be determined for any source category, either ahead of or following control devices. Odor emission rate can be calculated as odor units per minute by multiplying the odor concentration by the volumetric flow rate. Mills [19] has determined odor emission rates for both controlled and uncontrolled industrial sources in Los Angeles County. Although Los Angeles has not developed emission standards based on odor units per minute, they have applied the sampling procedure administratively in evaluating performance of odor-control devices and in abating nuisances.

CONCLUSIONS

Recent trends in air-pollution-control regulations have been toward conservation of air resources through required application of maximum control technology. Older style concentration emission standards are rapidly being replaced by ones that limit total mass-emission rates on a schedule that requires increasing control with increasing size of source. Control of all visible emissions in being accepted as necessary to any control program. Particulate matter from fuel-burning equipment can be and is being controlled to a high degree; emission standards for sulfur oxides created by fuel combustion will probably be established. Control of process industries represents a real challenge in the design of equitable emission standards. The process-weight-rate concept, developed on the Pacific coast, is rapidly becoming the standard for this varied category of sources. The potential-emission-rate concept, developed more recently in the East, shows real promise for certain source types. Incinerator emission standards are relatively undeveloped, because of the present scarcity of units equipped with efficient collectors. Odor regulations have dealt mainly with ambient air measurements using the sense of smell, although Los Angeles County has used a similar procedure for source sampling of odorus effluents. Some possible developments in control regulations include:

1. Required elimination of all visible emissions.
2. Emission standards for sulfur oxides from fuel combustion similar to ones now used for particulate matter.
3. Process-weight-rate and potential-emission-rate regulations for specific industry types for both particulate and gaseous pollutants.
4. Mass-emission-rate standards that require application of modern fly-ash collectors to incinerators.
5. Emission standards that limit the mass rate of emission of odors measurable by source sampling.

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[19] Mills, J. L., et al., "Quantitative Odor Measurement," Journal of the Air Pollution Control Association, September 1963.

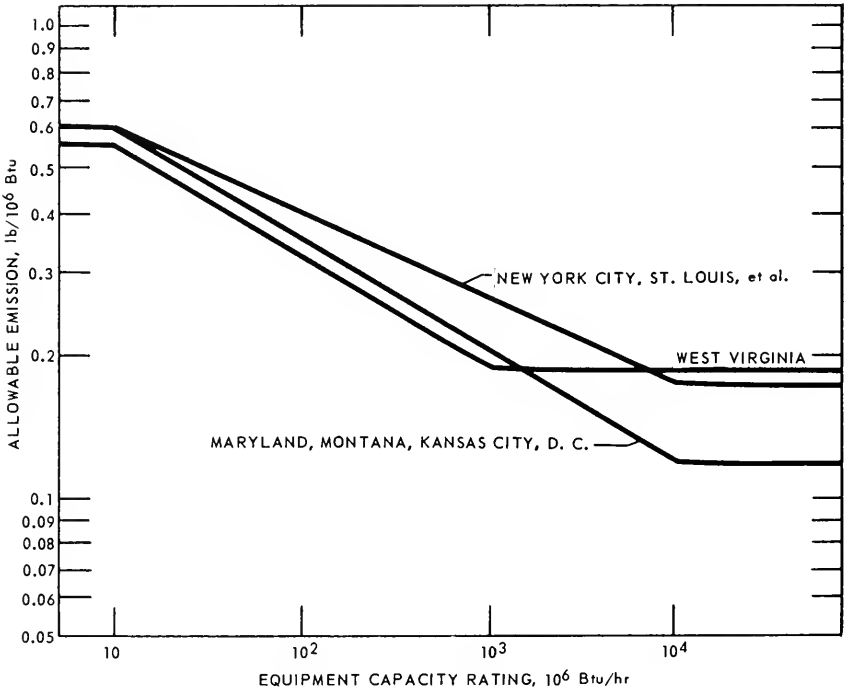

Figure 1. Particulate matter standards for fuel-burning equipment.

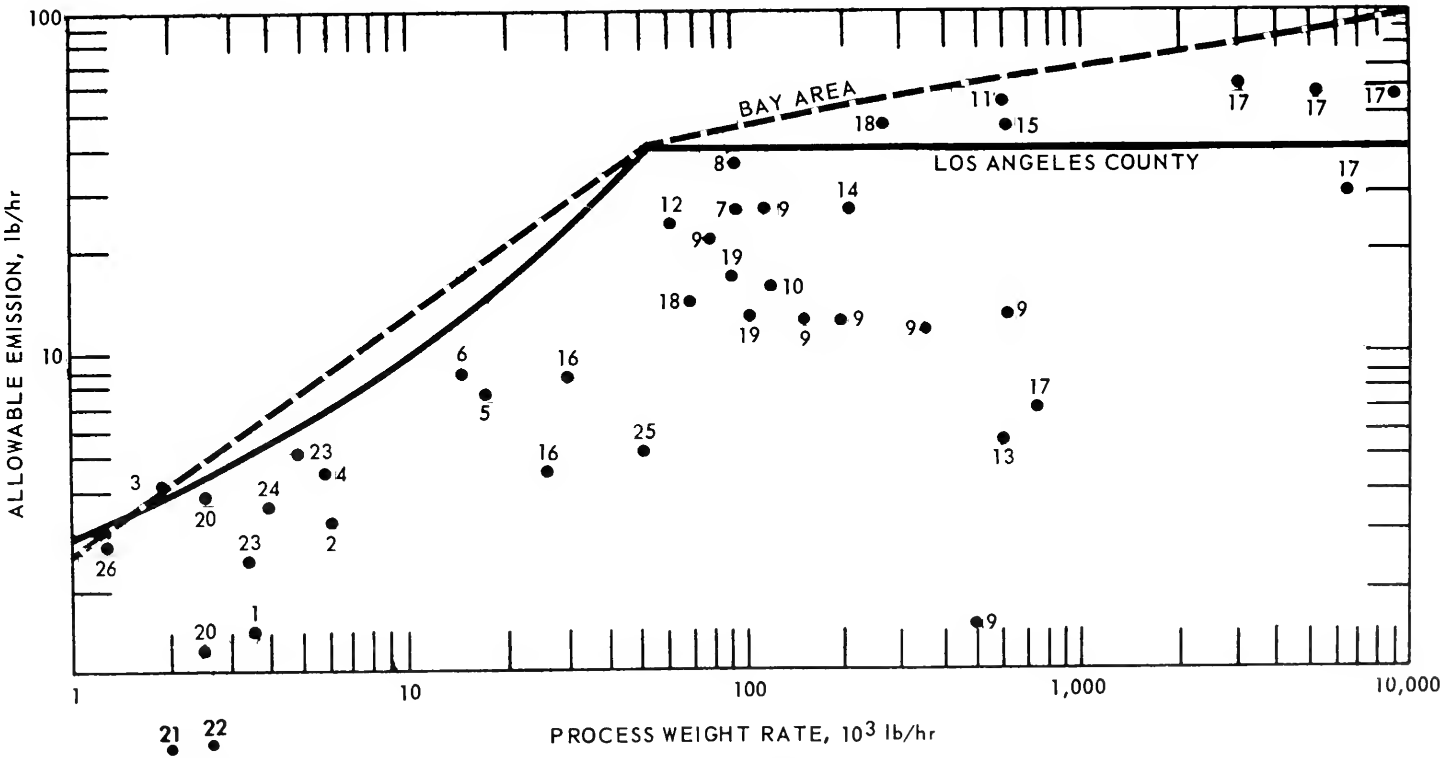

Figure 2. Examples of controlled processes meeting selected process weight standards.

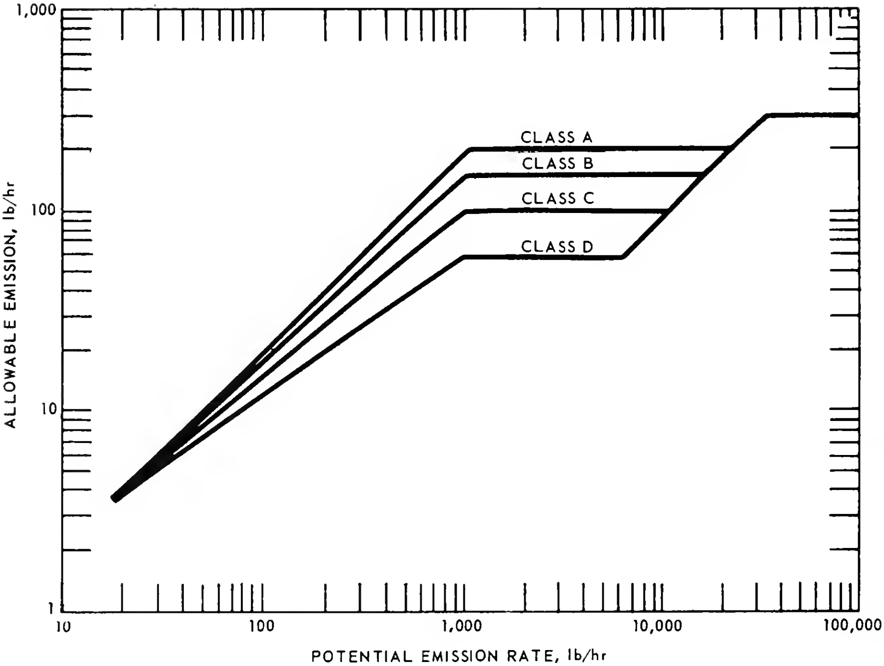

Figure 3. Pennsylvania potential-emission-rate standard.

