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DEVELOPMENT PLAN
FOR
REGULATION OF BENZENE EMISSIONS
UNDER SECTION 112 OF THE CLEAN AIR ACT
AND OTHER APPROPRIATE STATUTES

I. Purpose and Background

On June 8, 1977, the Agency published in the Federal Register its decision to list benzene as a hazardous air pollutant under Section 112 of the Clean Air Act (CAA). As indicated in the notice, an intensive health risk analysis will be conducted with full public participation. Upon completion of this assessment, a determination will be made as to which sources of benzene emissions must be controlled and the extent of control required.

Benzene is an organic chemical known to cause or contribute to adverse health effects at high levels of exposure. Scientific reports strongly suggest an increased incidence of leukemia in workers exposed to benzene. In response to these data, the National Institute of Occupational Safety and Health recommended to the Department of Labor in September of 1976 that current occupational standards for benzene be tightened considerably. In April 1977, NIOSH published a study indicating high levels of leukemia in workers exposed to benzene alone. This was the first study of its kind implicating benzene alone in the workplace as the potential cause of observed leukemia. Subsequently, the Occupational Safety and Health Administration (OSHA) on May 27, 1977, issued emergency temporary standards for workplace exposures.

The observed levels of benzene in the workplace where increased incidences of leukemia have resulted are considerably higher than those levels present in ambient air. However, in proximity to certain sources the public may be

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exposed to excessive ambient levels on a continuous basis while workplace exposures are essentially 8 hours per day, 5 days per week. Thus, considerable uncertainty exists regarding the significance of observed ambient levels. As a result of this uncertainty, EPA will undertake an intensive study of the potential risk at ambient levels about sources of atmospheric benzene before proposing regulations. This health risk assessment will be subject to review by the public and the Science Advisory Board (SAB). Following the completion of that review, and upon completion of the final document, EPA will announce which sources will be controlled and the extent of control which will be required. The schedule for completion of these key activities calls for a draft health risk assessment to be available for public review by mid-September with a final document scheduled for release by November, 1977.

Decision to List Benzene

The decision to list benzene as a hazardous air pollutant under Section 112 (b)(1)(A) was the result of an accumulation of evidence that exposure to benzene is related to an increased incidence of leukemia in humans. Leukemia is a type of cancer which is a "serious irreversible or incapacitating reversible illness." Since benzene exposures have been shown to result in an increased incidence of leukemia and since no ambient air quality standard has been promulgated for it, benzene clearly satisfies the criteria for a hazardous air pollutant as defined in Section 112 (a)(1) of the Clean Air Act, as amended, June 1974.

Listing benzene as a hazardous air pollutant under Section 112 will result in more expeditious control than would implementation of Sections 108, 109, and 111 which allow substantially more time to effect emission reductions. Also, the decision to list under Section 112 and not Sections 108 or 109 is supported by the strong suspicion that emissions from certain sources represent a potentially greater risk to public health than from emissions of other sources; Section 112 allows control measures to address these specific sources directly and expeditiously.

As indicated in the Federal Register notice of June 8, previous Agency experience with regulation of vinyl chloride suggests that the required 180 days from listing of the compound to date of proposed regulations will not be feasible. More than 180 days will be required.

II. Regulatory Alternatives

EPA has a wide range of regulatory authorities which could be used in place of or in addition to Section 112. The Toxic Substances Control Act (TSCA) is being considered for possible regulation of the benzene content of gasoline and as a way to prohibit the use of benzene in consumer products and industrial chemicals. An issue paper dealing with TSCA use will be developed by SASD early in the regulatory program.

In addition, certain sources which do not warrant the development of 112 regulations will be given high priority in developing 111 regulations. For example, EPA's current program to develop New Source Performance Standards for chemical manufacturing facilities will also evaluate those benzene sources which may be potential candidates for 112 regulations; where applicable, supporting information for NESHAPS will be documented.

