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Benzene Emissions from Coke By-Product Recovery Plants, Benzene Storage Vessels, Equipment Leaks, and Ethylbenzene/ Styrene Process Vents - Background Information and Responses to Technical Comments for 1989 Final Decisions

Emissions Standards Division

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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ENVIRONMENTAL PROTECTION AGENCY

Benzene Emissions from Ethylbenzene/Styrene Process Vents, Benzene Storage Vessels, Equipment Leaks, and Coke By-Product Recovery Plants - Background Information and Responses to Technical Comments for 1989 Final Decisions, and Final Environmental Impact Statement

8/31/89
(Date)

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1. Final decisions have been made on regulation of benzene emissions from existing and new coke by-product recovery plants, benzene storage vessels, equipment leaks, and ethylbenzene/styrene process vents. These decisions implement Section 112 of the Clean Air Act and are based on the Administrator's determination of June 8, 1977 (42 FR 29332), that benzene presents a significant risk to human health as a result of air emissions from one or more stationary source categories, and is therefore a hazardous air pollutant. Regions II, III, IV, V, and VI will be the most affected, because most of the facilities subject to the regulations are located in those regions.

2. Copies of this document have been sent to the following Federal Departments: Health and Human Services, Defense, Transportation, Agriculture, Commerce, Interior, and Energy; the Council on Environmental Quality; members of the State and Territorial Air Pollution Program Administrators; the Association of Local Air Pollution Control Officials; EPA Regional Headquarters; and other interested parties.

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1.0 INTRODUCTION

This background information document (BID) contains information about the U. S. Environmental Protection Agency's (EPA) final actions regarding the proposed standards for benzene emissions from ethylbenzene/styrene (EB/S) process vents, benzene storage vessels, benzene equipment leaks, and coke by-product recovery plants. On July 28, 1988, EPA proposed national emission standards for benzene emissions from these four source categories under authority of Section 112 of the Clean Air Act (CAA). Public comments were requested in the Federal Register (53 FR 28496). There were about 275 commenters composed mainly of industries, trade organizations, State and local government agencies, environmental and public interest groups, and private citizens. A list of the commenters and the index listing in the docket are given in Appendix A. The technical comments that were submitted, along with responses to these comments, are summarized in this document.

1.1 BACKGROUND

Benzene was listed as a hazardous air pollutant under Section 112 of the CAA in June 1977. In June 1984, EPA promulgated standards for benzene equipment leaks and withdrew proposed standards for EB/S process vents, benzene storage vessels, and maleic anhydride process vents. The Natural Resources Defense Council (NRDC) filed a petition in the U. S. Court of Appeals for the District of Columbia Circuit asking EPA to reconsider these actions (Natural Resources Defense Council, Inc. v. Thomas, No. 84-1387 [also referred to as "Benzene"]). This petition was denied by EPA in August 1985.

In 1987, EPA was granted a voluntary remand in Benzene to reconsider these standards in light of the District of Columbia Court's decision on the vinyl chloride standard (Natural Resources Defense Council, Inc. v. EPA, 824 F.2d at 1146 (1987) [also referred to as Vinyl Chloride]). The EPA also decided to reconsider the standards proposed in June 1984 for benzene emissions from coke by-product recovery plants. The Vinyl Chloride case established a two-step process in setting national emission standards for hazardous air pollutants (NESHAP): (1) to determine a "safe" or "acceptable" risk level without regard to cost or feasibility, and (2) to set the standard at a level that provides an ample margin of safety to protect public health. Cost, feasibility, and other relevant factors can be considered in this second step along with the information considered in the first step.

On July 28, 1988, EPA proposed four alternative policy approaches to setting NESHAP that would be consistent with the Vinyl Chloride decision. Under each policy approach, decisions on the risk levels that are "acceptable" and that provide an ample margin of safety were made for each of the source categories above based on the Vinyl Chloride two-step process. No standards were proposed for maleic anhydride process vents under any approach because benzene is no longer used to produce maleic anhydride.

The four proposed alternative policy approaches are briefly noted below:

(1) Approach A - a case-by-case approach which considers all the health, risk, and exposure information, including incidence, maximum risk, risk distribution, and uncertainties in the risk assessment in determining the level of acceptable risk for each source category;

(2) Approach B - an incidence-based approach which establishes an acceptable risk level at 1 case per year (case/year) per source category;

(3) Approach C - a risk cut-off approach which sets a maximum individual lifetime risk (MIR) of 1×10^{-4} or lower as the acceptable risk level; and

(4) Approach D - a more stringent risk cut-off approach with a MIR of 1×10^{-6} or lower as the acceptable risk level.

Following the acceptable risk decision, under each approach, additional factors are considered in determining whether an ample margin of safety is provided.

Table 1-1 summarizes the standards proposed for the four source categories under the four proposed policy approaches. As shown on the table, under some approaches, it was determined that some source categories did not

TABLE 1-1. SUMMARY OF AMPLE MARGIN OF SAFETY DECISIONS UNDER THE ALTERNATIVE POLICY APPROACHES

	Ethylbenzene/Styrene Process Vents	Benzene Storage Vessels	Equipment Leaks	Coke By-Product Recovery Plants
Approach A: Case-by-Case				
Level of Control	No additional control. Existing control provides ample margin.	Cost-effective equipment.[a]	1984 NESHAP Provides ample margin.	Cost-effective equipment and work practices.[b]
MIR[c]/ case/year	$2 \times 10^{-5}/0.004$	$3 \times 10^{-5}/0.04$	$6 \times 10^{-4}/0.2$	$4 \times 10^{-4}/0.2$
Population at $>10^{-4}/10^{-6}$	0/40,000	0/80,000	3,000/1,000,000	2,000/2,000,000
Approach B: <1 case/year				
Level of Control	Same as above.	Same as above.	Same as above.	Same as above.
MIR/ case/year				
Population at $>10^{-4}/10^{-6}$				
Approach C: $\leq 1 \times 10^{-4}$				
Level of Control	Same as above.	Same as above.	14 kg/day[d] and 1984 NESHAP.	34 kg/day[d] and controls required in Approach A.
MIR/ case/year			$1 \times 10^{-4}/0.07$	$1 \times 10^{-4}/0.07$
Population at $>10^{-4}/10^{-6}$			0/unknown	0/unknown
Approach D: $\leq 1 \times 10^{-6}$				
Level of Control	5.5 kg/day[d]	0.47 kg/day[d]	0.14 kg/day[d]	0.34 kg/day[d]
MIR/ case/year	$1 \times 10^{-6}/0.0007$	$1 \times 10^{-6}/0.002$	$1 \times 10^{-6}/0.0007$	$1 \times 10^{-6}/0.0004$
Population at $>10^{-4}/10^{-6}$	0/0	0/0	0/0	0/0

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[a] Controls required are internal floating roofs (IFR's) on fixed roof vessels, effective primary seals and fittings on all vessels, and secondary seals on external floating roof (EFR) vessels.

[b] Controls required are gas blanketing on all process vessels, tar-bottom final coolers at foundry plants, wash-oil final coolers at furnace plants, and leak detection and repair for equipment leaks.

[c] MIR = maximum individual lifetime risk.

[d] Limit on total benzene emissions from plant.

require regulation to achieve an acceptable risk level and provide an ample margin of safety (e.g., EB/S process vents under Approaches A, B, and C). In some cases, equipment and work practice standards were proposed to achieve an ample margin of safety (e.g., benzene storage vessels under Approaches A, B, and C). In other cases, plantwide emission limits were proposed (e.g., all source categories under Approach D) because specific measures to achieve the desired emission level could not be identified.

Public comment was solicited and received on the proposed policy approaches, technical issues, and the format selected for the standards. Policy comments and the rationale for the final policy approach are discussed in the Federal Register notice announcing the final standards, rather than in this BID. Comments of a technical nature are summarized and responded to here. These include certain legal comments, comments on control techniques, emissions, costs, etc., for each of the four source categories, comments on risk assessment, and other miscellaneous comments. All docket item numbers listed in this BID without a docket number are contained in Docket No. OAQPS-79-3, Part I. Whenever another docket is referred to, both the docket number and the docket item number are given.

1.2 SUMMARY OF FINAL STANDARDS AND IMPACTS

No standards are promulgated for maleic anhydride or EB/S process vents. No additional standards are promulgated for benzene equipment leaks beyond those contained in 40 CFR 61 Subpart J. The final standards for coke by-product recovery plants and benzene storage vessels and the associated health, environmental, energy, cost, and economic impacts are summarized below.

1.2.1 Coke By-Product Recovery Plants

Summary of Standards: The final regulations, in 40 CFR 61 Subpart L, establish equipment standards for the control of emissions from each tar decanter, tar dewatering tank, tar-intercepting sump, tar storage tank, flushing-liquor circulation tank, light-oil condenser, light-oil decanter, wash-oil decanter, and wash-oil circulation tank. These standards also apply to storage tanks containing benzene, benzene-toluene-xylene (BTX) mixtures, light-oil, or excess ammonia-liquor at furnace coke by-product recovery plants. "Furnace coke" and "foundry coke" are defined in the regulations to identify plants subject to controls for these storage tanks. Each of these sources are required to be totally enclosed with emissions ducted to the gas collection system, gas distribution system, or other enclosed point in the by-product recovery process. Unless otherwise specified, pressure-relief devices, vacuum-relief devices, access hatches, and sampling ports are the only openings allowed on each source. Access hatches and sampling ports must be equipped with a gasketed cover.

The standards for these sources are achievable with the use of a gas blanketing system. A gas blanketing system is a closed system operated at positive (or negative) pressure and is generally composed of piping, connections, and flow-inducing devices (if necessary) that transport emissions from the enclosed source back to the coke-oven battery gas holder, the collecting main, or another point in the by-product recovery process. Dirty or clean coke oven gas, nitrogen, or natural gas are examples of gases that may be used as the gas blanket.

To ensure proper operation and maintenance of the control equipment, Subpart L requires a semiannual inspection of the connections and seals on each gas blanketing system for leaks, using EPA Method 21 (40 CFR Part 60, Appendix A). Monitoring also is required at any time after the control system is repressurized following removal of the cover or opening of any access hatch. For the gas blanketing system, an organic chemical concentration of more than 500 parts per million by volume (ppmv) above a background concentration indicates the presence of a leak. The standards also require a semiannual visual inspection of each source and the piping of the control system for visible defects such as gaps or tears. A first attempt at repair of each leak or visible defect is required within 5 days of detection, with repair within 15 days. The owner or operator is required to record the results of the inspections for each source and to include the results in a semiannual report. The standards also require an annual maintenance inspection for abnormalities such as pluggages, sticking valves, and clogged or improperly operating condensate traps. A first attempt at repair is required within 5 days, and any necessary repairs are to be made within 15 days of the inspection.

Equipment standards are also established for the control of emissions from light-oil sumps. The standards require that the surface area of each sump be completely enclosed. These standards are based on the use of a tightly fitting permanent or removable cover, with a gasket on the rim of the cover. The standards allow the use of an access hatch and a vent in the sump cover. However, any access hatch must be equipped with a gasket and with a cover or lid, and any vent must be equipped with a water leg seal, pressure-relief device, or vacuum-relief device. Semiannual inspections of the gaskets and seals for detectable emissions are required; monitoring also is required at any time the seal system is disturbed by removal of the cover. The inspection and monitoring requirements are the same as previously described for gas-blanketed sources. The standards do not allow venting of steam or gases from other points in the coke by-product process to the light-oil sump.

For furnace and foundry coke by-product plants, the standards for naphthalene processing operations, final coolers, and the associated cooling towers require zero emissions from the final cooler and cooling tower, as well as from naphthalene processing. These standards are based on the use of a wash-oil final cooler; however, other final cooler designs that achieve the emission limit can be used.

The standards also apply to leaks (i.e., fugitive emissions) from new and existing pieces of equipment in benzene service, including pumps, valves, exhausters, pressure-relief devices, sampling connections, and open-ended lines, all of which except exhausters comprise those components that contact or contain materials having a benzene concentration of at least 10 percent by weight. Exhausters that contact or contain materials having a benzene concentration of at least 1 percent by weight also are in benzene service. Because the standards for equipment leaks are the same as the requirements in 40 CFR 61 Subpart V, for equipment except exhausters, the Subpart L for coke by-product recovery plants references Subpart V where appropriate rather than repeating the provisions. Subpart V also has been amended where necessary for clarification of the cross referencing. The specific requirements for exhausters are summarized in detail below, because they are not in Subpart V.

The standards require that all exhausters in benzene service be monitored quarterly for the detection of leaks. If an organic chemical concentration at or above 10,000 ppmv is detected, as measured by Method 21, the standards require a first attempt at repair within 5 days, with repair of the leak within 15 days from the date the leak was detected, except when repair would require a process unit shutdown. "Repair" means that the measured concentration is below 10,000 ppmv.

The standards provide three types of alternatives to the leak detection and repair requirements for exhausters. An owner or operator may: (1) use "leakless" equipment to achieve a "no detectable emission" limit (i.e., 500 ppmv above a background concentration, as measured by Method 21); (2) equip the exhauster with enclosed seal areas vented to a control device designed and operated to achieve a 95-percent benzene control efficiency; or (3) equip the exhauster with seals having a barrier fluid system. Specific requirements for each of these three alternatives to the leak detection and repair program are also included in the regulation.

Compliance with the standards will be assessed through plant inspections and the review of records and reports that document implementation of the requirements. On a semiannual basis, the owner or operator is required to report the number of leaks detected and the number of leaks not repaired during the 6-month period. The owner or operator is also required to submit a signed statement in each semiannual report, indicating whether provisions of the standards have been met for the 6-month period.

<u>Summary of Environmental, Health, and Energy Impacts</u>: The EPA estimates that the final standards will reduce nationwide benzene emissions from 36 coke by-product recovery plants by about 16,500 megagrams per year (Mg/yr), a reduction of 97 percent from the baseline level of about 17,000 Mg/yr. Nationwide emissions of volatile organic compounds (VOC's) (including benzene) from these plants would be reduced by about 116,000 Mg/yr (or by about 99 percent) from the baseline level of about 117,000 Mg/yr. Implementation of the standards is expected to reduce the annual leukemia incidence

associated with nationwide benzene emissions from these plants from 1 case every 6 months (2 cases/year) at the baseline level to about 1 case every 20 years (0.05 case/year), a reduction of 97 percent. The MIR would be reduced from about 7×10^{-3} at baseline to about 2×10^{-4}.

Implementation of the standards is expected to result in a national energy savings of approximately 14,500 terajoules (TJ)/yr from recovered coke oven gas, assuming recovery of at least 16 liters of gas/minute/Mg of coke/day at furnace plants and 12 liters of gas/minute/Mg of coke/day at foundry plants. Although an increased cyanide concentration in wastewater is expected with the use of indirect cooling instead of direct final cooling at coke by-product plants, the increase (about 200 grams (g)/Mg of coke) is not anticipated to cause problems for compliance with effluent regulations.

Summary of Cost and Economic Impacts: The nationwide capital cost of the standards for furnace and foundry plants combined is estimated at about $74 million (1984 dollars); nationwide annual costs are estimated at $16 million/year.

The increase incurred in the price of furnace and foundry coke as a result of the standards is estimated to be less than 1 percent. The EPA's economic analysis indicates that at baseline, several plants may have marginal costs of operation greater than the price of coke. The analysis predicts that implementation of the standards may add one more plant to this group. However, a company decision to actually close a plant is based on a number of factors that an economic model cannot consider, including: the premium a plant is willing to pay for a secure, captive coke supply; requirements for a particular coke quality; age of the batteries, foundry, or steel mill; continued access to profits from steel production; and management's perception regarding their future costs and revenues. The EPA recognizes that implementation of the standards could be the factor that would trigger closure decisions at plants that are presently marginal or operating at a loss.

1.2.2 Benzene Storage Vessels

Summary of the Standards: The final standards, in 40 CFR 61 Subpart Y, are most similar to the standards proposed for benzene storage vessels under proposed policy Approaches A, B, and C. The standards require control of all new and existing storage vessels greater than or equal to 38 m^3 (10,000 gallons) used to store benzene meeting the specifications incorporated by reference in Section 61.270(a) for industrial grade benzene or refined benzene-485, -535, or -545. The standards do not apply to storage vessels used for storing benzene at coke by-product recovery facilities because they are considered under the coke by-product recovery plants NESHAP. The standards require use of certain kinds of equipment on each type of benzene storage vessel. Table 1-2 lists the requirements.

The benzene storage vessel standards require that fixed roof vessels include an internal floating roof (IFR) with a continuous seal and gasketed roof fittings. Specifically, the standards require that new fixed roof vessels and existing fixed roof vessels to which an IFR was added after July 28, 1988, must have IFR's with either: (1) a liquid-mounted continuous seal, or (2) a vapor-mounted primary seal, with a secondary seal, both of which are continuous, or (3) a mechanical shoe seal. These vessels are also required to have gasketed roof fittings, even if they have a secondary seal. These requirements must be met before vessel-filling for new vessels or within 90 days of the effective date of this regulation for existing vessels. Existing fixed roof vessels that already had IFR's on July 28, 1988, and have vapor-mounted primary seals are not required to add secondary seals or to have their vapor-mounted seals replaced with liquid-mounted seals. However, existing shingled-seal IFR vessels are required to replace their shingled seal with a continuous seal within the 90-day compliance period. All vessels with IFR's prior to July 28, 1988, are also required to have gasketed fittings, even if they have secondary seals. However, for these existing vessels, the fittings can be retrofitted at the first degassing or within 10 years (whichever is first).

Owners of existing and new external floating roof (EFR) vessels would have to install liquid-mounted primary seals (or mechanical shoe seals) and continuous secondary seals meeting certain gap requirements. For new vessels, these requirements must be met before vessel-filling. For existing vessels that did not have liquid-mounted primary seals as of July 28, 1988, they must

TABLE 1-2. EQUIPMENT REQUIRED ON BENZENE STORAGE VESSELS BY 40 CFR 61 SUBPART Y

Vessel Size and Time of Construction	Requirements
1. Fixed IFR vessel	
a. $\geq 38\ m^3$, commenced construction after July 28, 1988; or $\geq 38\ m^3$, commenced construction prior to July 28, 1988, and had no IFR, or had an IFR without a continuous seal as of July 28, 1988.	IFR with liquid-mounted or mechanical shoe continuous primary seal[1] and gasketed roof fittings.
b. $\geq 38\ m^3$, commenced construction prior to July 28, 1988, and had an IFR as of July 28, 1988.	IFR with a continuous seal[2] and gasketed roof fittings[3].
2. EFR vessel	
a. $\geq 38\ m^3$, commenced construction after July 28, 1988; or $\geq 38\ m^3$, commenced construction prior to July 28, 1988, and did not have a liquid-mounted primary seal as of July 28, 1988.	Liquid-mounted or mechanical shoe primary seal and a continuous secondary seal.
b. $\geq 38\ m^3$, commenced construction prior to July 28, 1988, and had a liquid-mounted primary seal as of July 28, 1988.	Liquid-mounted primary seal and a continuous secondary seal.[4]

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[1] A vapor-mounted primary seal is also allowed, provided that the vessel is also equipped with a continuous secondary seal.

[2] For example, liquid-mounted, vapor-mounted, or mechanical shoe seals are allowed.

[3] Gasketing of roof fittings is required the first time vessel is degassed.

[4] The secondary seal is required the first time the vessel is degassed.

be met within 90 days of the effective date of this regulation. Existing EFR vessels already equipped with a liquid-mounted primary seal as of July 28, 1988, are required to add the secondary seal at the first degassing of the vessel. However, those with other types of primary seals (e.g., vapor or mechanical shoe) must add the required types of primary and secondary seals within 90 days of the effective date of the regulation.

The standards require that each IFR vessel be inspected from inside prior to the filling of the vessel (if it is a new vessel or is emptied to install control equipment) and at least once every 10 years. An IFR having defects or a seal having holes or tears would have to be repaired before filling the storage vessel with benzene. The standards also require that the IFR and its seal be inspected through roof hatches on the fixed roof at least once annually. However, if an IFR were equipped with a primary and secondary seal, the owner or operator could conduct an internal inspection every 5 years rather than perform the annual inspections. Any defects such as roof sinking, liquid on the deck, holes or tears in the seal, or primary seal detachment (or secondary seal detachment, if one is in service) as viewed through the roof hatches are required to be repaired within 45 days or the storage vessel would have to be emptied. If repair within 45 days is not possible, and alternate storage is not available to allow the vessel to be emptied, the owner or operator could request an extension of up to 30 additional days.

The standards also require that, for EFR vessels, the primary seal and secondary seal gaps be measured initially and at least once every 5 years for the primary seal and at least once annually for the secondary seal. Conditions not meeting the standards which are identified during these inspections must be repaired within 45 days or the vessel would have to be emptied. An extension of up to 30 days may be requested if the repair is not possible within the 45 days allowed.

Summary of the Environmental, Health, and Energy Impacts: Under the standards summarized above, benzene emissions from this source category are estimated to be reduced from the baseline range of 620 to 1,290 Mg/yr to a level of 510 Mg/yr. The residual incidence of leukemia from exposure to benzene emissions after application of the standards is estimated to be 1 case every 25 years (0.04 case/year), and the MIR is predicted to be 3×10^{-5}. This can be compared with an incidence range of 1 case every 10 to 20 years (0.1 to 0.05 case/year) and an MIR range of 4×10^{-5} to 4×10^{-4} under the baseline conditions.

Because the control equipment and work practices required by the standards do not involve the generation of any wastewater or solid waste, there are no expected impacts on water quality or solid waste disposal. Further, no noise or radiation impacts are expected, nor are any changes in energy use predicted.

Summary of the Cost and Economic Impacts: National capital costs of control associated with achieving the standards are $0.66 million (1982 dollars). The nationwide annual cost is $0.1 million/year (1982 dollars). No major adverse economic impacts are anticipated as a result of these standards.

2.0 LEGAL ARGUMENTS

2.1 APPROACH TO ACCEPTABLE RISK

Comment: Commenters XII-F-1, XII-F-6, XII-F-8, XII-F-9, XII-F-11, XII-F-13, XII-D-06, XII-D-27, XII-D-28, XII-D-29, XII-D-32, XII-D-33, XII-D-34, XII-D-36, XII-D-49, XII-D-50, XII-D-55, XII-D-57, XII-D-59, XII-D-60, XII-D-98, XII-D-99, XII-D-220, XII-D-246, and Docket No. A-79-27, Item IX-D-04 felt that the Vinyl Chloride decision requires the Administrator to make an "expert judgment" regarding the emission level that will result in an "acceptable" risk, and in doing so must determine what inferences should be drawn from all available scientific data. These commenters felt that because the proposed Approaches B, C, and D rely on a single measure of risk to be used inflexibly, they are arbitrary and capricious, as they ignore other important factors in determining acceptable risk.

Response: As the commenters point out, Vinyl Chloride requires the Administrator to make a decision as to what is "safe" based upon "an expert judgment with regard to the level of emission that will result in an 'acceptable' risk to health," and in so doing "must determine what inferences should be drawn from available scientific data." 824 F.2d at 1146.

The approach chosen by the Administrator, which is described in the Federal Register notice for the final actions associated with this document, considers and weighs the scientific data including the uncertainties in the risk measurements and thus conforms with Vinyl Chloride. It takes into account not just MIR, but also incidence as a measure of risk. Both cancer and noncancer health effects are considered. It does not rely solely on one measurement of risk, nor is it inflexible, as it allows the various health and risk variables to be weighed in each individual pollutant assessment.

Comment: Commenter XII-D-219 stated that the proposed Approach A directly contradicts the Vinyl Chloride decision because it does not establish an up-front ceiling for acceptability, but allows case-specific factors to be evaluated before maximum acceptable risk is determined.

<u>Response</u>: The <u>Vinyl Chloride</u> decision did not mandate any specific method for determining acceptable risk, but merely required that it be health based. Approach A, which would allow consideration of all health information, risk measures, and potential biases, underlying assumptions and uncertainties in reaching a decision regarding acceptable risk, is not in contradiction with the <u>Vinyl Chloride</u> decision. Neither is it the only approach that would be acceptable. The <u>Vinyl Chloride</u> court stated that the Administrator is required to make an initial determination of what is "safe," based on his "expert judgment with regard to the level of emission that will result in an 'acceptable' risk to health . . . . In this regard, the Administrator must determine what inferences should be drawn from available scientific data . . ." 824 F.2d at 1146. Thus, the court recognized that the acceptable risk determination is within the expert judgment of the Administrator, and therefore does not require an up-front ceiling for acceptability. The available scientific data for each pollutant will vary and the Administrator should exercise his judgment to weigh the data. This process could vary from pollutant to pollutant. Nothing in the <u>Vinyl Chloride</u> decision prohibits the Administrator from reviewing these facts independently for each pollutant. All that <u>Vinyl Chloride</u> prohibits is consideration of factors other than health, such as cost and feasibility, at the initial stage of the analysis.

2.2 TREATMENT OF UNCERTAINTY IN AMPLE MARGIN OF SAFETY STEP

<u>Comment</u>: Commenters XII-F-6, XII-D-27, XII-D-28, XII-D-60, XII-D-104, XII-D-105, XII-D-197, XII-D-199, XII-D-220, and Docket No. A-79-27, Item IX-D-04 felt that under the <u>Vinyl Chloride</u> decision, the ample margin step is the appropriate place for reducing uncertainty. Therefore, according to these commenters, EPA should use realistic or most plausible risk estimates in the acceptable risk step, and only examine conservative upperbound estimates in the ample margin step. Commenter XII-D-27 stated specifically that determining a single upperbound risk estimate as a beginning for the acceptable risk step is inconsistent with the <u>Vinyl Chloride</u> decision. Other commenters felt similarly that risk estimates should be most likely rather than upperbound values, but did not cite <u>Vinyl Chloride</u> as support for their opinion.

One commenter (XII-D-243) rebutted these arguments on legal grounds, stating that use of upperbound risk estimates are lawful and consistent with Section 112 of the CAA and Vinyl Chloride. In light of scientific uncertainties, it is reasonable and is within the EPA's discretion to make conservative assumptions in quantifying leukemia risks of benzene emissions. The commenter interpreted that when stating that uncertainty should be considered in the ample margin step, the court was referring to consideration of unknown health effects. This is a separate uncertainty issue from the risk assessment methodology used to quantify known health effects (e.g., leukemia). Commenter XII-D-243 also stated that under Vinyl Chloride uncertainty should be considered only in the ample margin step. However, if considered in the acceptable risk step, uncertainty should not be allowed to become a justification for allowing higher risks. This would be contrary to Vinyl Chloride.

Response: The Vinyl Chloride decision acknowledges that there is a degree of uncertainty which needs to be addressed in the initial step of determining what is an "acceptable risk." The court said that "uncertainty about the effects of a particular carcinogenic pollutant invokes the Administrator's discretion under Section 112," 824 F.2d at 1153, and that:

> the Administrator's decision does not require a finding that "safe" means "risk free . . . or a finding that the determination is free from uncertainty. Instead, we find only that the Administrator's decision must be based upon expert judgment with regard to the level of emission that will result in an "acceptable" risk to health. 824 F.2d at 1164-65.

Thus the court recognized that there are uncertainties inherent in the assessment of health risk required at the "acceptable risk" step of the analysis, and that the Administrator must exercise his expert judgment in evaluating those uncertainties.

The regulatory approach chosen by EPA provides for consideration of the uncertainties inherent in the existing health risk assessments along with other factors in reaching a determination of what is an acceptable risk. However, uncertainty is also addressed in the second step of the analysis where an "ample margin of safety" must be provided for. As some commenters have stated, this allows for protection "against incompletely understood dangers to public health and the environment, in addition to well-known risks." 824 F.2d at 1165. This does not, as the commenter alleges, mean that EPA must consider the likelihood of unknown health effects, but rather must consider dangers "before their extent is conclusively ascertained." 824 F.2d at 1165.

<u>Comment</u>: Commenter XII-D-100 wrote that the <u>Vinyl Chloride</u> opinion states that the duty to assure "an ample margin of safety" ... requires EPA to add an extra measure of protection in the second step to safeguard against uncertainties that increase the likelihood of greater danger to health. The commenter felt that the ample margin of safety step had been interpreted by EPA, in the application of four proposed approaches to the benzene NESHAP, as addressing only whether the residual risk from the first-step decision warrants any additional controls. The commenter (and Commenter XII-D-243) stated that uncertainties which cause the unit risk assessment to be underestimated, and other known benzene-induced risks such as multiple myeloma, were ignored in the proposals for the ample margin of safety decision; to comply with the <u>Vinyl Chloride</u> decision, these factors need to be given tangible weight in the ample margin of safety step.

<u>Response</u>: Once a determination has been made regarding what constitutes "acceptable risk" based on health protection considerations, the <u>Vinyl Chloride</u> decision provides that EPA may consider other factors including cost and technological feasibility of controls beyond those required to reach the "acceptable risk" level. If appropriate, EPA will then set an emission standard which may consider technical and economical feasibility, to provide an "ample margin of safety." This standard <u>may</u> be below the level found to be "safe." 824 F.2d at 1165. The purpose of this second step in the analysis is to "protect against dangers before their extent is conclusively ascertained." 824 F.2d at 1165. However, the ample margin of safety is not intended to give weight to as yet unknown health effects.

<u>Comment</u>: Commenter XII-D-37 urged EPA to reconsider its proposal that the Administrator must determine acceptable levels of risk in emissions standards

without considering cost, economic impacts, benefits of the risk-causing activity, feasibility of control, or other factors. The commenter observed that although mandated by the Vinyl Chloride decision, such an approach is unprecedented.

Response: The EPA is bound to follow the holding of the Vinyl Chloride case with respect to when and where cost, economic impacts, feasibility of controls, and other factors may be considered. The decision is unequivocal in that it mandates that the question of what is "safe" be answered solely on the basis of health factors. All other information must be considered only at the second step, where an "ample margin of safety" is provided for.

Comment: Three commenters (XII-D-34, XII-D-59, and XII-D-97), supported by XII-D-29, XII-D-32, XII-D-36, XII-D-55, XII-D-98, XII-D-104, XII-D-197, XII-D-199, and XII-D-250 felt that the benefits associated with a risk-creating activity must be considered when determining whether the risk is acceptable, and that the Vinyl Chloride decision does not preclude consideration of these benefits. Commenter XII-D-34 stated that EPA apparently believes, because of the court's determination that cost and technological feasibility cannot be considered, that the Vinyl Chloride decision precludes consideration of benefits. The commenter reasoned that benefits are wholly separate from the cost and feasibility of control technology. This commenter felt that the Vinyl Chloride decision mandates that benefits be considered because it cannot be determined whether risks are "acceptable in the world in which we live" without considering the benefits of those risks. Commenter XII-D-34 defined benefits to include the beneficial use--including positive health-related uses--of products produced by the risk-causing activity; the employment of people in the manufacture of such products; the extent to which resources committed to manufacture of the products could be redirected or would be irretrievably lost; the degree to which alternative products would present risks; and the degree to which substitutes are available.

One commenter (XII-D-199) added that any rational decision about the acceptability of a particular risk associated with a particular decision must also consider risks associated with the alternative decisions. All health risk, including health risks from unemployment and economic and social disruption caused by a regulatory alternative, and risks from substitutes can and should be considered in the acceptable risk step. The commenter believed that consideration of these types of health risks is allowable under _Vinyl Chloride_.

An opposing viewpoint was expressed by Commenters XII-D-243 and XII-D-254. Commenter XII-D-243 stated that consideration of the benefits of a risk-causing activity is plainly not permissible under the _Vinyl Chloride_ decision. Commenter XII-D-254 stated that the Chemical Manufacturers Association (CMA), the American Petroleum Institute (API), and others had in various ways asserted that EPA may consider cost and flexibility in the acceptable risk determination, which is plainly contrary to the intent of _Vinyl Chloride_.

Response: The _Vinyl Chloride_ decision clearly held that the determination of what constitutes an acceptable risk "must be based solely upon the risk to health," and that "[t]he Administrator cannot under any circumstances consider cost and technological feasibility at this stage of the analysis." 824 F.2d at 1169.

Some commenters, however, contend that certain "benefits" of the risk-generating activity may be taken into consideration during the first step finding of what is an acceptable risk. These "benefits" are described as: beneficial uses of the product involved, employment created by production, and the benefit of continuing production where substitutes are either unavailable or are high risk items themselves.

The EPA believes that both Section 112 itself, and the _Vinyl Chloride_ decision construe the risk to health to refer only to health effects directly resulting from emissions of benzene. The items the commenters call "benefits" are better described as indirect costs or effects. The EPA is free to look at these and any other costs or effects when considering what would constitute an ample margin of safety. Considering these costs during the "acceptable risk" determination process would violate the _Vinyl Chloride_ court's holding.

Comment: One commenter (XII-D-59), supported by XII-D-29, XII-D-32, XII-D-36, XII-D-55, XII-D-98, XII-D-104, XII-D-197, and XII-D-199, stated that the

Vinyl Chloride court recognized that Congress did not intend Section 112 to require EPA to create standards which would result in severe economic impacts and social dislocation. The commenter thus felt that the policy of a 1×10^{-6} acceptable risk level (Approach D), which would cause widespread plant closures and severe economic and social dislocation, would be inconsistent with the court's opinion.

Response: The Vinyl Chloride court held that EPA must initially make a judgment regarding what level of emission will result in an "acceptable" risk to health, and that in making this determination the Administrator "cannot under any circumstances consider cost and technological feasibility." 824 F.2d at 1165. The court explained further that cost and feasibility have no relevance to the determination of what is safe, and that if the Administrator cannot find that there is an acceptable risk at any level then he must set the level at zero. Thus, clearly, the court contemplated the possibility of the EPA's action having severe economic impacts and recognized that such a result may be necessary in certain circumstances. However, once a safe level has been ascertained, the court allows economics to be considered in setting an ample margin of safety, thus allowing for some minimization of economic impact.

2.3 TECHNOLOGY FORCING REQUIREMENTS

Comment: Commenter XII-D-49 said there was no statutory basis for requiring controls which do not significantly advance the goal of risk reduction merely because such controls may be feasible and affordable.

Commenters XII-D-45, XII-D-97, and XII-D-250 argued that nothing in Section 112 of the CAA suggested Congress intended technology-forcing requirements to be applied under Section 112.

Response: The Vinyl Chloride court made it clear that cost and feasibility are not permissible considerations in the initial decision as to what is "safe." 824 F.2d at 1165. However, the court did not prohibit such considerations from the determinations of what constitutes "an ample margin of safety to protect the public health." 824 F.2d at 1155.

Section 112(b) specifically provides that the Administrator shall establish a standard which "in his judgment" provides an "ample margin of safety." 42 U.S. 7412(b). Thus, the Administrator has the discretion to determine what factors to consider in finding an ample margin of safety.

In discussing the specific language of Section 112, the <u>Vinyl Chloride</u> court stated that, while the legislative history of Section 112 is ambiguous as to the permissibility of considering cost and feasibility, the statute itself neither permits nor prohibits any particular factor. 824 F.2d at 1157. The court concluded that:

> Since we cannot discern clear Congressional intent to preclude consideration of cost and technological feasibility in setting emission standards under Section 112, we necessarily find that the Administrator <u>may</u> consider these factors. (emphasis added)

The court went on to say that at the second step in the process, the Administrator <u>may</u> turn to questions of technological feasibility in setting an emission standard with an "ample margin of safety," but that "it is not the court's intention to bind the Administrator to any specific method of determining what is 'safe' or what constitutes an 'ample margin'." 824 F.2d at 1166. Therefore, the determination of the weight to be given to technological feasibility in deciding what constitutes an "ample margin of safety" is within the discretion of the Administrator.

<u>Comment</u>: Commenter XII-D-48 felt that Congress intended the CAA to be a technology-forcing statute, as evidenced by the previous experience with mobile source controls. According to this commenter, the exclusion of "feasibility" and "cost" considerations from Section 112, and the fact that Section 112 already contains waiver provisions that allow existing sources time to comply, support a technology-forcing approach.

<u>Response</u>: As was made clear by the <u>Vinyl Chloride</u> decision, the absence of specific reference to cost and feasibility in Section 112 does not preclude their consideration. Congress did not provide that these factors were not permissible, and the Court of Appeals has found that in determining what constitutes an ample margin of safety may be taken into account.

The legislative history of Section 112 does not address the technology-forcing issue specifically.

The provisions of Section 112 allowing existing sources time to comply with new regulations is not, standing alone, evidence of Congressional intent to require technology forcing. As a practical matter, existing sources need time to adapt their operations to new requirements whether they are technology forcing or not.

2.4 PROCEDURAL COMMENTS

<u>Comment</u>: Commenter XII-D-246 noted that Section 117(f)(3) [sic] of the CAA provides that the Administrator should consult with the appropriate advisory committees to the maximum extent practicable prior to publishing any standards under Section 112 of the CAA. In particular, the commenter felt that exposure assessment procedures suggested by API and other commenters should be considered by EPA and reviewed by the Science Advisory Board.

<u>Response</u>: Section 117(c)(3) of the CAA provides for consultation with advisory committees and independent experts "to the maximum extent practicable within the time provided." In this case, where promulgation of the NESHAP is governed by a strict court ordered schedule such consultation is by necessity at least partially restricted. However, EPA has carefully considered all comments submitted, and alternative regulatory approaches suggested, and incorporated into the final regulations all useful changes.

2.5 LISTING OF CARCINOGENS UNDER SECTION 112

<u>Comment</u>: One commenter (XII-F-1, XII-D-209) challenged the policy of regulating all carcinogens under Section 112 on the basis that there is no known, absolutely safe level of exposure, as overly simplistic and unlawful, ignoring the basic requirements of the CAA. He argued that this assumption cannot be substituted for a determination of "significant risk". The commenter explained that the 1977 amendments require a finding of "a significant risk of harm" before a pollutant may be regulated. The commenter further argued that data must demonstrate that the emissions in question "make more than a minimal contribution to total human exposure". The

commenter proposed that the "significance threshold" is higher for Section 112 pollutants than for any other section of the CAA. He maintained that the potential health effects of pollutants regulated under Section 112 are of a more serious nature, which narrows the number of pollutants that should be dealt with under it. He went on to say EPA has listed hazardous air pollutants under Section 112 on the basis of a very low threshold. The commenter asserted that EPA had listed hazardous air pollutants on the basis of "an assumption 'of probable carcinogenicity coupled with human exposure' and then attempted to mitigate the effect of those decisions by relaxing the controls through a best available technology determination". He recommended that EPA revise its framework for regulating hazardous air pollutants beginning with the listing step.

Response: The EPA's decision, in 1977, to list benzene under Section 112 as a hazardous air pollutant, was based on a review of evidence of carcinogenicity obtained from occupational studies which led EPA to the conclusion that there was sufficient evidence of a causal relationship between benzene exposure and leukemia to warrant classification of benzene as a Group A known human carcinogen. 53 FR 28505 (July 28, 1988).

The EPA continues to believe that the inclusion of benzene on the list of hazardous air pollutants maintained under Section 112 of the CAA is appropriate.

The assumption that there is no known totally risk-free exposure level is, at this time, generally accepted in the scientific community, and the EPA's acceptance of the assumption was recognized and ratified by the Vinyl Chloride court.