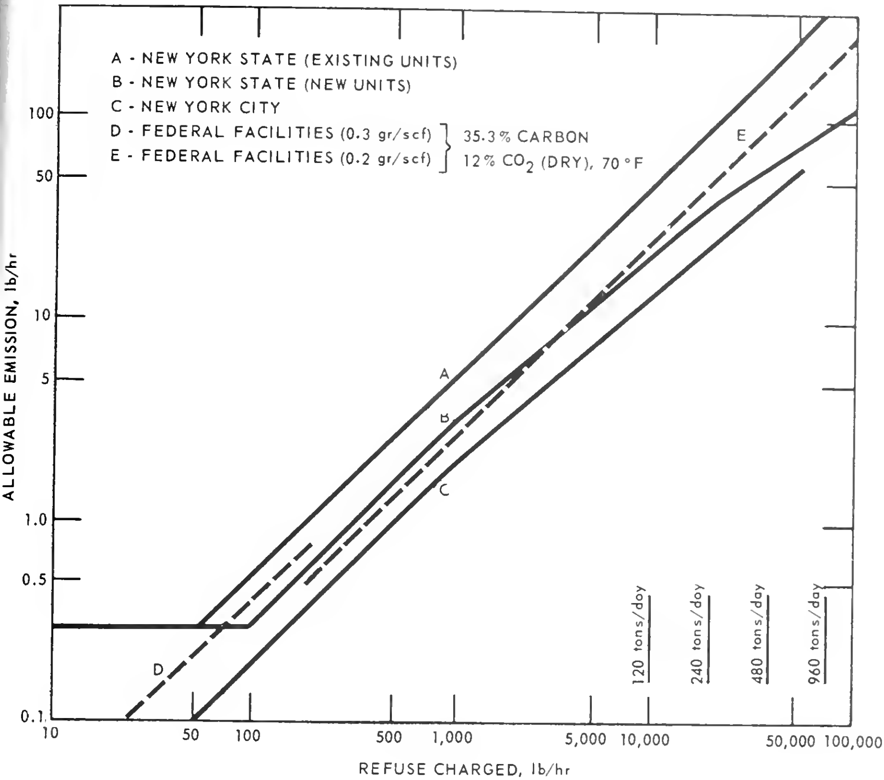

Figure 4. Particulate matter standards for refuse-burning equipment.

TABLE I.—REQUIRED COLLECTION EFFICIENCIES FOR FUEL-BURNING INSTALLATIONS[1]

Unit	Size 10^6 B.t.u. per hour	Required collection efficiency (percent) West Virginia	Maryland, et al.	New York City, et al.
Underfeed	10	70.8	68.8	68.8
Traveling grate	50	80.2	78.6	76.0
Spreader stoker	50	92.3	91.9	90.9
	[2] 50	95.0	94.6	94.0
	100	93.3	93.0	92.0
	[2] 100	95.7	95.4	94.8
Cyclone	500	88.5	87.4	84.3
	5,000	90.1	92.6	89.5
	10,000	90.1	93.7	90.6
Pulverized	500	96.4	96.0	95.2
	5,000	96.9	97.7	96.8
	10,000	96.9	98.1	97.1

[1] Basis: 10 percent ash and 13,000 B.t.u. per pound.
[2] Reinjection.

TABLE II.—*Controlled processes illustrate in figure 2*

1. Coffee roaster.
2. Electric steel furnance.
3. Chemical drying and fertilizer operation.
4. Battery plate smelting.
5. Steel open-hearth furnace.
6. Gray iron cupola.
7. Lead smelting.
8. Lead sintering.
9. Asphalt batch plant.
10. Thermofor catalytic cracker regenerator.
11. Fluid catalytic cracker regenerator.
12. Kraft recovery furnace.
13. Blast furnace.
14. Sintering (main strand).
15. BOF (no gas recovery).
16. Gray iron cupola.
17. Fluid catalytic cracker regenerator.
18. Dry-process cement kiln.
19. Wet-process cement kiln.
20. Secondary lead smelting.
21. Secondary zinc sweating furnace.
22. Secondary aluminum sweating furnace.
23. Mineral wool curing oven.
24. Mineral wool blowchamber.
25. Barley grain cleaner.
26. Frit smelter.

TABLE III.—COMPARISON OF BAY AREA PROCESS WEIGHT REGULATION AND STATE OF PENNSYLVANIA POTENTIAL-EMISSION-RATE REGULATION (CLASS D) FOR SELECTED SOURCES

Source and size	Emission factor, lb./ton	Process weight rate, lb./hr.	Established potential emission rate, lb./hr.	Allowable emissions, lb./hr. BAAPCD	Allowable emissions, lb./hr. Pennsylvania	Controlled emissions, lb./hr.	Collector
Asphalt plant:							
182 tons/hr	5	364,000	909	57.3	56.0	25.5	Scrubber
42 tons/hr	5	84,000	210	43.0	20.0	21 2	Do.
Cement plant:							
9,580 bbl./day	[1] 46	276,000	18,300	54.6	183	52 7	Baghouse.
3,900 bbl./day	[2] 38	112,000	6,170	45.6	62	16	Electrostatic precipitator.
Gray iron cupola:							
9.9 tons/hr	17.4	24,650	172	22.0	17.8	7.7	Baghouse.
42.4 tons/hr	17.4	105,400	738	45.1	48	11.0	Venturi.
Kraft recovery furnace:							
233 tons/day	150	62,000	1,450	40.3	60	23	Electrostatic precipitator and scrubber.

[1] Pounds per barrel (dry).
[2] Pounds per barre (wet).

AMBIENT AIR QUALITY STANDARDS

CONTENTS

I. Areas other than air quality control regions:
- Table 1. Sulfur dioxide.
- Table 2. Suspended particulate matter.
- Table 3. Nitrogen oxides.
- Table 4. Carbon monoxide.
- Table 5. Oxidants.
- Table 6. Fluorides.
- Table 7. Lead.
- Table 8. Berryllium.
- Table 9. Hydrogen sulfide.
- Table 10. Sulfuric acid test.

II. Air Quality control regions:
- Table 11. Sulful dioxide.
- Table 12. Suspended particulate matter.

NOTES

Averaging time. The period of time over which the concentration is measured; for example, a 24-hour value is the average value for a 24-hour period.

Maximum value. The highest value expected to be reached throughout an entire year; for example, a 24-hour maximum is the highest 24-hour average expected to be reached on a single day during a year.

Percentile. The percentage of time a specified value isallowed to be equaled or exceeded in a year; for example, a 24-hour value shown in a column headed "one percent" can be reached or exceeded approximately 4 days in a year.

Annual arithmetic mean. The simple average of all measurements; it is obtained by adding all measured values and dividing by the total number of such values.

Annual geometric mean. The midpoint of all measured values; it divides the highest 50 percent of values from the lowest 50 percent.

Ug/m^3, micrograms per cubic meter.

Ppm. Parts per million.

Ppb. Parts per billion.

TABLE 1.—SULFUR DIOXIDE AIR QUALITY STANDARDS (p.p.m.)

Political jurisdiction	Area type	Annual geometric mean (24 hours)	Annual arithmetic mean	24 hours				8-hour maximum	1 hour			20-minute maximum	5-minute maximum
				Maximum	10 percent	5 percent	1 percent		Maximum	5 percent	1 percent		
New York State	Levels I–IV						0.10				0.15		
Do	Level V						.25				.40		
Pennsylvania		0.02		0.10					0.25				
Delaware		.025	0.030	.13			.10		.30				
Tennessee	Industrial						[1].20				[2].5		
Do	Commercial						[1].15				[2].4		
Do	Residential						[1].10				[2].3		
Do	Recreational						[1].10				[2].3		
Tennessee, Nashville, Davidson County			.02				[1].10						
Tennessee, Chattanooga, Hamilton County.				.10					.50				
Tennessee, Memphis, Shelby County		[3].03				0.10				0.25			
South Carolina	Industrial			.17					.50				
Do	Residential			.10					.30				
South Carolina, Charleston County	Industrial			.17					.50				
Do	Residential			.10					.30				
Florida, Manatee County [4]	Sulfuric acid plant												
Florida, Dade County								0.10				[5]1.0	
Florida, City of Jacksonville				.08					.2				0.5
Georgia				.2					.5				
Georgia, Chatham County				.2					.5				
Georgia, Fulton County				.2					.5				
Georgia, Macon, Bibb County				.2					.5				

Political jurisdiction	Area type	Annual geometric mean (24 hours)	Annual arithmetic mean	1-month maximum	24 hours			2 hours maximum	1 hour			30-minutes 4.2 percent	5-minutes 1 percent
					Maximum	10 percent	1 percent		Maximum	1 percent	0.83 percent		
Virginia		0.03				0.10							
Nevada-Reno, Sparks and Washoe County			0.01				[6] 0.03				[7] 0.08		
California					[8] 0.04				0.05				
Minnesota			.02				[6] .10						
Texas	Land uses A, B, and D				.2							[9] 0.4	
Do	Land use, C				.3							[9] .5	
Colorado					.1				.5				
Montana			.02				[6] .10			[10] 0.25			
Wyoming			.02				[11] .10						
Massachusetts		.025			.105				.280				
Arkansas			.02				[6] .10			.20			[12] 0.50
New Mexico		.03					[1] .14						
North Carolina			.02					0.10	.30				
Kentucky		.02		0.05	.10			.30	.42				
Utah [13]													

[1] Not to be exceeded 24 hours out of 100 consecutive days.
[2] Not to be exceeded 1 hour out of 100 consecutive hours.
[3] Also included is a 1-hour geometric mean standard of 0.07 p.p.m.
[4] 0.10 p.p.m. above background, not to be exceeded at any time.
[5] Not to be exceeded in a 20-minute period of any hour.
[6] 24-hour average, not to be exceeded over 1 percent of the days in any 3-month period.
[7] Not to be exceeded for more than 1 hour in any 5 consecutive days.
[8] Applicable in areas where the particulate matter standard is exceeded.
[9] Concentration during any 30-minute period of time, with no more than one such 30-minute period during any 12 hours.
[10] Not to be exceeded for more than 1 hour in any 4 consecutive days.
[11] 24-hour average not to be exceeded over 1 day in any 3-month period.
[12] Not to be exceeded for more than 5 minutes in any 8-hour period.
[13] Maximum 3-minute concentration of 1.5 p.p.m. in addition to numerous cumulative exposure limits.