III. Health Risk Assessment

The health risk assessment for which ORD has responsibility will be the cornerstone of the Agency's regulatory decisions regarding which sources to control and the extent of control needed. Basically, this assessment will provide estimates of the total incidence of leukemia which could be expected to result from benzene emissions from specific sources at specific locations as well as aggregate sources (i.e., all petroleum refineries). Additionally, estimates will be developed regarding implications of the use of control technology to reducing incidence. From these two types of estimates, a priority will be assigned to each source category.

To estimate incidences of leukemia, essentially three pieces of information will be needed. They are:

1. Benzene concentrations in the vicinity of sources,
2. Estimates of the population living in the vicinity of the sources, and
3. A risk rate coefficient which relates leukemia incidence to benzene exposure levels.

Items 1 and 2 are being developed by Stanford Research Institute (SRI) in conjunction with SASD. A draft of these estimates was submitted to EPA on July 29, 1977, and has been reviewed internally with a final scheduled to be completed by early September. Item 3, the risk rate coefficients, are being developed by ORD's Cancer Assessment Group (CAG). The CAG's coefficients are to be applied to SRI exposure estimates to obtain total incidence. A draft of this integrated estimate is scheduled to be available for review by EPA's Science Advisory Board and the interested public by mid-September. Incorporated in the draft will be a review of the toxicity of benzene inhalation being conducted by Dr. Leonard Goldstein of New York University.

Following review and comment, a final report will be made available to the public by November 1977. By mid-December 1977, recommendations will have been made as to which sources of benzene emissions should be controlled and the extent of control needed to reduce incidences to acceptable levels.

IV. Methodology

A report of benzene emissions has been prepared by PEDCo. The report indicates that benzene emissions can be grouped into seven major source categories: (1) motor vehicles, principally gasoline fueled; (2) gasoline marketing; (3) storage of gasoline, crude oil, benzene, and benzene-rich liquids; (4) petroleum refineries and other petroleum-related benzene production facilities; (5) coke ovens; (6) organic chemical manufacture; and (7) industrial solvent usage. Section 112 (NESHAPS) of the Clean Air Act will be the principal vehicle for controlling stationary sources, however, the TSCA or possibly Section 211 of the CAA (fuel additive regulations) may be a more appropriate vehicle for preventing benzene emissions from solvent evaporation and gasoline marketing. Where it is necessary to control only new sources, Section 111 (NSPS) may be an effective vehicle. For mobile and stationary sources, it will be necessary to confirm the magnitude of reported emissions as well as the effectiveness of control devices in removing benzene. OSHA regulations governing the workplace are expected to reduce the health risk to the general public, possibly obviating the need for EPA regulations in some instances.

Until the health risk assessment is completed, it won't be possible to discount any significant source. Each area will be investigated until such time as it is shown that it does not present a significant health risk.

Mobile Sources

Gasoline-powered motor vehicles are estimated to represent about 80 percent of current benzene emissions; the bulk of this total is released from the tail pipe, the remainder from evaporative losses. Though they are the largest sources both in terms of numbers as well as total emissions, their resulting impact on atmospheric levels because of being so geographically dispersed, is considered to be significantly smaller than many other sources of benzene. Recent modeling for Center City and highway benzene concentrations using a variety of scenarios most favorable to atmospheric loading demonstrate that the impacts of benzene from motor vehicles are generally much lower than from certain stationary sources.

Diesel-powered motor vehicles are not believed to be a large source of benzene.

Available information suggests that oxidation catalysts provide 50 to 90 percent reductions in tail pipe benzene. Thus, the replacement of older models with catalyst-equipped vehicles should reduce benzene emissions but the increment is uncertain as is the resultant health risk. The effectiveness of exhaust controls should be quantified with consideration given to any anticipated modifications in catalysts, engine designs and gasoline composition. Evaporation controls also should be analyzed for benzene effectiveness.