> Scientific uncertainty, due to the unavailability of dose/response data and the 20-year latency period between initial exposure . . . and the occurrence of disease, makes it impossible to establish any definite threshold below which there are no adverse effects to human health. 824 F.2d at 1148.

While the "no threshold" issue is a relevant consideration, EPA also evaluates the particular evidence of carcinogenicity in each individual case before making a decision to list a pollutant under Section 112.

In response to the <u>Vinyl Chloride</u> decision, EPA has reevaluated its approach to regulating hazardous air pollutants, and will, both here and in the future, make an "acceptable risk" determination based exclusively on the health effects of the substance, and then set a standard providing for an "ample margin of safety."

2.6 OTHER COMMENTS

<u>Comment</u>: One-hundred and twenty-one commenters (XII-D-05, XII-D-14, XII-D-17-C, XII-D-17-E, XII-D-17-F, XII-D-17-H, XII-D-17-K, XII-D-17-R, XII-D-17-V, XII-D-17-W, XII-D-17-BB, XII-D-17-DD, XII-D-17-FF, XII-D-17-II, XII-D-41, XII-D-43, XII-D-62, XII-D-65, XII-D-66, XII-D-70, XII-D-71, XII-D-74, XII-D-75, XII-D-80, XII-D-81, XII-D-82, XII-D-90, XII-D-93, XII-D-94, XII-D-108, XII-D-69, XII-D-110, XII-D-114, XII-D-118, XII-D-119, XII-D-121, XII-D-122, XII-D-127, XII-D-129, XII-D-132, XII-D-134, XII-D-135, XII-D-136, XII-D-137 XII-D-182-A thru M, XII-D-181-A thru T, XII-D-183, XII-D-184, XII-D-186, XII-D-141, XII-D-142, XII-D-143, XII-D-145, XII-D-146, XII-D-148, XII-D-151, XII-D-152, XII-D-153, XII-D-155, XII-D-159, XII-D-161, XII-D-162, XII-D-164, XII-D-165, XII-D-166, XII-D-167, XII-D-169, XII-D-172, XII-D-174, XII-D-178, XII-D-179, XII-D-180, XII-D-186, XII-D-188, XII-D-189, XII-D-190, XII-D-193, XII-D-194, XII-D-195, XII-D-196, XII-D-202, XII-D-213, XII-D-214) found it wrong and/or unconstitutional to kill people through exposures to hazardous air pollutants allowed by regulation.
Commenter XII-D-41 stated, in particular, that the Constitution does not empower government with the perogative to cause human life to be taken at random.

<u>Response</u>: The present state of scientific knowledge is such that "for a carcinogen it should be assumed, in the absence of strong evidence to the contrary, that there is no atmospheric concentration that poses absolutely no public health risk." 40 FR 59534 (1975). Therefore, the only way to absolutely assure no risk of loss of human life due to benzene emissions would be to ban <u>all</u> emissions. However, the courts have considered this option and rejected it. In the <u>Vinyl Chloride</u> decision the D.C. Circuit Court rejected the NRDC's argument that "the uncertainty about the effects of

carcinogenic agents requires the Administrator to prohibit all emissions." 824 F.2d at 1147. Instead, the court stated that the Administrator's finding of "safe" does not require zero risk, but rather an "acceptable" risk to human health, considering what risks are "acceptable in the world in which we live" 824 F.2d at 1165 (citing Industrial Union Dept., AFL-CIO v. American Petroleum Inst., 448 U.S. 607, 642 (1980)). The regulations issued today incorporate what the Administrator, exercising his discretion, has determined to be an acceptable risk, within the meaning of the Vinyl Chloride decision.

Comment: One commenter (XII-D-24) stated that if, via the benzene rulemaking, EPA is establishing a formal policy for rulemaking, then this establishment of a generally applicable policy (such as those of Approaches B, C, and D) without complying with the informal rulemaking process violates the concept of administrative rulemaking. The commenter believed that Approach A is consistent with accepted administrative rulemaking, because it allows case-by-case decisionmaking.

Response: The EPA's proposed NESHAP for benzene, published July 28, 1988, included four alternative approaches to regulation. The proposal of these alternatives was a result of the Vinyl Chloride decision, which required some revision to the EPA's approach to promulgating regulations under Section 112 of the CAA. All four options have now been subjected to public comment as required by law, and EPA has responded to all significant comments, including comments suggesting further alternative approaches. This process is in full compliance with administrative rulemaking requirements. If, instead of proposing four options, EPA had proposed any one of the four options, the same administrative process would have been followed.

Any future Section 112 rulemaking actions will also be proposed for public comment before being promulgated, and thus will comply fully with the rulemaking requirements.

3.0 ETHYLBENZENE/STYRENE (EB/S) PROCESS VENTS

3.1 EMISSION ESTIMATION

Comment: One private citizen (XII-D-04) questioned whether emissions from leaks, spills, emergencies, startups, shutdowns and equipment malfunctions were included in the calculation of 98 percent control efficiency for boilers, flares and incinerators.

Response: The EPA's estimate of 135 Mg/yr (155 Mg/yr at proposal), from process vent releases includes emissions from continuous operations, as well as emissions from startup, shutdowns, and equipment malfunctions. These emissions are residual from control devices or are uncontrolled intermittent releases, such as emergency release vent emissions. Control devices and each emission source used at each EB/S plant are documented in Appendix B of the 1984 withdrawal BID.[1] The majority of vents (and emissions) at these facilities are already vented to a combustion control device such as a boiler, flare, or incinerator. For these types of combustion control devices, 98 percent control efficiency was assumed in calculating emissions. This is the expected performance of a well designed and operated unit. Emissions from EB/S process vents have been reduced by more than 98 percent from the uncontrolled emission level. This estimate is considered to reflect all process vent emissions aside from truly accidental releases. Emissions from equipment leaks and accidents are not included in the emission estimate because they are being addressed under other regulations. Equipment leaks are regulated by Subpart J of Part 61 of Title 40. Accidental releases are subject to the accidental release regulations in the Superfund Amendments and Reauthorization Act (SARA) Title III, Section 304.

3.2 DEMONSTRATION OF COMPLIANCE FOR STANDARDS PROPOSED UNDER APPROACH D

Comment: Two commenters (XII-D-104 and XII-D-220) requested that EPA extend the time limit for the demonstration of compliance required by the standards proposed under Approach D. One commenter (XII-D-104) stated that an emission test to demonstrate compliance might itself require 90 days to complete, and requested that the time limit on compliance reports be extended to 180 days.

The second commenter (XII-D-220) felt that the 90-day compliance time limit was inappropriate under Approach D, due to the extensive modifications which would likely be required for an existing facility.

Response: Since no standard is being established, the commenters concerns are no longer relevant. The EPA believes, however, that it would be useful to clarify the compliance and reporting requirements to clearly distinguish between these requirements. As required by the CAA and 40 CFR Section 61.05(c), existing sources must comply with the standards within 90 days, unless they have received a waiver as provided for under 40 CFR Section 61.11, or a Presidential waiver under Section 112(c)(2) of the CAA. This requirement cannot be changed without an amendment to the CAA. Sources that are unable to comply within the 90 days may apply for a waiver. Waivers may be granted to extend the compliance time for a period not to exceed 2 years.

Reporting of the compliance demonstration is a separate requirement. The EPA does recognize that where extensive emission testing is required, more than 90 days may be necessary to conduct the tests, analyze the results, and prepare the report. For this reason, reporting requirements in previous rulemakings under Section 112 have ranged from 120 to 180 days.

3.3 WORDING OF STANDARDS PROPOSED UNDER APPROACH D

Comment: One commenter (XII-D-104) suggested that the proposed standards should clarify which vents are to be controlled. He pointed out that there are a number of minor vents from analyzers and other monitoring equipment which have not required control. He advocated specifically exempting *de minimis* releases from these vents.

Response: As no standard is being established for EB/S process vents, the primary concerns of the commenters are no longer relevant. This comment does indicate the term "process vent" can be subject to interpretation and there may be confusion regarding the applicability of the decision to these minor vents. The process vents of concern in this rulemaking were associated with alkylation reactor sections, atmospheric or pressure columns, hydrogen separation systems and compressors. The vents of concern to the commenters might be a type of a sample connection and as such would be subject to the requirements of Subpart V of Title 40 Subpart 61.

Comment: Another commenter (XII-D-199) criticized the EPA's definition of malfunction in the proposed EB/S standards. He stated that few upsets would ever fit into the proposed definition, since in theory, any equipment breakdown would be preventable. He suggested the following revised definition of malfunction:

> "A failure of process or air pollution control equipment caused entirely by design deficiencies, poor maintenance, careless operation, or other reasonably preventable equipment breakdown is not considered to be a malfunction."

Response: Since no standard is being established, the issue is no longer relevant.

Comment: Commenter XII-D-247 suggested that instead of the new regulations proposed, EPA should amend the existing benzene NESHAP Section 61.242-11 by requiring all vents emitting over X lbs/hr of benzene to be routed to a 95 percent efficient control device. The X should be set on a case-by-case basis depending upon the emissions reduction needs at a particular plant. The commenter also suggested that Section 61.246 (Recordkeeping) and Section 61.247 (Reporting) of the equipment leaks standard should be revised to include vents.

Response: The commenter's suggestion was an alternative to the standard proposed under Approach D. Because under the final policy no standard is being established, neither the proposed standards or this suggestion is relevant. It should be noted, however, that the equipment leak standard is a broad-based standard affecting any facility using benzene and is not an appropriate place to address process vent emissions specific to EB/S plants.

3.4 REFERENCE

1. U. S. Environmental Protection Agency. Benzene Emissions from Ethylbenzene/Styrene Plants - Background Information for Proposal to Withdraw Proposed Standards. Environmental Protection Agency. Publication No. EPA-450/3-84-003. Appendix B. March 1984.

4.0 BENZENE STORAGE VESSELS

4.1 INTRODUCTION

Most of the comments on the benzene storage vessel source category came from industry and focused on the proposed standards, especially those proposed under policy Approach D. The comments are summarized below under sections addressing the emission limit proposed under Approach D, cost estimation, applicability of standards, wording of standards, and regulatory consistency.

4.2 THE EMISSION LIMIT PROPOSED UNDER APPROACH D

Comment: The CMA (XII-D-59) and its supporters (XII-D-29, XII-D-32, XII-D-36, XII-D-98, XII-D-104, XII-D-197 and XII-D-199) noted that attempting to achieve the 0.47 kilogram (kg)/day emission limit imposed by Approach D would be costly and problematic, creating operating problems and safety hazards disproportional to any marginal reduction in risk which might result. The CMA representative stated that all new and existing storage vessels would have to be modified to allow for the collection and routing of vapors to a control device. He believed that most operators would seal the rim vents, and then pad the enclosed vapor space with an inert gas to prevent the possible accumulation of an explosive mixture. Closing the vessel would make inspection of the floating roof more difficult, and the presence of inert gas would make it more dangerous.

One commenter (XII-D-199) stated that a reduction beyond the 1×10^{-4} MIR in the storage category would require major changes in emission control technology and redesign of vessels at his plant. He recognized that a floating roof would have to be used and emissions collected and routed to a flare, carbon canister, or incinerator. He indicated that at his facility this would require replacement, not retrofitting, of the vessels. He concluded by pointing out that the controls would have to be designed to prevent safety problems such as flashback from combustion devices into the vessel of flammable liquid or possible vessel rupture due to pressurization.

A terminal operator (XII-D-103) agreed, stating that public health and safety must be protected, but not without considering the safety of employees and equipment. He argued that safe and tested technology to achieve the Approach D limits is not yet available.

Using control techniques presently in use for most benzene storage vessels, he estimated that to meet the emission limit proposed under Approach D a plant would be limited to the use of a single 10,000-barrel storage vessel equipped with a floating roof system such as described under Approaches A, B, or C.

One commenter (XII-D-220) voiced concern about demonstrating compliance to the standard proposed under Approach D, stating that the current, accepted emission estimation techniques could only be used for existing control techniques, and that even using the lowest available emission factors, a facility with more than a few benzene vessels cannot demonstrate compliance.

Response: Because the emission limit under Approach D was not chosen as the final standard, the commenters' concerns are now moot.

4.3 COST ESTIMATION

Comment: One commenter (XII-D-220) believes the cost of the standards proposed under Approaches A, B, or C, could be significantly more than the $100,000 per year estimated by EPA, because the wording of Section 61.271(a)(8) of the proposed regulation would require some vessels to be removed from service solely for retrofitting. He noted that in his 1981 comments on the standards proposed on December 19, 1980, he had estimated degassing costs would be over $30,000 per vessel.

He stated that EPA also had not included the cost associated with the loss of operating flexibility when a storage vessel is out of service, and the potential additional costs due to the proposed inspection and repair provisions, which could require removing vessels from service on an unplanned basis.

Response: The EPA believes few, if any, plants would be required to degas vessels to comply with the proposed Section 61.271(a)(8) [which is renumbered in the final standards as Section 61.271(a)(4)] since this design specification represents current industry practice (see comment and response in Section 4.5 of this chapter). In addition, EPA expects that removal from service and degassing of vessels for repair would occur infrequently. The inspection and repair provisions referred to by the commenter are intended to detect major failures of the floating roof and seals, such as a sunken roof or a gap in the seal. The EPA anticipates that such failures would not occur at any one vessel or at several vessels at any one plant very often.

With regard to the cost of degassing, EPA reconsidered it after evaluating the comments on the 1980 proposal for benzene storage vessels (45 FR 835952). Additional vendor quotations were obtained, and the revised formula and degassing costs were developed.[1] Since neither the commenter's 1981 submittal, nor the recent comment, specified the size of the vessel in question, nor any additional information specific to his calculation, the commenter's cost estimate could not be specifically evaluated.

However, the EPA's revised estimates of the degassing costs, while higher than those in the 1980 proposal, are generally substantially less than the commenter's estimate of $30,000 per vessel. For example, if all seven of the vessels in the large benzene production model plant were degassed (which EPA believes would not be necessary to comply with the standards), the EPA's estimated cost is $47,000 (1982 dollars). The corresponding annualized cost over the 10-year period assumed for the rest of the equipment components is estimated to be $7,600 (1982 dollars).[2]

In light of the expected infrequency of the events noted by the commenter and the estimated cost of degassing, it is the EPA's engineering judgment that these events would be unlikely to substantially increase the nationwide annual costs of the standard.

Comment: Another commenter (XII-D-199 and XII-D-247) noted that although his company is currently retrofitting two vessels with additional seals and/or an IFR, an additional 4 tons per year (tpy) reduction at his plant would be necessary in order to comply with the emission limit proposed under Approach D. He projected the costs of routing storage vessel emissions to a control device to meet the Approach D standard to be between $10,000,000 for carbon canisters to $15,000,000 for using an existing flare system. He noted that Approach D controls are expensive because they require a step-change in control technology, with vessel replacement or rebuilding, rather than retrofit.

Response: Because Approach D was not chosen as the basis for the final rule, this comment is not relevant to the final standards.

4.4 APPLICABILITY OF STANDARDS

Comment: A spokesman for the City of Saint Louis, Division of Air Pollution Control (Docket No. A-80-14, Item XII-D-03), objected to the applicability of the proposed NESHAP for benzene storage vessels under all approaches because they exempt those vessels on trucks, rail cars, and barges of 10,000 gallons or greater capacity. While acknowledging that the use of floating roofs on such vessels is impractical, the Division said that provisions such as those proposed under Approach C in Section 61.273 should apply, which allows the use of alternative measures of emission control.

He stated that 11 rail tankers full of benzene arrive twice a week at a facility in the city for transfer to barges, trucks, or a 900,000-gallon storage vessel. Since the barges are on a navigable waterway, they are under the jurisdiction of the Federal government. He stated that the Missouri legislators have determined not to adopt regulations more stringent than those that apply to other States, so that if the NESHAP exempts trucks, rail cars, and barges, the State will not regulate them. The objection to the exemption in the NESHAP was based on calculations by the Division showing that transfer from the rail cars to barges emitted 114 tons of benzene in 1987. The Division felt this exposed the people in the vicinity of this facility to excessive amounts of benzene.

Response: The control technologies that would be necessary to control benzene emissions from storage vessels attached to mobile vehicles, such as tankers, barges, or tank trucks, are different from those that are typical for other storage vessels. Additionally, data collection on tankers, barges, and tank trucks was not part of the surveys performed by EPA to develop a data base to support the benzene storage vessel NESHAP. For these reasons, it was never the intent of EPA to consider these types of benzene storage vessels as designated sources under this NESHAP. Therefore, storage vessels attached to mobile vehicles have been specifically excluded in Section 61.270(d). This source category will be addressed separately as "benzene transfer operations," which is part of the EPA's response to the court decision in Natural Resources Defense Council, Inc., et. al v. U. S. EPA and American Petroleum Institute v. U. S. EPA (U.S. District Court, District of Columbia, No. 83-2011 and 83-2951).

Comment: Another commenter (Docket No. A-80-14, Item XII-D-04) requested clarification as to whether independent "for hire" storage vessels would be subject to the proposed regulations. He felt that since these operations do not process benzene, do not have any processing equipment, and are not connected to any processing plants or refineries, EPA did not intend to regulate them beyond the new source performance standards (NSPS) for storage vessels. The commenter stated that storage terminals do not have the constant throughput demand of a petrochemical plant or refinery and that terminals average approximately 4.2 vessel throughputs per year. He stated that the vessel and roof fitting loss calculations for storage-only vessels would be 15 to 20 times smaller than those presented in the BID for the rules proposed for benzene storage vessels in 1980. He also noted that the BID did not consider that a public storage terminal would not benefit from a recovery process like carbon absorption because it does not own the liquid recovered.

Response: The EPA has always clearly intended that the benzene storage vessel NESHAP would apply to independent bulk storage terminals. These independent terminals are similar to tank farms associated with refineries and processing plants, which are also covered by the standard. A model plant for these facilities was included in the technical analysis. This plant was developed based on information provided in responses to Section 114 requests in 1979; this information included responses from four public storage facilities.[3]

Only one of the responses from bulk storage facilities provided information about the number of turnovers. The model plant assumes 9 turnovers, compared to the 4.2 turnovers reported by the commenter. The EPA agrees that the working losses would be lower in vessels with a lower number of turnovers. However, the lower number of turnovers would not affect the breathing losses, which are a function of vessel size and diurnal temperature change. Furthermore, there may be other plant characteristics, different from the EPA's model plant, that would tend to cause higher emissions. For example, the model plant has only two vessels; in contrast, EPA has information that at least one bulk storage facility recently had five vessels storing benzene.[4]

In the development of the NSPS for VOC emissions from volatile organic liquid (VOL) storage vessels, EPA considered an exemption based on the number of turnovers. The EPA found that the number of turnovers that any one vessel undergoes in a year is neither constant, nor highly predictable at the time of construction or retrofit. A standard designed to exempt vessels based on low turnover rates would therefore be impractical from both the perspective of enforcement and of compliance. The EPA concluded at that time that such an exemption was not warranted.[5]

4.5 WORDING OF STANDARDS

Comment: One commenter (XII-D-34) stated that the American Society of Testing and Materials (ASTM) had changed the wording for "Nitration Grade Benzene" and suggested that the wording of 40 CFR 61.270(a) be changed to be consistent with the revised wording.

Response: The EPA agrees with the commenter that the wording of Section 61.270 (a) should be changed. Section 61.270(a) has been revised to specify:

ASTM D 836-84	Industrial Grade Benzene
ASTM D 835-85	Refined Benzene-485
ASTM D 2359-85a	Refined Benzene-535
ASTM D 4734-87	Refined Benzene-545

The above specifications represent the ASTM specification for various grades of benzene and are consistent with the grades EPA intended to regulate under these standards.

Comment: One commenter (XII-D-220) noted that with the exception of Section 61.271(a)(8) of the proposed regulation, all other requirements for vessels with internal floating roofs (IFR's) under Section 61.271(a) allow retrofits to take place the first time the vessel is emptied and degassed or 10 years from the date of promulgation, whichever comes first. As stated in the proposal for Approaches A, B, and C, Section 61.271(a)(8), which requires retrofitting of vessel openings to extend below the liquid surface, does not include this time provision. The commenter recommended that the compliance schedule for paragraph (a)(8) be rewritten similar to that in Sections 61.271(a)(4) and (5) of the regulation proposed under Approaches A, B, and C.

Response: This provision, in Section 61.271(a)(4) of the final standards, has not been changed. The API publication, "Evaporation Loss from Internal Floating-Roof Tanks," presents general descriptions of the components in use for IFR vessels (Docket No. A-80-14, Item IV-H-4). This publication describes two basic designs including noncontact floating roof decks, and both of these designs are provided with projections that extend below the liquid surface wherever penetrations occur in the deck. The 2519 test series upon which the emission factors for these vessels are based used a noncontact IFR with such projections as well. The EPA considers the noncontact deck provided with projections extending below the liquid surface at each opening to be the typical configuration. The intent of this requirement in the regulation is to ensure that vessels with noncontact IFR's conform with the typical baseline level of control. Therefore, it is unnecessary and unreasonable to allow a delay in compliance with this requirement.

4.6 REGULATORY CONSISTENCY

Comment: Several commenters were concerned that the final NESHAP should be consistent with the benzene storage vessel NSPS to which they are already subject. The CMA (XII-D-59) and its supporters and Commenter XII-D-34 advocated that the reporting and recordkeeping requirements of the new benzene storage vessels should be consistent with those requirements for VOL storage vessels under 40 CFR 60 Subpart Kb.

Another commenter (XII-D-199 and XII-D-247) proposed that EPA should make the benzene regulations as consistent with other regulations as possible in order to eliminate confusion and promote better compliance. He recommended that EPA adopt the NSPS requirements for storage vessels in Subpart Kb directly, since the proposed regulations for benzene vessels are so close already for seals and floating roofs. Commenter XII-D-247 suggested that this could be accomplished by adding a sentence to the existing benzene NESHAP (for equipment leaks) requiring all vessels to comply with Subpart Kb and by revising Sections 61.246 (Recordkeeping) and 61.247 (Reporting) of the equipment leaks standards to include vessels.

Response: The differences in the statutory requirements of Sections 111 and 112 of the CAA may result in different standards for emission sources that are similar. As the commenters noted, the control level that was proposed as an ample margin of safety under Approaches A, B, and C is based on control equipment similar to that in the NSPS for VOL storage vessels (40 CFR 60 Subpart Kb). Consequently, where appropriate, EPA made the wording of the requirements similar between Part 61 Subpart Y and Part 60 Subpart Kb. However, there are also appropriate differences, such as control requirements for existing as well as for new benzene storage vessels.

Comment: One commenter (XII-D-34) noted that the proposed standards permits an owner up to 10 years to install additional seals as controls, but only allows 60 days to fix a defective seal should it not pass the required yearly inspection. He viewed this as inconsistent and recommended that the repair be extended up to 18 months if immediate repair is not feasible. He asked EPA to consider, when setting the time period, that emptying the vessel and loading other vessels with the product would also create emissions. Another commenter (XII-D-104) advocated that EPA clarify compliance requirements to allow for repair of damaged seals without the facility being out of compliance.

Response: The inspections to which the first commenter (XII-D-34) referred are annual visual inspections from outside the vessel. These inspections would detect failures of the floating roof, such as a sunken roof or gaps in the seal. Such failures prohibit the roof from functioning as intended, until repair is made. The final standards (those proposed under Approaches A, B, and C) require that all existing fixed roof vessels be equipped with IFR's with continuous seals within 90 days of the effective date of the standards, unless a waiver of compliance has been granted. The EPA judged that it is reasonable to repair failures of these IFR's shortly after they are detected, rather than allowing the condition warranting repair to continue until the next scheduled degassing, or a period of up to 18 months, as suggested by the commenter.

However, EPA considered a 45-day (rather than the 30 days allowed by the standards proposed under Approaches A, B, and C) repair period, with a 30-day extension possible; the 45-day period would be consistent with the NSPS for VOL storage vessels (40 CFR 60 Subpart Kb). The reason that 40 CFR 60 Subpart Kb has a 45-day (versus 30-day) repair period is that in the event that special materials not normally kept in stock by suppliers were needed (such as Teflon® seals), 30 days would probably be insufficient for repair of this equipment.[6,7] The same situation would exist for vessels subject to the benzene rule. Therefore, EPA determined that it was reasonable to make this rule consistent with Subpart Kb. A 30-day extension may still be requested if repairs are likely to exceed the initial 45-day repair period. Facilities would not be out of compliance as long as repairs were completed within these time periods.

The requirements to add certain pieces of equipment at the first degassing was part of the option chosen by the Administrator to be proposed under Approaches A, B, and C and to provide an ample margin of safety for the final rule. The option was based on a grouping of controls that achieve similar emission reductions on a typical vessel given the costs of achieving them. The largest emission reductions are achieved with all fixed roof vessels having IFR's with continuous seals, and with retrofitting liquid-mounted primary seals and secondary seals on existing EFR vessels having vapor-mounted primary seals. These are required within 90 days of the effective date unless a waiver of compliance of up to 2 years has been granted. Smaller emission reductions are estimated to be achieved by the equipment that is not required until the first degassing (i.e., the cost of degassing would not be incurred only to add this equipment). This equipment is the addition of gasketed fittings on continuous IFR's that were in place before the effective date of the standards, and the addition of secondary seals on external floating roofs (EFR's) that were equipped with the best type of primary seals (i.e., liquid-mounted primary seals) before the effective date of the standards.

4.7 REFERENCES

1. Memorandum from Pelland, Alice, Radian Corporation, to Benzene Docket. May 24, 1988. Cost Analysis for Control of Benzene Emissions from Benzene Storage Tanks. Docket No. A-80-14, Item No. X-A-1.

2. Reference 1.

3. U. S. Environmental Protection Agency. Benzene Emissions from Benzene Storage Tanks - Background Information Document. Publication No. EPA-450/3-80-034a. Research Triangle Park, NC. December 1980.

4. Letter from Adamsky, Brian K., Unitank Terminal Service, to Hyunh, Thomas, Air Management Services, City of Philadelphia. June 12, 1987. Attachment (3) to: Motion for Partial Summary Judgment and Schedule of Attachments. Civil Action No. 87-6793, U.S. District Court for the Eastern District of Pennsylvania. United States of America, Plantiff, v. Unitank Terminal Service, et. al., Defendants. March 1989.

5. U. S. Environmental Protection Agency. VOC Emissions from Volatile Organic Liquid Storage Tanks - Background Information for Promulgated Standards. Publication No. EPA-450/3-81-003b. Research Triangle Park, NC. January 1987.

6. Telecon. Taylor, D., Midwest Research Institute, with Olsen, K., High Rise Services Corp. December 13, 1984. Inspection procedures for storage vessels.

7. Telecon. Friedman, E. M., Midwest Research Institute, with Ferry, R., Conservatek, Inc. December 11, 1984. Supply constraints for storage vessel repairs.

5.0 EQUIPMENT LEAKS

5.1 INTRODUCTION

Most of the commenters who expressed views on the equipment leaks source category were representatives of industries who were concerned about how the proposed standards under Approach C or D would affect them, or who raised technical points about complying with either of these emission limitations.

The comments discussed here concern control technologies, emissions estimates, cost estimates, demonstration of compliance, and specific points about the wording of the proposed benzene equipment leaks standard.

5.2 CONTROL TECHNOLOGIES

Several commenters discussed control technologies for pumps, flanges and valves, general availability of controls, and whether these technologies would enable facilities with equipment leaks to achieve compliance with the proposed standards under Approach C or D.

General Feasibility of Approach C or D Standards

Comment: Commenters XII-D-220, XII-D-247, and Docket No. A-79-27, Item IX-D-13, pointed out that standards proposed under Approaches C and D essentially put a cap on the maximum number of various pieces of equipment that could be present at a facility if the facility were not to exceed the emissions limit. Commenter XII-D-220 used the EPA stratified emission factors for equipment screening between 0 and 1,000 parts per million (ppm), the lowest generally accepted emission factors, to show that a facility could only have 20 valves, or 2 pumps, or 291 flanges before the proposed 0.14 kg/day limit of Approach D was exceeded. Commenter A-79-27, IX-D-13 stated that using the average emission factor for light liquid valves to calculate emissions, a plant could have no more than 82 light liquid valves without exceeding the proposed Approach C emission limit, and no more than 1 light liquid valve without exceeding the proposed Approach D emission limit.

Commenter XII-D-59 pointed out that even at a chemical facility where emissions from relief valves are routed to a flare system, where leakless pump technology is used, and where all open-ended lines are capped, the EPA's emission factor methodology was found to produce emissions estimates far in excess of even Approach C's 14 kg/day limit. Another commenter (XII-D-255) reported that site-by-site estimates of total air emissions indicates that none of its five facilities are below the 14 kg/day emission limit of Approach C and that most of the emissions are from equipment containing less than 10 percent benzene.

Commenter XII-D-199 stated that fugitive emissions could not be reduced significantly without the development of new technology. The commenter stated that even using the EPA's correlation curve method for calculation of emissions from his facility's 9,500 equipment components, their current emissions were 20 times higher than what would be allowed under the proposed Approach D limits. Such a major step change in emissions could not, according to the commenter, be achieved with any of the currently available control technologies. The commenter went on to discuss controls for specific equipment types.

Commenter XII-D-199 (and XII-D-247) estimated that emissions from 44 out of 46 pumps at his company could be reduced by a total of 0.2 to 0.3 tons/year by installation of either pumps with dual mechanical seals with barrier fluid or canned pumps (see Docket No. A-79-27, Item IX-E-6). The commenter considered dual mechanical seals to be a demonstrated technology, but stated that canned pumps have not been demonstrated for his company's EB/S unit's size and horsepower. Therefore, the commenter would expect problems in installing, operating and maintaining canned pumps. The other two pumps in the commenter's company are in corrosive service; the commenter did not know of any existing dual mechanical seal or canned pump designs which could withstand such conditions.

Commenter XII-D-199 stated that there is no known available technology to reduce flange emissions. The commenter discussed three theoretical methods to reduce flange emissions: routing to control devices, replacing the gasket material, and welding all flanges. The commenter stated that for his company's 7,000 separate flanges, routing to a control device would involve installing miles of piping and ensuring that there were no leaks from the piping or from leak capture devices. The commenter eliminated gasket material replacement as a possibility, since his company knew of no available nonleak material. The commenter further stated that the final choice, elimination of all flanges, was not practical because it would make it difficult to isolate and evacuate equipment so that maintenance could be performed safely. Even if some flanges could be eliminated, it would not be enough to reduce emissions to target levels.

Commenter XII-D-199 stated that his company has approximately 2,500 valves, many in processes that are corrosive in nature. The company had considered replacement with pinch and bellows valves, but did not feel that these technologies were readily available and demonstrated for their type of service. The commenter stated that a 3- to 4-year demonstration period would be needed to evaluate equipment failure rates before there could be any large scale use of these valves.

The commenter concluded that the lack of demonstrated technology to control valve and flange emissions would contribute to his facility's inability to meet the proposed Approach C and D limits.

Response: The EPA understood at the time of proposal that the proposed Approaches C and D equipment leaks emission limits would require performance beyond that which is achievable (or demonstrable) with existing technology and would limit the number of components at a facility. It is for this reason that EPA concluded that widespread closure could result from these standards should they be promulgated. Since the final decision does not implement one of these proposed emission limits, these issues are no longer relevant. Consequently, responses are not provided on these issues.

Feasibility for Pumps

Comment: Commenter XII-D-220 stated that a study of his company's maintenance records shows that dual mechanical seals on pumps last an average of only 8 months, versus 2 years for single mechanical seals. The commenter pointed out that shutdowns or upsets due to seal failures can, along with taking a pump out of service, lead to significant emissions; thus, net VOC emissions may actually be higher with dual mechanical seal pumps. The commenter suggested that EPA consider this issue when setting equipment leaks standards. The commenter wrote that his company was recommending that improved single seal designs be used on all their new installations.

Response: The specific issues regarding seal life and overall VOC reduction have not been investigated since EPA has not required sources to use dual mechanical seals on pumps. That is, because operating conditions in a given process determine the applicability and life of equipment, the existing standards for equipment leaks do allow the owner or operator of each source to determine for itself the best means of complying with the standards. In addition, neither of the standards proposed under Approach C or D required use of specific equipment.

Feasibility for Valves

Comment: One commenter (XII-F-17 and XII-D-198), an equipment vendor, described the development by his company of a bellows sealing mechanism which provides for hermetic sealing of rotary (quarter-turn) valves. The commenter stated that the current bellows design available from his company can be applied to typical ball and plug valves through 6 inches in size and butterfly valves through 12 inches in size, and that the technology is suitable for any rotary ball, plug, or butterfly valve. It can be applied to rotary motion of up to 360°. The commenter also stated that all wetted parts are of corrosion resistant materials, and that the design can satisfy the full pressure range for either Class 150-225 pounds per square inch (psi) or Class 300-720 psi service.

The commenter wrote that a stainless steel housing surrounding the bellows assembly provides, among other things, protection from external mechanical or chemical attack, and a backup sealing capability in the event of a bellows leak. The commenter acknowledged however, that an optimum solution to this and other problems has not yet been devised.

The commenter indicated that this technology has been used in borated water systems since the early 1960's, and testing of the original bellows seal concept and subsequent improvements have been conducted over the past 8 years. The commenter wrote that field trial units are currently underway in a wide range of specific applications including phosgene, hydrogen, benzene, chlorine, ammonia, uranium hexafluoride (UF_6), and high-purity fluids.

The commenter indicated that this technology is capable of achieving valve leakage rates below 1×10^{-8}. Overall, the commenter estimated that the technology applied to about 80 to 85 percent of the process valves in a typical piping system. For a typical $100 million facility, the commenter predicted that this technology could be installed at an additional cost of about 1 percent of capital costs or less.

Comment: Commenter XII-D-59 and XII-D-248 rebutted the presentation of Commenter XII-F-17, stating that sealed bellows valves, while useful in some situations, were not an acceptable control technology for all situations. Commenter XII-D-248 noted that bellows valves have limited applicability because they are not available in all materials, cannot be used in some high pressure applications, and are not suitable for fluids that may polymerize and restrict the movement of the bellows. Further, they are not generally available for process lines over nominal pipe sizes 6 for gate valves and 8 for globe valves, and only one manufacturer has a bellows seal that can be used on quarter-turn valves. The commenter also said that the lifetime of bellows equipment is unknown. He said a survey of plants showed that, for a 3-year period of use, reported failures ranged from 0 to 30 percent. The commenter also said there is a potential for high emissions when bellows valves fail. These valves still require a packing gland. The commenter said that if plants neglect packing maintenance, a catastrophic failure of the bellows may result; but if maintenance is good, plants may not detect the failure of the bellows. In the opinion of the commenter, valves without bellows seals already provide good service.

Response: Information available to EPA continues to support the conclusion that while sealed bellows valves are useful in some situations, they are not universally applicable and thus will not eliminate all benzene emissions from valves (Docket No. A-79-27, Item VII-A-2). Some of the considerations which have limited the applicability of sealed bellows valves are variability of service life, corrosion and mechanical failure in service with many chemicals, significant emissions when the bellows fail, and limits on pressure and temperature of service streams. The availability of alternative and equivalent performance systems demonstrates the advantage of standards which do not prescribe specific control equipment but instead give emission or performance levels which sources can achieve using any means available.

Other Comments

Comment: Commenter XII-D-220 advocated that equipment be considered "available" only after it has received adequate field trials and all aspects of the equipment operation have been properly evaluated.

One commenter (XII-D-199 and XII-D-247) emphasized that equipment controls instituted to attempt to meet Approaches C and D levels carried their own safety and environmental risks. The installation of new equipment could cause increased emissions at that time, and could also decrease safety thereby increasing risks for plant personnel and the community.

Response: In keeping with the Vinyl Chloride decision, the criterion of availability of technology cannot be considered in a NESHAP rulemaking decision unless it is considered in the ample margin of safety step.

Because neither EPA nor the commenter identified any equipment or control measures to achieve these proposed standards, EPA cannot evaluate safety issues connected with controls. Since EPA cannot know the details of the operating conditions at each individual plant, it is up to the owner or operator of each plant to evaluate such issues.

5.3 EMISSIONS ESTIMATION

Several commenters felt that EPA had substantially overestimated emissions from equipment leaks. Three commenters discussed what they saw as flaws in the emissions estimation methodology. Two other commenters discussed measured or predicted ambient air benzene concentrations which were significantly lower than the EPA's prediction as indicating that emissions were overestimated.

Emissions Estimation Methodology

Comment: Commenter XII-D-32 stated that the conventional synthetic organic chemical manufacturing industry (SOCMI) factors, developed from refinery data where the key issue was flammability of chemicals, were not appropriate for facilities that had to comply with the low Occupational Safety and Health Administration (OSHA) exposure limits presently in force for toxic chemicals such as benzene. The commenter attached several papers in support of the point that facilities handling toxic chemicals and facing low OSHA limits had emission factors lower than the SOCMI factors.

Commenter XII-D-59 (the CMA) and their supporters believed the estimated total benzene emissions of 2,500 Mg/yr to be substantially overstated for three reasons: (1) the estimate assumed a higher percentage of leaking components than is actually found in the chemical industry, (2) the estimate assumed higher emission rates for both leaking and nonleaking components than are actually found in the chemical industry, and (3) the estimate does not accurately reflect the extent to which effective control components are used in the chemical industry. The commenter referenced several studies in support of these points. Three of these studies, including one with bagging data, pointed to the conclusion that the percentage of components screening as zero in chemical facilities is higher than the maximum percentage implied in the screening value distributions used to develop the EPA's "leak/no leak" factors. The CMA argued that EPA should have developed more realistic estimates of benzene emissions.

One commenter (Docket No. A-79-27, Item IX-D-04) stated that the emissions data and information in "Benzene Fugitive Emissions -- Background Information for Promulgated Standards", EPA-450/3-8-032b, was in some cases wrong or highly suspect and contributed to overconservative emission estimates. The commenter pointed out that Table C-2 in this document showed Plant Number 75 as having benzene emissions of 1.92 g/sec from sources subject to the original benzene NESHAP; however, the commenter's company is confident that those emissions are actually less than 0.71 g/sec.

Response: In the July 28, 1988, notice (53 FR 28496) EPA discussed many of the same concerns expressed by the commenters and indicated that this overstatement of emissions was a consideration in the proposed decision under Approach A. No quantitative estimates of the overstatement, or the bias, were presented at proposal because of the limited data available. Moreover, better estimates could not be developed because an industry-wide study of the necessary scope could not be conducted within the 180-day period allowed by the court order for proposal.

Since proposal, EPA has further considered whether a better estimate of emissions or an estimate of the likely bias could be made. In this, EPA recognized that complete resolution of the issues would require a major research effort including extensive mass emission measurements for components screening at 0 to 200 ppm. Such a fundamental assessment was not feasible in the year between proposal and promulgation. Consequently, efforts were directed at developing an estimate of the expected bias. This was evaluated using information from compliance reports and emission studies of units handling air toxics. The specific information obtained and considered is summarized below.