TABLE 2.—SUSPENDED PARTICULATE AIR QUALITY STANDARDS ($\mu g./m.^3$)

Political jurisdiction	Area type	Annual geometric mean (24 hours)	Annual arithmetic mean	24 hours: Maximum	24 hours: 16 percent	24 hours: 10 percent	24 hours: 5 percent	24 hours: 1 percent	1 hour maximum
New York State	Level I	45			70				
Do	Level II	55			85				
Do	Level III	65			100				
Do	Level IV	80			120				
Do	Level V	100			150				
Pennsylvania		65		195					
Delaware		70		200					500
Tennessee	Industrial	[1] 100				[2] 200			
Do	Commercial	[1] 75				[2] 150			
Do	Residential	[1] 60				[2] 120			
Do	Recreational	[1] 40				[2] 80			
Tennessee, Nashville, Davidson County	Industrial			200					
Do	General	50						[3] 150	
South Carolina	Industrial	125					200		
Do	Residential	75					150		
South Carolina, Charleston County	Industrial	125					200		
Do	Residential	75					150		
Florida, Manatee County	Rural		60						
Do	Residential		75						
Do	Commercial		95						
Do	Industrial		125						
Alabama, Huntsville	Quarrying Area			[4] 150					

Political jurisdiction	Area type	Annual geometric mean (24 hours)	Annual arithmetic mean	3-months maximum	1-month maximum	1-week maximum	24 hours: Maximum	24 hours: 10 percent	24 hours: 5 percent	24 hours: 1 percent
West Virginia, Kanawha Valley		100								250
Nevada-Reno, Sparks and Washoe County	Residential		50							[5] 150
Do	Residential-commercial		150							[5] 250
Do	Commercial-industrial		150							[5] 350
California [6]		60					100			
Minnesota		75								200
Texas	Residential and recreation							125		
Do	Commercial							150		
Do	Industrial							175		
Do	Type D							200		
Colorado				90						
Idaho	Residential							125		
Do	Commercial							150		
Do	Industrial							175		
Do	Agricultural							150		
Do	Recreational							100		
Montana		75								200
Utah		90							[7] 200	[7] 200
Wyoming		75								200
Massachusetts		75					180			
Arkansas		75						140		
New Mexico		60			90	110	150			
North Carolina		60					210			
Kentucky		65					220			180

[1] Not to be exceeded more than 50 percent of time in 30 days.
[2] Not to be exceeded more than 10 percent of time in 30 days.
[3] Not to be exceeded over 1 day in 100 consecutive days.
[4] Above background.
[5] No 24-hour sample to exceed the specified level more than 1 percent of the days in any 3-month period.
[6] Additional standard for visisility reducing particles states in sufficient concentration to reduce visibility to 10 miles at relative humidity of less than 70 percent.
[7] Not more than 1 percent of samples collected between Apr. 1 and Oct. 31, nor more than 5 percent of the samples collected between Nov. 1 and Mar. 31 shall exceed a concentration of 200 $\mu g./m.^3$.

TABLE 3.—NITROGEN OXIDES AIR QUALITY STANDARDS ($NO+NO_2$) (p.p.m.)

Political jurisdiction	Annual arithmetic mean	24 hours, 1 percent	1 hour: Maximum	1 hour: 1 percent	1 hour: 0.83 percent
Nevada—Reno, Sparks, and Washoe County	0.15	[1] 0.20			[2] 0.30
California			[3] 0.25		
Colorado			.1		
Wyoming				[4] 0.15	

[1] Not to be exceeded over 1 percent of the days in any 3-month period.
[2] Not to be exceeded for more than 1 hour in any 5 consecutive days.
[3] Nitrogen dioxide.
[4] Maximum allowable 1-hour value, not to be exceeded for 1 percent of the time during any 3-month period.

TABLE 4.—CARBON MONOXIDE AIR QUALITY STANDARDS (p.p.m.)

Political jurisdiction	Area type	Annual arithmetic mean	24 hours: Maximum	24 hours: 1 percent	8 hours: Maximum	8 hours: 15 percent	1 hour: Maximum	1 hour: 1 percent	1 hour: 0.83 percent
New York State	Levels I–V				30	15		60	
Pennsylvania			25						
Kentucky					8		30		
Nevada—Reno, Sparks, Washoe County.		2.50		[1] 5.00					[2] 10
California					20				

[1] 24-hour average, not to be exceeded over 1 percent of the days in any 3-month period.
[2] Not to be exceeded for more than 1 hour in any 5 consecutive days.

TABLE 5.—TOTAL OXIDANTS AIR QUALITY STANDARDS (PPM)

Political jurisdiction	Area type	Annual arithmetic mean	24 hours: Maximum	24 hours: 1 percent	4 hours maximum	1 hour: Maximum	1 hour: 0.83 percent	1 hour: 0.32 percent
New York State	Levels I and II		[1] 0.05		[1] 0.10	[1] 0.15		
Do	Level III		[1] .05			[1] .15		
Do	Level IV and V		[1] .10			[1] .15		
Pennsylvania						.05		
Kentucky			[2] .02			[2] .05		
Nevada-Reno, Sparks and Washoe County.		0.01		[3] 0.03			[4] 0.15	
California								[5] 0.1
Minnesota						.15		
Missouri-St. Louis						.15		
Missouri-Kansas City						.15		
Colorado						.1		
Wyoming						.15		

[1] Including ozone, photochemical aerosols, and other oxidant contaminants not listed separately.
[2] As ozone.
[3] 24-hour average, not to be exceeded over 1 percent of the days in any 3-month period.
[4] Not to be exceeded for more than 1 hour in any 5 consecutive days.
[5] 1-hour concentration, not to be equalled or exceeded 3 days consecutively or 7 days in any 90-day period (corrected for NO_2).

TABLE 6.—FLUORIDES AIR QUALITY STANDARDS

Political jurisdiction	Area type	Total fluorides (as F) [1]			HF [2]	HF				Gaseous fluorides (as F) in air			
		6-month maximum	2-month maximum	1-month maximum	24-hour maximum	1-month maximum	1-week maximum	24-hour maximum	12-hour maximum	1-month maximum	1-week maximum	24-hour maximum	12-hour maximum
New York State	Levels I–V	[3] 40	[3] 60	[3] 80						[4] 1.0	[4] 2.0	[4] 3.5	[4] 4.5
Pennsylvania					[5] 5								
Tennessee						[4] 1.5	[4] 2.0	[4] 3.5	[4] 4.5				
Kentucky		[3] 40	[3] 60	[3] 80		[4] 1	[4] 2	[4] 3.5	[4] 4.5				
Montana		(7)	(7)	(7)				[4] 1		[5] 0.3			
Wyoming		(7)	(7)	(7)				[4 6] 1		[5] 0.3			
Florida, Manatee County [8]													

[1] Dry weight basis in and on forage for consumption by grazing ruminants.
[2] Total soluble (as HF).
[3] Parts per million.
[4] Parts per barrel.
[5] μg./m^3.
[6] Total, as HF in air.
[7] 35 p.p.m. (averaging time not specified).
[8] 1.0 [4] above background, not to be exceeded.

TABLE 7.—LEAD AIR QUALITY STANDARDS

Political jurisdiction:	1-month maximum (µg./m.³)
Pennsylvania	5
New Mexico	10
Montana	5

TABLE 8.—BERYLLIUM AIR QUALITY STANDARDS

Political jurisdiction	Area type	1-month maximum (µg./m.³)
New York State	Levels I to V	0.01
Pennsylvania		.01
New Mexico		.01
Montana		.01

TABLE 9.—HYDROGEN SULFIDE AIR QUALITY STANDARDS (P.P.M.)

Political jurisdiction	Area type	24-hour maximum	1-hr. maximum	30 minutes			
				Maximum	0.83 percent	0.011 percent	0.027 percent
New York State	Levels I-V		0.10				
Pennsylvania		0.005	.10				
Kentucky			.10				
California			.03				
Minnesota					[1] 0.03	[1] 0.05	
Missouri-St. Louis						[2] .05	[3] 0.03
Missouri-Kansas City						[2] .05	[3] .03
New Mexico			.003				
Texas	Land use A and B			0.08			
Do	Land use C and D			.12			
Montana					[1] .03	[2] .05	
Wyoming					[1] .03	[2] .05	

[1] 30-minute average not to be exceeded over 2 times in any 5 consecutive days.
[2] 30-minute average not to be exceeded over 2 times per year.
[3] 30-minute average not to be exceeded more than 2 times in any 5 consecutive months.

TABLE 10.—SULFURIC ACID MIST AIR QUALITY STANDARDS (µg./m.³)

Political jurisdiction	Area type	Annual arithmetic mean	24 hours		12-hour, 3.3 percent	1 hour		
			Maximum	1 percent		Maximum	4.2 percent	1 percent
New York State	Levels I-V		[1] 0.10					
Minnesota		4		12				30
Arkansas					[2] 15	40		
Texas			20.0				[3] 80	
Idaho				[4] 12				[5] 30
Montana		4						
Wyoming		4		12				30

[1] Mg./m.³.
[2] 12-hour concentration not to be exceeded more than 2 times in any 30-pay period.
[3] During any 1-hour period of time, with no more than 1 such 1-hour period during any 24 hours.
[4] 24-hour average, not to be exceeded on more than 1 day in any 3 months.
[5] 1-hour average, not to be exceeded during more than 2 hours in any week.

TABLE 11.—COMPILATION OF PROPOSED AND/OR ADOPTED SULFUR DIOXIDE STANDARDS, MAY 15, 1970

[In micrograms per cubic meter]

Air quality control region	State	Standards due	Attained date and (notes)	Annual geometric mean (24 hour)	Annual arithmetic mean	24 hours: Maximum	24 hours: 10 percent	24 hours: 1 percent	1 hour: Maximum	1 hour: 1 percent	1 hour: 0.1 percent	5 minutes: 0.1 percent
Washington, D.C.	Virginia [1]	Nov. 10, 1969	[2] 1970	57				286				
Do	District of Columbia [1]	do	1973		75	285			860			
Do	do	do	1977		57	225			715			
Do	Maryland [1]	do	[3] 1973		86	286					572	1,430
Do	do	do	[3] 1977		43	143					286	715
Chicago	Illinois [1]	do	1972	43		486		286	1,201			
Co	Indiana [1]	do	1972		43	286			1,201			
Philadelphia	Delaware [1]	do	1975	72	86	373		287	860			
Do	Pennsylvania [1]	do		57		286			715			
Do	New Jersey [1]	do	(4)	49	57	286		229	715		572	
Denver	Colorado	May 17, 1970	(5)		25	150					300	
New York City	New York [1]	Nov. 10, 1969	[6] 1973		114	400		285	1,430	715		
Do	New Jersey [1]	do	(4)	49	57	286		229	715		572	
Do	Connecticut [1]	do		57		428		286	1,425			
Los Angeles	California [1]	do	(7)			114			1,430			
St. Louis	Missouri [1]	Jan. 6, 1970	(8)		57			286	1,030			
Do	Illinois [1]	do	1972	43		486		286	1,201			