It has been postulated that most of the tail pipe benzene results from benzene itself in the gasoline. However, tail pipe benzene also could be the product of dealkylation of toluene and other aromatic hydrocarbons and from reactions of other fuel components. As a result of removing tetraethyl lead from gasoline, it is expected that the aromatics including benzene will increase over current levels. If catalysts and/or other tail gas technologies are effective in oxidizing benzene, increases in fuel aromatics may not be

important. The point has to be investigated.

Depending on results of these investigations, several courses of action are possible: (1) no action if current tail pipe and evaporative technologies are effective for benzene; (2) modifications of tail pipe and/or evaporative control programs if investigations show that modifications are practicable and necessary to protect the public health; (3) establishing limits for benzene in gasoline through TSCA or fuel additives regulations; and (4) limiting the content of benzene-forming aromatics in gasoline motor fuels either through TSCA or fuel additives regulations.

A decision to limit benzene or total aromatics in gasoline will impact on EPA actions to control the storage and marketing of gasoline.

Gasoline Marketing

Benzene emissions from the several transfer points in the gasoline marketing chain are less than one percent of nationwide emissions, however, the exposure levels at terminals and service stations may represent a significant health risk. Consideration will be given to two alternatives; namely, limiting benzene levels in gasoline and controlling transfer points in the marketing chain. As differentiated from the motor vehicle program, this effort would be concerned only with benzene, not with other aromatics which might form benzene in the engine.

A contract study is being initiated to analyze the cost and technical feasibility of removing benzene from gasoline blending stocks. At the same time, available control technology is being reviewed for the major marketing emission sources which are bulk terminals, bulk plants, and service stations (tank loading and vehicle fueling). The two alternatives will be evaluated in light of the respective health risk assessment.

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Guidance documents for marketing and storage facilities are being prepared to assist States in oxidant control programs. Under these programs, regulations are being promulgated; in some instances, controls are already being operated. While designed for total hydrocarbons, the controls will also reduce benzene emissions.

Storage

Estimated benzene emissions from the storage of gasoline and benzene are less than 0.2 percent of the nationwide total. Losses from crude oil storage and transport are virtually unknown. OAQPS has promulgated new source performance standards for the storage of gasoline, crude and other petroleum liquids of greater than 1.5 psia vapor pressure. Many States have incorporated similar requirements in SIP's. OAQPS is currently reviewing the storage tank NSPS and plans to propose a revision in late 1977 which would reduce emissions of all hydrocarbons including benzene. An evaluation will be conducted to determine the benzene effectiveness of current and improved control techniques for gasoline and crude storage tanks. In the case of gasoline, it may be preferable to limit benzene levels through TSCA or Section 211 rather than NESHAPS. For crude oil storage the need for Section 112 standards would be expected to hinge on benzene levels.

For the storage of benzene and benzene-rich liquids, OAQPS will evaluate pressurized tanks, and vapor recovery equipment which has been used with toxic liquids to some degree. It would appear probable that regulations for the storage of benzene and benzene-rich liquids will be promulgated under Section 112.

Petroleum Refineries and Related Benzene Production Facilities

The bulk of our current benzene supply is extracted from refinery reformer streams. Benzene is also present in other refinery process streams, most of which are gasoline blending components. Principal processing facilities will be reviewed

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with the aim of establishing Section 112 standards for emission points as well as fugitive sources (pumps, valves, etc.) and waste disposal. Section 112 standards will be needed for the transfer and handling of benzene, particularly the loading of trucks, barges, and rail cars.

Coke Ovens

Under a separate development plan, Section 112 standards are planned for coke ovens. These will apply to carcinogenic emissions which include benzene as well as other organic pollutants; they are expected to obviate the need for specific benzene NESHAPS.