To consider a representative sample of current performance from compliance reports, EPA randomly selected a sample of 25 facilities in Texas subject to the benzene NESHAP, many of them large plants and some with more than 1,000 pieces of equipment. This sample included roughly equal numbers of refinery and SOCMI facilities. Next, the most recent year's worth of self-monitoring records were obtained for as many facilities in the sample as time would allow. Almost all of these data are for 1987 and 1988 and the data are presumed to reflect the current status of equipment leak emissions control. From the monthly values reported for the number of pumps and valves found to be leaking, the average percentage leakers rates for pumps and valves were calculated for each plant.

In addition, self-monitoring reports for 11 facilities in Louisiana were provided by State Office of Air Quality officials, and were selected at random from readily available files of facilities required to report emissions of hazardous air pollutants. Almost all of these facilities were SOCMI plants. Average percentage leaker rates for pumps and valves were also calculated for these plants.

Many of these units had no leaking pumps or valves (i.e., a leak frequency of 0.0 percent), and the average leak frequencies were 0.27 percent for valves and 2.3 percent for pumps (see Docket No. A-79-27, Item IX-B-5). As shown in Table 5-1, these leak frequencies are comparable to the leak frequencies reported for a survey of facilities that was submitted by CMA (Docket No. A-79-27, Item IX-D-08). These leak frequencies are lower than the average expected leak rates of 3 to 5 percent for valves and roughly 10 percent for pumps.

In addition to the compliance reports for facilities subject to the existing NESHAP, EPA also reviewed a limited amount of more comprehensive data for several process units with equipment in benzene service. The derived component average emission rates for these units are summarized in Table 5-2. For these units, the measured concentrations showed emission rates that were up to 20 to 30 times lower than would be predicted using the EPA's estimation procedures.

Data for other air toxics show a similar pattern. Specifically, recent comprehensive studies on process units handling butadiene or ethylene oxide indicate average leak frequencies of 0 to 5 percent and emission rates that are a factor of 5 to 20, or more, lower than the EPA's estimates. These data were obtained from 12 butadiene and 10 ethylene oxide producers using a joint EPA-CMA protocol for the data collection. These data are one of the more comprehensive sets available and are considered to be representative of facilities handling these compounds. Table 5-3 compares the derived average emission factors for ethylene oxide and butadiene with average refinery factors and with the derived estimates for one benzene unit.

Based on this information, and the information from the Subpart J compliance reports, EPA concluded that control levels being achieved are significantly better than originally predicted. Based on limited comprehensive data for benzene process units and the comprehensive data for other air toxics, benzene equipment leak emissions may be overstated by a factor of 5 to 20.

Although this information provides an indication of the magnitude of the bias in the emission estimates, it is not a sufficient basis for actually developing new emission factors that would be generally applicable to all

TABLE 5-1. A COMPARISON OF LEAK RATES BY COMPONENT FOR SUBPART J MONITORING REPORTS AND CMA SURVEY DATA

Component	Subpart J Monitoring Reports	CMA Member Survey
Valves, gas	0.27%[a]	0.37%
(range)	(0 - 1.3%)	(0 - 4.0%)
liquid	0.27%[a]	0.49%
(range)	(0 - 1.3%)	(0 - 4.0%)
Pumps	2.27%	2.7%
(range)	(0 - 12.5%)	(0 - 25%)
Pressure relief valves,		
gas	NA	1.2%
light liquid	NA	0.85%
Flanges	NA	0.036%

[a] Compliance reports do not distinguish between service types for valves.

NA - not available. Compliance reports do not include survey of pressure relief valves or flanges.

TABLE 5-2. COMPARISON OF AVERAGE EMISSION FACTORS, UNADJUSTED FOR BENZENE CONTENT, FOR EQUIPMENT IN BENZENE SERVICE

Equipment Component	Emission Factor (kg/hr/source)			
	Average Refinery Controlled[a]	Docket No. A-79-27 Item IX-D-15[b]	CMA Survey[c]	Docket No. OAQPS 79-3 Item XII-D-59[d]
Gas Valves	0.0072	0.000306	0.00065	0.000081
Light Liquid Valves	0.0045	0.000306	0.00212	0.00094
Pumps	0.0445	0.00086	0.0235	NA
Flanges	0.00025	0.00002	0.00007	NA

[a] EPA emission factors used to calculate emission levels expected after application of NESHAP controls.

[b] From screening survey results and correlation curve.

[c] From leak/no-leak factors and survey composited data for 20 companies (Docket No. A-79-27, Item IX-D-08). Thus, the estimated factor will have as a minimum the emission rate of the no-leak factor and hence will overstate emissions at facilities which primarily had components screening at 0 ppm.

[d] From stratified factors and the number of leaking, nonleaking, and zero screening valves reported in "A Review of the Performance of Plants Subject to the Benzene Fugitive Emission Rules" in Session 93, Air Toxics Fugitive Emission Inventories, the 80th Annual Meeting of APCA, June 1987, Attachment 2 (Docket No. OAQPS 79-3, Part I, Item XII-D-59). These estimates may be slightly overstated (< a factor of 3) due to the high proportion of zero screening valves (97.8 percent) and the uncertainties in the correlation at concentrations lower than 100 ppm.

NA = not available.

TABLE 5-3. COMPARISON OF AVERAGE EMISSION FACTORS FOR ETHYLENE OXIDE AND BUTADIENE WITH REFINERY FACTOR ESTIMATES

Equipment Component	Emission Factor (kg/hr/source)								
	Average Uncontrolled Refinery	Average Uncontrolled SOCMI	Average Refinery (Monthly LDAR)[a]	Average SOCMI (Monthly LDAR)	Average Butadiene	High Butadiene	Average Ethylene Oxide	High Ethylene Oxide	Docket No. A-79-27 Item IX-D-15[b]
					(from EPA correlations)				
Gas Valves	0.0268	0.0056	0.0072	0.0015	0.0002	0.00033	0.00014	0.00022	0.000306
Light Liquid Valves	0.0109	0.0031	0.0045	0.0029	0.0012	0.0014	0.0005	0	0.000306
Pumps	0.114	0.0494	0.0445	0.0193	0.0033	0.0049	0.0079	0.041	0.00086
Flanges	0.00025	0.00083	NA	NA	0.00023	0.00021	0.00084	0.0017	0.00002

[a] Emission rates used to calculate emission levels expected under the NESHAP. LDAR = leak detection and repair.

[b] From screening survey results and EPA correlations.

NA = not available.

facilities. This occurs because leak frequency and the associated emission rates vary widely among facilities and are believed to be a function of original design, age of the process unit, equipment used, quality of the maintenance, and motivation. Development of less biased emission estimates requires information that is not available at this time and that can only be obtained through an extensive study of the industry. Consequently, EPA has not yet been able to develop better estimates and the emission estimates remain as presented in the proposal notice. However, EPA has begun compiling a data base for equipment component screening and bagging data of sufficient quality to develop revised emission factors and leak rate/screening value correlations.

In response to Commenter Docket No. A-79-27, Item IX-D-04, EPA would like to point out that the Table C-2 of the final BID to which the commenter referred gives pre-NESHAP baseline emissions estimates. For the emissions and risk assessment for the current rulemaking, EPA assumed emission rates which reflected the level of control projected to have been achieved under the existing NESHAP. For Plant Number 75, this post-NESHAP emission rate was 0.68 g/sec, which is slightly less than the 0.71 g/sec cited by the commenter.

Modeled and Monitored Ambient Concentrations

Comment: One commenter (Docket No. A-79-27, Item IX-D-04) pointed out that Table C-2 shows a predicted maximum annual average benzene concentration of 25 micrograms per cubic meter (ug/m^3) in the vicinity of Plant Number 105. The commenter stated that a study done by the Texas State Air Control Board and based on actual monitoring data, showed the average benzene concentration in the vicinity of that plant to be 6 ug/m^3. The commenter also cited other data from the same study which showed that the annual average ambient benzene concentration in one city with many benzene sources ranges from 4 to 20 ug/m^3, and that similar concentrations were measured in another city with no significant stationary sources of benzene.

Response: The concentration of 25 ug/m^3 for Plant Number 105 which the commenter cited was the maximum annual average benzene concentration for baseline emissions before the benzene NESHAP was promulgated. The modeled maximum annual average benzene concentration for Plant Number 105 under the current NESHAP is 7.3 ug/m^3; this is the value with which the commenter should be making comparisons.

The EPA obtained a copy of the ambient monitoring report to which the commenter referred. Included in this report was information on the precision and accuracy of the monitoring results. The EPA feels that the comparison of the 7.3 ug/m^3 predicted by the EPA's Human Exposure Model (HEM) to the 6 ug/m^3 calculated from study data for the vicinity of this particular plant shows the two values are in agreement given the range of uncertainty of the model, uncertainties in the emissions estimates, and the uncertainties in the analysis of the ambient monitoring samples.

Comment: One commenter (XII-D-199) compared the EPA's typical predicted fugitive emission impacts of 24 parts per billion (ppb) with the 4.3 ppb fenceline emission level which his company had modeled based on their emission estimate for equipment leaks. The commenter further stated that after his company finished storage vessel modifications, their emissions would yield a fenceline concentration of 1.3 ppb. The commenter pointed out that his plant was older than most in the industry and their fenceline was close to their neighbors. Furthermore, the commenter compared the 1.3 ppb to typical background concentrations of 5 to 6 ppb. The commenter believed that the EPA's analysis would result in requiring controls when risks were actually already at an acceptable level.

Response: The EPA contacted the commenter to determine the basis for the conclusion that typical modeled maximum concentrations were 24 ppb (Docket No. A-79-27, Item IX-E-9). The commenter calculated the 24 ppb concentration by dividing the 6 x 10^{-4} MIR given for equipment leaks in Table IV-2, 53 FR 28510 of the preamble, by the unit risk factor of 0.026/ppm cited in the preamble.

According to the EPA's modeling results and calculations for the commenter's specific facility, the maximum benzene concentration predicted for that facility under the existing NESHAP would be approximately 27.3 ug/m^3, or 8.5 ppb. The difference between this 8.5 ppb and the 4.3 ppb modeled by the commenter is within the uncertainty ranges of the emission estimates and differences among dispersion models.

Comment: One commenter (XII-D-255) reported that benzene concentrations (of 1 to 3 ppb) measured at the fenceline at five facilities are an order of magnitude less than those EPA apparently used in the risk estimate.

Response: Information provided by the commenter regarding the benzene concentrations and the conditions under which they were measured is insufficient to evaluate the comparison. Without knowing such information as the wind direction and speed, the monitoring method, whether the concentrations were annual averages or represent grab samples, it is impossible to compare the annual average concentrations modeled by EPA to the concentrations cited by the commenter. However, agreement to within an order of magnitude is well within the uncertainty of the estimates.

5.4 PLANT LOCATIONS USED IN RISK ESTIMATION

Comment: Commenter XII-D-253 (API) reviewed the plant locations used by EPA in risk modeling for equipment leaks. They stated that the latitude and longitude used for 65 of the 131 equipment leaks sources were in error and provided new coordinates for 55 of these emission sources. Copies of United States Geological Survey (USGS) maps showing the plant locations were also submitted. The commenter claimed that the errors in plant location could lead to drastic changes in estimates of risks, particularly MIR. The commenter also used the maps to identify the distance from the emission source to the closest residence, and found that for many plants, the distance was greater than assumed by the HEM. The commenter thought that this could also cause overestimation of MIR.

Response: The EPA has rerun the HEM using the API's coordinates to consider the effect of facility location on estimated MIR, incidence, and risk distribution. The revised analysis used the facility locations provided by the commenter for 55 of the 131 plants. The EPA spot checked some of these latitudes and longitudes against USGS maps provided by the commenter to verify that the coordinates were reasonable, and corrected one error found.

The EPA also calculated coordinates for 10 plants that the commenter indicated were in error but did not provide new coordinates. Finally, the locations of the other 65 plants were also reviewed, and several corrections were made. In particular, locations assigned to some facilities had been inadvertently switched in the previous model run. Also, seven plants which are known to be closed or no longer use benzene were deleted.

The revised risk estimates are located in Docket No. A-79-27, Item IX-B-1. A comparison of the revised results with the previous HEM run (Table 5-4) shows that there is no change in the overall MIR or incidence for the equipment leak source category. Changes in the risk distribution are also negligible. Although the locations of 77 plants changed, MIR increased or decreased for only 30 individual plants. The magnitude of the change varied from about 2 percent for some plants to over three orders of magnitude (a thousand-fold change) for two plants. The change in MIR for 20 of the 30 plants was less than one order of magnitude. Those plants where the MIR changed drastically were plants that had clearly been mislocated in the previous analysis (e.g., in a bay), and the large change is reasonable. However, as previously noted, these changes at individual plants do not change the risk estimates for the source category as a whole.

The response to the commenter's points about the distance from emission sources to the nearest residences is contained in Chapter 7.0 with other comments on exposure modeling procedures.

5.5 COST ESTIMATION

Comment: Commenter XII-D-28 challenged the EPA's estimated costs for Option 1 controls (sealed bellows valves and dual mechanical seals on pumps) for equipment leaks at petroleum refineries. The commenter said that the EPA estimate averages to about $400,000 per facility. For one of his facilities, the commenter had conducted an engineering evaluation showing costs of about $1,250,000, or more than three times as great as the EPA estimates.

Response: To clarify the commenter's estimate of $1,250,000, EPA contacted the commenter for a breakdown of the costs that were included in the

TABLE 5-4. RISK[a] ESTIMATIONS USING REVISED PLANT LOCATIONS

		Risk Estimate Using Revised Plant Locations	Proposal Risk Estimate for NESHAP
Incidence (case/year)		0.2	0.2
MIR		6×10^{-4}	6×10^{-4}
Risk distribution, cumulative[b,c] (persons) (modeled to 50 km)	$\geq 1 \times 10^{-2}$	0	0
	$\geq 1 \times 10^{-3}$	0	0
	$\geq 1 \times 10^{-4}$	2,000	3,000
	$\geq 1 \times 10^{-5}$	50,000	60,000
	$\geq 1 \times 10^{-6}$	1,000,000	1,000,000
	Total Modeled	200,000,000	200,000,000
Incidence for each risk group, noncumulative[d] (case/year)	$\geq 1 \times 10^{-2}$	0	0
	$\geq 1 \times 10^{-3}$	0	0
	$\geq 1 \times 10^{-4}$	0.005	0.007
	$\geq 1 \times 10^{-5}$	0.01	0.02
	$\geq 1 \times 10^{-6}$	0.04	0.04
	$< 1 \times 10^{-6}$	0.2	0.2

[a] All risk estimates are rounded to one significant figure. Due to independent rounding, figures given in the table for risk group incidence may not sum to the value given for total incidence.

[b] The estimated number of people exposed to ambient concentrations resulting in predicted individual risk levels above the level shown. Population is cumulative (e.g., at baseline 1,000,000 people are exposed to risks greater than or equal to 1 in 1,000,000).

[c] Risks were calculated on a plant-by-plant basis and summed. Persons exposed to emissions from more than one plant were counted for each plant's impact.

[d] This is the estimated annual number of cases of leukemia for the population exposed to each risk level. It is not cumulative (e.g., at baseline there would be 0.04 case/year in the population exposed to risk levels greater than or equal to 1 in 1,000,000 but less than 1 in 100,000).

calculation of this number (Docket No. A-79-27, Item IX-E-5). According to the commenter, the calculation included only replacement of all valves by sealless valves, as the facility in question had already vented all tandem seal pumps to flares. The commenter provided a detailed list of the number, size, and current supplier-quoted costs for the valves which would be replaced. The commenter also included a labor cost for installation, and the cost of a piping system.

According to the commenter, the $1,250,000 was a one-time capital cost. Since EPA costs for equipment leaks controls presented in the preamble were all amortized costs expressed in 1979 dollars, it was necessary to convert any costs quoted by commenters to the same basis. Thus, in order to compare the $1,250,000 with the EPA cost figures for Option 1 controls, this valve replacement cost was converted to May 1979 dollars and amortized over 10 years at an interest rate of 10 percent (Docket No. A-79-27, Item IX-B-2). After adjustment, the $1,250,000 became an annualized cost of $139,000 in 1979 dollars. This is less than the average EPA estimate of $400,000 to which the commenter compared his estimated cost for his facility.

<u>Comment</u>: Commenter XII-D-199 estimated that to replace 44 of the 46 pumps at his facility in order to reduce emissions, it would cost from $4,000,000 (pumps with double seals with barrier fluid) to $15,000,000 (canned pumps).

<u>Response</u>: To clarify the commenter's estimate of $4 to $15 million, EPA contacted the commenter for a breakdown of the costs that were included in the calculation of these numbers (Docket No. A-79-27, Item IX-E-9). The commenter did not give a breakdown of what was included in these costs, but did say that they were total installed capital costs in 1988 dollars.

In order to compare these values to the EPA costs for pumps, they were converted to 1979 dollars and amortized over 2 years at a 10-percent interest rate (Docket No. A-79-27, Item IX-B-3). After adjustment, the $4 to $15 million becomes an annualized cost of $1,380,000 to $5,190,000 in 1979 dollars. For the replacement of 44 pumps, this is equivalent to an amortized cost of $31,000 to $118,000 per pump, in 1979 dollars. Although the lack of information on exactly what costs were included in the commenter's calculations admits the possibility that some legitimate costs were included which EPA is not aware of, EPA considers these cost estimates to be excessive when compared to the net annualized installed cost of $1,444 per pump calculated by EPA (Table A-4, pg. A-13, Docket No. A-79-27, Item V-B-1).

5.6 DEMONSTRATION OF COMPLIANCE

Five commenters felt that compliance with an emission limit standard would be difficult or impossible to demonstrate.

Comment: Commenter XII-D-220 expressed concern about how compliance would be determined under an emission or risk standard, since no direct measure is possible because background levels dwarf the regulated emission levels. The commenter felt that it would be totally inappropriate to determine whether a facility should shut down or not based on calculations using imprecise emission factors.

The CMA (XII-D-59) and their supporters, and Commenters XII-D-243 and Docket No. A-79-27, Item XI-D-13 felt that it would be difficult to demonstrate compliance with the emission limit of standards proposed for equipment leaks under Approaches C and D. The CMA stated that demonstration of compliance with a plant emission limit could not be done through use of the EPA's emission calculation procedures because these procedures overestimated emissions; thus, a demonstration of compliance would require bagging to measure the actual emissions. Commenters XII-D-247 and Docket No. A-79-27, Item XI-D-13 said that continuous bagging tests are not feasible, but that any interruption in continuous monitoring would leave the source owner unable to demonstrate that they were not in violation of compliance. Commenter Docket No. A-79-27, Item IX-D-13 stated that because fugitive equipment leaks occur randomly, any attempt to demonstrate compliance would have to use a statistically-based emission measurement program. The commenter stated that since the proposed emission limitation is expressed on a daily basis, his company knows of no way to assure that the cumulative emissions from fugitive sources would always be less than the proposed limitations.

<u>Response</u>: Since the final decision does not implement one of the proposed emission limits, the commenters' concerns regarding demonstration of compliance are no longer relevant. The EPA does, however, acknowledge that existing procedures for estimating emissions from equipment leaks would make demonstration of compliance difficult (and would be impossible at facilities with a large number of components). For this reason, EPA is investigating a new regulatory approach that will result in quantifiable emission levels.

<u>Comment</u>: Commenter XII-D-199 and XII-D-247 protested the lack of testing methodology to prove compliance, and stated that the testing protocol which EPA and CMA had been working on for several years had still not been finalized.

<u>Response</u>: Since the final decision does not implement one of the proposed emission limits, the presence or absence of a final test protocol is no longer relevant. It should be noted, however, that the "Protocols" document was finalized in October 1988. Before being finalized, this document was reviewed by CMA panel members and a number of others. The document number of this publication is EPA-450/3-88-010; it can be obtained from the Library Service Office (MD-35), U. S. Environmental Protection Agency, Research Triangle, Park, North Carolina 27711, or from National Technical Information Services, 5285 Port Royal Road, Springfield, Virginia 22161 (NTIS No. PB-89-138689), at $21.95 per copy.

5.7 APPLICABILITY OF STANDARDS

<u>Comment</u>: One commenter (Docket No. A-79-27, Item IX-D-05, Docket No. A-80-14, Item XII-D-04) requested clarification as to whether independent "for hire" storage vessels which do not have any processing equipment, do not process benzene, and are not connected to or dependent on petrochemical processing plants or refineries, would be subject to the proposed equipment leaks regulations. The commenter read 40 CFR 61.110 (the section on applicability), as applying to process plant equipment. Furthermore, according to the commenter, the throughput and pressure assumptions found in the BID on benzene equipment leaks showed that EPA did not study static storage conditions of public storage terminals, but limited the scope to process

industries. Therefore, the commenter strongly opposed any proposal in Subpart J which would introduce an emissions limitation on the public storage industry.

Response: Like the existing standards in Subpart J of Part 61, Title 40, the proposed alternative standards applied to each of the following equipment in benzene service: pumps, compressors, pressure relief devices, sampling connection systems, open ended lines or valves, valves, flanges and other connectors, product accumulator vessels, and any control devices or systems required by the standards. Facilities storing benzene, or materials containing greater than 10 percent benzene (by weight), include equipment such as pumps and valves that are in benzene service. Thus, any storage terminal with a throughput of 1,000 Mg of benzene per year or greater is subject to the requirements of the standard for equipment leaks of benzene. The applicability of the standard to storage terminals has not changed since the standard was promulgated (June 6, 1984, 49 FR 23948). The commenter's association apparently was aware that the standard was applicable because they notified association members of the standard and the 60-day period for filing petitions for review (Docket No. A-79-27, Item IX-J-11).

The commenter's specific arguments to support his position that the standard should not apply are also inconsistent with the intent and efforts associated with the standard. Independent terminals were included in the analysis of emissions and risks from facilities with equipment in benzene service as well as in the assessment of impacts of the standard. These analyses are presented in "Benzene Fugitive Emissions - Background Information for Promulgated Standards." Publication No. EPA-450/3-80-032b, June 1982 (Docket No. A-79-27, Item V-B-1) as well as in various memoranda to the docket (Docket No. A-79-27, Items IV-B-7, IV-B-11, and IV-B-15). As shown in the BID and the memoranda, emissions from equipment leaks depend on the number and type of equipment in benzene service and are not related to static pressure. The throughput (or quantity of benzene handled) is only related to emissions in the sense that fewer pieces of equipment would be used at very small operations than at very large ones. Since the basis for estimating emissions and risks from storage terminals (Docket No. A-79-27, Item IV-B-7) is a facility with just one pump, EPA believes that the conditions at independent storage sites have been adequately considered in the development of the standard.

The commenter's interpretation that the standard only applies to process plant equipment is based on a narrow interpretation of the language. The commenter interpreted the term "use of benzene" in Section 61.110 of the existing standard and Section 61.111(b)(2) of the proposed alternative standards to mean only "to consume benzene." There are other definitions of the word "use." In this case, the word is being used in the sense of, to carry out a purpose or action, by means of, or utilize. In this sense, the material being stored (i.e., benzene) is used to provide a service. Thus equipment at storage facilities uses benzene and is subject to the standard.

Comment: Commenter XII-D-199 pointed out that EPA seemed to ignore emissions from spills resulting from process upsets, and felt that this source would be included in the fugitives source category.

Response: The commenter did not provide sufficient information for EPA to determine whether the spills about which he was speaking are accidental, or are from equipment presently subject to Subpart J or some other regulation. If the process upsets or spills truly are the result of an accident, then their emissions are subject to the accidental release regulations in the SARA Title III, Section 304.

If the spills are from equipment subject to Subpart J, then these would be regulated by the current Subpart J requirements to minimize emissions. Without more information, EPA cannot determine the nature of the problem.

5.8 WORDING OF STANDARDS

Comment: Two commenters (XII-D-32 and XII-D-59) objected to EPA requiring the use of a draft document ("Protocols for Generating Unit-Specific Estimates for Equipment Leaks of VOC and VHAP - Draft") in Section 61.113(a) under Approaches C and D. Commenter XII-D-32 recommended that EPA either finalize the document before promulgation of the benzene equipment leaks standards, or not refer to it in the wording of the regulations for Approach C or D.

<u>Response</u>: The "Protocols" document was finalized in October 1988. Please see the response to a similar comment under the previous "Demonstration of Compliance" section.

<u>Comment</u>: Commenter XII-D-220 requested clarification on the statement in the preamble, "This 14 kg/day limit would apply to benzene emissions from all equipment contacting benzene at each and any plant site which contains equipment subject to the existing NESHAP", saying that the phrase "all equipment containing benzene" implies that equipment contacting less than 10 percent benzene (not currently covered under the existing NESHAP) would be included in the emission limit if benzene NESHAP equipment is present at the facility. The commenter objected to this if it was the EPA's intent. The commenter requested clarification on the scope of the facility emission limit, and recommended that the last sentence of Section 61.112(d) (Approach C) and Section 61.112(a) (Approach D) should be changed for clarification to "Leaking equipment shall include <u>only</u> equipment in benzene service".

<u>Response</u>: Since the standards proposed under Approach D are not being established, this question concerning the applicability is no longer relevant.

5.9 REPORTING AND RECORDKEEPING REQUIREMENTS

<u>Comment</u>: Commenter XII-D-59 urged EPA to make sure that if additional equipment leak limitations are added to Subpart J (National Emission Standard for Equipment Leaks of Benzene), that the revised Subpart J reporting and recordkeeping requirements do not duplicate and are consistent with comparable requirements under Subpart V (National Emission Standard for Equipment Leaks). Commenter XII-D-32 also stated that the proposed 40 CFR 61.114 and 40 CFR 61.115 requirements for both Approaches C and D duplicate, in some cases, the already existing corresponding requirements of 40 CFR 61.246 and 40 CFR 61.247. The commenter urged EPA to review all reporting and recordkeeping requirements, and eliminate redundancy.

<u>Response</u>: Since the existing standard has not been revised, this concern is no longer relevant.

Comment: The commenter (XII-D-32) advocated that the required period for reporting monitoring results in 61.115(a)(3) and (a)(2) for Approaches C and D respectively, be extended from 30 days to 90 days, explaining that 30 days would be too short for large plants.

Response: Since the existing standard has not been revised, the reporting requirements have not been affected and the commenter's concerns are now moot.

Comment: Commenter XII-D-32 suggested that wording of 40 CFR 61.114(b)(4) as proposed under Approach C, which requires recording of "all maintenance and repairs to each air pollutant control device in controlling benzene emissions", be clarified to indicate that it applies only to the specific control devices required by 40 CFR Subparts V and J.

Commenter XII-D-59 wrote that the proposed Sections 61.114(a)(3) and (4) under Approach D is too broad, and suggested it be modified by adding the phrase "subject to Section 61.112" at the end of paragraphs (3) and (4).

Response: Since the standard has not been revised, the commenters' concerns are no longer relevant. The EPA would like to clarify that it was not intended for 40 CFR 61.114(a)(3) and (4) under Approach C, and 61.114(b)(3) and (4) under Approach D to apply to all equipment at the plant site, but only to the equipment subject to the requirements of 40 CFR Subpart V.

Comment: Commenter XII-D-32 also suggested that existing requirements of 40 CFR 61.242-11(e) are preferable to those of 40 CFR 61.114 under Approaches C and D since they can be satisfied by automatic instrumentation and alarms rather than recordkeeping.

Response: Since the existing standard has not been revised, the monitoring requirements have not been affected and the commenter's concerns are now moot.

6.0 COKE BY-PRODUCT RECOVERY PLANTS

6.1 CONTROL TECHNIQUES

Comment: Commenters VI-D-1, VI-D-2, and VI-D-5 in Docket A-79-16 note concerns regarding the safety of coke oven gas-blanketing systems like the one EPA costed as the basis of the proposed standard for process vessels under Approaches A, B, and C. In support, the commenters cite the report, "Review of EPA NESHAP Methodology for Benzene Emissions and Risk Assessment of the Manifolded Venting System on U.S. Steel's Gary, Indiana, Coking Operations" (Docket A-79-16, Docket Item VI-E-7). In general, the report and the commenters compare risks under current plant conditions without gas blanketing to projected risks with installation of a gas blanketing system designed and costed by Kaiser Engineers for the USS Gary plant. The report and the commenters conclude that the blanketing system would increase worker risk, the risk of overpressure or underpressure of vessels, and the severity of potential fire or explosions. Commenter VI-D-2 also notes the potential safety problems associated with the introduction of explosive or oxygen-deficient gas into parts of plants where it is not currently present. According to the report, the size and the complexity of the design also would lead to system failures that result in higher emissions than under existing conditions. System reliability and safety would be enhanced only if natural gas or nitrogen were used as the purge gas and if a feed-forward positive pressure purge system that incorporates additional safety features were installed.

The report and Commenters VI-D-1, VI-D-2, and VI-D-5 also describe potential operating problems with gas blanketing systems that contribute to safety concerns. In general, the commenters do not believe that insulated, steam-traced lines are sufficient to alleviate clogging and fouling problems. Commenter VI-D-1 also describes fouling problems that could affect pressure control devices and instrumentation, and how clogging in the gas manifold could result in a tank collapse. In addition, Commenters VI-D-2 and VI-D-5 believe the analyses overstate the extent that gas blanketing has been demonstrated as an emission control technique.

Response: The EPA has worked with the industry and independent experts over the past 10 years to understand the features of gas blanketing systems already installed and to include features in the cost analysis for safe and effective operation. Prior to initial proposal of the standard in 1984, EPA thoroughly evaluated the safety aspects of gas blanketing systems. This review included visits to each of the five plant sites with blanketing systems to discuss safety and operating problems with plant personnel. No safety or operation problems were reported that routine maintenance would not resolve (Docket A-79-16, Docket Items II-B-45, II-B-46, and II-B-47). Appropriate safety features also were evaluated by an independent consultant (Docket A-79-16, Docket Item II-B-49). In addition, since the 1988 proposal, EPA learned that gas blanketing systems are present at three additional plants. No comments have been received by EPA regarding safety or operating problems with these systems.

The system costed by EPA as the basis of the proposed standards under Approaches A, B, and C includes such features as flame arrestors; an atmospheric vent on the collecting main or gas holder to relieve excess pressure; three-way valves to lower the possibility of operator error; and steam-traced lines with drip points, condensate traps, and steam-out connections (coupled with an annual maintenance check) to reduce plugging problems. The EPA considers that the provisions included in the standards are adequate to ensure proper operation and maintenance once a system is installed and that adherence to these provisions will reduce or eliminate factors that cause unsafe conditions. Although the EPA has carefully reviewed the report submitted by the commenters in support of their concerns, the Agency remains convinced that, with proper design, operation, and maintenance, the system costed as the basis of the standards does not pose the degree of safety problems alleged in the report. The points raised by the report and the commenters are addressed below.

The report submitted by the commenters is based on an interpretation of the gas blanketing system costed as the basis of the 1984 proposed standards. The risk estimates in the report are derived from company confidential data for plant accidents (and near accidents) under current conditions. These data were applied to fault tree (i.e., logic diagram) models for each type of equipment or vessel and each of the potential hazards cited in the report. A composite diagram for each equipment type and hazard combination then was generated to provide an overall incident frequency reflecting the actual total number of vessels in which such an event could occur.

The report concludes that the use of a manifold system like the one costed as the basis of the standards increases worker risk compared to current plant conditions. Higher worker risk is projected to result due to short-term exposure to higher concentrations of benzene from excess gas releases caused by operator error or pluggage of the system, including safety equipment (e.g., pressure relief devices) and instrumentation.

The EPA notes that the report attempted to compare worker exposure under current conditions (i.e., no gas blanketing) to hypothetical risks with gas blanketing. However, for current conditions, the report used the estimated concentration of benzene 300 meters downwind as the basis for continuous worker exposure. No account was taken of the higher exposures that occur to those operators whose normal duties require them to be near openings on the process vessels. The comparison of worker exposure with and without gas blanketing is not quantitatively valid for that reason. The EPA believes that worker risk will decrease from current levels with implementation of gas blanketing system controls. Excess gas releases as described by the commenters should occur infrequently with a system that is properly designed and maintained. If an emergency pressure release does occur and the pressure relief device remains open, the source should be isolated from the blanketing system until repairs are made. After the source is isolated, the mass emission rate from the source would be no worse than when it is uncontrolled, and furthermore, would last only until repairs are made. Provisions also are included in the standards to reduce or eliminate the factors that can cause excess gas releases (e.g., annual maintenance checks and semiannual leak detection and repair requirements). In addition, high-pressure water cleaning can be used as needed to keep lines free from pluggages and three-way valves can be used to reduce the potential for operator error.

The report contends that the risk of overpressure or underpressure of vessels is increased by changing from open-vented tanks to a positive pressure system. The EPA agrees that the probability of overpressure or underpressure of vessels will increase. With open-vented tanks, emissions are released to the atmosphere continuously rather than contained within the system. The installation of any emission control device or system on an open-vented tank will increase the pressure within the tank over current levels. The gas blanketing system design costed by EPA as the basis of the standard would produce only slight positive pressure; tanks in good condition (or upgraded to good condition) can accept this pressure. Pressure/vacuum relief devices would be installed on each vessel to prevent catastrophic failure, and emergency vents on the collecting main or gas holder are usual industry practice. The EPA believes that these provisions are sufficient safeguards to prevent serious overpressure or underpressure of blanketed vessels. The commenters' contention that these overpressure or underpressure events will cause greater worker exposure has been addressed above.

According to the report, use of a positive pressure plantwide manifolding system violates the principles for safe design and increases the severity of potential fires or explosions because of propagation to other vessels connected via the blanketing system. However, the manifolding system included in the design costed by EPA is subdivided into small groups of similar vessels (e.g., tar vessels, light-oil vessels, etc.). Review of a cost report by Kaiser Engineers for the USS Gary plant submitted by the commenters indicates the presence of three manifolds, one of which is connected to 20 sources. The EPA believes that subdivision of the blanketing system reduces the risk of propagation. The system costed by EPA also includes flame arrestors for each vessel to reduce the potential for propagation of fire or explosions; it is unclear to EPA if the design used as the basis of the fault tree hazard analysis incorporates these safety devices. As recommended in the principles for safe design described in the report, provisions for efficient and safe maintenance of the system are included in the requirements of the standards.

Commenter VI-D-2 also notes concerns regarding the potential safety problems associated with the introduction of explosive or oxygen-deficient gas into areas of plants where it is not currently present. It is typical for coke oven gas to be widely distributed throughout coke and associated steel plant installations as a fuel gas. The distribution of coke oven gas for gas blanketing is no less safe than typical current practice. With respect to the claim that coke oven gas is being introduced into places where it is not currently present, coke oven gas is in fact present at many of these sources. Dissolved or entrained coke oven gas is the cause of emissions from many of these sources, such as tar decanters and tar intercepting sumps. This may be less true for some sources such as tar storage. However, with proper closure and sealing of such vessels, introduction of coke oven gas to these sources is no less safe than storing the gas in a gas holding tank.

The report also alleges that the size and complexity of the blanketing system will lead to failures that result in higher emissions than under existing conditions. However, industry operating experience does not support the contention that the size and complexity of a system like EPA costed as the basis of the standards will lead to frequent or major system failures. As discussed further below, gas blanketing systems are currently in use at a number of plants with no reported system failures. The EPA believes that the potential for system failure would not be due to the size and complexity of the system (as the report points out, the feed-forward design suggested as being safer is even more complex), but to improper or inadequate operation and maintenance. The EPA also doubts that incidents leading to system failure would occur as frequently as estimated in the report or that resulting emissions would be higher than under existing conditions. The fault tree diagram and the specific scenario given as the basis for the frequent overpressure and underpressure events (i.e., a system coated with heavy organics) is based on an event probability not supported in the report. The scenario itself also should not occur in a well-maintained system.

According to the report, system safety would be enhanced only with the use of natural gas or nitrogen as a purge gas in a feed-forward positive pressure system. The feed-forward system recommended in the report differs from the system costed by EPA in that the design has a purge gas supply, adjusted with a pressure control valve, that allows makeup gas (natural gas) to regulate the pressure whenever vessel pressure falls below a specified limit. The natural gas flows through pressure control valves and the purge gas flow indicator into the vessel. When vessel pressure rises, the gases would vent via a sealpot to a receiving coke oven gas manifold. The vent line from the vessel to the sealpot contains a dipleg designed to maintain a water seal between the vent line from the vessel and the manifold system. The water level in the sealpot isolates the vessel vapor space from the manifold system vapor space to prevent any fire or explosion from propagating from the vessel to the manifold and visa versa. The vessel pressure would be monitored by the field operator via the vessel pressure indicator on the vent line from the vessel to the sealpot; the control room operator would monitor both a pressure recorder and a pressure alarm. The water flow indicator from the sealpot would be monitored periodically by the field operator. According to the report, these protective systems (the manifold vent via the sealpot, the pressure/vacuum safety valve, and the high- and low- pressure alarm and other pressure and flow indicators for the purge gas) decrease the risk of overpressure or underpressure, fire or explosion, and excess purge gas releases as compared to the positive pressure manifold design studied in the report.

The EPA believes that the system costed as the basis of the standards is safe and efficient and does not agree that the design recommended in the report should be the basis of the nationwide cost estimates. However, the modifications suggested in the report may include desirable (although more costly) design features that companies may want to consider. The standards certainly would not preclude the use of an alternative or modified design with additional features or the use of nitrogen or natural gas as a purge gas or as a blanketing agent, as gas blanketing designs are expected to vary according to site-specific factors. The EPA made a preliminary cost estimate for nitrogen blanketing and estimated the cost to be in the range of 20 to 75 percent higher than the cost of coke oven gas-blanketing.

Commenters VI-D-1, VI-D-2, VI-D-5, and VI-E-7 contend that operating problems such as potential plugging and fouling of lines and devices contribute to safety concerns. Commenter VI-D-1 describes how pressure reduction devices must be installed to reduce the normal pressure of the plant (18-20 inches water column) to the pressure that most vessels are designed to handle (1-2 inches) and how fouling would affect the pressure control mechanism and the instrumentation. The commenter also points out that coke oven gas contains compounds that are corrosive to many types of metal surfaces, which could cause seals and O-rings to malfunction, further compounding the unreliability of instrumentation. Condensation of compounds such as naphthalene in the gas manifold also could restrict the gas-carrying capacity of the manifold sufficiently that pressure or vacuum might not be relieved during liquid transfer operations. According to the commenter, one coke plant has experienced a tank collapse as a direct result of such a restriction.

In response to similar comments on the 1984 proposal, EPA included in the standards proposed under Approaches A, B, and C provisions requiring an annual maintenance inspection of the gas blanketing system for signs of pluggages, sticking valves, and clogged condensate traps. Good operating practice also would include checking sampling/gauging instrumentation and seals, as well as pressure control or reduction devices used in blanketing systems no matter what the blanketing gas (e.g., clean coke oven gas, dirty coke oven gas, nitrogen, or natural gas) during the annual maintenance inspection. Companies should include any additional items or features in the annual inspection they feel are needed for safe operation of the control system and should make more frequent inspections if needed to comply with site-specific or corporate safety policies or operating plans.