TABLE II.—COMPILATION OF PROPOSED AND/OR ADOPTED SULFUR DIOXIDE STANDARDS, MAY 15, 1970—Continued

Air quality control region	State	Standards due	Attained date and (notes)	Averaging time and percentile: Annual geometric mean (24 hours)	Annual arithmetic mean	1-month maximum	3-day maximum	24 hours: Maximum	24 hours: 10 percent	24 hours: 1 percent	2-hours maximum	1 hour: Maximum	1 hour: 1 percent	1 hour: 0.1 percent	5 minutes 0.1 percent
Boston	Massachusetts [1]	Jan. 7, 1970	[9] 1975	73				300				800			
Buffalo	New York [1]	Jan. 26, 1970	[10] 1974		57			400		286		1,430	715		
Do	do	do	[11] 1974		114			400		286		1,430	715		
Pittsburgh	Pennsylvania [1]	do		57				286				715			
San Francisco	California [1]	do	(7)					114				1,430			
Cincinnati	Indiana [1]	Jan. 27, 1970	1975		43			286				1,201			
Do	Ohio [1]	do	[12] 1973		43					286		858			
Do	Kentucky [1]	do		57		143		286			858	1,201			
Cleveland	Ohio [1]	Feb. 17, 1970	[12] 1975		43					286		858			
Kansas City	Missouri [1]	Apr. 15, 1970	[12] 1969	43						215		1,001			
Do	Kansas [1]	do	(12)	43						215		1,001			
Minneapolis-St. Paul	Minnesota	May 13, 1970	(12)	57						286		715			
Baltimore	Maryland	do	[3] 1975		86			286						572	1,430
Do			[3] 1980		43			143						286	715
Indianapolis	Indiana	June 15, 1970		43				286				1,201			
Milwaukee	Wisconsin	do		72						286		1,201			
Hartford-Springfield	Connecticut	June 30, 1970		57				428		286		1,425			
Phoenix-Tucson	Arizona				57		138	286				1,430			

[1] Standards submitted to NAPCA for approval.

[2] 24-hour concentration not to be exceeded more than 10-percent of the time in any 30-day period, or not more than 1 percent of the time in 1 year.

[3] 1-hour concentration not to be exceeded more than once per calendar month; 5-minute concentration not to be exceeded more than twice per calendar week.

[4] 1-hour concentration may attain but not exceed 572 $\mu g./m.^3$ no more than 9 times during any consecutive 12-month period; 24-hour concentration may attain but not exceed 229 $\mu g./m.^3$ no more than 4 times during any consectuive 12-month period.

[5] 1-hour maximum arithmetic mean of 300 $\mu g./m.^3$ in any 24-hour period, and must not be exceeded more than once in any 1 month period.

[6] The annual arithmetic mean is to be achieved through implementation plans effective not later than January 1974.

[7] 24-hour maximum standard of 114 $\mu g./m.^3$ applicable only in locations where the ambient air quality standard for suspended particulate matter is exceeded.

[8] 24-hour concentration not to be exceeded over 1 dayin any 3-month period.

[9] The annual average value shall be the arithmetic average of 4 consecutive seasonal geometric means.

[10] Standards applicable to land use New York State levels I and II.

[11] Standards applicable to land use, New York State levels III and IV.

[12] Not to be exceeded on more than 1 24-hour period in any 3 consecutive calendar months.

TABLE 12.—COMPILATION OF PROPOSED AND/OR ADOPTED SUSPENDED PARTICULATE STANDARDS—MAY 15, 1970

[In micrograms per cubic meter]

Air quality control region and State	Standards due	Attainment date and (notes)	Averaging time and percentile: Ann. Geo. mean (24 hr.)	Ann. arith. mean	24 hr.: Max.	16 percent	10 percent	1 percent	1 hr. Max.
Washington, D.C.:									
Virginia*	Nov. 10, 1969	[1] 1970	60				100		
District of Columbia*	do	1973		75				160	
Do	do	1977		65				140	
Maryland	do	1973		75	160				
Do	do	1977		65	140				
Chicago:									
Illinois*	do	1972	75		260			200	
Indiana*	do	1972	75		260			200	
Philadelphia:									
Delaware*	do	1975	70		200				500
Pennsylvania*	do		65		195				
New Jersey	do		65		195				
Denver, Colo	May 7, 1970			55	180				
N.Y. City:									
New York*	Nov. 10, 1969	[2] 1973	45		250	70			
Do	do	[3] 1973	55		250	85			
Do	do	[4] 1973	65		250	100			
Do	do	[5] 1973	80		250	120			
New Jersey*	do		65		195				
Connect cut	do		70		210	105			
Los Angeles, Calif	do	(6)	60		100				
St. Louis:									
Missouri*	Jan. 6, 1970	(7)	75					200	
Illinois*	do	1972	75		260			200	
Boston, Mass.*	Jan. 7, 1970	[8] 1975	75		180				
Buffalo:									
New York*	Jan. 26, 1970	[2] 1974	45		250	70			
Do	do	[3] 1974	55		250	85			
Do	do	[4] 1974	65		250	100			
Do	do	[5] 1974	80		250	120			
Pittsburgh, Pa.*	do		65		195				
San Francisco, Calif.*	do	(6)	60		100				
Cincinnati:									
Indiana*	Jan. 27, 1970	1975	75		260			200	
Ohio*	do	[7] 1973	65		260			200	
Kentucky*	do		65		220			180	
Cleveland, Ohio*	Feb. 17, 1970	[7] 1975	65		260			200	
Kansas City:									
Missouri*	Apr. 15, 1970	(7)	60					150	
Kansas*	do	(7)	60					150	
Minneapolis-St. Paul, Minnesota.	May 13, 1970		75					200	
Baltimore, Md	do	1975		75	160				
		1980		65	140				
Indianapolis, Ind	June 15, 1970		75		260			200	
Milwaukee, Wis	do		75		260			200	
Hartford-Springfield, Conn	June 30, 1970		70		210	105			
Phoenix-Tucson, Ariz			80		100				

*Standards submitted to NAPCA for approval.

[1] 24-hour concentration not to be exceeded more than 10 percent of the time in any 30-day period.

[2] Standards applicable to Land Use, New York State level I category.

[3] Standards applicable to Land Use, New York State level II category.

[4] Standards applicable to Land Use, New York State level III category.

[5] Standards applicable to Land Use, New York State level IV category.

[6] An additional standard for visibility reducing particles states that the prevailing visibility, when relative humidity is less than 70 percent, is not to be reduced to 10 miles or less on 7 or more days in 90 consecutive days, or 3 or more consecutive days (based on 2 successive observations 1 hour apart).

[7] 24-hour concentration not to be exceeded over one day in any 3-month period.

[8] The annual average value shall be the arithmetic average of 4 consecutive seasonal geometric means.

Question 1. Section 210 of the Air Quality Act of 1967 provided for the registration of fuel additives. Would you provide the committee with a copy of the regulations proposed by the Department? Have these regulations been promulgated? If not, why not?

Answer. Proposed regulations for registration of gasoline additives were published in the Federal Register on July 30, 1969 (copy attached). The proposed regulations would have required manufacturers to furnish information not only on the purposes and amounts of additives used in gasoline but also any information available to them on emissions resulting from the use of such additives and on the health effects of such emissions. Manufacturers also would have been required to conduct research on emissions resulting from the use of additives and on the effects of such emissions: Fuel producers and additive manufacturers objected in part, to these requirements. The resulting controversy held up final publication of the regulations. It is anticipated that final regulations will be published shortly.

[From the Federal Register, July 30, 1969]

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE

[42 CFR Part 79]

REGISTRATION OF FUEL ADDITIVES

Notice of Proposed Rule Making

Notice is hereby given that the Secretary of Health, Education, and Welfare proposes to amend Title 42, Code of Federal Regulations, by adding a new Part 79, as set forth below, applicable to the registration of fuel additives pursuant to section 210 of the Clean Air Act (42 U.S.C. 1857f–6c).

The regulations will become effective upon republication.

Interested persons may submit written data, views or arguments in triplicate in regard to the proposed regulations to the Secretary of Health, Education, and Welfare, Attention: National Air Pollution Control Administration, 801 North Randolph Street, Arlington, Va. 22203. All relevant materials received not later than 30 days after publication of this notice will be considered.

Subpart A—General Provisions

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SUBPART A—GENERAL PROVISIONS

§ 79.1 Applicability.

The regulations of this part apply to the registration of fuel additives contained in fuels designated by the Secretary, pursuant to section 210 of the Clean Air Act, as amended (42 U.S.C. 1857f–6c).

§ 79.2 Definitions.

As used in this part:

(a) "Act" means the Clean Air Act, as amended (42 U.S.C. 1857 et seq.).

(b) "Secretary" means the Secretary of Health, Education, and Welfare.

(c) "Commissioner" means the Commissioner of the National Air Pollution Control Administration.

(d) "Fuel" means any material which is capable of releasing energy or power by combustion or other chemical or physical reaction.

(e) "Fuel manufacturer or processor" means any person who causes or directs the alteration of the chemical composition or the mixture of chemical compounds in a fuel designated in this part by adding to it an additive.

(f) "Additive" means any substance added to a fuel designated in this part which contains an element other than carbon and/or hydrogen, except:

(1) A catalyst used in manufacturing the fuel, but removed from the fuel before such fuel is sold, and

(2) A fuel designated in this part which contains only registered additives.

(g) "Additive manufacturer" means any person who produces or formulates an additive.

(h) "Range of concentration" means the highest weekly average concentration at any single processing or manufacturing plant, the lowest weekly average concentration at any single manufacturing or processing plant, and the average concentration at all manufacturing or processing plants.

(i) "Chemical composition" means the name and percentage by weight of any compound in an additive containing an element other than carbon or hydrogen and the name and percentage by weight of each element in the additive including carbon and hydrogen.

(j) "Chemical structure" means the molecular structure of any compound in an additive containing an element other than carbon or hydrogen.

§ 79.3 Confidentiality of information.

All information reported to or otherwise obtained by the Secretary or his representatives pursuant to this part, which information contains or relates to a trade secret or other matter referred to in section 1905 of title 18 of the United States Code, shall be considered confidential for the purpose of such section 1905, except that such information may be disclosed to other officers or employees of the United States concerned with carrying out this Act or when relevant in any proceeding under Title II of the Act. Nothing in this part shall authorize the withholding of information by the Secretary or any officer or employee under his control from the duly authorized committees of the Congress.

§ 79.4 Requirement of registration.