Organic Chemical Manufacture

Large quantities of benzene are used as a raw material in the manufacture of organic chemicals such as maleic anhydride, ethylbenzene, nitrobenzene, cyclohexane, chlorobenzenes and others. Benzene is emitted principally from reactor exhaust vents, as fugitive leaks and during storage and handling operations. Control already has been accomplished to some degree through State and local regulation, and because benzene is a valuable commodity.

A fundamental part of EPA's benzene effort was initiated in March 1977 as the Synthetic Organic Chemical Manufacturing Industry Study. This is a three year study to develop control technology guidelines and new source performance standards for the synthetic organic chemical manufacturing industry. Available control technologies are to be identified for major vents, sources of fugitive emissions, storage and handling operations, and secondary sources of emissions such as waste disposal. Regulations for volatile organics (oxidant precursors) will likely require add-on control devices for process vents, process changes to reduce or eliminate those vents, and equipment and

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operating procedure changes to minimize losses of benzene. All of the processes which are suspect major benzene emitters are included in the initial portion of the study. Thus, all major benzene using processes are now or will shortly be under investigation. These findings will be used to develop Section 112 standards where appropriate.

Solvent Usage

Available information indicates that much of the solvent benzene in surface coatings, rubber and plastics manufacture, and pharmaceutical preparation has already been reduced by voluntary actions of users. OSHA has proposed a limit of 1 percent benzene for solvents used in the workplace, dropping to 0.1 percent after one year. Testimony at recent OSHA hearings indicated that the 0.1 percent level may not be practicable. OAQPS will investigate principal users of benzene or solvents in which benzene appears as a major constituent. Should the OSHA limits be promulgated, it is quite possible that no further action by EPA will be necessary to protect the public health. Close coordination with OSHA will be established and solvent usage outside the workplace will be investigated.

The Consumer Products Safety Commission has been petitioned to limit benzene levels in consumer products. Should this agency take action under the Federal Hazardous Products Act, EPA regulations in the area may not be necessary. EPA could limit benzene levels in consumer products under TSCA.

In summary, it is not anticipated at this time that Section 112 standards will be necessary or appropriate for many users of industrial solvents.

V. Internal Participation

Intra-agency coordination will be achieved through a Working Group which will include representatives of affected programs. In addition to the Working Group, close coordination will be maintained between the lead office, OAQPS,

and key programs. Because of its occupational health program for benzene, OSHA will be requested to participate in the Working Group. Invitations will also be tendered to CPSC, NIOSH, and FDA all of which have interest in benzene emissions.

A. Working Group

1. OAWM

a. OAQPS

(1) SASD - lead office - health risk assessment, coordination of mobile source aspects and OSHA coordination.

(2) ESED - lead office - regulation development and promulgation.

(3) MDAD - modeling and statistical evaluation.

(4) CPDD - implementation guidance.

b. MSAPC - Support re mobile source emissions.

2. OTS - Interface and if necessary prepare regulations governing benzene levels in solvents and gasoline.

3. Department of Labor/OSHA - Interagency coordination.

4. DHEW/National Institute of Occupational Safety and Health - Interagency cooperation.

5. Consumer Products Safety Commission - Interagency cooperation.

6. Food and Drug Administration - Interagency cooperation.

7. ORD

a. IERL - technology development and source assessment.

b. OHEE - health risk information.

c. EMSL - measurements and instruments.

d. ESRL - atmospheric chemistry.

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8. OWHM
EGD - interface effluent guidelines.
9. OE - representative.
10. OPE - representative.
11. OFA - representative.
12. OGC - representative.
13. Region III - representative.
14. Region VI - representative.
15. Region IX - representative.
16. ORIO - representative.
17. OPA - representative.

B. Other Coordination

Outside the Working Group, close coordination will be maintained between OAQPS elements, ORD, and OTS in preparing the HRA. In the development of standards, OAQPS will work closely with OSHA, NIOSH, CPSC, and FDA and will interface with OTS and MSAPC to the extent that other types of standards besides