Commenters VI-D-1, VI-D-2, VI-D-5, and VI-E-7 do not agree that insulated, steam-traced lines are sufficient to alleviate clogging and fouling problems. According to the commenters, some tar will deposit on pipe walls and cannot be removed by steam cleaning even when insulated, steam-traced lines are used; periodic shutdowns have been recommended by design firms in order that high-pressure water cleaning can be performed. Commenter VI-D-1 specifically does not agree with EPA's judgment that because most plant operations would cease until power was restored, naphthalene clogging poses no threat in the event of a power loss. According to the commenter, the coking process would continue in the event of a loss of power, thereby generating offgasses containing coal chemicals that could clog valves and lines. This would create a risk of venting or process upsets. Moreover, there may be a failure of the steam tracing (e.g., a trap may freeze) that leads to naphthalene clogging even though there has been no general power loss.

The EPA considered requiring high-pressure water cleaning as part of the maintenance inspection. However, site-specific factors generally dictate if and when high-pressure water cleaning is needed. The use of high-pressure water cleaning or steam cleaning is recommended as part of the annual maintenance inspection, or on a more frequent basis as needed.

The EPA agrees that a failure of the steam tracing (e.g., a trap may freeze) could lead to naphthalene clogging even if there has been no general power loss. However, frozen traps or other equipment can occur at any facility operating in cold climates. Although the regulation requires that the annual maintenance inspection include clogged condensate traps, EPA suggests that companies consider routine inspection of traps during freezing weather for evidence of clogging. Companies also may wish to consider the use of a purge gas design that keeps the gas moving continuously and reduces the probability of clogging. The feed-forward system is an example of such a design. The EPA notes, however, that such designs are more complex and costly due to the additional piping and purge gas consumption.

Commenters VI-D-2 and VI-D-5 contend that the analyses overstate the extent that gas blanketing has been demonstrated as an emission control technique. The commenters state that blanketing is not fully demonstrated because one plant cited in the BID as using a coke oven gas-blanketing system has since switched to nitrogen to reduce plugging problems. At this plant, blanketing of a limited number of light-oil sources was done originally to improve light-oil product quality, not for emissions control. Another commenter questions the total of 24 plant years of experience cited by EPA (Docket A-79-16, Docket Item VI-E-7). According to the commenter, proprietary information indicates that some of the plants to which EPA refers have had problems with the positive pressure manifold system, or have been closed during part of the 24 year period.

The EPA disagrees that the analyses overstate the industry's operating experience with gas blanketing systems. Gas blanketing from the collecting main was installed at Armco's Houston Works between 1976 and 1977 and was operated successfully until the plant shutdown in 1981 for economic reasons not associated with the emission control system. As of 1984, gas blanketing of the light-oil plant had been demonstrated at Bethlehem Steel-Sparrows Point, LTV-Cleveland, and the Armco-Houston plant. At the Sparrows Point plant, gas blanketing was installed in Plant B in 1954, and a similar system was installed in Plant A as part of the conversion to a wash-oil final cooler. The gas blanketing system at the LTV-Cleveland plant was installed in 1960. At this plant, the light-oil system at the No. 1 coke plant is partially gas-blanketed.

The EPA agrees that reduced muck formation and improved product quality is a benefit of gas blanketing for light oil plants. However, gas blanketing is also an emission control system. The fact that one of these plants switched to nitrogen to reduce plugging problems does not detract from their successful demonstration and operation of a blanketing system. The proprietary information mentioned by the commenter suggesting problems with the positive-pressure manifold system at one of these plants was not provided to EPA for review. However, problems with the manifold system could result if the system were not being properly operated and maintained. Provisions are included in the standards to ensure that blanketing systems are properly operated and maintained after installation.

Since the 1988 proposal, EPA has learned that gas blanketing is present at three additional plants. A negative pressure system is now used at National Steel-Granite City to control emissions from the four tar decanters and the tar condensate sump; the negative pressure is provided from a tie-in to the suction main upstream of the primary coolers. A positive pressure system using clean coke oven gas is applied to four light-oil condensers. At the LTV-South Chicago plant, all by-product sources are now gas-blanketed with nitrogen and at the LTV plant in Warren, Ohio, the light-oil plant is gas-blanketed with coke oven gas. In summary, EPA considers that gas blanketing has been fully demonstrated within the industry as a safe and effective emission control technique.

<u>Comment</u>: Commenter VI-D-1 in Docket A-79-16 states that while gas blanketing may be appropriate for new installations where tanks are designed to be pressurized, tanks at existing coke plants were never designed to be pressurized or designed to operate at negative pressure. Also, many of the existing tanks are of a riveted design which were not designed to be gas-tight. Commenters VI-D-2 and VI-D-5 in Docket A-79-16 note that the added stress on old welds or embrittlement of the steel if new

welds are made while repairing and reconstructing the old tanks to handle positive pressure could lead to failure. In support, Commenter VI-D-2 cites an article discussing the collapse of an Ashland Oil diesel fuel storage tank caused by a brittle steel fracture emanating from a flaw in the tank's bottom course steel plate. According to the article, brittle steel fractures have been documented in older steel construction, resulting from a combination of stress and cold temperatures.

Response: The commenters contend that retrofitting existing tanks to accept gas blanketing poses a danger of tank failure, particularly for old or riveted tanks. The EPA agrees that vessel upgrading, ranging from minor repairs to total replacement, may be needed on many vessels before installation of blanketing systems. The EPA does not agree, however, that necessary modifications cannot be performed on existing vessels since gas blanketing systems were installed on existing vessels at LTV-South Chicago, LTV-Cleveland, Bethlehem-Sparrows Point, and National Steel-Granite City. A gas blanketing system also was successfully installed and operated at the Armco-Houston plant prior to its closure.

The Ashland Oil spill cited by Commenter VI-D-2 did not involve a gas-blanketed vessel. The incident is an example of the danger posed by older tanks in poor condition. It also is an example of the need for close inspection and testing of tanks being repaired and reconstructed. In fact, the article cited by the commenter states that the company did not perform a full hydrostatic test by American Petroleum Institute (API) Method 650, the preferred method under API voluntary standards, prior to putting the tank in service; that x-ray examination would have revealed the flaw; and that "while the old steel used in the construction of the tank was in excellent condition, it would not have been used if current API 650 standards had been adhered to". In Congressional hearings on bills under consideration to prevent such spills in the future (e.g., S 2020, The Above Ground Storage Tank and Spill Prevention Act), a company spokesman acknowledged that Ashland did not secure a written permit before constructing the tank and did not follow adequate testing methods before filling it (Docket A-79-16, Docket Item VI-J-6).

Several of the existing coke by-product recovery plants were constructed in the 1940's and have not been modernized. Many of the tanks at these plants currently are vented to the atmosphere. Control of these emissions by any device or system may necessitate upgrading tanks to be able to accept a slight degree of pressure. The EPA contends that the issue at hand is not that older tanks at existing facilities cannot be upgraded to modern standards, but that additional costs will be incurred for some vessels that may require replacement or more than minor repairs. The standards include costs for minor repairs and for sealing vessels, but do not include costs for substantial upgrading or replacement. The EPA does not feel that the regulation should assume these costs because the industry will need to replace or substantially upgrade aged tanks in poor condition that do not meet current construction standards. Modernization of existing equipment may be needed as a routine part of plant maintenance. The industry may consider that it is reasonable to replace these tanks now rather than later. If replacement is done now, some additional costs over the costs estimated for the air standards will be incurred.

Comment: Commenter VI-D-1 in Docket A-79-16 does not agree with EPA's estimate of 98 percent control efficiency for gas blanketing systems based on coke plant operator experience. According to the commenter, coke plant operators state that significant downtime for the system is needed to perform regular maintenance on both the controls and instrumentation. In addition, operating records and design/engineering firms indicate that complete system shutdown is needed on at least a quarterly basis to perform high-pressure water cleaning. This cleaning necessitates that the tanks and vessels be open to the atmosphere. According to the commenter, the downtime for regular maintenance and for periodic line cleaning reduces the control efficiency below 98 percent.

Response: Commenter VI-D-1 contends that downtime for regular maintenance and for periodic (e.g., quarterly) high-pressure water cleaning reduces the efficiency below 98 percent. Although the commenter did not submit the operating records to which he refers that would document the length and frequency of shutdowns for maintenance, EPA does not believe that emissions from quarterly shutdowns would reduce the efficiency of gas blanketing to a large degree. For example, uncontrolled benzene emissions from sources to be gas-blanketed at a medium-size model furnace coke plant would total about 450 Mg/yr or 1.2 Mg/day. If the maintenance downtime were 4 days annually, emissions would be 4 times 1.2 Mg/day, or about 1 percent of annual uncontrolled emissions.

<u>Comment</u>: Commenter VI-D-2 of Docket A-79-16 recommends that the final standards allow installation of a pressure/vacuum relief breather valve and flame arrestor as an alternative to gas blanketing for the control of benzene emissions from light-oil condenser vents. The commenter contends this alternative is available, would be effective in preventing evaporative losses during normal operations, and would avoid safety and operating problems that can be created by gas blanketing controls on this source. Commenters VI-D-2 and VI-D-10 in Docket A-79-16 also state that gas blanketing should not be required for tar-intercepting sumps because of potential safety and worker exposure problems. The commenters contend that any leak in the gas blanketing system would be at a level where exposure is likely because tar-intercepting sumps are located at, or below, ground level. Instead of gas blanketing, the final standards should control benzene emissions from tar-intercepting sumps in the same way as light-oil sumps (e.g., enclose and seal the liquid surface). This control approach would reduce benzene emissions and would avoid the risk of employee exposure problems.

<u>Response</u>: Based on the information submitted by the commenters, EPA cannot determine if the use of a pressure/vacuum relief breather valve and flame arrestor as an alternative control system for light-oil condenser vents would provide as much control as the gas blanketing system. The commenters appear to be recommending that the pressure relief breather valve serve as the emission control device. However, if the pressure relief device were used in this manner, the gas flow from the condenser vent (which is typically released at a low, but continuous rate) would create a constant pressure on the device. This constant pressure would force the device to open and release the pressure on a continual basis. In contrast, pressure

relief devices in the gas blanketing system are intended to release gases only under emergency conditions to reduce dangerous high pressures within the process. With gas blanketing, such overpressure situations are not expected to occur frequently because the system provides a path for the gas to move freely to and from the vessels as pressures within the vessels change. The descriptive information provided by the commenters did not indicate whether the pressure relief device would be vented to a control device. However, if the device were vented to a control device, this alternative system might achieve an equivalent amount of control to gas blanketing.

Regarding the commenters' recommended alternative for tar sumps, EPA acknowledges that a sealed cover system like that required for the light-oil sump could provide the 98 percent control efficiency estimated for the light-oil sump if no emissions other than breathing losses were generated. However, because entrained or dissolved coke oven gas from flushing liquor, tar, or other by-product fluids at temperatures above ambient are typically present, and steam may be vented into the tar sump, a cover alone cannot be expected to achieve 98-percent efficiency. Also, the gases would tend to build up pressure under a cover and would have to be frequently released through a pressure relief or similar vent. In comparison, light-oil sumps typically contain wastewater that does not include entrained or dissolved gases. A vent on the light-oil sump cover is allowed by the standards for safety purposes to prevent the build up of pressure primarily from the transfer of liquids. The standards also prohibit the venting of steam or other gases from the by-product process to a light-oil sump. The EPA did not assess a cover system for the tar intercepting sump similar to that for the light-oil sump for these reasons.

Provisions for use of alternative means of emission limitation for process vessels, tar storage tanks, tar-intercepting sumps, and light-oil sumps are included in § 61.136 of the final standards. To apply for permission to use an alternative emission control system, the standards require that the owner or operator submit a design analysis with test data showing that the alternative control system (e.g., a combined closed vent system and control device) achieves a combined emission reduction efficiency of 98 percent or more (except for a tar decanter, which is 95 percent).

Comment: Commenter VI-D-1 in Docket A-79-16 believes that nitrogen contamination would lower the heating value of the coke oven gas unless natural gas is blended in to supplement the heating value.

Response: The EPA agrees that the use of nitrogen as a blanketing gas would dilute the heat content of the coke oven gas. Assuming a unit heat value of 550 British thermal units per cubic foot (Btu/ft^3) of coke oven gas, the reduction in heat value due to nitrogen addition to coke oven gas through gas blanketing could be 7 to 8 percent for small, medium, and large model plants. Additional information on the estimated impact on heat values of nitrogen combined with coke oven gas is included in Table 2 of Docket Item VI-B-6 in Docket A-79-16.

Comment: Commenter VI-D-5 in Docket A-79-16 agrees with EPA that formcoking and direct reduced ironmaking (DRI) offer long-term prospects for replacing conventional by-product coke making. However, these technologies are at least one to two decades away, especially for large (2.5 to 5.0 million tons/yr) fully integrated plants which comprise the bulk of the domestic steel industry. The commenter explains that coke provides three needs in the blast furnace process. It provides a source of reducing gas to reduce iron oxide, a source of heat for the process, and provides a permeable bed to allow for upward flow of reducing gases and downward flow and drainage of molten iron and slag. While partial replacement of coke by injected fuels such as oil, gas, and coal, may be able to fulfill the first two needs, the commenter states that none of the various formed coke processes have demonstrated the ability to fulfill the third function. The commenter also states that DRI will not be a major factor in reducing the need for coke ovens because of the high costs, intensive energy needs, and additional pollution problems of DRI-electric furnaces. Commenter VI-D-1 in Docket A-79-16 agrees that formcoking and DRI are not yet commercially available and adds that neither technology has undergone environmental assessment. According to the commenter, it is not even known if foundry coke can be replaced with formcoke. Commenter VI-D-5 adds that another alternative technology beside DRI is smelting-reduction, but it is not likely that this process will be commercially available in the next decade.

However, if this process were successful, a typical commercial facility would produce on such a small scale (less than 1 million tons/yr) that it would not be a viable option for large, fully integrated steel plants.

Response: The EPA thanks the commenters for sharing their expertise on the development of these new technologies. The EPA agrees that more research is needed on the use of these new processes to replace large and small furnace and foundry plants, as well as on the environmental impacts. While EPA does not disagree that new steelmaking technologies are not yet ready for broad commercial application, we are not as certain that the new processes are as far away from commercial viability as the commenters suggest. Many other industrialized countries that do not have access to abundant supplies of low cost energy (e.g., natural gas, electric or hydroelectric power) are moving ahead with new commercial processes. Countries with pilot or commercial plants based on DRI, direct smelting, or plasma processes include Sweden, Japan, West Germany, Canada, Italy, New Zealand, Mexico, Australia, Iran, Brazil, Peru, India, and South Africa, as well as the United States. Some of these plants are producing steel in quantities of about 300,000 to 500,000 tons/yr. Information on the status of new technologies is included in Docket A-79-16, Docket Item VI-J-4.

The by-product coking process was introduced on a large scale in the period between 1900 and 1910 and the methods currently used by the U.S. industry to make steel have not changed a great deal since World War II. New steelmaking technologies and modernized facilities may reduce or eliminate the multi-media environmental problems now facing the industry and many surrounding communties. The EPA believes that controls can be engineered into these new processes and newly constructed facilities that will decrease the environmental problems resulting from current steelmaking operations.

6.2 ENVIRONMENTAL IMPACTS

Comment: Commenters VI-D-1, VI-D-2, VI-D-5, and VI-D-10 in Docket A-79-16 believe that the nationwide emission estimates are overstated because the 1984 data base was not adjusted before reproposal to account for reduced plant capacities, changes in plant processes, and closures. In support, the commenters provide updated information for use in the data base (Docket A-79-16, Docket Item VI-E-7). Commenters VI-D-2 and VI-D-5 also recommend that EPA not include emissions from cold-idle plants. In support, the commenters state that two of the seven cold-idle furnace plants have closed and it is unreasonable to assume that the remaining cold-idle plants will continue to operate on a continuous, full capacity basis. At minimum, EPA should assume that no more than 50 percent of the capacity at these five plants will be utilized in the future.

Response: The EPA agrees that the nationwide emission estimates for the reproposed standard do not take into account the changes in capacity, processes, and operating status that have occurred in recent years. As stated in the preamble for the reproposed standard (see 53 FR 28497, July 28, 1988), the Administrator used data and analyses that had been revised after the June 6, 1984 proposal in his reassessment of coke by-product recovery plants. The reanalysis, shown in the BID for the revised proposed standard (EPA-450/3-83-016b), incorporated data available as of November 1984.

The environmental impact estimates included emissions from cold-idle plants because sufficient information was not available to determine if these closures would be temporary or permanent. As discussed in the response to comment 6.1 in the BID for the revised proposed standards (EPA-450/3-83-016b), six furnace plants were on cold-idle (e.g., temporarily closed but able to restart on demand). These plants included: (1) LTV Steel-Thomas, Alabama; (2) LTV Steel-East Chicago, Indiana; (3) USX-Fairless Hills; (4) USX-Lorain, Ohio; (5) USX- Fairfield, Alabama; and (6) Weirton Steel-Brown's Island, West Virginia. One foundry plant, Alabama By-Products in Keystone, Pennsylvania, also was listed as cold-idle. The BID also contained estimates of the capacity reductions that would result if these plants were deleted from the data base.

In response to the 1988 reproposal, several commenters provided updated information on industry operating status and changes in plant capacities and processes. The EPA also collected additional information from its regional offices (Docket A-79-16, Docket Item VI-B-5) and from responses to Section 114 information requests from nine companies (Docket A-79-16, Docket Items VI-D-16 through VI-D-25). This information has been factored into the data base to the extent permitted by the resources available for this reanalysis.

In updating the industry operating status, EPA first had to determine how the data base should reflect the cold-idle plants. The Agency considered the suggestion from Commenter VI-D-2 that because of the uncertainty in future operating plans for five cold-idle plants (USS-Fairless Hills, Lorain, and Fairfield; LTV-East Chicago; and Inland East Chicago plant No.3), emission estimates should be based on the assumption that no more than 50 percent of the capacity at these plants will be utilized. The Agency concluded, however, that the revised emission estimates should be based on EPA's best estimate of plants currently in operation or that may resume operation in the future. Thus, plants that have been demolished have been removed from the data base, as well as those plants that both EPA and the industry agree are permanently closed, inoperable, or that would require substantial construction or a padup rebuild before restarting (e.g., major cold-idle batteries). Plants that are currently closed but that have batteries that could operate in their current condition (e.g., hot-idle and minor cold-idle) or that may reopen have been retained in the data base. The EPA believes that this approach provides the most accurate depiction of plant operating status for impact estimates. Should any of the major cold-idle plants resume operation under existing or new ownership, the plant must meet the requirements of the standard upon reopening.

The EPA agrees with Commenter VI-D-2 that the LTV Steel-Thomas, Alabama and Alabama By-Products-Keystone, Pennsylvania plants should be deleted from the data base because they have been demolished. In addition, the LTV Steel-East Chicago, Indiana plant was removed from the data base. Since 1984, both batteries have been permanently shutdown and will undergo demolition in the near future. All information available to EPA indicates this coke plant will not ever resume operation, even under new ownership. At the USS-Fairless Hills, Pennsylvania plant, the batteries have been on cold-idle for several years and would need rebuilding before resuming operation. The EPA does not expect this plant to restart in the future. The LTV Steel-Aliquippa plant has announced that the facility will be permanently shutdown. The batteries have not operated since 1985 and the company has no plans to operate the plant. Although it is possible that this plant could be sold, major construction would be needed before the batteries could be restarted. The Weirton Steel-Brown's Island, West Virginia plant also is considered by EPA to be permanently closed and inoperable in its current condition. Revisions also have been made in the analysis to account for the permanent closure of Battery C at Inland Steel in East Chicago, Illinois. The other two batteries at the Inland facility were retained in the data base.

The EPA also agrees with Commenter VI-D-1 that two additional foundry plants are permanently closed. The Southern Coke plant in Chattanooga, Tennessee (formerly Chattanooga Coke) had a controlled shutdown in 1987. Although the batteries are not in inoperable condition, information from EPA Region IV (Docket A-79-16, Docket Item VI-B-5) indicates that the plant is not likely to restart due to economic conditions. The Carondolet plant in St. Louis, Missouri closed in 1988. The EPA agrees that the batteries would need a major rebuild to resume operation and the plant is not likely to reopen.

The EPA does not agree there is clear evidence that other plants have been permanently closed to never resume operation. For example, Commenter VI-D-2 states that the National Steel-Detroit, Michigan plant has placed all of its coke oven batteries on cold-idle and has rendered them inoperable. However, information from National Steel (Docket A-79-16, Docket Item VI-D-19) and from EPA Region V (Docket A-79-16, Docket Item VI-B-5) indicates that while Battery 5 is shutdown, Battery No. 4 is currently operating. National Steel also stated that the company plans a rebuild of the No. 5 battery with projected startup in 1992. The EPA included Battery 5 in the data base category "under construction", but excluded its projected emissions from revised emission and capacity estimates primarily because the battery is currently shutdown. However, the 1992 startup date for operation as a rebuilt battery also is too far in the future to know if or when construction will be completed and what the impact would be on the plant's overall emissions. Commenter VI-D-2 also states that the USS-Lorain, Ohio plant is a major cold-idle facility (e.g., batteries would require major construction or a padup rebuild before being restarted). However, information from EPA Region V indicates that, while this is true for batteries J, K, and L, batteries D, G, H, and I can potentially operate in their current condition (Docket A-79-16, Docket Item VI-B-5). Commenter VI-D-1 indicates that Welsh Coke and Coal in Terre Haute, Indiana closed in 1988. While the plant is closed at this time, information from EPA Region V indicates that the batteries could potentially operate and may be restarted (Docket A-79-16, Docket Item VI-B-5). Thus, EPA retained this foundry plant in the data base because it's recent closure could prove temporary. The USX-Fairfield, Alabama plant was retained in the data base because more detailed information from the Jefferson County Air Pollution Control Department (Docket A-79-16, Docket Item VI-B-5) indicates that while batteries Nos. 2, 5, and 6 are on major cold-idle (e.g., needing rebuild), battery No. 9 is considered to be on minor cold-idle and may be sold. Rouge Steel also was retained in the data base as information from EPA Region V and the Wayne County Air Pollution Control Department indicates that three of the batteries are on major cold-idle, but one battery (No. C) can be restarted and may be sold (Docket A-79-16, Docket Item VI-B-5). Because Battery C could be restarted, EPA included it in the revised analysis as a minor cold-idle battery.

The data base also has been adjusted to reflect changes that have occurred in recent years regarding the operating status of individual batteries, plant capacities, and the processes present at each site. Incorporated in the estimation of emissions was information from Commenter VI-D-2 that Inland Steel's two by-product facilities, serving different batteries, have different sets of emission sources; additional information was obtained from Inland's response to EPA's Section 114 information request (Docket A-79-16, Docket Item VI-D-21). Therefore, the emissions from the Inland Steel plant were estimated by calculating emissions from each by-product facility separately.

Information on revised capacities and individual battery status used in the reanalysis is shown in Tables 6-1 and 6-2. Information on changes in operating processes was provided in responses to Section 114 requests (Docket A-79-16, Docket Items VI-D-16 through VI-D-25) and by the commenters. This updated information is shown on Tables 6-3 and 6-4.

The responses to the Section 114 letters also included new information regarding the baseline level of control (i.e., current control with no NESHAP) for some plants. In particular, Docket Items VI-D-18 and VI-D-19 in Docket A-79-16 state that gas blanketing now is used at the the LTV Steel plants in South Chicago, Illinois and Warren, Ohio and at the National Steel-Granite City, Illinois plant. At the LTV-South Chicago plant, all by-product sources are gas-blanketed with nitrogen and at the LTV plant in Warren, Ohio, all sources in the light-oil plant are gas-blanketed with coke oven gas. At the Granite City plant, gas blanketing is used on the tar decanters, the tar condensate sump, and on sources in the light-oil plant. Emissions from the light-oil sump are controlled by use of a cover equipped with conservation vent valves. In addition, some states (e.g., Indiana, Illinois, Ohio, and Alabama) and counties (e.g., Jefferson County, Alabama, Lake County/Porter County, Indiana) now require controls for some sources at by-product plants such as naphthalene processing, sumps, and pumps and valves. Some plants indicated in their responses to the Section 114 request letters that controls had been installed on certain sources as a result of these State or local regulations.

More detailed information on the specific design and operation of each control system than was contained in the Section 114 responses would be needed to evaluate the reductions provided by these control measures. To carry out such an evaluation and to incorporate the results into the calculations of baseline and regulatory options impacts would be more resource-intensive than the other changes made to the data base. Furthermore, and most importantly, incorporation of this information into the data base would not substantially change the estimated nationwide emissions, risks, or costs, nor would it affect the maximum individual lifetime risk estimated for the source category. The EPA estimates that if these site-specific controls were included, baseline benzene emissions would decrease from 17,000 Mg/yr to 16,000 Mg/yr, assuming that all the

TABLE 6-1. FURNACE COKE BY-PRODUCT RECOVERY PLANTS: COKE-OVEN AND PLANT CAPACITY STATUS
(1,000 Mg/yr)

No.	Plant	Battery no.	Battery capacity	Status[a]	No. of ovens	Online	Hot idle	Minor Cold idle	Under construction	Existing plant total
1	New Boston, Portsmouth, OH	1	364	0	70	364	0	0	0	364
2	Sharon Steel, Monessen, PA	1A	195	2B	37	295	0	0	0	295
		1B	195	0	37					
		2	100	0	19					
3	Lone Star Steel, Lone Star, TX	C	507	1	70	0	507	0	0	507
4	LTV Steel, So. Chicago, IL	2	596	0	60	596	0	0	0	598
5	National Steel, Granite City, IL	A	314	0	45	628	0	0	0	628
		B	314	0	45					
		C	0	5	47					
6	Acme Steel, Chicago, IL	1	291	0	50	582	0	0	0	582
		2	291	0	50					
7	Gulf States Steel, Gasden, AL	2	379	0	65	758	0	0	0	758
		3	379	0	65					
8	Rouge Steel, Dearborn, MI	A	258	2B	45	0	0	425	0	425
		Ax	57	2B	10					
		B	312	2B	55					
		C	425	2A	61					
		Dx	153	2B	27					
9	LTV Steel, Warren, OH	4	540	0	85	540	0	0	0	540
10	Armco Inc., Ashland, KY	3	430	0	76	1,061	0	0	0	1,061
		4	631	0	70					
11	Geneva Steel, Provo, UT	1	290	0	63	1,160	0	0	0	1,160
		2	290	0	63					
		3	290	0	63					
		4	290	0	63					

Footnotes at end of table.

(continued)

TABLE 6-1. (continued)

No.	Plant	Battery no.	Battery capacity	Status[a]	No. of ovens	Online	Hot idle	Minor Cold idle	Under construction	Existing plant total
12	Bethlehem Steel, Lackawanna, NY	7 8 9	397 397 364	0 0 0	76 76 73	1,158	0	0	0	1,158
13	National Steel, Ecorse, MI	4 5	345 907	0 3	78 85	345	0	0	907[b]	345
14	U.S. Steel, Lorain, OH	D G H I J K L	218 218 218 218 208 208 208	2A 2A 2A 2A 2B 2B 2B	59 59 59 59 59 59 59	0	0	872	0	872
15	Wheeling-Pitt, E. Steubenville, WV	1 2 3 8	199 199 215 896	0 0 0 0	47 47 51 79	1,509	0	0	0	1,509
16	LTV Steel, Cleveland, OH	1 2 3 4 6 7	274 274 274 274 366 366	0 0 0 2B 0 0	51 51 51 51 63 63	1,554	0	0	0	1,554
17	Armco Inc., Middletown, OH	1 2 4	544 544 343	0 0 0	57 57 76	1,431	0	0	0	1,431
18	Bethlehem Steel, Burns Harbor, IN	1 2	880 880	0 0	82 82	1,760	0	0	0	1,760
19	LTV Steel, Pittsburgh, PA	P1 P2 P3N P3S P4	340 340 340 340 432	0 0 0 0 0	59 59 59 59 59	1,792	0	0	0	1,792

Footnotes at end of table.

(continued)

TABLE 6-1. (continued)

No.	Plant	Battery no.	Battery capacity	Status[a]	No. of ovens	Online	Hot idle	Minor Cold idle	Under construction	Existing plant total
20	U.S. Steel, Fairfield, AL	2	818	2B	57	0	0	384	0	384
		5	320	2B	77					
		6	320	2B	77					
		9	384	2A	63					
21	Bethlehem Steel, Bethlehem, PA	A	808	0	80	1,916	0	0	0	1,916
		2A	728	0	102					
		5	380	0	80					
22	Bethlehem Steel, Sparrows Pt., MD	1	273	2B	63	1,235	0	0	0	1,235
		2	263	2B	60					
		3	273	2B	63					
		4	273	2B	63					
		5	273	2B	63					
		6	273	2B	63					
		11	220	0	65					
		12	220	0	65					
		A	795	0	80					
23	Inland Steel, E. Chicago, IN	6	226	0	65	2,994	0	0	0	2,994
		7	381	0	87					
		8	343	0	87					
		9	343	0	87					
		10	547	0	51					
		11	1,154	0	69					
		C	830	2B	56					
24	U.S Steel, Gary, IN	1	761	2B	65	2,030	0	530	0	2,560
		2	750	0	57					
		3	750	0	57					
		5	265	0	77					
		7	265	0	77					
		13	265	2B	77					
		15	265	2A	77					
		16	265	2A	77					

Footnotes at end of table.

(continued)

TABLE 6-1. (continued)

No.	Plant	Battery no.	Battery capacity	Status[a]	No. of ovens	Online	Hot idle	Minor Cold idle	Under construction	Existing plant total
25	U.S Steel, Clairton, PA	1	285	0	64	3,847	0	598	0	4,445
		2	285	0	64					
		3	285	0	64					
		7	285	0	64					
		8	285	0	64					
		9	285	0	64					
		13	299	2A	61					
		14	299	2A	61					
		15	299	0	61					
		19	500	0	87					
		20	500	0	87					
		21	500	2B	88					
		22	500	2B	87					
		B	838	0	75					
	Total (25 plants)		41,584		7,181	27,555	507	2,789	907[b]	30,851

Note: Data current as of January 1989.

[a] Status: 0 = online; 1 = hot idle; 2A = minor cold idle; 2B = major cold idle; 3 = under constuction; 4 = closed, demolished; 5 = construction halted, no plans to complete

[b] Planned rebuild of battery with projected startup in 1992 excluded from capacity estimates.

TABLE 6-2. FOUNDRY COKE BY-PRODUCT RECOVERY PLANTS: COKE-OVEN AND PLANT CAPACITY STATUS
(1,000 Mg/yr)

No.	Plant	Battery no.	Battery capacity	Status[a]	No. of ovens	Online	Hot idle	Minor Cold idle	Under construction	Existing plant total
1	Welsh Coke and Coal, Terre Haute, IN	1	66	O	30	0	0	132	0	132
		2	66	O	30					
2	Toledo Coke, Toledo, OH	C	157	O	57	157	0	0	0	157
3	Empire Coke, Holt, AL	1	107	O	20	161	0	0	0	161
		2	54	O	40					
4	Erie Coke, Erie, PA	A	82	O	23	207	0	0	0	207
		B	125	O	35					
5	Tonawanda, Buffalo, NY	1	299	O	60	299	0	0	0	299
6	Citizens Gas, Indianapolis, IN	E	93	O	47	477	0	0	0	477
		H	79	O	41					
		I	305	O	72					
7	Sloss Industries, Birmingham, AL	3	100	O	30	397	0	0	0	397
		4	100	O	30					
		5	197	O	60					
8	Shenango, Pittsburgh, PA	1	322	O	56	521	0	0	0	521
		4	199	O	35					
9	Koppers, Woodward, AL	1	252	O	60	693	0	0	0	693
		2A	161	O	38					
		2B	128	O	40					
		4	97	O	58					
		5	55	O	30					

Footnotes at end of table.

(continued)

TABLE 6-2. FOUNDRY COKE BY-PRODUCT RECOVERY PLANTS: COKE-OVEN AND PLANT CAPACITY STATUS (1,000 Mg/yr)

No.	Plant	Battery no.	Battery capacity	Status[a]	No. of ovens	Online	Hot idle	Minor Cold idle	Under construction	Existing plant total
10	ABC Coke, Tarrant, AL	A	353	0	78	583	0	0	0	583
		5	113	0	25					
		6	117	0	29					
11	Detroit Coke, Detroit, MI	1	617	0	70	617	0	0	0	617
	Total (11 plants)		4,374		1,341	4,112	0	132	0	4,244

Note: Data current as of January 1989.

[a] Status: 0 = online; 1 = hot idle; 2 = minor cold idle; 2B = major cold idle; 3 = under constuction; 4 = demolished.

TABLE 6-3. FURNACE COKE BY-PRODUCT PLANT OPERATING PROCESSES

					Excess-ammonia	Flushing	Tar-	Light			Naphthalene processing/handling		
No.	Plant	Tar decanter	Tar dewatering	Tar storage	liquor storage	liquor circ. tank	interc. sump	oil storage	BTX storage	Benzene storage	Denver flo. unit	Naphth. melt pit	Naphth. dry tanks
1	New Boston, Portsmouth, OH	1	1	1	1	1	1	1	0	0	0	0	0
2	Sharon Steel, Monessen, PA	1	1	1	1	1	1	1	0	0	0	0	0
3	Lone Star Steel, Lone Star, TX	1	1	1	1	1	1	1	1	0	1	1	1
4	LTV Steel, So. Chicago, IL	1	0	1	1	1	1	1	1	1	0	0	0
5	National Steel, Granite City, IL	1	1	1	1	1	1	1	1	0	1	1	1
6	Acme Steel, Chicago, IL	1	1	1	1	1	1	1	0	0	1	1	1
7	Gulf States Steel, Gadsden, AL	1	1	1	1	1	1	1	0	0	1	1	1
8	Rouge Steel, Dearborn, MI	1	1	1	1	1	1	1	1	0	1	1	1
9	LTV Steel, Warren, OH	1	1	1	1	1	1	1	0	0	0	0	0
10	Armco, Inc., Ashland, KY	1	1	1	1	1	1	1	0	0	0	0	0
11	Geneva Steel, Provo, UT	1	1	1	1	1	1	1	0	1	0	0	0
12.	Bethlehem Steel, Lackawanna, NY	1	1	1	1	1	1	1	1	0	1	1	1
13.	National Steel, Ecorse, MI	1	1	1	1	1	1	1	0	0	1	1	1
14.	U.S. Steel, Lorain, OH	1	1	1	1	1	1	1	0	0	1	1	1
15.	Wheeling-Pitt, E. Steubenville, WV	1	1	1	1	1	1	1	0	0	0	0	0
16.	LTV Steel, Cleveland, OH	1	1	1	1	1	1	1	1	0	0	0	0
17.	Armco, Inc., Middletown, OH	1	1	1	1	1	1	0	0	0	0	0	0
18.	Bethlehem Steel Burns Harbor, IN	1	1	1	1	1	1	0	0	0	0	0	0

(continued)

TABLE 6-3. FURNACE COKE BY-PRODUCT PLANT OPERATING PROCESSES (continued)

No.	Plant	Tar decanter	Tar dewatering	Tar storage	Excess-ammonia liquor storage	Flushing liquor circ. tank	Tar-interc. sump	Light oil storage	BTX storage	Benzene storage	Naphthalene processing/handling		
											Denver flo. unit	Naphth. melt pit	Naphth. dry tanks
19.	LTV Steel, Pittsburgh, PA	1	1	1	1	1	1	1	0	0	1	1	1
20.	U.S. Steel, Fairfield, AL	1	1	1	1	1	1	1	0	0	1	1	1
21.	Bethlehem Steel, Bethlehem, PA	1	1	1	1	1	1	1	1	0	1	1	1
22.	Bethlehem Steel, Sparrows Pt., MD	1	1	1	1	1	1	1	0	1	0	0	0
23A.	Inland Steel, E. Chicago, IN[a]	1	1	1	1	1	0	0	0	0	0	0	0
23B.	Inland Steel, E. Chicago, IN[a]	1	1	1	1	1	1	1	0	0	1	1	1
24.	U.S. Steel, Gary, IN	1	1	1	1	1	1	1	0	0	0	0	0
25.	U.S. Steel, Clairton, PA	1	0	1	1	1	1	1	0	0	0	0	0
	Total	25	23	25	25	25	25	23	7	3	12	12	12

[a] Processes for two by-product plants at Inland-East Chicago are shown separately, but are not counted as independent plants.

TABLE 6-3. FURNACE COKE BY-PRODUCT PLANT OPERATING PROCESSES (continued)

No.	Plant	Direct water final cooler	Tar-bottom final cooler	Wash-oil final cooler	Light-oil sump	Light oil/decanter condenser vent	Wash-oil decanter	Wash-oil circ. tank	Equipment leaks
1	New Boston, Portsmouth, OH	0	1	0	1	1	1	1	1
2	Wheeling-Pitt, Monessen, PA	0	1	0	1	1	1	1	1
3	Lone Star Steel, Lone Star, TX	1	0	0	1	1	1	1	1
4	LTV Steel, So. Chicago, IL	0	0	0	1	1	1	1	1
5	National Steel, Granite City, IL	1	0	0	1	1	1	1	1
6	Interlake, Chicago, IL	1	0	0	1	1	1	1	1
7	LTV Steel, Gadsden, AL	1	0	0	1	1	1	1	1
8	Rouge Steel, Dearborn, MI	1	0	0	1	1	1	1	1
9	LTV Steel, Warren, OH	0	0	1	1	1	1	1	1
10	Armco, Inc., Ashland, KY	0	0	0	1	1	1	1	1
11	U. S. Steel, Provo, UT	0	1	0	1	1	1	1	1
12.	Bethlehem Steel, Lackawanna, NY	1	0	0	1	1	1	1	1
13.	National Steel, Detroit, MI	1	0	0	1	1	1	1	1
14.	U.S. Steel, Lorain, OH	1	0	0	1	1	1	1	1
15.	Wheeling-Pitt, E. Steubenville, WV	0	0	1	1	1	1	1	1
16.	LTV Steel, Cleveland, OH	0	0	1	1	1	1	1	1
17.	Armco, Inc., Middletown, OH	1	0	0	0	0	0	0	0
18.	Bethlehem Steel Burns Harbor, IN	0	0	0	0	0	0	0	0

(continued)

TABLE 6-3. FURNACE COKE BY-PRODUCT PLANT OPERATING PROCESSES (continued)

No.	Plant	Direct water final cooler	Tar-bottom final cooler	Wash-oil final cooler	Light-oil sump	Light oil/decanter condenser vent	Wash-oil decanter	Wash-oil circ. tank	Equipment leaks
19.	LTV Steel, Pittsburgh, PA	1	0	0	1	1	0	1	1
20.	U.S. Steel, Fairfield, AL	1	0	0	1	1	1	1	1
21.	Bethlehem Steel, Bethlehem, PA	1	0	0	1	1	1	1	1
22.	Bethlehem Steel, Sparrows Pt., MD	0	0	1	1	1	1	1	1
23A.	Inland Steel, E. Chicago, IN[a]	0	0	0	0	0	0	0	0
23B.	Inland Steel, E. Chicago, IN[a]	1	0	0	1	1	1	1	1
24.	U.S. Steel, Gary, IN	1	0	0	1	1	1	1	1
25.	U.S. Steel, Clairton, PA	0	0	0	1	1	1	1	1
	Total	14	3	4	23	23	22	23	23

Note: Data current as of January 1989.