No manufacturer or processor of any fuel designated under this part may, after the date prescribed for such fuel in this part, deliver such fuel for introduction into interstate commerce or to another person who, it can reasonably be expected, will deliver such fuel for such introduction unless:

(a) For any additive contained in the fuel which does not appear on the list of registered additives maintained by the Commissioner pursuant to § 79.16, such fuel manufacturer or processor has provided the information and assurances required under § 79.11 and has received notice of the registration of such additive, and

(b) For any additive contained in the fuel which appears on the list of registered additives maintained by the Commissioner pursuant to § 79.16, such fuel manufacturer or processor, prior to or promptly upon initial use of such additive, provides the Commissioner with an assurance that he will submit the information and assurances required under § 79.11 within 30 days of such initial use.

§ 79.5 Reports of additive usage.

Each fuel manufacturer or processor shall, on April 1 and October 1 of each year, submit to the Commissioner a report of additive usage for each of the two quarterly periods comprising the 6-month period ending 1 month prior to the submission of such report. Each report shall show the range of concentration for any additive used during that quarter. Reports shall be submitted on forms which shall be supplied by the Commissioner upon request of the fuel manufacturer or processor.

SUBPART B—REGISTRATION PROCEDURES

§ 79.10 Notification by fuel manufacturer or processor.

Any manufacturer or processor of a deignated fuel who wishes to have an additive registered for use in such fuel shall, at least 120 days prior to (a) the date prescribed by the Secretary in Subpart D of this part, or (b) the date on which such fuel manufacturer or processor proposes to begin introducing a fuel containing such additive for delivery into interestate commerce or to another person who, it can reasonably be expected, will deliver such fuel for such introduction, whichever date is later, notify the Commissioner, National Air Pollution Control Administration, 411 West Chapel Hill Street, Durham, N.C. 27701, in accordance with § 79.11. Each notification shall be signed by the fuel manufacturer or processor or his agent, and shall be submitted on such forms as the Commissioner shall supply upon request.

§ 79.11 Information and assurances to be provided by the fuel manufacturer or processor.

Each notification submitted by the fuel manufacturer or processor shall include the following:

(a) The commercial identifying name of any additive to be used in a designated fuel subsequent to the date prescribed for such fuel in Subpart D of this part, and any other name used by the fuel manufacturer or processor to identify such additive;

(b) The name and address of the additive manufacturer of any additive named;

(c) The range of concentration of any additive named, as follows:

(1) In the case of an additive used in a designated fuel at any time during the period beginning with the date of designation of such fuel and ending with the submission date of notification under this subpart, the range of concentration for any two successive weeks within the period beginning with such date of designation and ending with such date of notification, and

(2) For any other additive, the expected range of concentration;

(d) The purpose in the use of any additive named, including:

(1) The function the additive is designed to perform, and

(2) Summaries of any information developed by or available to the fuel manufacturer or processor concerning the following:

(i) Mechanisms of reactions between the additive and the designated fuel.

(ii) The emissions which result directly from the use of the additive in the fuel and the effect of the additive on all other emissions, and

(iii) Toxicity or injurious effects of emission products resulting from the use of the additive in such fuel;

(e) Assurances that information of the type described in subdivisions (i) and (iii) of paragraph (d) (2) of this section which is developed by or becomes available to the fuel manufacturer or processor will be provided to the Commissioner on April 1 of each year;

(f) If complete information describing both the emissions which result directly from the use of the additive in the fuel and the effect of the additive on all other emissions is not included in the notification submitted for such additive pursuant to § 79.10, the fuel manufacturer or processor shall provide assurances that such information will be provided no later than 1 year from the date of such notification. Such information shall constitute a part of the fuel manufacturer's or processor's notification for such additive;

(g) Assurances that changes in information submitted pursuant to paragraphs (a), (b), and (d) (1) of this section will be provided to the Commissioner, within 30 days of such change. Forms for reporting changes will be provided by the Commissioner at the fuel manufacturer or processor's request;

(h) Assurance that the additive manufacturer will not represent diretcly or provided to the Commissioner; and

(i) Assurances that the fuel manufacturer or processor will not represent, directly or indirectly, in any notice, circular, letter, or other written communication, or any written, oral, or pictorial notice or other announcement in any publication or by radio or television, that registration of an additive contained in a fuel constitutes endorsement, certification, or approval of the fuel or additive by any agency of the United States.

§ 79.12 Action by the Commissioner.

Following receipt of the notification submitted by the fuel manufacturer or processor pursuant to § 79.11, the Commissioner shall, in writing, advise the manufacturer of any unregistered additive named in such notification to provide the information and assurances required by § 79.14. The Commissioner shall provide notification forms for the additive manufacturer's use.

§ 79.13 Notification by the additive manufacturer.

(a) Any additive manufacturer who has been advised by the Commissioner pursuant to § 79.12, shall file with the Commissioner, National Air Pollution Control Administration, 411 West Chapel Hill Street, Durham, N.C. 27701, a notification in accordance with § 79.14. A separate notification shall be submitted for each additive. Each notification shall be signed by the additive manufacturer or his agent.

(b) If an additive manufacturer who has been advised by the Commissioner pursuant to § 79.12 has not notified the Commissioner within 30 days after being advised pursuant to this subpart, the Commissioner shall inform any fuel manufacturer or processor concerned that the additive manufacturer's failure to notify the Commissioner will prevent registration of the additive.

(c) Any manufacturer of an additive designed for use in a fuel designated by the Secretary under Subpart D of this part may file with the Commissioner, National Air Pollution Control Administration, 411 West Chapel Hill Street, Durham, N.C. 27701, a notification in accordance with § 79.14. A separate notification, signed by the additive manufacturer or his agent, shall be submitted for each such additive.

(d) If, in the opinion of the Commissioner, such additive manufacturer has complied with the provisions of this part requiring the submission of information and the giving of assurances for any such additive, he shall provide such additive manufacturer with a letter acknowledging that compliance, and stating that registration of such additive may be accomplished at such time as any fuel manufacturer or processor complies with the notification requirements of § 79.10.

§ 79.14 Information and assurances to be provided by the additive manufacturer.

Each notification submitted by the additive manufacturer shall include the following:

(a) The recommended range of concentration of the additive;

(b) The recommended purpose in the use of the additive, including:

(1) The function such additive is designed to perform.

(2) Summaries of any information developed by or available to the additive manufacturer concerning the following:

(i) Mechanisms of reactions between the additive and the designated fuel.

(ii) The emissions which result directly from the use of the additive in the fuel and the effect of the additive on all other emissions, and

(iii) Toxicity or injurious effects of emission products resulting from the use of the additive in such fuel;

(c) The chemical composition of the additive;

(d) The chemical structure of such additive to the extent such information is available;

(e) Assurances that information of the type described in subdivisions (i) and (iii) of paragraph (b)(2) of this section which is developed by or becomes available to the additive manufacturer will be provided to the Commissioner on April 1 of each year;

(f) If complete information describing both the emissions which result directly from the use of the additive in the fuel and the effect of the additive on all other emissions is not included in the modification submitted for such additive pursuant to § 79.13, the additive manufacturer shall provide assurances that such information will be provided no later than 1 year from the date of such notification. Such information shall constitute a part of the additive manufacturer's notification for such additive;

(g) Assurances that any change in information submitted pursuant to paragraphs (a), (b)(1), (c), and (d) of § 79.14 will be provided to the Commissioner within 30 days of such change. Forms for reporting changes will be provided by the Commissioner at the additive manufacturer's request; and

(h) Assurance that the additive manufacturer will not represent directly or indirectly, in any notice, circular, letter or other written communication or any written, oral, or pictorial notice or other announcement in any publication or by radio or television that registration oof any additive produced or formulated by him constitutes endorsement, certification, or approval by any agency of the United States.

§ 79.15 Determination of noncompliance.

Whenever the Commissioner determines that there are deficiencies in a notification which constitute failure to comply with the regulations of this part, he shall inform the noncomplying fuel manufacturer or processor or noncomplying additive manufacturer of the reasons for such determination. In the case of a noncompliance by an additive manufacturer, the Commissioner shall also inform any fuel manufacturer or processor concerned of such determination.

§ 79.16 Registration.

(a) If, in the opinion of the Commissioner, the provisions of this part requiring the submission of information and the giving of assurances have been complied with for a particular additive, he shall register that additive and notify the additive manufacturer and each fuel manufacturer or processor concerned of such registration.

(b) The Commissioner shall maintain a list of registered additives, each identified by the name of the appropriate additive manufacturer, which he shall publish in the Code of Federal Regulations and keep current by publication in the FEDERAL REGISTER.

SUBPART C—WITHDRAWAL OF REGISTRATION

§ 79.20 Withdrawal of registration: fuel manufacturer or processor.

If the Commissioner determines that a fuel manufacturer or processor is not in compliance with the regulations of this part with respect to a registered additive, he may, after informing such noncomplying fuel manufacturer or processor of the reasons for such determination, and providing such noncomplying fuel manufacturer or processor a reasonable time in which to comply and/or to present his views concerning such determination, withdraw the registration of such additive for use in any designated fuel of such noncomplying fuel manufacturer or processor.

§ 79.21 Withdrawal of registration: additive manufacturer.

If the Commissioner determines that an additive manufacturer is not in compliance with the regulations of this part with respect to a registered additive, he may withdraw the registration of such additive and remove it from the list of registered additives maintained pursuant to § 79.16. Prior to withdrawing registration, the Commissioner shall:

(a) Inform such noncomplying additive manufacturer and all affected fuel manufacturers and processors of the reasons for such determination;

(b) Provide such noncomplying additive manufacturer a reasonable time in which to comply and/or to present his views concerning such determination; and

(c) Publish in the FEDERAL REGISTER a notice that he intends to withdraw registration, allowing interested persons 30 days in which to comment upon the intended withdrawal.

SUBPART D—DESIGNATION OF FUELS

§ 79.30 Scope.

Fuels designated and dates prescribed by the Secretary for the registration of fuel additives, pursuant to section 210 of the Act, are listed in this subpart. Additional fuels may be designated and additional dates prescribed as the Secretary deems advisable.

§ 79.31 Motor gasolines.

All fuels commonly or commercially known or sold as motor gasoline, with the exception of aviation gasoline, are hereby designated. All additives contained in such fuels must be registered by __________ (one hundred eighty (180) days following final publication of this notice).

Dated: July 24, 1969.

JOHN T. MIDDLETON,
Commissioner.

[F.R. Doc. 69-8866; Filed, July 29, 1969; 8:45 a.m.]