TABLE 6-4. FOUNDRY COKE BY-PRODUCT PLANT OPERATING PROCESSES

No.	Plant	Tar decanter	Tar dewatering	Tar storage	Excess-ammonia liquor storage	Flushing liquor circ. tank	Tar-interc. sump	Light oil storage	BTX storage	Benzene storage	Naphthalene processing/handling: Denver flo. unit	Naphthalene processing/handling: Naphth. melt pit	Naphthalene processing/handling: Naphth. dry tanks
1	Welsh Coke and Coal, Terre Haute, IN	1	1	1	1	1	1	1	0	0	1	1	1
2	Toledo Coke, Toledo, OH	1	1	1	1	1	1	0	0	0	0	0	0
3	Empire Coke, Holt, AL	1	0	1	1	1	1	1	0	0	1	1	1
4	Erie Coke, Erie, PA	1	1	1	1	1	1	0	0	0	0	0	0
5	Tonawanda, Buffalo, NY	1	1	1	1	1	1	1	0	0	0	0	0
6	Citizens Gas, Indianapolis, IN	1	1	1	1	1	1	0	0	0	1	1	1
7	Sloss Industries, Birmingham, AL	1	1	1	1	1	1	1	0	0	1	1	1
8	Shenango, Pittsburgh, PA	1	1	1	1	1	1	1	0	0	0	0	0
9	Koppers, Woodward, AL	1	1	1	1	1	1	1	0	0	1	1	1
10	ABC Coke, Tarrant, AL	1	1	1	1	1	1	1	0	0	1	1	1
11	Detroit Coke, Detroit, MI	1	1	1	1	1	1	0	0	0	0	0	0
	Total	11	10	11	11	11	11	6	0	0	6	6	6

(continued)

TABLE 6-4. FOUNDRY COKE BY-PRODUCT PLANT OPERATING PROCESSES (continued)

No.	Plant	Wash-oil final cooler	Direct water final cooler	Tar-bottom final cooler	Light-oil sump	Light oil/decanter condenser vent	Wash-oil decanter	Wash-oil circ. tank	Equipment leaks
1	Welsh Coke and Coal, Terre Haute, IN	0	1	0	1	1	1	1	1
2	Toledo Coke, Toledo, OH	0	0	1	0	0	0	0	0
3	Empire Coke, Holt, AL	0	1	0	1	1	1	1	1
4	Erie Coke, Erie, PA	0	0	0	0	0	0	0	0
5	Tonawanda, Buffalo, NY	0	0	0	0	0	0	0	0
6	Citizens Gas, Indianapolis, IN	0	1	0	0	0	0	0	0
7	Sloss Industries, Birmingham, AL	0	1	0	1	1	1	1	1
8	Shenango, Pittsburgh, PA	0	0	0	1	1	1	1	1
9	Koppers, Woodward, AL	0	1	0	1	1	1	1	1
10	ABC Coke, Tarrant, AL	0	1	0	1	1	1	0	1
11	Detroit Coke, Detroit, MI	0	0	0	0	0	0	0	0
	Total	0	6	1	6	6	6	5	6

Note: Data current as of January 1989.

controls installed by the companies achieve emission reductions equivalent to the controls required by the standards for those sources. The purpose of the analysis is to examine nationwide impacts for NESHAP development; therefore, whether or not these controls are included in the emissions estimates will not affect EPA's regulatory decisions. However, EPA recognizes that the emission and risk estimates for these individual plants may be overstated without including these controls in the analyses, particularly for the National Steel and LTV plants that now have gas blanketing systems.

The revised data base includes a total of 25 furnace plants. Three of the 25 plants are on minor cold-idle; the rest are on-line although minor cold-idle batteries may be present. Six closed or major cold-idle furnace plants have been deleted. Three of the 14 foundry plants included in the 1984 data base have been deleted because they are permanently closed or demolished. Of the 11 foundry plants included in the updated data base, 1 is considered minor cold-idle and the rest are on-line. Thus, a total of 36 plants are included in the revised data base.

In the 1988 proposal, nationwide emissions of benzene and VOC from 44 plants were estimated at 26,000 Mg/yr and 171,000 Mg/yr (including benzene), respectively. Coke production capacity for the industry was estimated at about 50.9 million Mg/yr. In comparison, the revised data base includes a total of 36 plants with an estimated coke production capacity of about 35 million Mg/yr. Nationwide benzene emissions from these plants are estimated at 17,000 Mg/yr; nationwide VOC emissions are estimated at 117,000 Mg/yr. The furnace plant industry segment accounts for about 15,500 Mg/yr of the estimated nationwide benzene emissions (or approximately 91 percent) based on a coke production capacity of about 30.8 million Mg/yr. Foundry plants account for about 1,500 Mg/yr of nationwide benzene emissions (or about 9 percent), based on a coke production capacity of about 4.2 million Mg/yr. Nationwide VOC emissions from furnace and foundry plants are estimated at 106,000 Mg/yr and 11,000 Mg/yr, respectively. Tables 6-5 and 6-6 show the nationwide effects of controls on emission sources based on the revised data base.

TABLE 6-5. NATIONWIDE EFFECTS OF CONTROLS ON EMISSION SOURCES AT FURNACE PLANTS

Emission source	Control efficiency (%)		Controlled emissions, Mg/yr, Benzene	Controlled emissions, Mg/yr, VOC[a]	Annual costs,[b] 1984 $/yr	Benzene cost effectiveness,[b,c] $1984/Mg aver.	Benzene cost effectiveness,[b,c] $1984/Mg incre.	VOC[a] cost effectiveness,[b,c] $1984/Mg aver.	VOC[a] cost effectiveness,[b,c] $1984/Mg incre.
Final cooler cooling tower and naphthalene processing/handling	Baseline[d]:		5,420	68,220					
	Tar-bottom final cooler	81	1,190	18,700	401,170	90	90	10	10
	Wash-oil final cooler	100	0	0	9,284,380	700	7,450	40	70
Tar decanter, tar-intercepting sump, and flushing-liquor circulation tank	Baseline[d]:		5,470	11,460					
	Gas blanketing	98[e]	180	380	482,940	(90)	(90)	(50)	(50)
Tar storage tanks and tar-dewatering tanks	Baseline[d]:		910	21,370					
	Gas blanketing	98	20	430	1,367,880	1,530	1,530	70	70
Light-oil condenser, light-oil decanter, wash-oil decanter and wash-oil circulation tanks	Baseline[d]:		2,160	3,060					
	Gas blanketing	98	50	70	480,830	230	230	160	160
Excess-ammonia liquor storage tank	Baseline[d]		230	380					
	Gas blanketing	98	6	8	639,410	2,350	2,350	1,640	1,640
Light-oil storage tanks and BTX storage tank	Baseline[d]:		170	260					
	Gas blanketing	98	4	6	791,440	4,730	4,730	3,300	3,300
Benzene storage tanks	Baseline[d]:		17	17					
	N_2 gas blanketing	98	0	0	58,100	3,420	3,420	3,420	3,420
Light-oil sump	Baseline[d]:		400	570					
	Cover	98	8	10	284,480	730	730	510	510
Pumps	Baseline[d]:		290	420					
	Quarterly inspections	71	90	120	23,710	120	120	80	80
	Monthly inpsections	83	50	70	28,500	120	130	80	90
	Dual mechanical seals	100	0	0	841,280	2,900	18,720	2,030	11,700

Footnotes at end of table.

TABLE 6-6. NATIONWIDE EFFECTS OF CONTROLS ON EMISSION SOURCES AT FURNACE PLANTS

Emission source	Control efficiency (%)		Controlled emissions, Mg/yr.		Annual costs,[b] 1984 $/yr	Benzene cost effectiveness,[b,c] $1984/Mg		VOC[a] cost effectiveness,[b,c] $1984/Mg	
			Benzene	VOC[a]		aver.	incre.	aver.	incre.
Valves	Baseline[d]:		200	280					
	Quarterly inspections	63	70	100	(28,810)	(240)	(240)	(160)	(160)
	Monthly inpsections	73	50	80	(15,390)	(110)	730	(80)	510
	Sealed-bellows valves	100	0	0	3,407,040	17,420	62,910	12,190	43,040
Exhausters	Baseline[d]:		14	20					
	Quarterly Inspections	55	6	9	11,000	1,450	1,450	1,020	1,020
	Monthly inpsections	64	5	7	23,920	2,740	11,230	1,920	7,870
	Degassing reservoir	100	0	0	346,840	25,130	63,820	17,590	44,680
Pressure-relief devices	Baseline[d]:		130	190					
	Quarterly inspections	44	70	110	(24,340)	(420)	(420)	(290)	(290)
	Monthly inpsections	52	60	90	(21,220)	(310)	290	(210)	200
	Rupture disc system	100	0	0	121,470	920	2,280	640	1,600
Sampling connection systems	Baseline[d]:		30	40					
	Cap or plug	100	0	0	32,140	1,250	1,250	880	880
Open-ended lines	Baseline[d]:		9	12					
	Cap or plug	100	0	0	5,650	650	650	450	450
Naphthalene processing/ handling[f]	Baseline[d]:		2,100	1,880					
	Mixer-settler	100	0	0	1,145,210	960	960	610	610

Note: Data current as of January 1989.

[a] VOC estimates include benzene.

[b] Parentheses denote cost savings.

[c] "Average" means compared to baseline; "incremental" means compared to the next less stringent control option.

[d] Baseline numbers represent relatively uncontrolled levels.

[e] 95% efficiency for tar decanter.

[f] The mixer-settler control option for napthalene processing and handling is shown separately to address a comment on new indirect cooling technology that would not necessarily control napthalene processing emissions.

TABLE 6-6. NATIONWIDE EFFECTS OF CONTROLS ON EMISSION SOURCES AT FOUNDRY PLANTS

Emission source	Control efficiency (%)		Controlled emissions, Mg/yr, Benzene/VOC[a]		Annual costs,[b] 1984 $/yr	Benzene cost effectiveness,[b,c] $1984/Mg aver./incre.		VOC[a] cost effectiveness,[b,c] $1984/Mg aver./incre.	
			Benzene	VOC		aver.	incre.	aver.	incre.
Final cooler cooling tower and naphthalene processing/ handling	Baseline[d]:		680	7,990					
	Tar-bottom final cooler	81	130	2,090	273,620	500	500	50	50
	Wash-oil final cooler	100	0	0	2,261,070	3,310	14,890	280	950
Tar decanter, tar-intercepting sump, and flushing-liquor circulation tank	Baseline[d]:		370	770					
	Gas blanketing	98[e]	12	25	320,920	890	890	430	430
Tar storage tanks and tar-dewatering tanks	Baseline[d]:		64	1,600					
	Gas blanketing	98	1.3	30	329,280	5,230	5,230	220	220
Light-oil condenser, light-oil decanter, wash-oil decanter and wash-oil circulation tanks	Baseline[d]:		140	210					
	Gas blanketing	98	3	4	165,650	1,310	1,310	920	920
Excess-ammonia liquor storage tank	Baseline[d]		28	40					
	Gas blanketing	98	0.6	0.8	219,370	8,030	8,030	5,600	5,600
Light-oil storage tanks and BTX storage tank	Baseline[d]:		10	14					
	Gas blanketing	98	0.2	0.3	198,180	20,290	20,290	14,180	14,180
Benzene storage tanks	Baseline[d]:		0.0	0.0					
	N_2 gas blanketing	98	0.0	0.0	0	0	0	0	0
Light-oil sump	Baseline[d]:		20	30					
	Cover	98	0.5	0.6	37,420	1,690	1,690	1,190	1,190
Pumps	Baseline[d]:		70	110					
	Quarterly inspections	71	20	30	7,640	160	160	100	100
	Monthly inpsections	83	10	20	9,320	160	200	100	130
	Dual mechanical seals	100	0	0	228,590	3,350	19,120	2,130	12,140

Footnotes at end of table.

TABLE 6-6. NATIONWIDE EFFECTS OF CONTROLS ON EMISSION SOURCES AT FOUNDRY PLANTS

Emission source		Control efficiency (%)	Controlled emissions, Mg/yr, Benzene/VOC[a]		Annual costs,[b] 1984 $/yr	Benzene cost effectiveness,[b,c] $1984/Mg aver./incre.		VOC[a] cost effectiveness,[b,c] $1984/Mg aver./incre.	
Valves	Baseline[d]:		50	70					
	Quarterly inspections	63	20	30	(6,920)	(240)	(240)	(150)	(150)
	Monthly inpsections	73	10	20	(3,200)	(110)	830	(60)	530
	Sealed-bellows valves	100	0	0	917,280	20,000	72,250	12,700	45,880
Exhausters	Baseline[d]:		4	6					
	Quarterly inspections	55	2	3	3,350	1,590	1,590	1,010	1,010
	Monthly inpsections	64	1	2	7,280	3,010	12,340	1,910	7,840
	Degassing reservoir	100	0	0	108,560	27,820	70,130	17,540	44,530
Pressure-relief devices	Baseline[d]:		30	50					
	Quarterly inspections	44	20	30	(6,330)	(450)	(450)	(290)	(290)
	Monthly inpsections	52	15	20	(5,460)	(330)	340	(210)	220
	Rupture disc system	100	0	0	34,220	1,090	2,860	690	1,680
Sampling connection systems	Baseline[d]:		6	9					
	Cap or plug	100	0	0	8,740	1,460	1,460	930	930
Open-ended lines	Baseline[d]:		2	3					
	Cap or plug	100	0	0	1,760	880	880	540	540
Naphthalene processing/handling[f]	Baseline[d]:		190	300					
	Mixer-settler	100	0	0	424,800	2,230	2,230	1,420	1,420

Note: Data current as of January 1989.

[a] VOC estimates include benzene.

[b] Parentheses denote cost savings.

[c] "Average" means compared to baseline; "incremental" means compared to the next less stringent control option.

[d] Baseline numbers represent relatively uncontrolled levels.

[e] 95% efficiency for tar decanter.

[f] The mixer-settler control option for napthalene processing and handling is shown separately to address a comment on new indirect cooling technology that would not necessarily control napthalene processing emissions.

Comment: Commenters VI-D-2, VI-D-5, and VI-D-10 in Docket A-79-16 believe that a different methodology should be used for estimating emissions from vessels for which gas blanketing controls were proposed under Approaches A, B, and C (tar decanters, tar storage tanks, flushing liquor circulation tanks, wash-oil circulation tanks, and wash-oil decanters). The commenters recommend that EPA use equations in the EPA document, "Compilation for Air Pollutant Emission Factors, AP-42", for tanks storing volatile organic liquids that consider specific vessel size and benzene concentration of the contained liquid. The commenters contend that these equations would result in better estimates than the EPA estimates, which were based on only one to three data points with wide variability for some sources. In support, the commenters state that the AP-42 methodology is approved for use in reporting emissions under Title III of the Superfund Amendments and Reauthorization Act (SARA). The commenters also present comparisons of Inland Steel's emission estimates for these vessels using AP-42 submitted to the the State of Indiana for use in its rulemaking for by-product plants. Sample calculations using the AP-42 equations also were provided to EPA to show how emissions are lower based on these methodologies (Docket A-79-16, Docket Item VI-E-6). While the commenters believe that the EPA emission factors for other sources are fairly representative of furnace plants, benzene emissions from these particular vessels are lower than EPA estimates.

Response: The purpose of the AP-42 equations is to estimate working and breathing losses for fixed roof tanks storing volatile organic liquids. Section 4.3 of AP-42 (September 1985) describes a typical fixed roof tank as consisting of a cylindrical steel shell with a permanently affixed roof (Docket A-79-16, Docket Item VI-J-5). According to AP-42, fixed roofs are commonly equipped with a pressure/vacuum valve that allows them to operate at a slight internal pressure or vacuum to prevent the release of vapors during very small changes in temperature, pressure, or liquid level. The introduction to the AP-42 emission equations for fixed roof tanks in Section 4.3.2 states that they apply only to vessels that are substantially liquid and vapor-tight and that operate at approximately atmospheric pressure. Openings on the vessel (e.g., from a partial or no cover, open vents with no pressure/vacuum valve, supplemental vents in tank sidewalls that allow wind to pass through the vessel, warped or unsealed access hatches, etc.) indicate that the vessel is not liquid and vapor-tight. Assuming that the vessels meet the AP-42 criteria, application of the equations may be appropriate for some vessels at a particular coke by-product recovery plant. However, EPA's review of information contained in the docket indicates that even as of 1987, many plants have vessels (such as tar decanters and sumps) that cannot be considered liquid and vapor-tight due to the presence of open vents and only partial or no covers (Docket A-79-16, Docket Item VI-B-8). Also, vessels at several of the plants would need repairs in order to be considered liquid/vapor-tight, with warped covers on access hatches or openings at the roof's edge. Thus, application of the AP-42 equations would be inappropriate for nationwide emissions estimates.

In addition, the emission mechanisms of these vessels, particularly tar processing vessels, also are such that the equations are not appropriate for nationwide emission estimates. For example, tar storage and tar dewatering tanks are heated in many cases to remove water, which increases the flow and concentration of emissions - a situation not accounted for by the AP-42 equations. The liquids in tar decanters and other sources also contain dissolved gases that are released with temperature and pressure changes. In comparison, breathing losses are caused by expansion or contraction of the vapor volume with change in temperature or pressure. The loss of dissolved gases is in addition to working and breathing losses. In fact, our review of documentation on the condition of process vessels and tanks indicates that a high proportion of process vessels and storage tanks are heated or hold liquids containing dissolved benzene at temperatures above ambient. The AP-42 methodology does not estimate emissions from generation of water vapor or dissolution of gases from these tanks. Estimates by AP-42 for these vessels would tend to underestimate emissions.

Because the AP-42 equations are not appropriate for nationwide emission estimates for most sources at by-product plants, direct measurements of emissions are a preferred basis for the estimates. The field testing performed as the basis of the EPA emission factors included direct measurement of vapor phase concentrations and flow rates. In comparison, the AP-42 equations require a theoretical (and highly uncertain) estimate of vapor phase concentration, and the vapor flow rate is based only on vapor displacement by liquid and breathing losses. As described above, the tar decanter and flushing liquor tank, for instance, hold liquids containing dissolved gases and thus, the AP-42 equations cannot be applied to these sources.

Equations based on the same principles as those in AP-42 were used to develop the emission factor for storage tanks containing light-oil, benzene-toluene-xylene (BTX) mixtures, or benzene. These vessels tend to be covered and sealed to prevent product loss. In addition, the liquids in these vessels are pure, as in the case of refined benzene, or, like BTX, are mixtures of constitutents with well-known vapor pressures. The AP-42 equations can be applied with more accurate results for these conditions than for the nonhomogeneous mixtures contained in other types of vessels.

Commenter VI-D-2 also states that the AP-42 emission equations were applied in a study of coke by-product recovery plants conducted by the Midwest Research Institute whenever possible because of the greater sensitivity and accuracy. However, an examination of the study (Docket A-79-16, Docket Item VI-A-1) reveals that a different methodology was not used and the AP-42 factors were not applied in the analysis of the Inland plant to the extent implied by the commenter. As stated on page G-20 of the report,

> "... the use of AP-42 equations to estimate emissions from storage tanks and process vessels may not be appropriate for some by-product recovery streams, since these equations were originally developed for petroleum liquids. Also, working losses could not be accurately estimated because most process vessels are at constant liquid level, and the capacity and throughput do not accurately reflect changes in vapor space height. As a result of the variability in emission estimating methodologies, emissions for both the No. 2 plant and the no. 11 battery complex were estimated using both EPA's emission factors and the stated analytical methods when possible to do both".

Even though the report indicates that AP-42 estimates would be preferrable, EPA notes that the EPA factors, not the AP-42 equations, were applied in most cases. This indicates the judgement of the report authors that AP-42 equations were not generally applicable. The emission estimates applied for plant no. 2 and the no. 11 battery complex are included in

Appendix G, pages G-16 and G-33, respectively. As shown on the table on page G-16, the EPA's emission factors from the BID were applied to estimate emissions from tar decanters and tar storage tanks. The AP-42 equations were applied to the light-oil process vessels and storage tanks. Emissions from trenches were estimated using mass transfer equations. The table on page G-33 indicates that the BID emission factors were applied to all sources except the flushing liquor collection tank and settling pits. AP-42 was used only for the flushing liquor collection tank; mass transfer equations were used to estimate emissions from settling pits associated with the battery 11 complex. Again, the proper application of AP-42 equations to flushing liquor circulation tanks, light-oil process vessels, and other vessels would depend on site-specific conditions that vary widely from plant to plant.

The use of mass transfer equations for trenches and settling pits deserves special comment. Although trenches are not a source for regulation, settling pits may include tar or light-oil intercepting sumps and these are sources for regulation. Mass transfer equations can be used to estimate sump emissions most accurately if the liquid level is near the top of the sump such that wind sweeps across the liquid surface of the sump. If the liquid level is below the top of the sump, the effect of wind action on emissions is reduced. The lower the liquid surface below the top of the sump, i.e., the more freeboard that exists, the less applicable are mass transfer equations. However, the liquid level of tar and light-oil sumps is typically below the top of the sump. Although mass transfer equations may be applied if site-specific conditions warrant, the methodology would be inapplicable for nationwide emission estimates due to differences among the plants.

In summary, although AP-42 equations may be appropriate for some vessels at some plants, the equations are not appropriate for vessels at other plants that are not liquid or vapor-tight, that are heated, or that contain dissolved gases. Because EPA's information indicates that many of the vessels noted by the commenters have characteristics that make the AP-42 equations inappropriate, EPA concluded that the nationwide emission estimates for vessels for which gas blanketing controls were proposed should not be revised using AP-42.

Comment: Commenter VI-D-1 in Docket A-79-16 believes that emission estimates factors for final coolers, cooling towers, and naphthalene processing/handling at foundry plants are too high. In support, the commenter states test data for these sources will be provided for EPA review (Docket A-79-16, Docket Item VI-D-14).

Response: The commenter did not provide any technical information or reasons to support his belief. While the commenter stated that his organization would submit test data to be incorporated into the comments, none was submitted before the court-ordered deadline of August 31, 1989 to promulgate final rules.

6.4 COST IMPACTS

Comment: In Docket A-79-16, Docket Items VI-E-6 and VI-E-7 contain summaries of meetings held with representatives of the American Iron and Steel Institute (AISI) and United States Steel (USS), a division of USX Corporation, to discuss their comments on the revised proposed NESHAP. In these meetings, Commenter VI-E-6 stated that the cost of gas blanketing is higher than EPA's estimate because EPA's estimate excludes costs for tank draining, cleaning, repairs, and other work needed to prepare vessels to accept gas blanketing. In support, Commenter VI-E-7 refers to the 1987 report by Kaiser Engineers containing preliminary cost estimates for installing major controls at the Gary Works (Docket A-79-16, Docket Item IV-D-33). According to the report, the cost of repairing vessels and installing gas blanketing controls at the Gary plant is about $8.6 million; AISI notes in other comments that this excludes the cost of tank cleaning and sludge disposal (Docket A-79-16, Docket Item VI-D-2). Commenter VI-E-7 also provided a draft, order-of-magnitude engineering cost study for the Clairton Works prepared by Kaiser Engineers. This report estimates a cost of about $14.2 million for Clairton to perform remedial work and install major controls. The estimate includes about $8 million for repairing, modifying, and replacing various vessels and for adding a gas blanketing system; an additional $5 million is estimated for vessel cleaning and sludge removal and disposal. Commenter VI-E-6 also noted that the higher costs to repair tanks vessels to accept gas blanketing could not be counted as part of a vessel life-extension program. If gas blanketing were not required, the industry could operate tar tanks in their current condition because that does not affect product quality. Thus, the industry would not need to perform these repairs to extend the life of the vessels.

Response: The EPA estimates that the nationwide capital cost of a gas blanketing system like the one costed as the basis of the final standards is about $61.7 million for furnace plants and $12.7 million for foundry plants, for a nationwide total of about $74.4 million (1984 dollars). These estimates were derived by developing control costs as a function of coke production rate. The cost functions represent average facility costs (i.e., the average of minimum and maximum cases). For example, the minimum case assumes short gas blanket piping runs and low costs to prepare vessels for gas blanketing while the maximum case includes long piping distances and high costs to prepare vessels for gas blanketing. Included in EPA's estimates are costs for draining and cleaning vessels and for preparing them to accept gas blanketing (e.g., replacing old covers, sealing roof openings, patches, installing sump covers, and new roofs for some tanks). As discussed in Chapter 7 of the BID for the revised proposed standard (EPA-450/3-83-016b), these costs were prepared based on data received from commenters following the initial 1984 proposal, in addition to cost data developed by a third-party design and engineering firm.

The EPA agrees that higher costs may be incurred at some sites (e.g., Clairton and Gary Works) to repair vessels to their original design conditions to accept gas blanketing. However, EPA disagrees that much of the additional costs included in Kaiser's estimates for Clairton should be attributable to these standards. These additional costs include: (1) replacing aged, corroded components that are due or past due for replacement as part of periodic refurbishment, rebuilding, or good engineering practice; (2) replacing deteriorated vessels; (3) abandoning tanks that cannot be repaired; and (4) removing and disposing of sludge that has accumulated in the vessels over many years. The EPA's reasons are discussed below.

The Kaiser cost estimates for the Clairton site (which is the largest coke plant in the country) include approximately $4 million for vessel repairs. According to the report, a large portion of the costs for sealing existing vessels would be incurred due to needed repairs or replacement of corroded equipment due to ammonium thiocyanate and chloride attack. The EPA believes that the costs to upgrade vessels from their design condition to a condition capable of accepting gas blanketing are fairly attributable to the standard and are adequately represented in our estimates for typical plants. However, much of the costs cited in the Kaiser estimates is for replacing corroded or aged components associated with vessels that were constructed in the 1920's and last refurbished in the 1950's according to the inspection records contained in the report. Based on review of the inspection records, the Agency believes that the vessels are due for another periodic overhaul that is part of normal plant life cycle, and good engineering practice.

Thus, the costs for major overhaul and upgrading of the vessel components should not be attributed to these standards.

Another cost EPA believes should not be attributable to the standards is for adding steam-jacketed pressure relief devices. The use of steam-jacketed pressure relief devices rather than nonsteam-jacketed pressure relief devices may be helpful to reduce plugging from naphthalene deposits or freezing water. However, this is a site-specific decision and the steam-jacketed devices are not essential, assuming the standard pressure relief devices are properly maintained. The use of steam-jacketed pressure relief devices on vessels amount to about $221,100 more than the standard devices (assuming a cost of $1,300 for each standard pressure relief device compared to $7,380 for each steam-jacketed device, a difference of over $6,000 per device).

Of the $4 million estimated by Kaiser for remedial work at Clairton, about $1.8 million is for replacing three hot drain tanks with one new flushing-liquor collecting tank and a new spare tank, and for replacing one light-oil recovery tank. The costs of replacing vessels in poor condition will be incurred at some point regardless of when this rule is promulgated because all industrial plants must eventually replace old equipment. In fact, promulgation of this rule may accelerate the replacement of older, deteriorated vessels, but that is an economic decision each plant must make (i.e., is it cheaper to upgrade existing facilities to accept controls or replace them and put the controls on new equipment). The EPA does not agree that the cost of replacing these vessels is attributable to the standards.

The Kaiser estimates also include costs for cleaning and preparing 19 vessels for being abandoned in place and for dismantling 4 vessels in preparation for replacing them as described above. The estimated cost of preparing tanks for abandonment is about $400,000. The cost of dismantling four existing tanks (three hot drain tanks and one light oil recovery tank) and preparing for replacement vessels is about $126,000. The EPA does not consider that the costs associated with abandoning and dismantling tanks can be reasonably attributable to the air standards.

The report also estimates a cost of almost $4 million for disposal of tar sludge that has accumulated in the vessels over many years (excluding costs for vessel draining, decontamination, and high-pressure water cleaning because these costs may not be incurred at all sites). It is true that sludge from the tar decanter should be removed so that vessels can be cleaned and repairs performed prior to adding gas blanketing. Once the tar decanter sludge is removed, the material (unless delisted on a site-specific basis) is a hazardous waste (K087) subject to Resource Conservation and Recovery Act (RCRA) regulations. However, EPA notes that sludge is generated by the process regardless of the air controls; the installation of gas blanketing will not increase, decrease, or otherwise affect the volume of sludge generated by the process. In addition, hazardous waste rules require that this material be removed and properly disposed of whenever the plant closes, so this cost must be incurred for vessels holding hazardous waste at some point in time. For these reasons, EPA considers that the costs of sludge removal and disposal must be attributed to hazardous waste management rather than to this NESHAP.

Commenter VI-E-6 also claimed that costs for vessel replacement and repairs could not be considered part of a life extension program because the vessels could continue operating in their current condition without affecting product quality. The EPA believes that product quality is not the only basis for determining when life extension work is necessary. The reported condition of some vessels at the Clairton site and the reported date of the last major repair work suggests that life-cycle extension may be due for many vessels. The EPA does not agree that continuing to operate vessels in deteriorated physical condition is conducive to good safety, operating, or engineering practice. In addition, while operating vessels in poor physical condition may not affect product quality, recoverable products or fuel are being lost to the air.

<u>Comment</u>: Commenter VI-D-1 in Docket A-79-16 believes the costs for gas blanketing at foundry plants are higher than EPA estimates. According to the commenter, the typical cost for a foundry plant to install gas blanketing is at least $4 million. Gas blanketing for the merchant industry alone would be over $40 million. The capital cost of compliance for final cooler, cooling tower, and naphthalene processing/handling controls at a plant is at least $2.5 million. Therefore, the anticipated cost to the merchant industry for these controls amounts to over $25 million. The

capital costs associated with one merchant coke plant for pressure relief devices is at least \$75,000 or \$750,000 for foundry plants nationwide. The costs of complying with the inspection requirements at one merchant coke plant is \$100,000, or \$1 million for foundry plants nationwide.

Response: The commenter did not specify why (or what aspects of) EPA's costs are too low or any breakdown or basis for the foundry plant cost estimates. Without such information, EPA cannot evaluate the commenter's concerns in detail. However, EPA notes that for each of the costs cited by the commenter, the commenter's estimate for the total merchant industry cost is 10 times higher than the cost for a single plant. The EPA presumes that this is because the commenter estimates there are 10 foundry plants (according to EPA's data base there are 11) and the commenter assumed that the same cost would apply to each plant. The Agency disagrees because not all the controls would apply to the each plant. For example, only 6 of the 11 foundry plants included in the data base for the final standard have naphthalene processing and handling. The use of rupture discs for pressure relief devices was proposed under Approaches A and B for equipment servicing gas or liquid containing less than 10-percent benzene. The EPA anticipates that this equipment would most likely occur only in the light-oil recovery portion of the plant. However, only about 6 of the 11 foundry plants recover light-oil.

The EPA's cost estimates presented in the 1988 proposal were revised after the 1984 proposal based on industry comments and on cost data developed by a third-party design and engineering firm. While the costs at a particular plant may be higher or lower than EPA's estimates due to site-specific conditions, EPA believes the nationwide cost estimate for foundry plants is representative for the industry as a whole.

Comment: Commenter VI-D-1 in Docket A-79-16 states that the operating problems posed by nitrogen gas blanketing would impact both foundry and furnace producers. However, the costs of supplementing with natural gas to supplement the heating value of coke oven gas contaminated due to nitrogen blanketing would be prohibitive to many foundry coke plants.

Response: In response to the commenter's concern, EPA examined the impact of nitrogen gas blanketing on the heat value of coke oven gas. The results of this analysis are included in Docket Item VI-B-6. The analysis indicates that the addition of nitrogen from a blanketing system to coke oven gas may decrease the heating value of the coke oven gas by 7 to 8 percent for small, medium, and large model plants, depending on the number of sources to be blanketed. This decrease would be expected to occur regardless of the initial heat content of the coke oven gas. Plants with coke oven gas having a heating value in the range of 500 to 550 Btu/ft^3 coke oven gas prior to nitrogen dilution may be able to make adjustments to their combustion equipment (e.g., burner operating characteristics) to accomodate the reduction in heating value without a natural gas supplement. In comparison, plants with coke oven gas having a lower heating value prior to nitrogen dilution (e.g., 500 Btu or less) may need to supplement with natural gas for proper burner operation. The EPA could not estimate the additional nationwide costs or economic impacts that might be incurred at foundry plants for supplementary natural gas because the costs would be highly dependent on site-specific factors such as the current heat value of the coke oven gas (dependent on stage charging practices), the burner designs, and the burner tolerances for fuel gas changes. However, EPA views the decision to use nitrogen for gas blanketing rather than coke oven gas as a site-specific decision and the standards neither require nor preclude the use of nitrogen as the blanketing agent for any source.

6.5 ECONOMIC IMPACTS

Comment: Commenter VI-D-1 in Docket A-79-16 submitted information showing that currently, there is insufficient coke capacity to support existing iron and steel casting capacity. Coke inventory levels are the lowest since pre1980 levels and imports have increased to fulfill domestic demand. The commenter predicts the capacity reduction will have at least two adverse effects on the economy: (1) the impact of increasing reliance on imported coke, and (2) the increased prices in end-use products ranging from steel and iron castings to household products manufactured from by-products generated from the coking process. In addition, while steel production has recently increased, domestic coke production is expected to decline further as the number of active plants and coking capacity diminishes.

Response: The commenter did not specifically relate the submitted information to the proposed rulemaking. The EPA interprets the comment as a prediction of the potential economic impacts of a regulation that would require substantial cutbacks in production capacity, such as were estimated for the proposed emission limits under Approaches C and D because it was not technologically feasible for all plants to achieve the limits without production cutbacks. The final rules are a combination of equipment and work practice standards that are technologically feasible. Therefore, no cutbacks in production capacity are necessary in order for plants to comply. However, as EPA acknowledges in the summary of the impacts of the final standards, implementation of the standards could be a factor in triggering closure decisions at plants that are presently marginal or operating at a loss.

Comment: Commenter VI-D-10 in Docket A-79-16 believes that the impacts of closures are underestimated under proposed Approach D. Shutdown of the domestic coking industry would result in the loss of 7,000 jobs at coke plants, 100,000 jobs in iron and steel making, and 250,000 jobs in secondary fields. If the EPA proposal is enacted, only finishing mills, employing about 50,000 people, would be able to continue operations, assuming semifinished slabs could be purchased on the world market. The Gary plant, which employs about 600 persons directly would not be able to compete in these circumstances and may not be able to operate in the future.

Response: The EPA appreciates the commenter's perspective on the potential impacts of proposed Approach D. However, because Approach D was not chosen as the basis for the final standards, the commenter's concerns are no longer relevant.

Comment: Commenter VI-E-6 in Docket A-79-16 believes that the actual nationwide cost of the standards proposed under Approachs A and B (considering additional costs for tank cleaning and other work needed to prepare vessels for gas blanketing) exceeds $100 million and requires a more detailed economic analysis. Commenter VI-D-10 agrees, adding that over $25 million would be required for the Clairton and Gary Works. This projects to over $100 million for all domestic coke producers, classifying the proposal as a major rule, subject to OMB review.

Response: A large part of the above cost estimates for the Clairton and Gary Works are for costs that are not attributable to these standards, such as tank maintenance and the disposal of sludge accumulated from the tar storage operation. These are discussed more fully in Section 6.4 of this chapter. In addition, the types of costs cited by the commenters are capital costs. A major rule, which requires a regulatory impact analysis for OMB review, is defined by Executive Order 12291 as a rule that is likely to result in an annual cost of $100 million or more. The annual cost of the final standards is estimated to be $16 million (1984 dollars), and is not a major rule.

6.6 MISCELLANEOUS

Comment: Commenter VI-D-1 in Docket A-79-16 recommends that the computation of the ratio of foundry/furnace coke production used in the definitions distinguishing furnace from foundry coke by-product recovery plants be made on an annual basis. While the commenter accepts the EPA definitions, he notes that in the discussion of the definition on page 4-2 of the BID for the revised proposed standards, EPA mistakenly identified a corresponding increase in benzene emissions with an increase in the the production of foundry rather than furnace coke.

Response: The EPA agrees with the commenter. The proposed standard under Approaches A, B, and C included the computation of foundry/furnace coke production on an annual basis (53 FR 28575). Also, EPA agrees that on page 4-2 of the BID for the revised proposed standard (EPA-450/3-83-016b), the third to the last sentence should have stated that as the percentage of furnace coke increases, there is a corresponding increase in benzene emissions.

7.0 RISK ASSESSMENT

7.1 INTRODUCTION

Many commenters expressed views on various aspects or analyses in the risk assessment. The comments ranged from the general to the specific, from criticisms to suggestions for improvement, and from the opinion that the EPA's analysis was too conservative because of underlying unrealistic assumptions or methodologies to the opinion that the analysis was not conservative enough because many factors had not been considered.

This chapter is divided into four sections; comments that deal with the development of the unit risk estimate and health effects, with the exposure analysis, with the uncertainty of the risk estimates, and with a mix of policy and science issues.

7.2 UNIT RISK ESTIMATE

Many commenters discussed the EPA's unit risk estimate (URE) and the various steps in the procedure used to develop the URE. In specific, the commenters addressed the health effects stemming from benzene exposure that should be considered, the data that were used, and the dose/response assessment, particularly the dose/response model. These topics are presented in the following sections. In late July, API submitted additional comments regarding the dose/response analysis for benzene (XII-D-264). The comments included three detailed reports. These reports were not received in time for EPA to evaluate them before the August 31, 1989, court-ordered deadline for promulgating final rules.

Specific Criticisms of the EPA's Unit Risk Estimate for Benzene

Dose/Response Model and Data Used

Comment: One commenter (XII-D-60, see also XII-J-2) (API) submitted a new quantitative risk assessment on the benzene-induced risk of leukemia, based solely on the cohort studied by Rinsky (1987). An important theme presented in the document is that the model used is an improvement over the model used in the 1985 EPA assessment (Docket No. OAQPS 79-3, Part I, Item VIII-A-4).

The major points raised in the commenter's risk assessment are as follows:

a. The Rinsky study is the best of all studies and thus should be the sole data base for risk calculations.

b. The EPA's low-dose extrapolation model for risk calculation is inferior to the new model for several reasons. The best epidemiological and biological data available today are inconsistent with the linear one-hit hypothesis and support a quadratic model as a more plausible, but still conservative, measure of potency. The commenter stated that there is now significant biological support for the conclusion that benzene-induced leukemia requires at least two distinct steps, with the best epidemiologic data indicating that perhaps more than two are needed. The quadratic dose/response relationship yields risk estimates about three orders of magnitude below those predicted by the updated linear one-hit model.

c. The relative risk model should not be used because the benzene-induced leukemia death rate is not proportional to the background leukemia death rate at all ages.

Comment: Commenter XII-D-38 presented a mainly qualitative evaluation of available epidemiologic studies. Three major arguments were made in this submission:

a. Acute myeloid leukemia (AML) is the only leukemia cell type that can be considered, on the basis of epidemiological studies, for quantitative risk estimation. This commenter based his recommendation on an evaluation of the six epidemiological studies for benzene-exposed workers that EPA considered in developing the URE. The commenter felt that it is inappropriate to extrapolate the risk associated with acute myeloid leukemias to all leukemias when the risk appears to be biologically specific to acute myeloid leukemias.

b. The existing data suggest a nonlinear and threshold dose/response relationship.

c. Blood count data do not correlate well with the Rinsky exposure estimate but correlate well with the estimate by Crump and Allen (1984), suggesting that the exposure estimate by Crump and Allen is more reasonable and should be used for quantitative risk calculation. The commenter compared the Crump and Allen and NIOSH exposure estimates, and recommended that the Crump and Allen estimates be used because they: (1) are related to the benzene exposure standards of the time and (2) include exposure calculations for all Pliofilm workers, not just those assigned to the "wet side". The commenter also observed that data for the three plant locations in the Ohio Pliofilm study conducted by NIOSH showed that all cases of AML occurred at one location and only among workers in the plant prior to 1945. The commenter recommended that the risk analysis treat each location separately, given the possible explanation that workers in that location prior to 1945 had a much higher lifetime benzene exposure than assumed in the NIOSH study, and higher than those men working at the other two locations.

Health Effects Endpoints

Comment: Six commenters (XII-F-14, XII-D-04, XII-D-35, XII-D-203, XII-D-216, XII-D-254) felt that health risks were understated because other health effects of benzene, such as cancer-causing but nonleukemogenic health effects, noncarcinogenic health effects, interactive effects, birth defects, and reduction of the immune system, had not been taken into account in the EPA analysis. Commenters XII-F-12, XII-D-26, XII-D-35, XII-D-102, XII-D-130, XII-D-158, XII-D-185, and XII-D-217 stated that all health impacts of benzene should be considered, and implied that risks would be understated if such effects were not accounted for. Commenter XII-D-218 said the risk assessment methodology should include determination of risks for noncancer effects of benzene.

One commenter (XII-D-254) also noted that the Clement Associates report submitted by API examined only leukemia while there are studies that indicate that multiple myeloma is also associated with benzene, and that there may be other forms, or higher rates of cancer as well.

Response to Comments on Benzene Unit Risk Estimate

The comments on the risk assessment for benzene focus on the following groups of issues:

1. The appropriateness of using Rinsky's cohort as the sole data base for risk calculation;
2. The differences between the Rinsky data tapes used by API and the Rinsky data tapes used by Rinsky in his 1987 published paper;
3. Indication by data from epidemiologic studies that only certain types of leukemia are induced by benzene;
4. Support from the Kipen et al. (1987) study on blood counts for the assumption that the Crump and Allen exposure estimate is better than the Rinsky estimate;
5. The sufficiency of evidence to indicate that benzene has a nonlinear and threshold dose effect;
6. The implications by API that the EPA's procedures in the 1985 risk assessment are inadequate with respect to API's interpretation of the EPA's model;
7. Problems with the API procedures for risk calculation; and
8. Exclusion of other cancers and noncancer health effects, resulting in understatement of the risk.

Outlined below is a discussion of the EPA's position on these issues, including a review of the relevant epidemiological studies and assumptions used by EPA in the carcinogen risk assessment.

Issue 1. Rinsky's Cohort as the Sole Data Base

The API argued that only the Rinsky study should be used for quantitative risk assessment because it is the best among all available epidemiologic studies. The EPA disagrees. As discussed below, there is no reason to choose among several epidemiologic studies of varying quality, none of which can be considered necessarily better than any other. Data from studies other than the Rinsky study should also be used for the purpose of risk calculation. Although the Rinsky study possesses many of the attributes of a good epidemiologic study, it still suffers from a lack of definitive information concerning the levels of benzene exposure to which the Pliofilm workers were subjected in the 1940's. As Rinsky has pointed out there are no exposure data at Location 1 during the period 1940 through 1945 and also 1951 through 1963. During the period 1946 through 1950 there were 15 measurements performed on four different days. At Plant 1 of Location 2, only 3 measurements were taken in 1948. No exposure measurements were taken at Plant 2 of Location 2 until 1957. Six of the 9 leukemia cases in the Rinsky cohort were employed at Location 2. Rinsky has argued that although additional environmental measurements were available during this period, those measurements were taken in areas where no employees were ever assigned, hence those measurements were not used. Rinsky believes that these measurements were used in the Crump and Allen assessment and subsequently in the API assessment.

The assumption was made by Rinsky that the levels of exposure at Location 2 were similar to those of Location 1. Nothing has changed in any of the updates of this study to improve upon that assumption. Rinsky has pointed out that there has been little change in work practices, industrial processes or engineering controls during the early years of operation, and as a result, there would be little expectation that the levels of exposure would have fallen during the early years. Furthermore, rising white blood counts that were described by Kipen, et al. (1987) as providing corroborating evidence that exposures were declining during this early period are described by Rinsky (1989) as "artifactual" since averaged blood count levels were observed to rise in both exposed and unexposed employees during the same period (see Issue 4). Assumptions made by Kipen, et al. cannot overcome this basic drawback of the Rinsky study; i.e., lack of adequate exposure information during the early but critical years of employment of the cases. This exposure situation argues for the use of all good data bases in the attempt to reduce uncertainties in any one estimate of risk. None of the three epidemiological studies used by EPA is considered to be superior to any other.

The EPA believes that the authors of the API document gave an incomplete picture of other studies and therefore reduced their usefulness by leaving out important details about those studies that argued against the use of the Rinsky study as the sole data source. For example, a dose/response relationship of cumulative exposure to benzene and cancer of the "lymphatic and hematopoietic system" was noted by Wong, et al. as well as generalized leukemia and aleukemia. The cancer types identified included 4 lymphatic, 2 myeloid and 1 acute unspecified leukemia. This is contrary to the commenter's assumption that AML is the only type of leukemia associated with benzene exposure. The reason the observed dose/response relationship with respect to the lymphatic and hematopoietic system is ignored is not clear from reading the API document. The EPA does agree with API that this study suffers from several other deficiencies that were adequately discussed by the authors.

A major argument by API against using the Ott, et al. study was that the investigators did not observe a dose/response relationship between benzene and leukemia. The EPA believes this study demonstrated an association between exposure to benzene and leukemia. However, the small size of the cohort limited the ability of the study to demonstrate a dose/response effect.

A discussion of the EPA's assessment of benzene carcinogenicity is presented in the July 28, 1988, Federal Register (53 FR 28496) announcing the EPA's proposed response to the remand for the benzene source categories.

Issue 2. Differences between API and Rinsky in the utilization of Rinsky data tapes

The API used data from the same population studied by Rinsky (1987) but employed different cohort selection criteria. There appear to be some differences between the Rinsky data tapes utilized by API and the Rinsky data tapes utilized by Rinsky in his 1987 published paper. Rinsky has maintained that a subset of the 575 "dryside" workers who had some documented exposure to benzene were included in his data tapes. If the remaining "dryside" workers in this group that were added to API's cohort indeed were not exposed to benzene, as maintained by Rinsky, the inclusion of them will serve only to dilute risk estimates based on latency and add nothing to elucidating a dose/response relationship.

Issue 3. Only Certain Types of Leukemia Are Induced by Benzene

The EPA disagrees with Commenter XII-D-38's inference that AML is the only type of leukemia caused by benzene simply because it is more frequently seen in epidemiologic studies. In addition to leukemia, several studies (described in 53 FR 28496) have noted increases in other cancers, most notably lymphosarcoma and multiple myeloma. There is substantial evidence from case reports and epidemiologic studies that benzene causes all major cell types of leukemia as well as lymphomas and other diseases (Docket No. OAQPS 79-3, Part I, Item XII-B-1). This is consistent with the observation that other leukemogens (e.g. radiation, oncogenic viruses, alkylating agents and anti-neoplastic drugs) cause cancers in different cell types. There is insufficient evidence to discount the association of benzene with leukemia types other than AML.

The API uses only AML and aplastic anemia as disease end points for calculating risk due to exposure to benzene. It is well established that acute nonlymphatic leukemia is causally related to benzene exposure as well. However, there is also evidence linking acute and chronic forms of lymphatic leukemia to benzene exposure. There are several epidemiologic studies and case reports associating lymphatic leukemia with benzene exposure, although the API concludes from their literature review that "chronic leukemias were not associated with exposure to benzene". It is imprudent to assume at this time that these types of leukemia are not related to benzene exposure. Rinsky found a significantly high risk of multiple myeloma in his cohort as did several other researchers. This type of leukemia, arising out of lymphoid tissue, also appears related to benzene exposure. The added contribution of this particular type of cancer should be assessed.

While EPA does not disagree with API in considering aplastic anemia as a benzene-induced disease, EPA is concerned that API's recorded mortality rates underestimate the disease incidence because not all aplastic anemia is fatal.

Issue 4. Blood Counts and the Crump-Allen Exposure Estimate

The evidence provided by API to justify the use of the Crump and Allen exposure estimate is disputed by Rinsky (Docket No. OAQPS 79-3, Part I, Item XII-B-1). Given the uncertainty associated with the Crump and Allen exposure estimate, EPA feels that both the Rinsky and Crump and Allen exposure estimates should be considered in risk assessment.

There are two exposure estimates for the Rinsky cohort; Rinsky's, and Crump and Allen's. Since there are no industrial hygiene data taken prior to 1946, benzene exposure for a given job prior to 1946 must be assumed. Rinsky assumed that for a given job the exposure levels were the same before 1946 as they were in 1946 when some exposure data existed, since there were no major technological changes or improvements in production or control of benzene emissions within the plants. Crump and Allen adjusted the exposure level before 1946 upward from the existing exposure data by multiplying the ratio of prevailing occupational standards at the two different time periods. The argument that the Crump and Allen exposure estimate is superior to the Rinsky exposure estimate is based on an observation that the Crump and Allen estimates have a high correlation with rising peripheral blood counts (higher blood counts are associated with lower exposure estimates), while no correlation is found for the Rinsky estimate. The EPA believes that this finding of a high correlation is "artifactual". Blood counts rose in both exposed and unexposed employees over time, which may have been due to changes in diagnostic methods, techniques or interpretations. Furthermore, low white blood cell counts would tend to bias estimates upward with time because of a company policy that leads to the removal of such employees from exposure. It is difficult to make a judgment about whose exposure estimate is more appropriate based on those blood count data because of poor statistical representation of the population that was monitored for blood evaluation.

Issue 5. Benzene Has a Non-Linear and Threshold Dose Effect

Both Commenter XII-D-38 and API claim that Rinsky's study showed a strong nonlinearity of leukemia mortality rate with dose using either the Rinsky or the Crump and Allen exposure estimates. Commenter XII-D-38 further argues that the observation of pancytopenia prior to leukemia, the short post exposure latent period (i.e., the time interval from last exposure to death from leukemia), and the nonlinearity of risk with exposure dose, are all consistent with leukemia as an indirect effect of benzene.

The observed "pancytopenia" effect, which is a cytotoxic effect, of benzene in some but not all cases preceding leukemia indeed should not be construed as causal evidence for an indirect leukemogenic action. Such a conclusion is only speculative given the lack of consensus about benzene mechanism(s).

Commenter XII-D-38 has implied that a threshold dose effect exists for benzene because of suggestions that leukemia is induced by benzene via indirect mechanisms which are not really well established. The EPA believes that, at this time, it is premature to assume a threshold effect due to the lack of understanding about the mechanisms of carcinogenic action of benzene.

Commenter XII-D-38 argues that benzene acts at a later stage in the carcinogenic process (perhaps, through action of promotion or disease progression) because 80 percent of benzene-associated leukemia deaths occurred no more than two years after their last benzene exposure. This argument is at best speculative. Given that the average latent period in Rinsky's study from first exposure is about 16-20 years, the observation that several cases showing a short post exposure latent period does not imply that benzene acts at a later stage of a carcinogenic process. Under the multistage model for carcinogenesis, a logical way to show that an agent may act at a later stage of a carcinogenic process is to demonstrate that the cancer risk is much greater for older persons than young adults when they were subjected to the same intensity of exposure for a similar duration and have a similar period of follow up.

The EPA does not agree with the comment that the demonstration of a nonlinear dose/response relationship in the observed data is a sufficient basis to argue that the shape of the dose/response curve is nonlinear at untested low dose levels. The EPA's view is that linear low-dose extrapolation is preferred, unless low-dose data and/or mechanism of action or metabolism data show otherwise.

While not unique to benzene per se, there is a general argument for linearity at low doses, which is referred to as "additivity to background". In the additive background model proposed by Crump et al. (1976), spontaneous tumors are associated with an effective background dose, with exposure to carcinogens present in the environment adding to this background dose. In this regard, Crump et al. (1976) stated that "If carcinogenesis by an external agent acts additively with an already ongoing process, then under almost any model the response will be linear at low doses." Hoel (1980) subsequently demonstrated that this result also holds even in the case of partial additivity.

Issue 6. API's Model is Superior to EPA's 1985 Model

The API considers its new risk extrapolation model to be an offshoot of the one used by EPA (1985). The new risk extrapolation, the authors of the API report argue, represents a significant improvement over the existing EPA risk assessment (1985) because more biological information (e.g., the use of latency period actually estimated from data) is incorporated and a better estimation procedure (i.e., the use of individual exposure information rather than categorical data) is used. However, the assertion that their new assessment procedure is an improvement over the EPA procedure is not accurate in EPA's view and the way that latency is incorporated in the model is not appropriate.

The authors of the API document claim that the following mathematic expression, $hl(t)$, can be used to represent the benzene-induced age-specific cancer rate that was used in the 1985 EPA risk assessment.

$$hl(t) = INT\{bx(v)a(v)rw(t-v)dv\} \tag{1}$$

where INT is used to represent the mathematical integration from 0 to t; $a(v)$ is the background rate at age v; $r = 1$ for the relative risk model and $r = 0$ for the absolute risk model; $x(v)$ is the exposure at age v and $w(t-v)$ is the effect (weight) of the exposure incurred at age v to the cancer response at age t; b is a parameter representing carcinogenic potency of benzene.

The EPA does not agree that this new assessment procedure is, a priori, an improvement over the EPA procedure because EPA believes the way that cellular dynamics and latency are incorporated in the new model is both mathematically and biologically inappropriate. While EPA believes that the EPA's linear nonthreshold dose/response assessment for benzene is the most appropriate approach at this time, EPA encourages the development of new approaches that involve the incorporation of biological information, as appropriate, into the risk assessment procedure.

It should be noted that Eq. 1 is only one of many possible ways to interpret risk models used by EPA. The EPA model is a simple standard procedure for calculating dose/response which is not intended to be a characterization of any specific, yet, hypothetical carcinogenic process. This procedure is considered appropriate in the absence of specific mechanistic information. Evidence to indicate why Eq. 1 cannot be used to interpret the EPA model is noted below. The API has used Eq. 1 to show the implication in the EPA model that the background leukemia rate is given by

$$a(t) = c[1 - (1 + kt)\exp(-kt)]$$

where $k \approx 0.399$ and c is a constant representing the background rate of inducing a single malignant cell. They argue that the EPA model is not appropriate because a(t) becomes constant, c, when age t is greater than 20; this is contrary to the fact that background rate is highly age-dependent. The fact is that the EPA model does not make any assumption about the background rate: it used background rates that are reported in the U.S. vital statistics, be they exponentially or linearly related to age. The fallacy is that, in the API model, the background rate is now represented by a mathematical function which includes the probability distribution of latency period which is defined as the time interval from the beginning of the first malignant cell to the death of a person from leukemia. As discussed in the next section, the latency as defined and used in the model is not appropriate.

In its 1985 risk assessment, EPA used two models (relative and absolute risk) and two exposure estimates (cumulative and weighted cumulative) to calculate leukemia risk due to benzene exposure, using data from three different epidemiological studies. This diversity of the use of data and models reflects uncertainties perceived by EPA at the time the document was prepared. These uncertainties remain today.

Issue 7. Problems in the API Procedures for Risk Calculation

A simplified version of the Moolgavkar (MVK) model (1979) is used by API as the backbone to calculate benzene-induced leukemia risk. If this simplified MVK model were used to fit the leukemia mortality data, it would imply that a person dies immediately with a probability of one at the occurrence of the first malignant cell. The API has made an attempt to account for the fact that a person will not die immediately at the occurrence of the first cancer cell by introducing the concept of latency in the model. The latency is defined as time interval from the occurrence of the first malignant cell to death from leukemia. The distribution of the latency period is assumed to have the mathematic form,

$$w(L) = K^2 L\exp[-KL], \qquad (2)$$

where L is the latency period as defined above and k is a parameter; the reciprocal of k is the mode of the distribution; k= 0.399 was estimated on the basis of mortality data on leukemia induced by therapeutic radiation for ankylosing spondylitis.

The way that the latency is incorporated by API into the MVK model is both mathematically and biologically inappropriate because it assumes that one and only one single tumor cell will eventually lead to leukemia death. The API cites the paper by Wittemore and Keller (1978) in which the probability density function (p.d.f) of the time to tumor for a normal cell is expressed as the convolution of p.d.fs' of both time to malignant transformation and the time to tumor (or death) after it becomes malignant. Wittemore and Keller's approach is appropriate because they consider only a single cell which is not subject to cell proliferation before it becomes malignant while the MVK model allows for such a cell growth; thus, a normal cell which is initiated has a potential to produce many initiated and/or malignant cells.

Despite the inadequacy of the methodology employed in the API risk calculations, EPA offers the following comments about the API risk assessment.

1. The mathematical form of the distribution function of the latency has an effect on the final risk estimation. The reason Eq. 2 was selected is not known except that it is mathematically easier to handle. The API demonstration that the risk estimate is not sensitive to the selection of the value of the parameter k is interesting but not the main issue. The question here is why this particular form of a distribution function was selected. In his letter to the EPA Administrator, Dr. Hattis (XII-D-251) has also expressed the same concern.

2. The parameter k in the latency distribution is superimposed upon epidemiological data for which the only information known about the epidemiologic latency period is the period of time from the first exposure to death of a person. These data should only be used to estimate a range of latency as defined in the API model. For instance, if a person died from leukemia after 30 years of exposure to benzene, the only information one could get from this case is that the first malignant cell may have occurred when he was first employed 30 years earlier, or near the end of his employment. In this case, the latency could range from one month to 30 years. This example suggests the inadequacy of estimating the latent period from midpoint of employment until death and then using it to estimate parameter k, as did the authors of the API document. This inadequacy is compounded by the likelihood that there are some fundamental differences between benzene-induced leukemia and radiation-induced leukemia. The API used radiation-induced leukemia to estimate latency. According to the literature both acute lymphatic as well as acute myelocytic leukemia appeared excessive within 2 to 5 years after the Hiroshima bomb blast, followed some 20 years later by an increase in multiple myeloma and carcinoma. In Rinsky's cohort, however,

nearly all of his cases of acute nonlymphatic leukemia appeared well after the estimated median latency among those exposed to the atomic bomb radiation. Indeed, even if one considers the midpoint of their exposure as a reasonable estimate of the time of the first "transformation event" as did the authors of the API document, a considerable lapse of time occurred before manifestation of leukemia.

In the Bond/Ott study, although all 5 cases were acute myelogenous leukemia, the period of time between last exposure to benzene and death ranged from 8 years to 18 years in 4 of the 5 cases thus indicating that the time from transition into malignancy probably exceeded 8 years by a considerable time period. Furthermore, 2 of these cases died from their disease at age 80, which was outside the age range used to justify the use of the absolute risk model. These observations highlight the problem of using a small cohort of workers to estimate the so-called biological latency of rare cancer. This wide range of latency for leukemia demonstrated in the epidemiological studies of benzene points out the difficulty of estimating the biological latency period and thus casts doubt on the reliability of the resultant risk estimate.

3. The use of individual exposure data in the parameter estimation in general is better than grouping into categories. However, the procedure suffers from the deficiency that the background leukemia rate must be estimated and expressed in a mathematical function, which is very much model dependent. This procedure, which forces the background rate to have a certain mathematic form, unnecessarily introduces uncertainties into the risk estimate.

4. An argument is offered to support the use of an absolute risk model over a relative risk model. The main argument against the use of a relative risk model is that the benzene exposure does not change the background mortality rate by a constant fraction at all ages. This argument is not convincing. It is not necessary to assume that benzene exposure will change background by a constant fraction at all ages in order for the relative risk model to be valid. The EPA does not have a preference with regard to which model to use: either the absolute or the relative risk model. In their

report to OSHA from which the EPA risk estimate was derived, Crump and Allen (1984) indicate that each of the models (relative risk and absolute risk), combined with each of the exposure measures (cumulative and weighted cumulative), fit each of the data sets adequately, as well as combined data from different studies. An extensive discussion and justification about the use of absolute and relative risk models for benzene risk calculations are also provided by both Infante and Rinsky. In summary, EPA believes that use of both relative and absolute risk models to calculate benzene risk is appropriate.

Issue 8. Risk is Understated by Omission of Other Cancers and Noncancer Health Effects

Although human exposure to benzene in the workplace has been associated with leukemia, aplastic anemia, multiple myeloma, lymphomas, pancytopenia, chromosomal breakages and depression of bone marrow, EPA believes that the leukemia incidence in epidemiology studies provides the most comprehensive and up-to-date basis for dose/response estimation purposes. In benzene-exposed animals, toxic effects such as histopathological changes in the testes and bone marrow have been observed. Toxicity of the hematopoietic system as well as cytogenetic effects in humans have been causally related to benzene exposure; however, the magnitude and duration of exposure required to elicit these effects are not developed at this time.

The estimated ambient levels of benzene associated with emissions from stationary industrial sources after controls are applied (in the low ppb range) are generally at least three orders of magnitude lower than the lowest-observed-effect levels in animals (in the ppm range). However, the carcinogenic effect, unlike noncancer health endpoints, is presumed to be nonthreshold in nature. Consequently, in the interest of protecting public health, EPA has identified carcinogenicity, specifically leukemia, as the health endpoint of greatest concern in this risk assessment.

In addition to the issues discussed above, other comments received by EPA are summarized in the following section.

General Comments on Benzene Health Effects

Comment: One commenter (XII-D-10) stated that the human epidemiology results for benzene used by EPA are unacceptable to the scientific community because no acceptable evidence has been presented of any case of benzene-induced leukemia outside of the workplace, and because there has been a significant increase in benzene exposure in America over the last 15 years without a corresponding significant increase in leukemia cases.

Response: The EPA believes that the existing epidemiological studies clearly demonstrate an association between benzene exposure and increased risk of leukemia. The EPA does not believe that this conclusion is now seriously challenged.

While epidemiological studies have clearly established a dose/response relationship between cancer in workers and occupational exposure to benzene, it has not been proven through epidemiological studies that exposure to benzene at ambient levels causes cancers. Epidemiological studies that have revealed a statistically significant association between occupational exposure and cancer for substances such as asbestos, coke oven emissions, vinyl chloride, and ionizing radiation, as well as for benzene, are not as easily applied to the general public with the inherent number of confounding variables such as a much more diverse and mobile exposed population, a lack of consolidated medical records, and limited historical exposure data. Given the above characteristics, EPA considers it improbable that any epidemiological association, short of very large increases in cancer, can be detected among the public with any reasonable certainty. The EPA has taken the position, shared by other Federal regulatory agencies, that in the absence of sound scientific evidence to the contrary, carcinogens should be considered to pose some cancer risk at any exposure level.

Comment: Four commenters (XII-D-04, XII-D-41, XII-D-44, XII-D-216, XII-D-252) believed that the risk was understated because of use of data from healthy workers which fail to account for sensitive subpopulations such as children and the elderly.

Commenters XII-D-43 and XII-D-207 believed that risk analysis should consider individual sensitivities. Commenter XII-D-43 referred to the study by Ott et al. as evidence that some individuals are sensitive and may develop chronic effects in only a short time (e.g., 18 months of exposure).

Response: As discussed in response to comments on the uncertainty of risk estimates, this is one of the uncertainties that may cause the risks to be understated and is one that cannot be quantified with the present understanding of biological mechanisms of causation. Since the distribution of individual susceptibility to leukemia is unknown, the risk to individuals or subpopulations cannot be considered quantitatively.

General Criticisms of Linearized Multistage Model

Several commenters had criticisms or suggestions for improvement of the dose/response assessment part of the unit risk estimation procedure. They are described under the next three comment headings and answered in the response that follows. Some commenters criticized the linear multistage model used by EPA for carcinogenic risk assessment. Two commenters supported the use of the linear, no threshold model.

Comment: Commenters XII-F-9, XII-D-06, XII-D-38, XII-D-59, XII-D-60, and XII-D-235, supported by XII-D-27, XII-D-28, XII-D-29, XII-D-32, XII-D-36, XII-D-55, XII-D-57, XII-D-98, XII-D-101, XII-D-104, XII-D-105, XII-D-197, XII-D-199, and XII-D-220 objected to the use of the linear, multistage model and suggested the use of recent scientific advances in pharmacokinetic models, biologically-based dose/response models, and toxicology information. Their comments, given below, elaborate further on this.

Commenter XII-D-101 recommended broad application of a generic model which resulted from the efforts of a subcommittee of the EPA's Risk Assessment Forum. According to the commenter, this model relies on biological information in a two-step mechanism that appears to describe a more biologically accurate estimate of the likely course of a disease and reduces the risk below the upper bound. This commenter advocated tracking the distribution of chemicals through pharmacokinetic approaches, including measurements of bioavailability, laboratory bioassays of actual environmental materials, and mathematical modeling. The commenter felt this would improve the assessment of the dosage delivered to an organ in the body that might be damaged by exposure to a toxic chemical, and of the half-life of chemicals in the body.

Commenter XII-D-59 reasoned that the assumption of low dose linearity is not biologically plausible for some chemicals.

Commenter XII-D-06 objected to the fact that the EPA Guidelines for Carcinogenic Risk Assessment's preferred dose/response modeling procedure, the linearized multistage model, uses only part of the available data -- tumors -- as a function of dose. The commenter stated that pharmacokinetics, metabolic, and other biological data including species-specific factors, are not included in the model and do not figure in the risk calculation.

Another commenter (XII-F-9) stated that the limitations of the linear multistage model are so great that its risk estimates are only useful for relative risk comparisons and not for absolute measures of risk. Specifically, the commenter mentioned the model's unresponsiveness to data in the observed range and the linear constraint placed on the upper bounding procedure. Given the inherent limitations of any statistically based model for extrapolating risk to very low exposure levels, the commenter urged the Administrator to consider all the plausible estimates as part of the "weight of evidence."

Commenter XII-D-10 pointed out that threshold effects are known to exist for substances that act by promotion, as well as cessation of effects of some substances upon cessation of their dosage. In these cases, linear models would be inappropriate.

<u>Comment</u>: In contrast to the preceding commenters, one commenter (XII-D-04) did not support anything other than a linear, no threshold model because no definitive information exists to prove otherwise. Commenter XII-D-216, representing a group of States, said that his agency's Air Toxics Committee, in preparing a guidance document for the member States to use in regulating air toxics, recommended the use of the linear multistage model because of uncertainties regarding low dose extrapolation.

Comment: One commenter (XII-D-10) stated that the risk assessment method is conservative and not pharmacologically sound because EPA assumes that the total lifetime dose, no matter how or when incurred, is the controlling factor. The commenter pointed out that this is wrong because any dosage received less than the length of the latency period before the death of an individual cannot cause that death. Also, any exposure, no matter how large, which is incurred after the initiation of a fatal cancer, will not be an added risk.

Response: The EPA does not agree with the comments that evidence suggesting a nonlinear dose/response relationship in the observed data is a sufficient basis to argue that the shape of the dose/response curve is nonlinear at untested low dose levels. The EPA's view is that linear low-dose extrapolation is preferred, unless low-dose data and/or mechanism of action or metabolism data show otherwise. The EPA also believes that it is premature to assume a threshold effect for benzene due to the lack of understanding about the mechanism of carcinogenic action. The EPA has elected to use the linear nonthreshold assumption for the benzene dose/response assessment because as a matter of science policy, EPA prefers to use assumptions which will provide risk estimates which are most likely to be exceeded given the lack of understanding about the mechanism of carcinogenic action. This choice of models results in an upper bound (i.e., because of the linear assumption) estimate of leukemia risk to the exposed population.

Other Comments

Comment: The NRDC (XII-D-254) commented that there was not sufficient time to allow peer review of the Clement report. They said EPA ought not to implement the many changes in its risk assessment methodology recommended by API in the Clement report outside the normal process for reviewing EPA risk assessment guidelines. The NRDC cautioned that the Clement report proposed a number of changes in data and assumptions specific to benzene. One change in particular would increase the exposure levels previously determined by Rinsky et al. and that such a proposal needs to be critically reviewed before accepting these changes.

Response: No response is needed since the URE has not been revised.

7.3 EXPOSURE ANALYSIS

Many commenters criticized specific assumptions and methods that were a part of the EPA's exposure analysis, while others had more general suggestions on how to improve the assessment. The majority of the comments dealt with specific aspects of the exposure analysis, such as 70-year, 24-hour per day exposure assumption, population location, exposure to multiple sources, and area source modeling. As with the URE section, underlying many of these comments was the view that the exposure analysis was either too conservative or not conservative enough, and therefore, a more plausible or a more protective assessment is needed. Following the discussion of the very specific comments are a few comments of a more general nature on the development of a more plausible exposure analysis.

Exposure Duration and Population Location

Comments described under the following five comment headings are all addressed together in the one response following them.

Comment: Several commenters (XII-D-06, XII-D-09, XII-D-27, XII-D-32, XII-D-33, XII-D-34, XII-D-36, XII-D-45, XII-D-57, XII-D-59, XII-D-60, XII-D-99, XII-D-104, XII-D-105, XII-D-207, XII-D-253, XII-F-9) felt that the assumption of a 24-hour per day, 70-year exposure was unrealistic. One commenter (XII-D-45) stated that sources subject to regulation often have useful production lives of only 15 to 20 years and do not operate continuously. Two of these commenters (XII-D-34, XII-D-105) advocated basing exposure on realistic estimates of time spent at residences and actual population trends. Commenter XII-D-27 recommended that EPA should acknowledge the TEAM study which indicates the general population at risk normally spends approximately 20 hours per day indoors. One commenter (XII-D-33, supported by XII-D-99) suggested that EPA assume an 8-hour per day, 35-year exposure in calculating maximum risk. Another commenter (XII-D-207) said that a 35-year assumption would still provide a very conservative overestimate of exposure time, there is only a 0.04 percent chance of a person remaining in the same house his entire life. Commenter XII-D-60 and XII-D-253 recommended 22 hours per day and 25 years be used in calculating maximum risks. These are based on a probability analysis of exposure durations and represent the 95th percentile.

Comment: Commenter XII-D-60, supported by XII-D-28, XII-D-29, XII-D-33, XII-D-104, XII-D-105, XII-D-197, XII-D-199, XII-D-220, and Docket No. A-79-27, Item IX-D-04 advocated conducting a more robust statistical computation of concentration used for determining the maximum exposure using the current EPA data. This approach would use upper 95th or 99th percentile values of the population risk distribution estimates to predict a more realistic maximum exposure level for each source category.

However, one commenter (XII-D-43) rebutted the argument that 70-year exposures were overly conservative by pointing out that it may not take a 70-year exposure to develop a chronic effect. Another commenter (XII-D-254) rebutted API's use of the upper 95th percentile for duration of exposures, because this would underestimate risks for the 5 percent of the population that may remain in the house all day. This 5 percent would likely include infants, the elderly, and the disabled, who are also more sensitive to health risks than the general population.

Comment: Four commenters favored conservatism regarding the point of maximum pollutant concentration. Three commenters (XII-D-46, XII-D-219, XII-D-229) felt that to protect future residents, the maximum individual lifetime risk (MIR) should be calculated using the maximum offsite pollutant concentration, regardless of whether there are currently residences at that concentration point. One of the commenters (XII-D-219) indicated that this idea is in keeping with the policy of their State air program. Another commenter (XII-D-51) suggested that to add simplicity and conservatism to the risk calculation, risks should be calculated based on a standard individual permanently located at the greatest concentration point on the boundary of the facility being regulated.

Comment: Commenters XII-D-101 and XII-D-60 (also XII-D-253), supported by XII-D-28, XII-D-29, XII-D-33, XII-D-104, XII-D-105, XII-D-197, XII-D-199, XII-D-220, Docket No. A-79-27, Item IX-D-04, and Docket No. A-79-16, Item VI-E-7, advocated that EPA use site-specific exposure assessments which incorporate more accurate and relevant information on local conditions in terms of where residences are located in determining maximum exposure concentrations for the MIR. Commenter XII-D-253 provided locations for 130 plants, saying the EPA's coordinates were in error for some of the plants. Commenter XII-D-60 and XII-D-253 felt that the HEM model's assumption that residences are only 200 meters away from pollution sources caused exposure to be overstated because 200 meters is frequently on plant property. According to Commenter XII-D-253, the vast majority of residences where maximum exposed individuals live are over 200 meters from the source and most are well over that distance.

Comment: Commenter XII-D-27 recommended that EPA should identify the population at risk using current census data.

Response: As noted in the comments, risk estimates are calculated in a series of steps, and these involve use of simplifying assumptions as well as estimates of representative data. The EPA recognizes that the assumptions and procedures used do introduce uncertainty and do affect the quantitative risk estimates. It is for this (and other) reasons that risk estimates are not viewed as precise predictors of health risk and are viewed as being a tool better suited for relative comparisons of pollutants, sources, and emission controls.

The EPA recognizes that the assumption of 70 years of continuous exposure constitutes a simplification of actual conditions and represents, in part, a policy judgment by EPA, but feels that this assumption is preferable to the alternatives suggested. Although emissions of benzene from industrial sources would reasonably be expected to change over time, such changes cannot be predicted with any certainty. In lieu of closing, plants may elect to replace or even expand their operations and subsequently increase their emissions. The 70-year exposure duration represents a steady-state emissions assumption that is consistent with the way in which the measure of carcinogenic strength (URE) is expressed (i.e., as the probability of contracting cancer based upon a lifetime [70 year] exposure to a unit concentration). Constraining the analysis to an "average" plant lifetime carries the implication that no one could be exposed for a period longer than the average. Since, by definition, some plants would be expected to emit longer than the average, this assumption would tend to underestimate the possible MIR.

The MIR is a risk measure or indicator that was designed to evaluate the potential of an emitting plant or source category to cause cancer in the most exposed individual under the assumptions used in the exposure assessment. It is not an actuarially measured risk. The EPA is not attempting to estimate any specific individual's potential of developing the cancer endpoint of concern (for benzene, myelogenous leukemia). The MIR is calculated by multiplying the highest annual average concentration to which any person or group of persons may be exposed by the unit risk factor. Qualifying the definition of MIR with the statement "to which any person or group of persons may be exposed," in effect turns what is simply an estimate of the maximum annual average concentration predicted into an estimate of the highest potential exposure, or the MIR. The expected MIR is the MIR that one would expect if the assumptions used to calculate an annual average exposure persisted unchanged for 70 years, or if these assumptions reflected the average situation over the 70-year period. Furthermore, annual incidence is defined as the expected average annual incidence that might result over a lifetime if the current assumptions represent conditions averaged over 70 years. Incidence also is not actuarially determined.

The EPA agrees that the U.S. population is highly mobile and spends a proportionally greater amount of time indoors than outside. However, adjusting the exposure assumptions to constrain the possibility of exposure to benzene emissions implies that exposure during the periods inside or away from the residence are zero. In addition, a less-than-lifetime assumption would also have a proportional impact on the estimated MIR, suggesting that no individual could be exposed for 70 years. On balance, EPA believes that the present assumption of continuous exposure is consistent with the steady-state nature of the analysis and with the stated purpose of making plausible, if conservative, estimates of the potential health risks. It is the EPA's opinion that this assumption, while representing in part a policy judgment by EPA, continues to be preferable to the alternatives suggested, both in view of the shortcomings of such alternatives and in the absence of compelling evidence to the contrary. The complexity of human mobility in today's society makes it difficult to model exposure with any certainty. Specifically, it is unknown how long various portions of the population remain in an area and to what concentrations of benzene they may have been exposed in other places they have lived. Thus, the simplifying assumption of a 70-year residence in one location has been made. On a smaller scale, the exposure model also assumes that people are continuously exposed to the average ambient benzene concentration at their residence. In reality, people travel daily within and beyond the local area and they are exposed to different concentrations at their workplaces, schools, shopping centers, etc. However, it would be difficult to model local travel and indoor and outdoor exposures, and any result would be highly uncertain. For instance, even if were possible for EPA to collect this information over one particular time period, it may not be representative of population activities in times past or in the future. It is not known if this approach over or underestimates actual exposures.

The EPA believes that there is merit to using the simplifying assumption of 70-year resident immobility. When estimating risk, EPA is concerned about both the public exposure that is occurring and that could potentially occur. That group of people exposed to the highest predicted pollutant concentrations may include individuals, who for a variety of reasons, may spend a large majority of their lifetimes at a single residence. Presently, EPA does not have detailed information on those individuals that live near the sources. Such data, were they available, would not allow EPA to predict the exposure patterns that high exposure groups may experience in the future.

Other commenters suggested that EPA look at the subpopulation of highly exposed individuals, a 90 to 95 percent confidence interval on MIR instead of the "worst case." The EPA has looked into this and has concluded that a meaningful and consistent measure that represents a high but not the highest level of exposure would be difficult to calculate based on many of the reasons described in the uncertainty analysis, namely a lack of data and uncertainty regarding plant property and where people actually reside. Also, it is not clear what criteria would be used to determine the particular level of this estimate of the MIR.

The same commenters stated that EPA overestimates MIR because the sources subject to regulation often have useful productive lives of only 15 years and do not operate continuously. The EPA's response is similar to that given above. The MIR as calculated represents the potential risk to the most exposed population from plant emissions as that plant has recently been operating. The EPA agrees that it may not take 70 years of exposure for cancer to develop so assumptions addressing plant life and population migration may not be as important as they appear at first glance.

For the benzene source categories, other assumptions used in calculating the MIR do not give a worst-case estimate of the potential risk. For example, for most of these benzene source categories the emissions calculated represent a reasonable estimate of the plant's emission capability based on recent operations. Also, to avoid an atypical year meteorologically, an average of several years of meteorological data is used. In addition, the plants themselves are positioned, to the extent feasible, at their actual locations; rather than center-city or center-zip code. The MIR could be made more conservative by tying the measure to a certain point in space from the plant, or simply accepting the maximum concentration predicted at the plant site or the plant boundary.

A commenter stated that the 200-meter plant property assumption caused exposure to be overestimated. The EPA has used the 200-meter fenceline assumption routinely to facilitate comparison of the MIR among sources and source categories. Changes in this assumption have very little impact upon estimates of population risk (annual incidence) but can significantly affect the MIR since this measure of risk is normally predicted close in to the plant. Individual plant boundary information, however, is not readily available and is often difficult to obtain. Sensitivity analyses indicate that while the 200-meter assumption may result in an overestimate of the MIR in some cases, there are also cases where the risk may be underpredicted.

The choice of less sophisticated analyses and need for simplifying assumptions most often results from the lack of source-specific data. The collection of such data, which would facilitate more detailed assessments, is usually prohibitively expensive. The EPA believes that, in such circumstances, assumptions such as the 200-meter fenceline are a reasonable and appropriate surrogate.

Since an annual average exposure is used to calculate MIR, migration does not play a role in determining the conservatism of the estimate. As EPA is estimating the potential risk from exposure, even if a 70-year average exposure were calculated, migration would not be considered a significant factor. By using the 70-year lifetime, EPA calculates a conservative risk estimate in contrast to other estimates, e.g., annual average risk of traffic deaths.