Question 2. Lacking the technical information that registration was intended to provide, what is the basis for the administration's request for the authority to set standards for fuel composition and additives?

Answer. A sufficient base of scientific and technical information is available to demonstrate the need for regulatory action with respect to motor vehicle fuel composition and fuel additives.

This is particularly true with respect to lead additives. Available data suggest that continued lead contamination of the environment is potentially perilous from the standpoint of concern for public health. The attached statement provides information on this subject.

In addition to the environmental and public health implications, the use of lead additives interferes with the application of various techniques for the control of emissions of other motor vehicle pollutants. Automobile manufacturers have indicated that techniques such as exhaust gas recirculation and devices such as catalytic converters and/or thermal reactors will have to be employed to bring motor vehicle emissions into compliance with national standards proposed for application in the 1973 model year (for nitrogen oxides) and the 1975 model year (nitrogen oxides, hydrocarbons, and carbon monoxide). The presence of lead in gasoline interferes, to one degree or another, with the application of such techniques and devices. Lead tends to reduce the effective life of the catalysts that might be used. Lead deposits in exhaust gas recirculation systems are a handicap. Lead and lead salts chemically attack the materials that might be used in thermal reactors. In addition, lead and other additives used to minimize the buildup of lead deposits in motor vehicle engines and the effects of such deposits on combustion account for a major share of particulate emissions from motor vehicles; the national standards proposed for the 1975 model year call for a 66-percent reduction of particulate emissions.

If S. 3466 is enacted, lead compounds are expected to be the first motor vehicle fuel additives to be subject to regulation. Regulations dealing with other additives and with fuel composition would be developed on the basis of information already available and/or additional information submitted to the Department of Health, Education, and Welfare under the provisions for registration of fuels and additives; it should be noted that S. 3466 not only would authorize regulatory action, but also would extend and amend the current authority for registration in such a way as to overcome problems encountered in the application of existing section 210 of the Clean Air Act.

EFFECTS OF LEAD ON HEALTH

The effects of lead in the environment have been a subject of concern to public health workers for more than 40 years. Traditionally, this concern has been focused on the effects of occupational exposures to lead, particularly among workers in lead industries, and on the consequences of ingestion of lead-based paints and other lead-containing materials, particularly among children. In other words, efforts have been focused on identifying and preventing situations which may result in the occurrence of classical lead poisoning.

Normal levels of lead in human blood (that is, meaning levels among persons who have no known occupational exposure) now lie in the range of 10 to 30 micrograms per 100 grams of blood. Symptoms of acute lead poisoning have been observed among persons with blood lead levels as low as 60 micrograms per 100 grams. A few relatively recent studies have indicated that there may be interference with the blood forming process in the human body even when blood lead levels are below what has generally been accepted as the threshold level for classical lead poisoning. It is likely that chronic or subclinical acute deleterious effects on the blood forming system and the nervous system may occur at blood lead levels below 60 micrograms per 100 grams.

The amount of lead in the human body has been found to reflect the amount of lead in the environment, and body burdens of lead, in general, have been found to increase with age. Human intake of lead directly from the air probably is less than the combined intake from food and beverages. It appears, however, that airborne lead has become increasingly important as a source of the lead present in food and water; while the traditional sources of lead contamination of food and water (for example, lead in water pipes and in insecticides) have largely disappeared, lead levels in food and water have not declined.

The impact of long-term exposure to the levels of lead present in urban air remains to be determined. On the basis of available knowledge, however, it appears that certain groups may be in high-risk categories, either because of their repeated exposure to the elevated levels of lead in the air in areas of heavy traffic (for example, police, taxi drivers), or because of age or various biomedical factors (for example, children, pregnant women, persons afflicted with blood diseases). Further research is needed to determine the effects of lead exposure on such groups.

The automobile is by far the major source of lead in the atmosphere. From 1961 to 1968, the amount of lead contained in gasoline increased from 261 million pounds to 434 million pounds. Annual emissions of lead into the air currently are about 200,000 tons. Of this total, 95 percent comes from the use of leaded gasoline. Air sampling data show that lead levels in the air in the average urban area generally are about 10 times higher than those in the average nonurban area. Available data also show that lead levels in the air are related to traffic density. For example, in a survey made in downtown Los Angeles midday lead levels were 10 micrograms per cubic meter, as compared to morning rush hour levels of 23 micrograms per cubic meter. Finally, a recent study showed that about 95 percent of the lead in motor vehicle exhaust is associated with particles having diameters below 0.5 microns. Particles in this size range have the greatest ability to penetrate deeply into the respiratory system and be retained and absorbed. Particles in this size range may also be a factor in climate modification.

Question 3. To what extent has the Department compiled and analyzed information on the effects of fuel additives on health and welfare?

Answer. In 1969, under a contract with the National Air Pollution Control Administration, the Environmental Systems Division of Litton Industries, Inc., prepared a series of technical reports on 27 air pollutants, including several substances known to occur in fuel additives; for example, barium, boron, manganese, and iron. Each report summarized available information on sources, ambient air levels, health and welfare effects, and techniques for preventing and controlling emissions. These reports were intended to provide a basis for scheduling air quality criteria development and for planning research activities.

With respect to lead, preparation of air quality criteria is underway, with publication scheduled for early 1971.

Productive research on the health and welfare effects of fuel additives depends, in large part, on the availability of information on the chemical composition of such additives and on the nature of emission products resulting from their use. In this connection it should be noted that S. 3466 proposes to amend section 210 of the Clean Air Act in such a way as to enable the Department to obtain information that it cannot require manufacturers to submit under the existing provisions.

Question 4. Please cite for the record any additives for which standards may be promulgated.

Answer. Under S. 3466, standards could be promulgated for fuels and fuel additives used in transportation. More specifically, standards could be promulgated for fuel additives which would "cause or contribute to emissions which would endanger the public health or welfare or impair the performance of any emission control device or system which is in general use or likely to be in general use."

Lead additives used in gasoline are expected to be the first additives for which standards would be promulgated. Establishment of standards for other additives would depend on evaluation of the extent to which their use endangers public health or welfare or could impair the performance of motor vehicle emission control systems. In many instances, the information needed for such evaluation is not now available. S. 3466 would modify the provisions of the Clean Air Act relating to registration of fuel additives in such a way as to enable the Department of Health, Education, and Welfare to obtain the needed information.

Question 5. If lead is banned from gasoline, what assurances are available that other toxic additives will not be used?

Answer. Enactment of S. 3466 would enable the Department of Health, Education, and Welfare to establish and enforce "standards respecting the composition or the chemical or physical properties of any fuel or fuel additive to assure that such fuel or fuel additive will not cause or contribute to emissions which would endanger the public health or welfare * * *"

PRESIDENT'S AIR QUALITY ADVISORY BOARD

Question 1. When has the President's Air Quality Advisory Board met?

Answer. The Board has met four times: In September 1968, April 1969, October 1969, and December 1969.

Question 2. What policies has the Board reviewed or recommended, if any?

Answer. The Board has discussed a number of matters relating to the Federal Government's policies and programs in the area of air pollution research and control. Following is a summary of all instances in which the Board has made specific recommendations:

(*a*) In October 1969, the Board expressed concern about the possible fragmentation of research and development activities relating to low-pollution motor vehicles and requested an opportunity to hear representatives of the Department of Health, Education, and Welfare and the Department of Transportation discuss their respective plans for such activities.

The requested presentations were made on December 12, 1969, following which the Board recommended that the program for development of unconventional, low-emission motor vehicles be funded through the Department of Health, Education, and Welfare, with the Department of Transportation's involvement to be supported through transfers of funds from the Department of Health, Education, and Welfare.

(*b*) In October 1969, the Board urged increased funding for research and development and regulatory activities relating to the prevention and control of air pollution and suggested that automobiles operated by Federal departments and agencies be defined as Federal facilities for the purpose of controlling air pollution, thus making them subject to action under Executive Order No. 11282. (Note: Executive Order No. 11507, issued in February 1970, defines such automobiles as Federal facilities.)

NOISE POLLUTION

Question 1. Is noise pollution a health problem?

Answer. Noise-induced hearing loss is believed to be the most serious physical health hazard posed by excessive noise, and such problems are prevalent in mechanized industry. Surveys in a cross-section of manufacturing, construction, mining, farming, and other occupations have found noise levels potentially harmful to hearing, and hearing studies on select worker groups exposed to such noise have shown them to have poorer hearing than those in quieter jobs (office workers). Estimates of the total number of production workers experiencing noise conditions hazardous to their health range from 6 million to 17 million; the true figure is unknown.

Community and home noise exposures, owing to their generally less severe nature, do not pose the same hazard of noise-induced hearing loss as is the case in industry. Yet it is now contended that exposures to the aggregate of noises characterizing life in a modern society—noises from mass transportation, arrays of household appliances, power tools, and hobbies and recreational activities—can cause some degree of hearing loss aside from that due to the work environment. The Bureau of Occupational Safety and Health, Environmental Health Service, has undertaken some pilot work in this area and is planning more formidable studies in fiscal year 1971. In particular, representative noise measurements will be made in recreational activities including sport flying, drag-strip racing or cycling, and rock-and-roll music playing and rated against criteria for safe exposures to noise. Hearing of participant groups will also be tested and compared with others of comparable age having minimal noise exposure. Evidence of significant noise-induced hearing loss here will seriously complicate judgments of industrial hearing loss and pose problems in defining "normal" hearing.

Whether excessive noise conditions can cause other physical or mental health disorders is not yet established. That noise can trigger changes in cardiovascular, endocrine, neurologic, and other physiologic functions, with correlated feelings of distress, is readily demonstrated. At issue is whether repeated noise-induced changes of this nature ultimately result in a disease process. Many noise experts believe that man's tolerance to noise is quite high and that most environmental noise conditions can be adapted to without ill effects. Yet there are others who maintain that the stressful effects of noise, alone, or together with other stress factors, can eventually overwhelm man's capability for healthy adjustment with resultant physical or mental health problems. Scattered evidence for both points of view exist but in point of fact crucial, systematic studies remain to be done in this problem area.

Question 2. If a separate noise abatement agency is established, should that agency be located in the Department of Health. Education, and Welfare?

Answer. Whether the responsibility for noise abatement activities should be centralized in a single department or agency and if so, which department or agency should have responsibility for such activities are issues presently under consideration within the executive branch. Although there are several possible organizational alternatives, if a noise abatement agency should be established, the Department of Health, Education, and Welfare would be one suitable location for it.

PERSONNEL AND STAFFING

Question 1. What were NAPCA's originally projected staffing requirements to implement the Air Quality Act of 1967?

Answer. In response to questions which the Subcommittee on Air and Water Pollution of the Senate Committee on Public Works asked in March 1967, it was indicated, for the record of hearings on S. 780, that the staff of the National Air Pollution Control Administration (then the National Center for Air Pollution Control) was projected to reach 1,900 in fiscal 1970.

Following enactment of the Air Quality Act of 1967, NAPCA submitted an estimate of 106 additional positions for fiscal 1968 in addition to the 1,116 already included in the fiscal 1968 budget. This estimate was included in a supplemental appropriations request to the Congress; however, no such appropriation was made.

Question 2. What are the currently projected staffing requirements for NAPCA?

Answer. The President's budget for fiscal 1971 provides for 1,141 positions for NAPCA. This figure represents an increase of 117 positions over NAPCA's estimated end-of-year employment in fiscal 1970.

Question 3. How does actual staffing since enactment of the Air Quality Act of 1967 compare with these projections?

Answer. NAPCA's actual end-of-year employment (full-time personnel) was 1,070 in fiscal 1968 and 1,065 in fiscal 1969. It is estimated that end-of-year employment in fiscal 1970 will not exceed 1,024.

Question 4. In tabular form, please indicate: (a) The number of persons presently employed; (b) the number of persons needed to fully implement existing law; and (c) the number of persons required to implement proposed legislation.

Answer. (*a*) As of May 1, 1970, NAPCA had 971 full-time, permanent employees on its staff; (*b*) as indicated above, the President's budget for fiscal 1971 provides for 117 additional positions for NAPCA. Naturally, the budget estimates submitted to the Congress reflect current fiscal constraints. In the absence of such constraints, a large number of additional positions could be requested and undoubtedly could be used to speed up implementation of the Clean Air Act. Exactly how many positions are needed for full implementation of the act depends, of course, on how "full implementation" is defined. Accordingly, no single figure can be cited as being representative of the manpower needed for full implementation; (*c*) it is estimated that approximately 200 additional positions would be needed to set in motion the new activities that would be authorized under S. 3466; most of these positions would be involved in regulation of fuels and additives, assembly line testing of motor vehicles, establishment of stationary source emission standards, and expanded Federal enforcement. To some extent, enactment of S. 3466 would result in personnel savings through discontinuation of designation of air quality control regions and by obviating the need for review of State air quality standards. On the other hand, the provisions for State adoption of implementation plans for all areas will necessitate increases in Federal financial and technical assistance to State agencies, air quality surveillance activities, and manpower development and training activities. Personnel needs associated with such increases in ongoing activities are not included in the above estimate of 200 additional positions.

GOVERNMENTAL EXPENDITURES

Question 1. What were NAPCA's originally projected funding requirements under sections 104 and 309 to implement the Air Quality Act of 1967?

Answer. In August 1967, funding requirements were projected for the administration bill then under consideration by the House Committee on Interstate and Foreign Commerce. An estimate of the requirements was submitted by the Department of Health, Education, and Welfare and was included in the record of the committee's hearings. It was estimated that a supplemental appropriation of $33 million for fiscal 1968 would be necessary to set in motion the new activities that would have been authorized by the administration bill.

Following enactment of the Air Quality Act in November 1967, NAPCA submitted a supplemental budget estimate of $23 million under section 104 and $2 million under section 109. These estimates were submitted to the Bureau of the Budget. In the supplemental appropriations request submitted to the Congress, the amount for air pollution control was reduced to $6,086,000. No supplemental appropriation was made.

Question 2. What are the projected funding levels for NAPCA through 1975?

Answer. The following table shows the amount included in the President's budget for fiscal 1971. The projection for fiscal 1975 is derived from long-range planning guides set forth by the Department of Health, Education, and Welfare in August 1969; more specifically, the $182 million figure is the sum allocated to NAPCA by the Environmental Health Service from a total planning allocation of $504 million for its programs (which, at that time, included the Food and Drug Administration). The amounts indicated for fiscal 1972–74 are NAPCA interpolations.

Fiscal Year:	*Amount*
1971	[1] 112,018,000
1972	154,030,000
1973	170,590,000
1974	177,590,000
1975	182,000,000

[1] Includes projected carryover of $6,015,000 under section 104.

Question 3. How do the following figures for sections 104 and 309 compare: (a) authorization, (b) departmental requested funds, (c) appropriations, (d) budget authority, and (e) actual expenditures?

Answer. The following table provides the requested information, except that it shows actual obligations instead of expenditures. Actual obligations represent commitments of money, for example, research and development contracts, awards of grants to State and local agencies, et cetera, and thus a better measure of program activity and program costs. Since there generally is a lag between obligations and expenditures (cash disbursements), the latter do not necessarily reflect actual program activity. Figures are in thousands of dollars.

	Authorization	Budget estimate to Congress	Appropriation	Budget authority	Actual obligations
1967	$46,000	$39,481	$40,061	$40,061	$35,814
Sec. 104					
Sec. 309	46,000	39,481	40,061	40,061	35,814
1968	109,000	70,271	64,185	64,174	61,667
Sec. 104	35,000				
Sec. 309	74,000		64,185	64,174	61,667
1969	185,000	106,733	88,733	88,448	80,174
Sec. 104	90,000	42,300	18,700	18,700	13,055
Sec. 309	95,000	64,433	70,033	69,748	67,119
1970	179,300	95,800	108,800	108,638	102,662
Sec. 104	45,000	21,900	45,000	45,000	37,880
Sec. 309	134,300	73,900	63,800	63,638	64,782
1971	(1)	106,003		106,003	(2) 112,018
Sec. 104		27,900		27,900	43,915
Sec. 309		78,103		78,103	68,103

1 Proposed Clean Air Act amendments pending.
2 Estimate includes unobligated balance brought forward to fiscal year 1971 of $6,015.

Question 4. The administration bill, S. 3466, provides that the authorization shall be "such sums as may be necessary" for fiscal years 1971–73 for both sections 104 and 309. At what level do you expect to request appropriations for sections 104 and 309? Please indicate the proposed allocation of the appropriation requests: low emission vehicle research, criteria development, control technology information development, regional designation, enforcement, and so forth.

Answer. The President's budget for fiscal 1971 already includes $27,900,000 in new obligational authority under section 104 and $78,103,000 in new obligational authority under section 309. Whether additional funds will be requested for implementation of S. 3466 during fiscal 1971 remains to be determined; whether such a request will be made, and, if so, how much will be requested, will depend on normal budgetary considerations and, among other things, on when the bill is enacted.

As for fiscal 1972–73, it is impossible to predict, at this time, the level of appropriations requests. Obviously, implementation of S. 3466 would necessitate increased Federal spending for air pollution control activities. Exactly how great an increase will be requested in the form of appropriations will depend not only on normal budgetary considerations but also on the extent to which NAPCA and State and local air pollution control agencies can make effective use of increased funds, on progress in defining technical problems and opening the way for productive research and development, on the adequacy of scientific knowledge needed in determining the degree of air quality improvement requisite for protection of public health and welfare, and so forth. In some areas of activity, substantial increases in funding are already planned: efforts to promote the development and production of low-pollution motor vehicles are a prime example. It is likely that there also will be increased expenditures for research and development in the area of sulfur oxides pollution control, particularly if private sector commitments to participate in supporting large-scale demonstration projects can be obtained.

Question 5. What has been the total annual Federal-State-local funding for air pollution control since the Air Quality Act, including the estimated fiscal 1970 and 1971 expenditures?

Answer. It is assumed that this question refers to expenditures for State, local, and regional air pollution control programs, including funds made available under section 105 of the Clean Air Act.

The following table shows Federal funds provided in the form of grants under section 105 and the amounts of State and local expenditures, including expenditures by agencies receiving Federal grant support and estimated expenditures by agencies not currently receiving such support. It should be noted that estimated expenditures by nongrantee agencies currently account for less than 5 percent of the amounts shown as State and local funds.

Fiscal year	State and local funds	Federal funds	Total
1968	$30,000,000	$18,647,000	$48,647,000
1969	36,000,000	22,702,000	58,702,000
1970 [1]	38,500,000	25,175,000	63,675,000
1971 [1]	44,000,000	28,800,000	72,800,000

[1] Estimated.

Question 6. Could you update individual State and local agency figures supplied the committee in 1967?

Answer. The attached list shows the level of Federal and non-Federal funding of State, local, and regional air pollution control programs as of January 1, 1970.

State	Federal Government support	Local contribution	Total program budget
Alabama:			
Jefferson County	0	$35,000	$35,000
Huntsville	$14,642	12,500	27,142
Alabama State	0	146,000	146,000
Mobile County	0	12,000	12,000
Alaska: Tri-Borough Air Resources	53,528	20,700	74,228
Arizona:			
Mericopa County	79,500	109,800	189,300
Pima County	52,500	29,000	81,500
Arizona State	181,978	103,700	285,678
Arkansas: Arkansas State	48,934	43,667	92,601
California:			
Los Angeles County	630,302	3,952,139	4,582,441
San Bernardino County	0	304,000	304,000
Bay Area APCD	209,300	1,285,000	1,494,300
California State	793,641	1,924,237	2,717,878
Monterey and Santa Cruz	48,352	33,060	81,412
Ventura County	69,215	23,075	92,290
Humboldt County	52,035	17,345	69,380
Orange County	50,000	173,584	223,584
Riverside County	114,000	138,500	252,500
Sacramento	31,723	41,653	73,376
San Diego	63,762	76,812	140,574