Several commenters have suggested that the EPA's risk estimates should be derived considering actual locations of residential areas. In particular, one commenter specifically adjusted the benzene equipment leaks exposure estimates to predict concentrations where people reside. While it is true that EPA has to varying degrees made this check for some previous NESHAP, EPA does not believe it is appropriate to do so in the absence of exact information on population location. Even with the most sophisticated models, dispersion modelers are not able, with confidence, to predict that a specific concentration will occur at a specific point in space and time. They are confident, within limits, that the maximum concentration predicted will occur somewhere about the plant at some unspecified time. To require that one or more residences exist at the point of modeled maximum concentration places undue emphasis on the capability of the dispersion model to predict that a specific concentration will occur at a specific location. The EPA regards the models as accurate to the extent that the predicted maximum concentration can be expected to occur in the vicinity of the plant. The EPA concludes that while a rough check of the habitability of the area may be advisable, insistence on the verification of residences at the specific concentration point is not technically defensible.

Comment: One commenter (XII-D-60) argued that EPA needs to reexamine its approach to estimating exposure to introduce more real-world plausibility. The commenter specifically recommended that, in conjunction with considering more typical long-term mobility, EPA use the daily activity pattern distributions used in ambient standards development. The commenter also recommended that EPA estimate the concentrations at actual residential locations.

Response: The EPA has consistently taken the position that the models used to estimate exposure and risk should be commensurate with the quality and amount of data available. The national ambient air quality standards (NAAQS) exposure model (NEM) has been used by EPA exclusively for criteria air pollutants. Extensive national monitoring networks are established for these criteria air pollutants that facilitate the identification and evaluation of microenvironments representative of daily activities. Comparable data are not available for benzene and the gathering of such data for the much larger universe of toxic pollutants would be infeasible.

In addition, the health effects associated with exposure to the criteria pollutants are different from those attributable to benzene. In the criteria program there is a greater emphasis on the potential for effects from shorter term exposure and a greater need to evaluate the potential for such exposures.

While EPA agrees that the incorporation of human activity data would represent an analytical improvement, this increase in sophistication is not commensurate with the presently available data, the nature of the effects evaluated, and the underlying uncertainties in estimating cancer risks from exposure to benzene.

Emissions Estimates

Comment: Four commenters (XII-D-06, XII-D-32, XII-D-36, XII-D-104) stated that due to regulation, advances in technology, general concern for safety, and the likelihood that industries would control emissions to levels below the standard to ensure compliance, emissions are likely to decrease in the future; this was not taken into account in the emission estimates.

Response: Responses to comments on emission estimates specific to individual source categories or plants are contained, as needed, in the sections on each source category.

Dispersion Modeling Procedures

Comment: Some commenters thought the dispersion modeling procedures used by EPA caused risks to be overestimated. One commenter (XII-D-9) stated that adverse rather than typical dispersion modeling conditions were used. One commenter (XII-D-99) suggested that since a 70-year exposure was assumed, that 70 years of meteorological data be used to model the maximum annual pollutant concentration; the commenter believed this would result in lower concentrations than estimated using 1 to 5 years of data. One commenter (XII-D-34) suggested considering pollutant instability in the atmosphere.

Commenters XII-D-43, XII-D-44, and XII-D-254 felt that the assumption of flat terrain in the exposure modeling was incorrect and could cause exposures to be underestimated where elevated topography exists.

Response: The EPA agrees that the use of more sophisticated dispersion models, where justified, would result in more accurate concentration estimates. The EPA does not agree, however, that the substitution of a model such as the Industrial Source Complex Long-Term (ISC-LT) would result in substantial changes in the estimated risks or that the changes would be only in a downward direction. In addition, as the commenters noted, the use of more sophisticated predictive models is often precluded by the input data requirements, particularly where a large number of emitting sources, or emission points within the sources, are being assessed. The EPA does not generally utilize more sophisticated dispersion models unless the input data are of sufficient quality to ensure that the models' outputs are of better quality than those available from the screening model in the HEM. For the benzene sources addressed in this notice, EPA believes that the use of the HEM screening model was an appropriate choice.

The EPA agrees that the use of site-specific meteorology, where available in the appropriate amount and format, is superior to the selection of data from the nearest stability array (STAR) station. In the EPA's experience, however, such data sets are very limited and only rarely available. The EPA disagrees that the use of 70 years of meteorological data to obtain average long-term estimates of risk constitutes an improvement over the 1 to 5 years currently used. Even in those few cases in which such a historical record exists, these data could be no more and perhaps less representative than the more recent years. Dispersion is modeled using meteorological data from the nearest STAR stations, which are usually the nearest recording weather station. Site-specific meteorological data are almost never available and to obtain such data would be very resource-intensive. The average of several years (approximately 5) of data is used to minimize the influence of atypical weather patterns. The EPA disagrees that 70-year averages would necessarily produce lower concentrations than 5-year averages. The effect would depend on how representative the most recent 5 years of data were of the overall 70-year pattern. Also, 70 years of data are usually not available at STAR sites. Regardless of the number of years of meteorological data used in the dispersion modeling, considerable uncertainty will still remain due to the assumption that the meteorology of the STAR site is representative of the plant site.

The EPA does consider the stability of compounds in the assessment of exposure. Data indicate, however, that benzene is relatively stable in the atmosphere (with a half life of approximately 6 days) and would not degrade to the extent that there would be an appreciable impact on the exposure and risk estimates.

The effect of terrain on the estimation of exposure may vary from site to site. For any one site, the flat terrain assumption may tend to over- or underestimate exposure. In general, the effect of complex terrain is less for emissions released relatively close to the ground than for elevated process vent emissions that have the potential to impact on hillsides or be affected by building downwash. The EPA agrees that for sources located in complex terrain where the surrounding topography is at a higher elevation, exposure may be underestimated; however, the affect may vary by plant and may be relatively small given the low release heights of most of the modeled benzene sources.

Comment: Three commenters (XII-D-04, XII-D-43, XII-D-44) felt that the failure to account for benzene exposure from more than one facility was incorrect and results in underestimation of risks at some sites where many plants are located within very close proximity to each other.

<u>Response</u>: The EPA agrees that individuals residing in the vicinity of multiple benzene sources would be exposed to higher levels of benzene than is represented by the individual point source modeling approach used. The increase, however, would be expected to be very small and would not affect the estimate of population risk since each source would be modeled individually and the population risks aggregated across the category. The EPA has concluded from sensitivity analyses that the impact on the MIR estimates would be very small, since concentration falls off quickly with distance from the source, and would not, in most cases, affect the rounded estimate.

The EPA agrees in part that theoretically exposure may be underestimated if many plants are located in close proximity to each other. First, annual incidence is not underestimated for those people that are exposed to emissions from two or more plants is accounted for in the estimation of each plant's annual incidence. However, MIR can be underestimated. For a significant underestimation to occur, plants must be situated within several hundred meters of each other and two or more of these plants must have approximately the same magnitude of emissions. The odds of this occurring simultaneously for the plants which determine the MIR for the source category are very small.

<u>Comment</u>: Commenters XII-D-34 and XII-D-60, supported by XII-D-28, XII-D-29, XII-D-33, XII-D-104, XII-D-105, XII-D-197, XII-D-199, XII-D-220 and Docket No. A-79-27, Item IX-D-04 recommended that EPA include the use of area source modeling for at least the highest MIR plants in the source category since the HEM model is designed for point source emission calculations and is not optimal for use in predicting area source emission concentrations. Due to the high cost of using area source models for all sites, the commenters recommended that EPA validate the maximum concentration estimates for the plant sites with the highest MIR values using a suitable area source model such as the ISC-LT. In addition, Commenter VI-E-7 in Docket No. A-79-16 contended that the risk for one coke by-product recovery plant is overestimated by a factor of 1.4 due to the HEM's assumption that all emissions are released from a single location instead of being spatially distributed. The commenter had modeled that plant's emissions as being

spatially distributed using the ISC-LT model, which resulted in a lower predicted risk. The commenter believed that this plant would be representative of coke by-product plants in general.

Response: The EPA agrees that a more ideal assessment would have used an area source model and accounted for spatial distribution to estimate the MIR for source categories such as equipment leaks, benzene storage, and coke by-product recovery plants. Some of the commenters suggested the use of the ISC-LT as a possibility. However, EPA disagrees with the commenters' suggestion that use of the ISC-LT would validate the concentrations estimated by the HEM dispersion model. Other uncertainties, such as the emission estimates, and the meteorology would be the same. Furthermore, comparisons from other projects have shown that HEM and ISC-LT usually agree within a factor of two or three, and HEM does not always produce the higher value.

As the commenters noted, more sophisticated predictive models are often, and in this case, were too resource intensive to apply to a large number of sources. This is especially true for sources with numerous emission points at each source. The EPA does not generally exercise more sophisticated dispersion models unless the input data are of sufficient quality to ensure that the outputs of the sophisticated models are indeed better than those obtained from the screening model usually used. For benzene, several of the source categories have many emission points per source, EPA does not have site-specific characteristics for all facilities in the source categories, the emission estimates are quite uncertain on a per plant basis, and many plants have MIR estimates similar to the overall estimate for the source category. Thus, without expending considerable resources and time, it is unlikely that use of a more sophisticated model would result in a more accurate estimate of the MIR.

Use of Actual Measured Air Pollutant Concentrations

Comment: One commenter (XII-D-105) advocated using actual background and ambient air concentration levels in the exposure assessment, rather than modeling and worst-case assumptions. One commenter (XII-D-06), supported by XII-D-32, XII-D-36, and XII-D-104, suggested using monitoring data to verify modeled concentration estimates, stating that the EPA's current guidelines on exposure assessment express a preference for assessments based on measured data rather than 70-year modeled concentration estimates.

Response: While direct measurement of exposures would appear to be preferable to modeling, it is not feasible as a routine procedure for NESHAP development. Factors affecting the feasibility include cost, time, background concentrations of pollutants, and availability of sufficiently sensitive analytical methods. In particular, it is neither economically nor technically feasible to determine or verify exposure in the vicinity of emitting facilities. It would require siting large numbers of monitors near each plant to establish concentrations to which all persons living near the sources are exposed. Exposure will vary with distance and direction from the plant and the monitoring results could be potentially confounded by background levels or contributions from other benzene sources. In addition, monitoring data do not offer a means of predicting future ambient concentrations resulting from promulgation of a standard. Atmospheric dispersion models can be used to estimate the directional variations in exposure and to predict exposure under various emissions control scenarios.

In summary, EPA believes that routine, extensive collection of monitoring data to verify or substitute for dispersion modeling of emissions does not represent a feasible approach to assessing exposure to benzene. Where monitoring data are available, however, EPA does consider such information in the EPA's deliberative process.

Other Comments

Total Exposure and Risk Analysis

Several commenters felt that the EPA's risk analysis had not accounted for the total exposure, and thus the total risk, to the population. Some commenters felt that all routes of benzene exposure had not been accounted for because only benzene inhalation was considered; other commenters felt that exposures to pollutants other than benzene had not been factored in.

Comment: Three commenters (XII-D-101, XII-D-178, XII-D-203) mentioned the bioaccumulation of benzene and other carcinogens through the food chain. Commenters XII-D-10, XII-D-27, XII-D-41, and XII-D-44 advocated that EPA calculate contributions to exposure by oral, dermal, and inhalation routes, and determine risk to the exposed population by these three routes.

Comment: Commenters XII-F-12, XII-D-23, XII-D-26, XII-D-35, XII-D-102, XII-D-130, XII-D-158, XII-D-185, XII-D-200, XII-D-207, XII-D-217, XII-D-230, and XII-D-252 asked that EPA consider the cumulative effects of exposure to multiple environmental pollutants.

One agency (XII-D-218) cited the EPA's own science policy as stating that risks from individual carcinogens are additive, and thus the risk from benzene sources also emitting other carcinogenic substances is only partially represented by the risk associated with benzene.

Several commenters (XII-F-7, XII-F-12, XII-F-14, XII-D-14, XII-D-35, XII-D-41, XII-D-100, XII-D-102, XII-D-130, XII-D-158, XII-D-185, XII-D-203, XII-D-217, XII-D-252) stated that synergistic effects of various pollutants had not been taken into account. Commenter XII-D-252 stated that Dr. Irving Selicoff of the Mt. Sinai Medical Center has written that benzene exposure will increase damage from radioactivity, even if the exposure to benzene was many years before.

Commenter XII-D-59, supported by XII-D-29, XII-D-32, XII-D-36, XII-D-55, XII-D-98, XII-D-104, XII-D-197, XII-D-199 stated that the problem of significant multiple carcinogen exposures does not appear to widespread, and that where such exposures occur the impacts are likely to be additive rather than synergistic. Commenter XII-D-34 stated that epidemiological studies of benzene-exposed workers, who are also exposed to other chemicals, do not demonstrate additive or synergistic effects, and that evidence of synergism exists for only a very few specific chemicals.

Response: Although the principal focus of Section 112 is the regulation of air emissions of hazardous pollutants, EPA is aware of the potential for some substances to accumulate in other media or the food chain and result in indirect exposure. Available data do not indicate that benzene is accumulated by plants, animals, or soil or that significant indirect exposure is occurring. The EPA recognizes that concurrent exposure to other pollutants could adversely impact public health; however, no data are available concerning possible synergistic or antagonistic interactions with benzene.

7.4 UNCERTAINTY IN RISK ASSESSMENT

Comment: Commenter XII-D-06, supported by several others (XII-D-32, XII-D-36, and XII-D-104) recommended the use of sensitivity analyses to illustrate the effect of the assumptions used on the resultant magnitude of the risk estimate.

Comment: Two commenters (XII-F-3, XII-D-207) presented an alternative method for estimating the MIR and presenting uncertainty, using techniques that explicitly incorporate uncertainty and variability into the model predictions. The commenters described the method as being a simple model which multiplied together a source term, a dilution factor, an occupancy factor, fraction of time at site, etc., using Monte Carlo techniques. The commenters used this method to illustrate the effect of uncertainty on the potential risk to the most exposed individual posed by radon emissions from a uranium tailings pile. They illustrated this technique with a bar-graph which related the probability of a given risk estimate to the area of the bar. The method produced a maximum risk value about one order of magnitude smaller than the EPA's "worst-case" estimate. The commenters urged EPA to use such a method to develop the "best estimate" of risk, along with a quantitative statement about the uncertainty of the risk, when determining an acceptable risk level for any NESHAP being developed. In another comment letter (XII-D-97), the commenter presented a similar simulation of the uncertainty applied to risk estimates for phosphogypsum stacks. In this case, the EPA's estimate was a factor of 2 smaller than the highest value calculated by the commenter. The risk estimated developed by EPA procedures was described by the commenter as 99.6 percent value and considered to be very unlikely.

Another commenter (XII-D-253) also used Monte Carlo techniques to account for population mobility and exposure durations in estimating MIR for the equipment leaks source category. He recommended EPA use similar methodologies for other source categories.

Response: The EPA has long recognized and attempted to communicate the fact the quantitative risk estimates contain inherent uncertainties. Uncertainties arise in all stages of the analysis due to the fact that the relevant data and understanding of the processes are not complete nor perfectly accurate and precise. Where data gaps exist, qualitative and quantitative assumptions are made based on our present understanding of the biological mechanisms of cancer causation, estimates of air dispersion, engineering estimates, and other factors. Because of the nature as well as the number of assumptions made, EPA has in the previous rulemakings only attempted to quantify part of the uncertainties or to describe the uncertainties qualitatively. The presentation of quantitative estimates of only part of the uncertainty has been found to be somewhat misleading because this part of the uncertainty can be construed as representing the total uncertainty. Conversely, compounding of the individual uncertainties can obscure the importance of particular uncertainties.

The comments arguing for quantification of the uncertainty caused EPA to take a fresh look at the uncertainties in risk estimates. The objective of this review was to determine whether there are ways to portray the sensitivity of the risk estimates to changes in assumptions or ways to quantify the uncertainty. In doing so, the risk calculation procedures were reviewed and key parameters that significantly affected the estimates were identified. The feasibility of quantifying the uncertainties was assessed considering the availability of information on the range and distribution of values for the key parameters. The simulations submitted by Commenter XII-D-207 were developed assuming the distribution and variance of the parameters. In the case of the benzene source categories, EPA does not think that similar assumptions can be made and documented. In the absence of such data, any simulation of the combined uncertainties would be misleading in that it would cause an impression of more knowledge and understanding than is presently feasible.

A synopsis of the parameters considered and the assessment of the feasibility characterizing the distributions of values sufficiently to estimate the statistical uncertainty is described below.

Unit Risk Estimate

Major assumptions and factors that significantly affect the derivation the URE include: (1) the health effect modeled (e.g., the specific cancers considered); (2) the study or studies used to derive the estimate; (3) the model used to extrapolate from occupational exposures to the lower dose levels generally found in the environment; (4) consideration of sensitive subpopulations; and (5) consideration of synergistic and antagonistic interactions with other pollutants. At this time, many of these uncertainties can only be addressed qualitatively because the necessary data and understanding are not available. Moreover, in the case of some of these factors the data may never be available. Examples of the information that may never be available include the distribution of individual susceptibilities to cancer within the U.S. population and data defining the response at the low-dose levels. Without additional data and knowledge to define the likely range of some parameters, combined uncertainty analyses, or sensitivity analyses, would only provide an illusory benefit.

Emission Estimates and Source Release Parameters

For the majority of the benzene source categories, emission estimates were derived from emission factors and model plant analyses. Furthermore, for the purpose of the characterization of the risks and health benefits of any regulatory alternatives, it was assumed that these conditions persisted for 70 years. Major factors affecting the uncertainties of the emission estimates for the benzene source categories include: (1) the representativeness of the emission factors to actual emission rates and operations in specific facilities, (2) variations in emission rates among different facilities and operations in the source category, (3) the representativeness (and its variation) of the model plants assumed to actual facilities, and (4) the potential for major changes in source characteristics and emissions in the future. Very few emission tests have been conducted on benzene sources such as equipment leaks, coke by-product recovery plants, and storage vessels. None of the available test data is more recent than 1982. Due to a number of factors such as sparse original database, changes over time, and (in some cases) the impracticality of testing sources, it is infeasible to develop a meaningful estimate of the range and frequency distribution of the uncertainties in the emissions. The potential for future changes in emissions or in source characteristics, in the vast majority of cases, is obviously unquantifiable.

Dispersion Modeling

Factors with a significant effect on concentrations predicted by dispersion modeling include the meteorological data used, the assumption of urban or rural dispersion, and release height. Meteorological data are generally not available at specific plant sites, but are available only from the closest recording weather stations that may or may not be representative of the meteorology of the plant vicinity. The additional uncertainty introduced by this assumption is unknown; however, sensitivity analyses have shown that in some cases it can significantly (e.g., greater than a factor of 10) affect predicted concentrations. The uncertainty or error introduced by this assumption could only be assessed through collection of several years of meteorological data at a representative number of sites. Such data and an analysis are not presently available. The uncertainties of many of the other parameters (e.g., dispersion coefficients and release heights) can be quantified to within the general uncertainties of dispersion modeling.

Exposure Assessment

Exposure estimates are primarily affected by the modeled distance to census block group/enumeration districts (BG/ED) and the plant boundary assumption. The exposure modeling done in the benzene risk assessments predominantly calculated the exposure at the BG/ED centroid, and the location of actual residential areas is unknown. There can be considerable variation in the population distribution over a BG/ED and the variability among sites is very large. Information needed to assess the uncertainty in population locations is only partially available. Maps showing plant property and residential areas are often more than 10 years out of date and many are 20 to 30 years old. Since residential patterns do change, it is likely that refinements to population locations would introduce more uncertainty than use of census data presently introduces.

The conclusion drawn from this assessment was that for most steps in the risk assessment there is insufficient information on the expected range and statistical distribution of possible values. For other steps there are no data to define the uncertainty.

There is, however, sufficient experience and understanding to qualitatively describe the uncertainties and to illustrate representative ranges of the variability. Table 7-1 lists by parameter typical variations in the estimates of MIR resulting from use of different assumptions. These ranges were derived from previous sensitivity analyses of the HEM, literature information, and professional judgment based on general experience with risk modeling using HEM and knowledge of the source categories. The variations shown in Table 7-1 should be viewed as providing a perspective on the relative magnitude and direction of the uncertainties and not as defining the entire range for the parameter.

As shown in Table 7-1, there are a number of parameters that can substantially increase or decrease the estimated risk. It was concluded that on balance overall the risk estimates are plausible and do not represent the worst case. This conclusion was drawn recognizing that the assumption of a 70-year, 24-hour per day exposure adds a degree of conservatism.

<u>Comment</u>:

One commenter (XII-D-30) contested the mathematical methods used by EPA to estimate NESHAP risks, saying they fail to reflect the uncertainty in the data and experimental methods within the "level of risk" estimation. For example, dividing one normally-distributed variable by another results in a number, which the EPA method interprets as a mean value. However, the result actually is a Cauchy-distributed random variable whose mean does not even exist. By not using methods which carry the uncertainty through to the result, EPA may mislead itself and the public.

TABLE 7-1. SENSITIVITY OF MAXIMUM INDIVIDUAL RISK TO CHANGES IN ASSUMPTIONS

Factor in Risk Analysis	Is Factor Known to Exist and Are Data Available?	Direction of Effects on MIR	Representative Range of Variability
Sensitive subpopulation[a]	Unknown	+	~ 10x
Synergism[a]	Unknown	+	~ 10x
Antagonism[a]	Unknown	-	~ 10x
Other dose/response models[b]	Unknown	-	>~ 10x
Emission estimates		Depends on specific basis for estimates	
Height of release	Yes	±	5x
Plant life[c]	Yes	-	Up to 3x or more
Complex terrain	Yes	Extremely site-specific and difficult to evaluate	
Urban releases	Yes	±	4x
Meteorological data[b]	Yes	±	25x
Plant boundary[d] (200-meter assumption)	Yes	±	Up to ~ 10; typical 3-5x
Population location	Yes	±	+5 to -10x
Migration	Yes	-	3x
Mislocating plant	Yes	±	10 to 100

[a] Estimates reflect judgment on probable range of change for carcinogens in general. No information specific to benzene was located in literature sources.

[b] Data are not available to demonstrate more appropriate model assumption at the low-dose end.

[c] Typical plant life for chemical plants.

[d] Based on analysis of ~10 chemical plants using or producing butadiene, ethylene oxide, and chlorinated hydrocarbons. Review of U.S. Geological Survey maps for facilities subject to NESHAP for benzene equipment leaks showed typical effect was a decrease of roughly a factor of 3.

Response: While it is technically true that a mean does not exist for these estimates, standard practice is to assume initially that the variables are normally distributed and to treat all results as if they are normally distributed. The risk estimates are not unique in being treated in this manner.

7.5 REFERENCES

1. Whittemore, A., and J. B. Keller. Quantitative Theories of Carcinogenesis. SIAM Review, Vol. 20, No. 1, pp. 1-30. January 1978.

2. Moolgavkar, S., and D. J. Venzon. Two-Event Models for Carcinogenesis: Incidence Curves for Childhood and Adult Tumors. Mathematical Biosciences, 47:55-57, 1979.

3. Kipen, H. M., et al. Hematologic Effects of Benzene: A Thirty-Five Year Longitudinal Study of Rubber Workers. Toxicology and Industrial Health, Vol. 4, No. 4, pp. 411-430, 1988.

4. Crump, K. S., and B. C. Allen. Quantitative Estimates of Risk of Leukemia from Occupational Exposure to Benzene. Prepared for Occupational Safety and Health Administration. May 1984.

8.0 FORMATS AND COMPLIANCE PROVISIONS OF STANDARDS

8.1 FORMAT AND COMPLIANCE PROVISIONS OF STANDARDS

Several commenters discussed issues on format of standards and demonstration of compliance that are applicable to all of the benzene source categories. These are included below, except for comments on risk-based waivers or use of risk limits instead of emission limits, which are included in a separate section.

Comment: Several commenters (XII-D-34, Docket No. A-79-27, Item IX-D-05 and the CMA (XII-D-59 and XII-D-248) and their supporters) advocated design, equipment, and work practice standards for equipment leaks and storage, if standards are needed for these source categories. They preferred these types of standards to the plantwide emission limit type of standard proposed to apply to each of the source categories. These commenters and Commenter XII-D-199 said that the plant emission limits proposed for equipment leaks under Approaches C and D and storage under Approach D would be infeasible to enforce. The CMA (XII-D-59) said that demonstration of continuous compliance is not practical for storage and equipment leaks sources because in order to measure the emissions one would need to enclose the processes and monitor building exhaust. These commenters believe equipment standards are more enforceable for these types of sources.

One commenter (XII-D-199) said that if emission limits are established, EPA must develop methods of proving compliance. He said that it is extraordinarily difficult to prove compliance and that a plant could be in compliance without being able to prove it. The commenter pointed out that the low emission levels from vents, vessels, and equipment leaks which would be required under Approach D would be difficult to sample accurately, and that a testing protocol needed to be developed for this situation. Both commenters XII-D-199 and XII-D-248 raised the point that emission levels may be below the detection limit, or may be small relative to the variability in the test methods.

The commenter also protested that it would be impossible to sample every source in his company's plant, and recommended that some type of statistical test should be developed.

Response: The EPA agrees that for the equipment leaks and storage emission sources, and the control techniques applicable to them, emissions cannot be easily measured. However, the feasibility of emission measurement is not a relevant concern for the final standards for equipment leaks or for benzene storage vessels.

Comment: Three commenters (XII-D-34, XII-D-199, XII-D-248) believed that if emission limit standards are implemented, the limit should be expressed in terms of a longer averaging time period (e.g., kg/yr instead of kg/day). Commenter XII-D-34 pointed out that EPA used annual estimates to arrive at a daily average emission rate, and then in the standards used this daily average as a maximum permissible amount. The commenter said that to achieve compliance, sources would actually have to operate far below the level specified in the regulation to avoid violations. Thus, EPA has added an additional margin of safety by setting a daily limit. This commenter felt that the best approach would be to set a maximum amount of benzene that could be emitted over 1 year. However, he thought it might be impractical to keep track of the emissions for that period of time, and therefore suggested EPA could also consider a rolling 30-day average.

Commenter XII-D-248 suggested a way of determining the number of violations while using an annual emission limit for process vents. He suggested that plants record daily emissions. If the cumulative annual limit is exceeded, the highest daily emission should be subtracted from the total and counted as one violation, and then the next highest subtracted and counted until the remaining cumulative total is below the annual emission limit. The number of days subtracted would become the number of violations, and the basis for noncompliance findings and penalties.

Response: The final standards for these source categories are not expressed in terms of emission limits, such as kg/day. Consequently, the length of the averaging period is no longer an issue in these standards.

Comment: The CMA (XII-D-59) and their supporters protested the 90-day period given in the proposed Approach C and D standards for submitting an operating and maintenance plan as being unrealistically short.

The CMA also said that the 30-day limit for reporting compliance testing results was unrealistically short.

Response: The standards proposed under Approach C and D are not being established and therefore these concerns are now moot.

8.2 RISK-BASED STANDARDS OR WAIVERS

Many commenters suggested that EPA could set a risk-based standard rather than an emission limit. Others wanted EPA to develop risk-based waivers if the standard were written in an emission cap format. Or, some commenters suggested, if EPA performed plant-specific analyses of emissions and exposures, EPA could set plant-specific emission limits which reflect the differences in the risk per unit of emissions ratio at the various plants. Support for a risk-based standard or waiver/site-specific analysis came from industry, various State agencies or regulatory associations, and environmental/public interest groups. However, there were some variations in how these different parties would like to see such standards implemented. State agencies wanted to ensure that all plants regulated by such a standard would employ the best available control technology (BACT) and would have risks below 1×10^{-6}. Industry wanted to base the level of control for each plant on a site-specific risk analysis; i.e., plants with low risks may not need to install controls. These groups also indicated the regulation needed to include guidance on how to conduct or administrate such a risk-based/site-specific program. The various ideas they proposed are summarized below.

Comment: Ten commenters, representing the chemical and petroleum industries, including CMA, (XII-D-29, XII-D-32, XII-D-34, XII-D-36, XII-D-55, XII-D-98, XII-D-109, XII-D-197, XII-D-199 and XII-F-8) suggested that if EPA sets a plantwide emission limit for benzene or any other hazardous air pollutant as a means of achieving a target risk level, EPA should establish a simple mechanism for granting risk-based waivers. A waiver would allow an individual plant to exceed the emission limit established for the category as a whole if the higher level of emissions at the plant did not cause the target risk value to be exceeded. These commenters felt this would be desirable because it might reduce plant closures or production curtailments and would allow the risk level to be achieved more cost effectively.

Comment: Two commenters (NRDC and the American Lung Association, XII-D-48 and XII-D-100) proposed that a risk-based waiver be developed under Approach D, but that every facility should also be required to implement maximum feasible or maximum available control technology. If a plant applied this technology and still exceeded the emission limit, but complied with the 1×10^{-6} risk level, the plant would be considered in compliance. This would allow sources to determine a level of control that is not worst-case driven, but reflective of actual emissions and demographics at the site.

One State agency (XII-D-229) recommended that, in addition to requiring the lowest achievable emission reduction (LAER), a site-specific analysis be used to determine the level of emission/risk reduction to be required at that site.

Commenters XII-D-46 and XII-D-216 (State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials [STAPPA/ALAPCO] and Northeast States for Coordinated Air Use Management [NESCAUM]) suggested facilities should only be required to adopt controls beyond BACT until the 1×10^{-6} risk level is achieved. Achievement could be determined through site-specific analysis and risk-modeling. Three commenters (XII-D-46, XII-D-48 and XII-D-100) proposed that this risk cut-off or waiver (as opposed to the emission cap) would prevent many of the closures or curtailments which EPA had predicted under Approaches C or D.

Comment: Some groups suggested standards be expressed in terms of risk rather than emission limits, and that site-specific modeling be used to determine compliance. One State agency (XII-D-40) asked EPA to consider site-specific modeling analyses by sources to comply with the designated risk targets. Another State (Rhode Island Division of Air and Hazardous Materials, XII-D-219) also preferred a risk target approach, suggesting it would not involve substantial extra work because each source would have to be modeled anyway.

The Department of the Navy (XII-D-51) recommended that a risk-based limit be promulgated, along with the method required to determine the risk. The Department reasoned that an emission cap, which is actually based on a risk target, might actually result in greater-than-target-risk to a population residing downwind from a benzene facility.

Comment: Some commenters requested that EPA develop firm guidance on the site-specific modeling and review necessary to administer a risk-based program. One of these commenters (XII-D-100) suggested replicable protocols would need to be developed by EPA to manage this waiver process. He indicated that the EPA's review of waivers should be funded through applicant fees. Commenter XII-D-51 also said EPA should establish a method to determine the site-specific risks.

Other commenters (XII-D-34 and XII-D-219) believed EPA could develop guidance on modeling procedures fairly quickly. One commenter (XII-D-34) claimed meteorologic data, location of the nearest residences, and stack parameters are readily available. He also suggested that EPA could review risk modeling already submitted by many facilities to State agencies, determine which models are acceptable, and set a range of acceptable assumptions based on this review. Commenter XII-D-219 also noted that some States have already attempted to establish a protocol to insure consistent modeling.

Related to the site-specific analysis of risk, STAPPA/ALAPCO, NESCAUM and two States (XII-D-46, XII-D-216, XII-D-219 and XII-D-229) strongly advised that the calculation of risk at a given site be based on the highest concentration at the boundary or the maximum impact.

Comment: On the other hand, the API (XII-D-60) argued that standards expressed in terms of MIR might not be feasible because only large sources could afford to do the risk modeling calculations necessary to prove compliance.

Response: Under the final policy developed for NESHAP, the acceptability of risks is judged considering all health and risk information and is not determined solely on the basis of one particular risk parameter. In the second step decisions, EPA selected standards that were based on application of specific equipment and work practices. Consequently, the standards do not correspond to a single risk level, and it is not possible to define a single risk level that provides equivalent protection on a nationwide basis. Therefore, the various recommendations to use risk-based standards are no longer pertinent.

8.3 MISCELLANEOUS COMMENTS ON REGULATIONS

Comments on sources regulated and other miscellaneous comments on standards applicable to multiple source categories are included here.

Comment: Commenter XII-D-36 found it difficult to understand why EPA was going to regulate certain stationary sources of benzene, possibly with severe economic impacts and uncertain health benefits, when it was not taking into account major sources of benzene (e.g., automobile exhaust and refueling operations), to which most people in this country are exposed on a daily basis.

Response: The focus of Section 112 of the CAA is on stationary sources; the other sources mentioned by the commenter are dealt with under other provisions of the CAA. Since all of these sources contribute to the atmospheric concentrations of benzene, it is appropriate to use all of the available regulatory tools, including the applicable CAA sections, to address the pollution problems caused by these sources.

Comment: One commenter (XII-D-32) objected to the definition of "plant" in the emission limit standards proposed for benzene source categories under Approaches C and D. The commenter felt that this definition, and the standards based on it, would favor small plants at different sites over a large multi-unit plant. The commenter recommended that if Approach A is chosen, that this definition not be included in the standards.

Response: The plantwide emission standards proposed under Approaches C and D are not being implemented as final standards. The final standards consist of equipment, design, and work practice requirements; these do not provide an advantage to small plants relative to large multi-unit plants.

APPENDIX A

LIST OF COMMENTERS

BENZENE HEALTH EFFECTS

Docket No. OAQPS 79-3, Part I

Subcategory XII-D

Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOCUMENT
XII-D-01	09-07-88	New Mexico Health & Env. Dept., Millicent Eidson	08-31-88
XII-D-02	09-09-88	Sealed Air Corporation, Nelson E. Malwitz	09-02-88
XII-D-03	09-13-88	CANAH Coalition for Alternatives in Nutrition and Healthcare, Inc., Catherine J. Frompovich	09-07-88
XII-D-04	09-12-88	Brandt Mannchen (Private Citizen) Houston, TX	09-03-88
XII-D-05	09-21-88	Environmental Research Foundation, Peter Montague	09-17-88
XII-D-06	09-19-88	Cleary Gottlieb Steen & Hamilton, Donald Stevenson (Counsel for) AIHC American Industrial Health Council,	09-20-88
XII-D-07	09-22-88	Morris Highlands Audubon Society, Charles Lenchitz	09-19-88
XII-D-08	09-27-88	Kentucky Resources Council, Tom FitzGerald	09-21-88
XII-D-09	09-27-88	Michigan Dept. of Natural Resources, Robert Miller	09-23-88
XII-D-10	09-28-88	John T. Barr (Private Citzen) Easley, SC	09-21-88
XII-D-11	09-28-88	Silicon Valley Toxics Coalition, Ted Smith	09-21-88
XII-D-12	09-28-88	Vermonters Organized for Clean Up (VOC), Theresa Freeman	09-21-88
XII-D-13	09-28-88	ICATW Ironbound Committee Against Toxic Waste, Arnold Cohen	09-21-88
XII-D-14	09-28-88	OCAW Oil, Chemical & Atomic Workers, Richard Miller	09-21-88
XII-D-15	09-28-88	W.A.T.E.R., Dorothy M. Lang	09-22-88
XII-D-16	09-28-88	Seeber, Bowkley, Greb & Zelante, Morris Greb	09-21-88
XII-D-17	AUG/SEP	Letters/post cards from Private Citizens dated August 13 thru September 24 (38 Letters)	
XII-D-18	09-29-88	Dr. & Mrs. T.J. Voneida (private citizens) Kent, Ohio	09-23-88

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NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-19	09-29-88	Vida Roth (private citizen) Bloomington, IN	N/D
XII-D-20	09-29-88	Michael G. Bennett (private citizen) Dover, NH	N/D
XII-D-21	09-29-88	Petition from members of the faculty of Oliver Street School in Newark, NJ (37 names)	N/D
XII-D-22	09-29-88	Bracewell & Patterson, William A. Anderson, II (Counsel for: STERLING CHEMICALS)	09-29-88
XII-D-23	09-29-88	Township of Egg Harbor, Maria T. Bohle; Letter w/attachments	09-21-88
XII-D-24	09-29-88	National Coal Association, David C. Banand Letter addressed to Lee M. Thomas	09-28-88
XII-D-25	09-29-88	Rowan Environmental Action Partners, Patricia Link	09-26-88
XII-D-26	09-29-88	New York City Coalition to Stop Food Irradiation, Michael C. Colby	09-26-88
XII-D-27	10-03-88	American Coke and Coal Chemicals Institute, Mark T. Engle (Same comment: A-79-16 IV-D-52 and A-79-27 IX-D-01)	N/D
XII-D-28	10-03-88	Citgo Petroleum Corp., W. James McCarthy	09-30-88
XII-D-29	10-03-88	Texaco Inc., U.H. Henderson, Jr.	09-28-88
XII-D-30	10-03-88	BP America Inc., Allen R. Ellett	09-30-88
XII-D-31	10-03-88	Beveridge & Diamond, Don G. Scroggin (Counsel for Idaho Mining Association (IMA)	10-03-88
XII-D-32	10-03-88	Monsanto Company, Charles D. Malloch; Letter w/ attachment	09-30-88
XII-D-33	10-03-88	should be "INSTITUTE" Wilmer Cutler & Pickering, Neil IAN King (Counsel for AMERICAN IRON AND STEEL INDUSTRY; Lettr w/ attachment (same comment A-79-16, IV-D-53)	10-03-88
XII-D-34	10-03-88	Dow Chemical U.S.A., R.S. Rose & F. Hoerger; Letter w/attachment	10-03-88

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NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-35	10-03-88	Gary Martin Cohen, PH.D (Highland Park, NJ) (request for an extension of deadline)	09-30-88
XII-D-36	10-03-88	Union Carbide Corporation, Robert T. Jackson Letter w/attachment	10-03-88
XII-D-37	10-03-88	Gelman Sciences, Charles Gelman	09-29-88
XII-D-38	10-03-88	CEOH Consultants in Epidemiology & Occupational Health, Inc.; Letter w/attachment	10-03-88
XII-D-39	10-03-88	Accord Research and Educational Associates, Inc. Richard Piccioni	10-01-88
XII-D-40	10-03-88	Connecticut Department of Health Services, David R. Brown & Hari Rao	09-30-88
XII-D-41	10-03-88	Larry E. Fink (private citizen) Falls Church, VA Letter w/attachment	10-03-88
XII-D-42	10-03-88	Reitman Parsonnet Maisel & Duggan, Bennet D. Zurofsky	09-26-88
XII-D-43	10-03-88	Colorado Department of Health, Bradley J. Beckham	09-30-88
XII-D-44	10-03-88	Commonwealth of Massachusetts, Elizabeth Anne Bourque; Letter w/attachment	09-30-88
XII-D-45	10-03-88	Kerr-McGee Corporation, Edwin T. Still and John C. Stauter	10-03-88
XII-D-46	10-03-88	Stappa/Alapco, S. William Becker; Letter w/attach.	09-30-88
XII-D-47	10-03-88	Hunton & Williams, F. William Brownell (Counsel for Utility Air Regulatory Group; Letter w/attachment	10-03-88
XII-D-48	10-03-88	American Lung Association, Conrad J. Mason Letter w/attachment	09-30-88
XII-D-49	10-03-88	ASARCO Inc., Donald A. Robbins	10-03-88
XII-D-50	10-03-88	HSIA Halogenated Solvents Industry Alliance, Paul A. Cammer; Letter w/attachments	10-03-88