State	Federal Government support	Local contribution	Total program budget
Colorado:			
City and County of Denver	$218,700	$186,674	$405,374
Tri-County Health Department	65,280	39,350	104,630
Colorado State	128,972	109,739	238,711
Jefferson County	0	10,761	10,761
Pueblo city-county	28,450	19,243	47,693
Boulder city-county	7,866	8,932	16,798
Colorado Springs	21,209	7,070	28,279
Weld County	17,319	5,773	23,092
Mesa County	11,894	4,000	15,894
Connecticut:			
Connecticut State	199,794	102,826	302,620
Bridgeport	40,000	20,000	60,000
Fairfield	4,170	12,559	17,729
Stratford	10,557	15,735	26,292
New Haven	46,000	57,870	103,870
Stamford	39,695	20,312	60,007
Greenwich	11,200	14,463	25,663
Norwalk	20,000	10,000	30,000
Milford	17,278	8,639	25,917
Meriden Health Department	20,000	10,000	30,000
Delaware: Delaware State	248,670	148,330	397,000
District of Columbia	213,382	106,691	320,073
Florida:			
Dade County	188,227	110,048	298,275
Palm Beach County	58,063	31,239	89,302
Manatee County	0	39,374	39,374
Hillsborough County	47,238	42,969	90,207
Florida State	134,493	387,477	521,970
City of Jacksonville (Dec. 1, 1969, awarded)	60,264	86,307	146,571
Georgia:			
Georgia State	181,484	129,792	311,276
Fulton County	111,150	44,474	155,624
Macon-Bibb County	10,553	6,613	17,166
Chatham County	13,189	10,896	24,0[illegible]5
Hawaii: Hawaii State	0	51,680	51,680
Idaho: Idaho State	46,288	37,072	83,360
Illinois:			
Chicago, Ill	1,105,050	1,478,160	2,583,210
Cook County	0	440,459	440,459
Illinois State	286,000	521,000	807,000
Indiana:			
Indiana State	86,540	87,930	174,470
East Chicago, Ind	22,620	38,795	61,415
Gary, Ind	55,073	70,957	126,030
Evansville, Ind	12,400	28,320	40,720
Indianapolis, Ind	103,100	122,945	226,045
Michigan City, Ind	3,200	14,710	17,910
Hammond, Ind	30,000	37,592	67,592
Vigo County	7,650	11,650	19,300
St. Joseph's County	27,400	11,533	38,933
Lake County	21,100	16,500	37,600
Iowa:			
Des Moines	32,931	10,977	43,908
Linn County	24,290	17,546	41,836
Black Hawk County	29,400	9,800	39,200
Kansas: Kansas City, Wyandotte County	68,300	31,800	100,100
Kansas State	58,264	29,132	87,396
Kentucky:			
Kentucky State	220,370	110,185	330,555
Jefferson County	95,955	31,985	127,940
Louisiana: Louisiana State	120,000	106,027	226,027
Maine: Maine State	54,000	27,000	81,000
Maryland:			
Prince Georges County	89,993	37,895	127,888
Montgomery County	140,000	56,667	196,667
Maryland State	702,326	516,000	1,218,326
Anne Arundel County	79,076	96,180	175,256
Baltimore County	175,440	87,720	263,160
Allegany County	18,811	11,708	30,519
Baltimore city	267,456	175,977	443,433
Frederick County	9,305	4,345	13,650
Massachusetts:			
Worcester	21,500	30,389	51,889
Boston metropolitan area	156,000	124,000	280,000
Springfield metropolitan area	63,000	42,000	105,000
Fitchburg	10,000	12,227	22,227
Massachusetts State	165,500	115,750	281,250
Michigan:			
Muskegon County	9,696	11,855	21,551
Wayne County	1,107,795	437,029	1,554,824
Michigan State	174,544	178,755	353,299
Grand Rapids	19,034	20,347	39,381
City of Flint	25,126	13,564	38,690

State	Federal Government support	Local contribution	Total program budget
Minnesota:			
St. Paul	$65, 864	$66, 940	$132, 804
Minneapolis	54, 000	54, 468	108, 468
Minnesota State	200, 000	100, 000	300, 000
St. Louis County	28, 545	9, 515	38, 060
Olmstead County	17, 786	5, 929	23, 715
St. Cloud	20, 508	14, 794	35, 302
Mississippi:			
Meridian	0	10, 000	10, 000
Mississippi State	44, 000	23, 000	67, 000
Missouri:			
St. Louis County	218, 883	119, 104	337, 987
St. Louis (city)	219, 972	220, 034	440, 006
Missouri State	165, 232	129, 901	295, 133
Greene County	17, 046	25, 630	42, 676
Kansas City	93, 704	48, 483	142, 187
Independence	17, 533	12, 612	30, 145
Montana			
Montana State	64, 622	54, 748	119, 370
Missoula City-County	27, 342	19, 024	46, 376
Great Falls City-County	12, 525	4, 250	16, 775
Billings	23, 400	7, 800	31, 200
Nebraska: Lincoln-Lancaster County	30, 000	15, 000	45, 000
Nevada:			
Reno-Sparks-Washoe County	44, 652	62, 500	107, 152
Clark County District	92, 698	93, 980	186, 678
Nevada State	19, 508	9, 754	29, 262
New Hampshire: New Hampshire State	32, 000	33, 948	65, 948
New Jersey:			
New Jersey State	850, 000	849, 763	1, 699, 763
West Orange (suburban Essex)	58, 869	19, 623	78, 492
Elizabeth	37, 938	21, 619	59, 557
New Mexico:			
New Mexico State	30, 000	25, 100	55, 100
Albuquerque	47, 786	31, 858	79, 644
New York:			
New Rochelle	0	3, 850	3, 850
Erie County	210, 500	205, 166	415, 666
Broome County	0	1, 850	1, 850
Dutchess County	0	15, 000	15, 000
Chemung County	0	10, 000	10, 000
Nassau County	155, 000	299, 142	454, 142
Schenectady	0	13, 000	13, 000
Albany County	0	20, 000	20, 000
Yonkers	0	13, 000	13, 000
Columbia County	0	4, 000	4, 000
Niagara	69, 260	68, 087	137, 347
New York City	814, 000	3, 921, 787	4, 735, 787
New York State	676, 172	2, 950, 988	3, 627, 160
Westchester County	33, 485	20, 404	53, 889
Rensselaer County	0	20, 000	20, 000
Suffolk County Department of Health	65, 764	36, 774	102, 538
Ulster County Department of Health	0	15, 000	15, 000
Qnondaga County Department of Health	63, 210	66, 200	129, 410
Rockland County Health Department	37, 041	12, 348	49, 389
Monroe County Health Department	70, 000	71, 737	141, 737
North Carolina:			
Guilford County	15, 184	13, 589	28, 773
Durham County	16, 217	10, 605	26, 822
Buncombe County	54, 750	26, 918	81, 668
Rowan County	13, 932	12, 703	26, 635
New Hanover	0	4, 200	4, 200
Gaston County	16, 200	15, 400	31, 600
Mecklenburg	108, 690	66, 230	174, 920
Craven County	0	14, 300	14, 300
Cleveland County	28, 081	15, 795	43, 876
State of North Carolina	109, 000	54, 500	163, 500
Catawba-Lincoln County	35, 771	12, 019	47, 790
Forsyth County	56, 112	18, 704	74, 816
North Dakota: North Dakota State	15, 000	12, 660	27, 660
Ohio:			
Lorain	17, 770	16, 899	34, 669
Akron	67, 000	81, 304	148, 304
Toledo	72, 591	72, 491	145, 082
Cleveland	221, 904	424, 877	646, 781
Canton	39, 998	37, 702	77, 700
Steubenville	13, 000	16, 500	29, 500
Portsmouth	16, 718	16, 910	33, 628
Cincinnati	36, 100	144, 527	180, 627
City of Ironton	15, 054	7, 527	22, 581
Montgomery County-Dayton	90, 000	57, 000	147, 000
Ohio State	100, 000	152, 570	252, 570
Lake County	30, 000	10, 500	40, 500

State	Federal Government support	Local contribution	Total program budget
Oklahoma:			
Oklahoma State	$52,112	$61,402	$113,514
Tulsa City-County	38,157	22,262	60,419
Oregon:			
Oregon State	105,494	225,000	330,494
Lane County	77,283	69,700	146,983
Mid-Willamette Valley	102,404	34,500	136,904
Columbia-Willamette	272,250	90,750	363,000
Pennsylvania:			
Pennsylvania State	669,222	706,031	1,375,253
Philadelphia	597,143	298,572	895,715
Allegheny County	309,672	309,193	618,865
York	12,000	8,000	20,000
Lehigh Valley	12,600	9,800	22,400
Rhode Island: Rhode Island State	114,239	69,585	183,824
South Carolina:			
Spartanburg	8,350	15,527	23,877
South Carolina State	115,664	102,713	218,377
Charleston County	60,000	28,489	88,489
Greenville County	31,978	10,816	42,794
Columbia	8,365	8,122	16,487
South Dakota	0	0	0
Tennessee:			
Chattanooga	77,985	143,594	221,579
Tennessee State	218,074	117,990	336,064
Nashville-Davidson County	90,000	36,500	126,500
Memphis-Shelby County	86,613	28,871	115,484
Knox County	30,000	10,000	40,000
Texas:			
Texas State	329,714	238,717	568,431
Dallas	79,250	73,925	153,175
Lubbock City-County	16,344	10,610	26,954
Houston	287,916	197,010	484,926
San Antonio	111,557	37,186	148,743
Galveston County	78,000	26,000	104,000
El Paso City-County	33,532	12,243	45,775
Laredo-Webb County	24,000	8,000	32,000
Fort Worth	60,823	38,374	99,197
Jefferson County	53,829	18,782	72,611
Pasadena	23,000	11,500	34,500
Corpus Christi-Nueces County	30,100	12,700	50,800
Utah: Utah State	123,240	80,362	203,602
Vermont: Vermont State	21,256	14,697	35,953
Virginia:			
Roanoke County	15,099	12,000	27,099
Richmond	25,000	12,500	37,500
Virginia State	73,858	74,678	148,536
Fairfax County	70,167	29,135	99,302
Alexandria	46,890	23,445	70,335
Washington:			
Puget Sound	548,100	183,000	731,100
Northwest APC Authority	69,999	27,500	97,499
Southwest APC Authority	76,214	36,500	112,714
Spokane County	23,103	11,310	34,413
Yakima County	25,755	8,585	34,340
Olympic	69,111	23,000	92,111
Washington State	340,000	691,000	1,031,000
West Virginia:			
Wheeling	13,392	6,696	20,088
West Virginia State	124,572	103,286	227,858
Wisconsin:			
Milwaukee County	0	288,736	288,736
Wisconsin State	50,000	30,400	80,400
Beloit	6,800	3,550	10,350
Wyoming: Wyoming State	16,000	9,370	25,370
Guam	0	0	0
Puerto Rico: Puerto Rico	144,346	72,173	216,519
Virgin Islands: Virgin Islands	30,000	15,000	45,000
Total	22,470,531	31,547,938	54,018,469