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Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-51	10-03-88	Department of the Navy, Richard A. Guida	10-03-88
XII-D-52	10-03-88	Oak Ridge National Laboratory, Curtis C. Travis Letter w/attachment	09-16-88
XII-D-53	10-03-88	Middle South Utilities System, George E. White; Letter w/attachment	09-30-88
XII-D-54	10-03-88	Commonwealth of Massachusetts, Diane M. Maganaro; Letter w/attachment	09-30-88
XII-D-55	10-03-88	Kodak Company, J.C. Edwards	09-29-88
XII-D-56	10-03-88	Environmental Conservation Board of the Graphic Communications Industries, Fred Rosenbloom	10-00-88
XII-D-57	10-03-88	Motor Vehicle Manufacturers Association, Fred W. Bowditch; Letter w/attachment	09-28-88
XII-D-58	10-03-88	Regional Air Pollution Control Agency, John A. Paul	09-30-88
XII-D-59	10-03-88	CMA Chemical Manufacturing Company, Geraldine V. Cox, et al., Letter w/attachments (same materials also put into Dockets A-79-27; A-79-49; & A-80-14)	10-03-88
XII-D-60	10-03-88	API American Petroleum Institute, Terry F. Yosie; Letter w/attachment (same material also put into Dockets A-79-16; A-79-27; A-79-49; & A-80-14)	10-03-88
XII-D-61	10-03-88	C.E. Atnip (private citizens), Calvert City, KY	09-24-88
XII-D-62	10-03-88	Stephen C. Sawtner (private citizen) Westfield, NJ	09-21-88
XII-D-63	10-03-88	Ralph Long (private citizen)	09-29-88
XII-D-64	10-03-88	Patsy Thureatt (private citizen) Calvert City, KY	09-24-88
XII-D-65	10-03-88	Keari Tohy (private citizen)	09-26-88
XII-D-66	10-03-88	Linda and Gregory Ward (private citizens)	09-26-88
XII-D-67	10-03-88	Donna Hayes (private citizen) Bunker, MO	09-26-88
XII-D-68	10-03-88	Harry Hayes (private citizen) Bunker, MO	09-26-88

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NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-69	10-03-88	Patricia Link (private citizen) Cleveland, NC	09-26-88
XII-D-70	10-03-88	Charles Leiden (private citizen) Altoona, PA	N/D
XII-D-71	10-03-88	Neil & Virginia Bonyor (private citizens) Great Meadows, NJ	09-28-88
XII-D-72	10-03-88	Verble Dullinger (private citizen) Bolivar, TN	09-26-88
XII-D-73	10-03-88	Dan & Rosemary Waldron (private citizens) Austin, TX	N/D
XII-D-74	10-03-88	Sherry L. Smith (private citizen) Austin, TX	N/D
XII-D-75	10-03-88	Clay Carter (private citizen) Birmingham, AL	N/D
XII-D-76	10-03-88	Donald L. Shepherd (private citizen) Salem, VA	09-28-88
XII-D-77	10-03-88	Thomas M. Strode (private citizen) New Port Richey, FL	09-26-88
XII-D-78	10-03-88	Bettina Redway (private citizen) Sacto, CA	09-26-88
XII-D-79	10-03-88	Donna Klewer (private citizen) Chesterton, IN	09-25-88
XII-D-80	10-03-88	Joan Candalino (private citizen) New Port Richey, FL	9-26-88
XII-D-81	10-03-88	Denise G. D'Atrio (private citizen) Belleville, NJ	09-23-88
XII-D-82	10-03-88	Cecilia Keller (private citizen) Bolivar, TN	N/D
XII-D-83	10-03-88	Don Clark (private citizen) Mutley, NJ	09-22-88
XII-D-84	10-03-88	Jack I. Stern (private citizen) Glen Ridge, NJ	09-22-88
XII-D-85	10-03-88	James Stewart (private citizen) Pottsboro, NC	09-27-88
XII-D-86	10-03-88	Kathy English (private citizen) Bolivar, TN	09-26-88
XII-D-87	10-03-88	Charles E. Holzer (private citizen) Gallipolis, OH	09-27-88
XII-D-88	10-03-88	Henry M. Harris (private citizen) Ashville, NC	09-25-88
XII-D-89	10-03-88	Ray & Carolyn Ervin (private citizens) Bolivar, TN	09-26-88

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NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-90	10-03-88	ARISE, Edmund F. Benson (private citizen) Maimi, FL	9-25-88
XII-D-91	10-03-88	Lawrence G. Hunter (private citizen)	09-26-88
XII-D-92	10-03-88	Patsy Hunter (private citizen)	09-26-88
XII-D-93	10-03-88	Martha A. Goldbach (private citizen) Evansville, IN	09-25-88
XII-D-94	10-03-88	J. Dwaine Phifer (private citizen) Cleveland, NC	09-19-88
XII-D-95	10-03-88	John White (private citizen) Black, MO	N/D
XII-D-96	10-04-88	Department of Energy, Raymond P. Berube; Letter w/attachment	10-03-88
XII-D-97	10-04-88	The Fertilizer Institute, Gary D. Myers; Letter w/attachment (same material also put into Dockets A-79-16; A-79-27; A-79-49; & A-80-14)	10-03-88
XII-D-98	10-04-88	Cain Chemical Inc., C.M. Moffitt	10-03-88
XII-D-99	10-04-88	Bethlehem Steel Corporation, David M. Anderson (duplicate of A-79-16, IV-D-56)	09-30-88
XII-D-100	10-04-88	NRDC Natural Resources Defense Council, David D. Doniger; Letter w/attachment	10-03-88
XII-D-101	10-04-88	Kaiser Aluminum & Chemical Corp., L.M. Rapp Letter w/attachment	10-03-88
XII-D-102	10-04-88	Food and Water Inc., Judith H. Johnsrud; Letter w/attachment	09-27-88
XII-D-103	10-04-88	GATX Terminals Corp., R.W. Bogan	09-29-88
XII-D-104	10-04-88	Amoco Corporation, Walter R. Quanstrom	10-03-88
XII-D-105	10-04-88	Chevron Environmental Health Center, Inc., William S. Bosan	10-03-88
XII-D-106	10-04-88	Ohio Council of Skin & Scuba Divers, Inc., Nathan Shaffer	09-29-88
XII-D-107	10-04-88	University of Southwestern Louisiana, Sheryl Moore	09-29-88
XII-D-108	10-04-88	Environmental Planning Lobby, Larry Shapiro, Anne Rabe, and Leslie Dame	09-30-88

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Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-109	10-04-88	Shenango Inc., James R. Zwikl	09-30-88
XII-D-110	10-04-88	Lin Kaatz Chary (private citizen) Gary, IN	09-26-88
XII-D-111	10-04-88	CANE, Marvin I. Lewis (private citizen)	N/D
XII-D-112	10-04-88	Associated Industries of Missouri, Brad Jones	10-04-88
XII-D-113	10-04-88	Lillian Robinson (private citizen) Fremont, OH	09-30-88
XII-D-114	10-04-88	Maxine Laugh (private citizen) Bunker, MO	09-27-88
XII-D-115	10-04-88	Bonnie Mertzlufft (private citizen) Bunker, MO	09-24-88
XII-D-116	10-04-88	Glenneda King (private citizen) Acme, PA	09-30-88
XII-D-117	10-04-88	Mr. & Mrs. John H. MacGovoan (private citizen) ~~N. Kingstorm, KY~~ N. Kingstown, RI.	09-23-88
XII-D-118	10-04-88	Sister Aloise Boone (private citizen) Benton KY	N/D
XII-D-119	10-04-88	Laurence Frederick (private citizen) Hermann, MO	N/D
XII-D-120	10-04-88	Carol Shonk (private citizen) Wichita, KS	09-28-88
XII-D-121	10-04-88	Esther M. Reynolds (private citizen) Linn, MO	N/D
XII-D-122	10-04-88	Donna Hinderliter (private citizen) Wichita, KS	09-29-88
XII-D-123	10-04-88	NY State Congress of Parents & Teachers Inc., Elsa Ford	09-30-88
XII-D-124	10-04-88	Arthur R. Woodke (private citizen) Tinley Park, IL	09-27-88
XII-D-125	10-04-88	Petition (30 names) private citizens	N/D
XII-D-126	10-04-88	Jim Ruiz (private citizen) Deerfield, IL	N//D
XII-D-127	10-04-88	Virginia Melvin (private citizen) Woodstock, IL	09-28-88
XII-D-128'	10-04-88	Virginia Shanahan (private citizen) Boulder, CO	09-28-88
XII-D-129	10-04-88	Jewell Marvin (private citizen) Bolviar, TN	N/D
XII-D-130	10-04-88	Native Americans for a Clean Environment, Jessie DeerInWater	09-29-88

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NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-131	10-04-88	Carol A. Unertl (private citizen) Doriners Groe, IL	9-29-88
XII-D-132	10-04-88	Joseph Nardone (private citizen) Newark, NJ	09-28-88
XII-D-133	10-04-88	Renee S. Gagnor (private citizen) Chicago, IL	09-29-88
XII-D-134	10-04-88	Cnythia Folke (private citizen) Oak Forest, IL	09-29-88
XII-D-135	10-04-88	Carmela Foster (private citizen) Chicago, IL	09-29-88
XII-D-136	10-04-88	Ilyasah Javett (private citizen) Chicago, IL	N/D
XII-D-137	10-04-88	Vincent Mertzlufft (private citizen) Bunker, MO	09-24-88
XII-D-138	10-04-88	Richard Murzyn (private citizen) Griffith, IN	09-25-88
XII-D-139	10-04-88	Rebecca Leonard (private citizen) Chicago, IL	09-29-88
XII-D-140	10-04-88	Steven Olsson (private citizen) Glen Ellyn, IL	09-29-88
XII-D-141	10-04-88	William F. Mosca (private citizen) Evanston, IL	09-29-88
XII-D-142	10-04-88	Chris Stodder (private citizen) Chicago, IL	N/D
XII-D-143	10-04-88	Charlotte Keller (private citizen) Jones Mills, PA	09-30-88
XII-D-144	10-04-88	Clifford Patts (private citizen) St. Anne, IL	09-29-88
XII-D-145	10-04-88	Julie L. Levensin (private citizen) Northbrook, IL	N/D
XII-D-146	10-04-88	Thomas Young (private citizen) Chicago, IL	09-29-88
XII-D-147	10-04-88	Paul R. Evans (private citizen) Chicago, IL	09-29-88
XII-D-148	10-04-88	Catherine M. Cameron (private citizen) Goldston, NC	9-29-88
XII-D-149	10-04-88	Elisabeth R. Br---- (private citizen) Evanston, IL	09-30-88
XII-D-150	10-04-88	Mark Stinson (private citizen) Chicago, IL	N/D
XII-D-151	10-04-88	Ann B. Iafrate (private citizen) Everett, MA	09-27-88
XII-D-152	10-04-88	Merle Pearson (private citizen) Fremont, OH	09-29-88
XII-D-153	10-04-88	George W. Brint (private citizen) Bolivar, TN	09-29-88

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NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-154	10-04-88	Glenneda Gearhart (private citizen) Acme, PA	N/D
XII-D-155	10-04-88	Kurt Palmer (private citizen) Chicago, IL	N/D
XII-D-156	10-04-88	Joe and Jane Chaplin (private citizens)	09-30-88
XII-D-157	10-04-88	Private Citizen (no name) Bunker, MO	09-2-7-88
XII-D-158	10-04-88	Central Pennsylvania Citizens for Survival, Gladys Zelinsky (Chairperson)	09-29-88
XII-D-159	10-04-88	Kevin Christinat (private citizen) Wichita, KS	09-29-88
XII-D-160	10-04-88	David Garrison (private citizen)	09-29-88
XII-D-161	10-04-88	Leone Beavers (private citizen)	N/D
XII-D-162	10-04-88	Billie Jean Pattrett (private citizen) Bunker, MO	09-26-88
XII-D-163	10-04-88	Catherine Lippert (private citizen) Kansas City, MO	9-25-88
XII-D-164	10-04-88	Gary Schwochow (private citizen) Fremont, OH	09-28-88
XII-D-165	10-04-88	Ewell F. McKinnie (private citizen) Middleton, TN	09-29-88
XII-D-166	10-04-88	Private Citizen, Duson, LA	09-25-88
XII-D-167	10-04-88	Kathryn Pearson (private citizen) Fremont, OH	09-28-88
XII-D-168	10-04-88	Mr & Mrs Monroe Barton (private citizens) Bunker, MO	9-27-88
XII-D-169	10-04-88	J.A. Ellis (private citizen) Chicago, IL	N/D
XII-D-170	10-04-88	Nancy E. Bishop (private citizen) Chicago, IL	09-29-88
XII-D-171	10-04-88	Kaye Sheets (private citizen) Cleveland, NC	09-29-88
XII-D-172	10-04-88	Milen Hayes (private citizen) Chicago, IL	09-29-88
XII-D-173	10-04-88	Chad Conzelmann (private citizen) Lafayette, LA	N/D
XII-D-174	10-04-88	Sandra S. Brauer (private citizen)	09-28-88
XII-D-175	10-04-88	Lincoln D. Rogala (private citizen) Wheaton, IL	09-28-88
XII-D-176	10-04-88	Robert J. Osswald (private citizen) Quincy, IL	09-29-88

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NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-177	10-04-88	Paul Conzelmann (private citizen) Lafayette, LA	N/D
XII-D-178	10-04-88	Debra L. Adams (private citizen) Acme, PA	09-28-88
XII-D-179	10-04-88	Donna Suan (private citizen) Boulder, CO	09-28-88
XII-D-180	10-04-88	Al & Lyn Wilson along w/ 9 additional signatures (private citizens) Salisbury, NC	N/D
XII-D-181	10-04-88	Standard Form Letter submitted separately by 20 people (private citizens)	N/D
XII-D-182	10-04-88	Standard Form Letter favoring Method D, submitted separately by 11 people (private citizens)	N/D
XII-D-183	10-05-88	Carolyn & Charles Merol (private citizens) Dillsboro, NC	09-26-88
XII-D-184	10-05-88	Norma B. Kirk (private citizen) Bolivar, TN	N/D
XII-D-185	10-05-88	Regina C. Rowan (private citizen) Hyde Park, MA	09-30-88
XII-D-186	10-05-88	Patty Clary, CAT Californians for Alternatives to Toxics (private citizen) Arcata, CA	09-29-88
XII-D-187	10-05-88	Beverly Braverman (private citizen) Acme, PA	N/D
XII-D-188	10-05-88	Mary Roy (private citizen) Amherst NH	10-02-88
XII-D-189	10-05-88	Carol Oldershaw (private citizen) Chicago, IL	N/D
XII-D-190	10-05-88	Gregory & Donna Smart (private citizens) Newport, NH	09-27-88
XII-D-191	10-05-88	Pete Sultatos (private citizen) Marietta, PA	10-01-88
XII-D-192	10-05-88	Hazel M. Gibbs (private citizen) Fremont, OH	09-29-88
XII-D-193	10-05-88	Barbara S. Patrick (private citizen) Esopus, NY	09-24-88
XII-D-194	10-05-88	Florence M. Sizemore (private citizen) Bunker, MO	09-30-88
XII-D-195	10-05-88	Louis Blumberg (private citizen) San Francisco, CA	09-29-88
XII-D-196	10-05-88	Vicki Shirey (private citizen) Mayport, PA	10-03-88

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Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-197	10-05-88	Keller and Heckman, Peter L. de la Cruz (Counsel for) SPI Society of the Plastics Industry, Inc.; Letter w/attachment	10-03-88
XII-D-198	10-06-88	Kerotest Manufacturing Corp., Richard W. Conley Letter w/attachment addressed to Eileen Claussen (EPA) (duplicate of A-79-27, IX-D-07)	09-30-88
XII-D-199	10-06-88	Bracewell & Patterson, William A. Anderson (Counsel for) Sterling Chemicals, Inc.; Letter w/attach.	10-03-88
XII-D-200	10-07-88	International Inst. of Concern for Public Health	10-04-88
XII-D-201	10-07-88	Rosendale Environmental Commission, Manna J. Greene	10-03-88
XII-D-202	10-07-88	Bountiful Gardens, Charles March, Paula Stobbe, and Katherine S. Hester	09-27-88
XII-D-203	10-07-88	Maryland Nuclear Safety Coalitition, Patricia Birnie; Letter w/ attachment	10-03-88
XII-D-204	10-07-88	Union Camp Corp., R. Thorne	10-03-88
XII-D-205	10-07-88	Handy & Harman, John C. Bullock	10-03-88
XII-D-206	10-07-88	UMD University of Medicine & Dentistry of N.J., Bernard D. Goldstein; Letter w/attachment	09-30-88
XII-D-207	10-07-88	AMC American Mining Congress, James E. Gilchrist; Letter w/attachment addressed to Lee M. Thomas	10-03-88
XII-D-208	10-11-88	Marvin I. Lewis (private citizen) Phila., PA Letter addressed to Lee Thomas	N/D
XII-D-209	10-11-88	American Chemical Society, Gordon Nelson	10-03-88
XII-D-210	10-11-88	Walter & Rose Lubin (private citizens) Parlin, NJ	09-30-88
XII-D-211	10-11-88	Dorothy Ingline (private citizen) Atlantic Highlands, NJ	10-07-88
XII-D-212	10-11-88	Gibson & Robbins-Penniman, Joseph M.Reidy	10-03-88
XII-D-213	10-11-88	Lee Gratwick (private citizen) Pavilion, NY	10-03-88
XII-D-214	10-11-88	David A. Murray (private citizen) Parlin, NJ	09-30-88

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Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOC.
XII-D-215	10-13-88	API American Petroleum Institute, G. William Frick Letter w/attachments	10-12-88
XII-D-216	10-13-88	NESCAUM Northeast States for Coordinated Air Use Management, Michael J. Bradley	10-03-88
XII-D-217	10-14-88	Environmental Coalition on Nuclear Power, L.J. Glicenstein; Letter w/attachment	09-29-88
XII-D-218	10-14-88	EPA, Region VIII (Denver) Risk Assessment Workgroup James B. Lehn	10-03-88
XII-D-219	10-14-88	Rhode Island and Providence Plantations, Division of Air and Hazardous Materials, Thomas Getz and Barbara Morin	N/D
XII-D-220	10-19-88	Chevron Corporation, R.L. Arscott; Letter w/attach.	10-12-88
XII-D-221	10-19-88	Burton L. Appleton (private citizen) Alexandria, VA	10-17-88
XII-D-222	10-19-88	Max Lyon (private citizen) Palo Alto, CA	10-12-88
XII-D-223	10-19-88	Richard L. Christie (private citizen) Moab, UT	10-03-88
XII-D-224	10-24-88	Colorado Department of Health, Jean Terry	10-14-88
XII-D-225	10-24-88	ASTHO Association of State and Territorial Health Officials, Thomas Vernon	10-19-88
XII-D-226	10-31-88	Evan Handler (private citizen) New York, NY	09-02-88
XII-D-227	10-31-88	NIRS Nuclear Information and Resource Service, Diane D'Arrigo; Letter addressed to Jack Farmer EPA/RTP, NC	09-28-88
XII-D-228	10-31-88	MNSC Maryland Nuclear Safety Coalition, Patricia Birnie; Letter w/attachment addressed EPA/RTP, N.C.	10-02-88
XII-D-229	10-31-88	New Jersey Department of Environmental Protection Jorge H. Berkowitz; Letter addressed to Robert L. Ajax (EPA, RTP)	10-05-88
XII-D-230	10-04-88	Martha C. Cottrell (private citizen) New York, NY	09-26-88

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NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOCUMENT
XII-D-231	10-31-88	Lu Mitterman (private citizen) Chicago, IL	09-29-88
XII-D-232	10-31-88	Hunton & Williams, F. William Brownell (Counsel for UTILITY AIR REGULATORY GROUP); Letter addressed to Lee M. Thomas [Enclosure may be found w/Document XII-D-47]	10-07-88
XII-D-233	11-02-88	AMC American Mining Congress, James E. Gilchrist Letter w/attachment addressed to Lee M. Thomas (supplemental comments to Document XII-D-207)	11-02-88
XII-D-234	11-08-88	U.S. Department of Energy, John C. Tseng; Letter w/attachment	11-07-88
XII-D-235	11-10-88	API American Paper Institute, John L. Festa & Robert C. Kaufmann; Letter w/attachment	11-09-88
XII-D-236	12-02-88	North Carolina Citizens Research Group	10-01-88
XII-D-237	12-02-88	David Shutan (Private Citizen) Hamden, CT	10-12-88
XII-D-238	12-02-88	Marine & Beverly Zimmerman (private citizens)	10-13-88
XII-D-239	12-02-88	AMC American Mining Congress; Letter w/attach.	12-01-88
XII-D-240	12-07-88	ASTHO Association of State and Territorial Health Officials, Thomas Vernon	12-05-88
XII-D-241	12-19-88	CEOH Consultants in Epidemiology & Occupational Health, Inc.	12-14-88
XII-D-242	12-30-88	Marvin I. Lewis (private citizen) Phila., PA	12-22-88
XII-D-243	01-03-89	Marta D. Harting, Baltimore, MD	12-27-88
XII-D-244	01-13-89	Perkins Coie, Anthony J. Thompson; Letter w/attachment	01-11-89
XII-D-245	01-26-89	Shelley Nelkens (private citizen) Antrim, NH	N/D
XII-D-246	01-30-89	AIHC American Industrial Health Council, Donald E. Stevenson, Letter w/attachment	01-30-89
XII-D-247	01-30-89	Sterling Chemicals, Inc., Mary E. Wall	01-30-89

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Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOCUMENT
XII-D-248	01-30-89	CMA Chemical Manufacturing Company, Geraldine V. Cox, et al.; Letter w/attachment (duplicate copy also put into Dockets A-79-27; A-79-49; & A-80-14)	01-30-89
XII-D-249	01-30-89	American Iron and Steel Institute, Neil Jay King (Counsel of); Letter w/attachments (duplicate copy also put into Docket A-79-16	01-30-89
XII-D-250	01-30-89	UARG Utility Air Regulatory Group, F. William Brownell (Counsel of); Letter w/attachment	01-27-89
XII-D-251	01-30-89	Massachusetts Institute of Technology, Dale Hattis; Letter addressed to Lee Thomas	11-07-88
XII-D-252	01-30-89	New York State Congress of Parents and Teachers, Inc., Elsa Ford	01-26-89
XII-D-253	01-30-89	API American Petroleum Institute, Terry F. Yosie; Letter w/attachments (duplicate copy of Docket A-79-27, IX-D-11)	01-30-89
XII-D-254	02-01-89	NRDC Natural Resources Defense Council, David D. Doniger	01-30-89'
XII-D-255	02-01-89	Exxon Company, U.S.A., H.T. Gibson; Letter w/ attachment (duplicate copy of Docket A-79-27, IX-D-12)	01-30-89
XII-D-256	02-13-89	Bethlehem Steel Corporation, David M. Anderson (duplicate copy also put into Docket A-79-16)	01-30-89
XII-D-257	03-06-89	API American Petroleum Institute, Terry F. Yosie; Letter addressed to Don R. Clay (EPA)	01-19-89
XII-D-258	04-28-89	TFT The Fertilizer Institute	11-22-88
XII-D-259	04-28-89	API American Petroleum Institute, Terry F. Yosie; Letter w/attachment addressed to Ila Cote (EPA)	02-21-89
XII-D-260	04-28-89	Marvin Lewis (Philadelphia, PA); Letter addressed to Robert Ajax (EPA)	N/D
XII-D-261	04-28-89	RFF Resources for the Future Center for Risk Management, Paul R. Portney; Letter addressed to William Reilly	03-22-89

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Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN DOCKET	COMMENTER etc.	DATE OF DOCUMENT
XII-D-262	05-12-89	API American Petroleum Institute, Terry F. Yosie; Letter w/attachment	05-12-89
XII-D-263	05-12-89	API American Petroleum Institute, Paul Price; Letter w/attachments	05-12-89
XII-D-264	07-24-89	API, Terry F. Yosie; Letter w/attachments	07-24-89

BENZENE HEALTH EFFECTS

Docket No. OAQPS 79-3, Part I

Subcategory XII-F

Transcript/Statements of Hearings

Docket No.	Description
XII-F-1	Statement of Richard Kerch on behalf of the American Mining Congress regarding September 1, 1988 Hearing before EPA
XII-F-2	Statement of Lewis M. Cook on behalf of the American Mining Congress regarding September 1, 1988 Hearing before EPA
XII-F-3	Statement of Dr. Douglas B. Chambers on behalf of the American Mining Congress regarding September 1, 1988 Hearing before EPA
XII-F-4	Presentation by Dr. Douglas B. Chambers on behalf of the American Mining Congress and The Fertilizer Institute before the Sources and Transport Subcommittee of the Radiation Advisory Committee, Science Advisory Board, of EPA; dated July 13, 1988
XII-F-5	Presentation by Dr. Douglas B. Chambers on behalf of the American Mining Congress before the Dose and Risk Subcommittee, Radiation Advisory Committee, Science Advisory Board, of EPA; dated June 20, 1988

Benzene Health Effects
Docket No. OAQPS 79-3, Part I
Subcategory XII-F
Transcript of Hearing

Document No.	Description
XII-F-6	Statement of the American Petroleum Institute, before the U.S. Environmental Protection Agency, September 1, 1988.
XII-F-7	Statement of David Doniger of the Natural Resources Defense Council, before the U.S. Environmental Protection Agency, September 1, 1988.
XII-F-8	Statement of Stephen Rose on Behalf of the Chemical Manufacturers Association, before the U.S. Environmental Protection Agency, September 1, 1988.
XII-F-9	Testimony of the American Industrial Health Council (AIHC), before the U.S. Environmental Protection Agency, September 1, 1988.
XII-F-10	Testimony of the American Coke and Coal Chemicals Institute, before the U.S. Environmental Protection Agency, September 1, 1988.
XII-F-11	Testimony of the Idaho Mining Association, before the U.S. Environmental Protection Agency, September 1, 1988.
XII-F-12	Statement of the Food and Water, Inc., before the U.S. Environmental Protection Agency, September 1, 1988.
XII-F-13	Testimony of the Utility Air Regulatory Group, before the U.S. Environmental Protection Agency, September 1, 1988.
XII-F-14	Testimony of the Nuclear Information and Resource Service, before the U.S. Environmental Protection Agency, September 1, 1988.
XII-F-15	Comments by the Residents Against Chemical Environment (R.A.C.E.), before the U.S. Environmental Protection Agency, September 1, 1988.

Benzene Health Effects
Docket No. OAQPS 79-3, Part I
Subcategory XII-F
Transcript of Hearing

Document No.	Description
XII-F-16	List of Hearing Panel Members, Speakers, and Attendees at the U.S. Environmental Protection Agency Public Hearing on Benzene, September 1, 1988.
XII-F-17	PUBLIC HEARING IN THE MATTER OF: Proposed Regulations on National Emission Standards for Hazardous Air Pollutants (Benzene), Transcript of Hearing, Washington, D.C., September 1, 1988.

COKE BY-PRODUCT RECOVERY PLANTS

Docket No. A-79-16

Subcategory VI-D

Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER OR ADDRESSEE, TITLE DESCRIPTION, ETC.	DATE OF DOCUMENT
VI-D-01	10-03-88	American Coke and Coal Chemicals Institute, Mark T. Engle (Same comment: OAQPS 79-3, Pt 1 XII-D-27 and A-79-27 IX-D-01)	N/D
VI-D-02	10-03-88	Wilmer Cutler & Pickering, Neil Jay King (Counsel for AMERICAN IRON AND STEEL INDUSTRY; Lettr w/ attachment (same comment OAQPS 79-3(I) XII-D-33)	10-03-88
VI-D-03	10-03-88	API American Petroleum Institute, Terry F. Yosie; Letter w/attachment (same material also put into Dockets A-79-27; A-79-49; A-80-14 and OAQPS 79-3)	10-03-88
VI-D-04	10-04-88	TFI The Fertilizer Institute, Gary D. Myers; Letter w/attachment (same material also put into Dockets A-79-27; A-79-49; & A-80-14; OAQPS 79-3)	10-03-88
VI-D-05	10-04-88	Bethlehem Steel Corporation, David M. Anderson (duplicate of OAQPS 79-3 (I), XII-D-99)	09-30-88
VI-D-06	09-12-88	Brandt Mannchen (Private Citizen) Houston, TX (duplicate of OAQPS 79-3 (I), XII-D-04)	09-03-88
VI-D-07	10-04-88	NRDC Natural Resources Defense Council, David D. Doniger; Letter w/attachment (duplicate of OAQPS 79-3 (I), XII-D-100)	10-03-88
VI-D-08	10-04-88	Food and Water Inc., Judith H. Johnsrud; Letter w/attachment (duplicate of OAQPS 79-3 (I), XII-D-102)	09-27-88
VI-D-09	10-04-88	Shenango Inc., James R. Zwikl (Duplicate of OAQPS 79-3 (I), XII-D-109)	09-30-88
VI-D-10	01-19-89	USS Technical Center, Richard Dworek; Letter addressed to Robert L. Ajax (EPA)	10-27-88
VI-D-11	01-19-89	USS Technical Center, Michale A. Hanson; Letter addressed to Marsha S. Branscome (EPA)	10-31-88

COKE BY-PRODUCT RECOVERY PLANTS

Docket No. A-79-16

Subcategory VI-D

Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN DOCKET	COMMENTER OR ADDRESSEE, TITLE DESCRIPTION, ETC.	DATE OF DOCUMENT
VI-D-12	01-19-89	USS United States Steel Corporation, Michael A. Hanson; letter w/attachment addressed to Brenda C. Shine (Midwest Research Institute) [B. Bierman, Indiana Dept of Environmental Mgmt, to G. Lacy, EPA:SDA, received 11/8/88 (no cover letter attached), Transmitting responses to questionnaires from USS Corporation used by the State of Indiana in the development of a control strategy for coke oven by-product plant emissions.	04-22-87
VI-D-13	01-30-89	American Iron and Steel Institute, Neil Jay King (Counsel of); Letter w/attachments (duplicate of Docket OAQPS 79-3(I), XII-D-249)	01-30-89
VI-D-14	01-30-89	American Coke and coal Chemicals Institute, Mark T. Engle	01-30-89
VI-D-15	02-13-89	Bethlehem Steel Corporation, David M. Anderson (duplicate of Docket OAQPS 79-3(I), XII-D-256	01-30-89
VI-D-16	04-14-89	ABC Coke Company, James A. Cleghorn; Letter addressed to Jack R. Farmer (EPA, RTP)	12-05-88
VI-D-17	04-14-89	Sloss Industries Corp., Dan Bell; Letter addressed to Jack R. Farmer (EPA, RTP)	12-05-88
VI-D-18	04-14-89	LTV Steel Company, Mary Lou Harmon; Letter addressed to Jack R. Farmer (EPA, RTP)	12-09-88
VI-D-19	04-14-89	National Steel Corp., Jack Heintz; Letter addressed to Jack R. Farmer (EPA, RTP)	12-16-88
VI-D-20	04-14-89	Bethlehem Steel Corp., William J. Riley; Letter addressed to Jack R. Farmer (EPA, RTP)	12-22-88
VI-D-21	04-14-89	Inland Steel Company, John D. Fekete; Letter addressed to Jack R. Farmer (EPA, RTP)	12-28-88
VI-D-22	04-14-89	Bethlehem Steel Corp., William J. Riley; Letter addressed to Jack R. Farmer (EPA, RTP)	12-29-88
VI-D-23	04-14-89	ARMCO Corporate Officers, B.A. Steiner; Letter addressed to Jack R. Farmer (EPA, RTP)	01-05-89
VI-D-24	04-14-89	Koppers Indutries, Spencer H. Tuggle; Letter addressed to Jack R. Farmer (EPA, RTP)	01-10-89
VI-D-25	04-15-89	USS Corp., Michael A. Hanson; Letter addressed to Jack R. Farmer (EPA, RTP)	01-16-89

FUGITIVE EMISSION SOURCES

Docket No. A-79-27

Subcategory IX-D

Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOCUMENT
IX-D-01	10-03-88	American Coke and Coal Chemicals Institute, Mark T. Engle (Same comment: OAQPS 79-3, Pt 1 XII-D-27 and A-79-16 IV-D-52)	N/D
IX-D-02	10-03-88	CMA Chemical Manufacturing Company, Geraldine V. Cox, et al., Letter w/attachments (same materials also put into Dockets A-79-49; A-80-14 and OAQPS 79-3, Part I)	10-03-88
IX-D-03	10-03-88	API American Petroleum Institute, Terry F. Yosie; Letter w/attachment (same material also put into Dockets A-79-16; A-79-49; A-80-14 and OAQPS 79-3)	10-03-88
IX-D-04	10-03-88	Unocal Corporation, Michael Cardin	09-30-88
IX-D-05	10-03-88	ILTA Independent Liquid Terminals Association, Clement Mesavage, Jr. (duplicate item submitted to Docket A-80-14)	09-30-88
IX-D-06	10-04-88	TFI The Fertilizer Institute, Gary D. Myers; Letter w/attachment (same material also put into Dockets A-79-16; A-79-49; A-80-14; & OAQPS 79-3)	10-03-88
IX-D-07	10-06-88	Kerotest Manufacturing Corp., Richard W. Conley Letter w/attachment addressed to Eileen Claussen (EPA) (duplicate of OAQPS 79-3, XII-D-198)	09-30-88
IX-D-08	10-31-88	CMA Chemical Manufacturers Association, Gerald V. Cox; Letter w/attachment addressed to Janet S. Meyer (EPA, RTP) (duplicate item submitted to Dockets A-79-49, A-80-14)	07-12-88
IX-D-09	10-31-88	CMA Chemical Manufacturers Association, Deborah D. Stine; Letter addressed to Jennifer Buzun (Radian Corporation) (duplicate item submitted to Dockets A-79-49, A-80-14)	07-12-88
IX-D-10	01-30-89	CMA Chemical Manufacturing Company, Geraldine V. Cox, et al.; Letter w/attachment (duplicate copy also put into Dockets A-79-49; A-80-14; and (OAQPS 79-3(I)	01-30-89

FUGITIVE EMISSION SOURCES

Docket No. A-79-27

Subcategory IX-D

Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOCUMENT
IX-D-11	01-30-89	API American Petroleum Institute, Terry Y. Yosie; Letter w/attachments (duplicate copy of Docket A-79-27, IX-D-11)	01-30-89
IX-D-12	02-01-89	Exxon Company, U.S.A., H.T. Gibson; Letter w/ attachment (duplicate copy of OAQPS 79-3 (I), XII-D-255)	01-30-89
IX-D-13	01-31-89	Exxon Company, U.S.A., B.L. Taranto	01-31-89
IX-D-14	04-28-89	Unocal Refining & Marketing Division, John K. Bassett	01-23-89
IX-D-15	04-28-89	Sterling Chemicals, Laura Inskeep; Letter addressed to Jan Meyer (EPA)	01-25-89
IX-D-16	05-12-89	API American Petroleum Institute, Terry F. Yosie; Letter w/attachment	05-12-89
IX-D-17	06-23-89	API American Petroleum Institute, Terry F. Yosie; Letter addressed to Robert L. Ajax (EPA)	03-01-89
IX-D-18	06-23-89	Marvin I. Lewis (private citizen) Phila. Pa. Letter addressed to Robert L. Ajax (EPA)	N/D

ETHYLBENZENE/STRYRENE PLANTS

Docket No. A-79-49

Subcategory XII-D

Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOCUMENT
XII-D-01	10-03-88	CMA Chemical Manufacturing Company, Geraldine V. Cox, et al., Letter w/attachments (same materials also put into Dockets A-79-27; A-80-14 and OAQPS 79-3, Part I)	10-03-88
XII-D-02	10-03-88	API American Petroleum Institute, Terry F. Yosie; Letter w/attachment (same material also put into Dockets A-79-16; A-79-27; A-80-14 and OAQPS 79-3)	10-03-88
XII-D-03	10-04-88	TFI The Fertilizer Institute, Gary D. Myers; Letter w/attachment (same material also put into Dockets A-79-16; A-79-27; A-80-14 & OAQPS 79-3)	10-03-88
XII-D-04	10-31-88	CMA Chemical Manufacturers Association, Gerald V. Cox; Letter w/attachment addressed to Janet S. Meyer (EPA, RTP) (duplicate item submitted to Dockets A-79-27, A-80-14)	07-12-88
XII-D-05	10-31-88	CMA Chemical Manufacturers Association, Deborah D. Stine; Letter addressed to Jennifer Buzun (Radian Corporation) (duplicate item submitted to Dockets A-79-27, A-80-14)	07-12-88
XII-D-06	01-30-89	CMA Chemical Manufacturing Company, Geraldine V. Cox, et al.; Letter w/attachment (duplicate copy also put into Dockets A-79-27; A-80-14; and (OAQPS 79-3(I)	01-30-89

BENZENE STORAGE

Docket No. A-80-14

Subcategory XII-D

Additional Comments Received After the Proposal

NUMBER	DATE REC'D IN CDS	COMMENTER etc.	DATE OF DOCUMENT
XII-D-01	10-03-88	CMA Chemical Manufacturing Company, Geraldine V. Cox, et al., Letter w/attachments (same materials also put into Dockets A-79-27; A-80-14 and OAQPS 79-3, Part I)	10-03-88
XII-D-02	10-03-88	API American Petroleum Institute, Terry F. Yosie; Letter w/attachment (same material also put into Dockets A-79-16; A-79-27; A-80-14 and OAQPS 79-3)	10-03-88
XII-D-03	10-03-88	Saint Louis Department of Public Safety, Richard C. Knapp	09-26-88
XII-D-04	10-03-88	ILTA Independent Liquid Terminals Association, Clement Mesavage, Jr. (duplicate item submitted to Docket A-79-27)	09-30-88
XII-D-05	10-04-88	TFI The Fertilizer Institute, Gary D. Myers; Letter w/attachment (same material also put into Dockets A-79-16; A-79-27; A-79-49; & OAQPS 79-3)	10-03-88
XII-D-06	10-31-88	CMA Chemical Manufacturers Association, Gerald V. Cox; Letter w/attachment addressed to Janet S. Meyer (EPA, RTP) (duplicate item submitted to Dockets A-79-27, A-80-14)	07-12-88
XII-D-07	10-31-88	CMA Chemical Manufacturers Association, Deborah D. Stine; Letter addressed to Jennifer Buzun (Radian Corporation) (duplicate item submitted to Dockets A-79-27, A-80-14)	07-12-88

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16. ABSTRACT

Final decisions have been made on regulation of benzene emissions from existing and new coke by-product recovery plants, benzene storage vessels, equipment leaks, and ethylbenzene/styrene process vents. These decisions implement Section 112 of the Clean Air Act and are based on the Administrator's determination of June 8, 1977 (42 FR 29332), that benzene presents a significant risk to human health as a result of air emissions from one or more stationary source categories, and is therefore a hazardous air pollutant. This document contains a summary of the comments on the proposal of these standards in the Federal Register (53 FR 28496), the Environmental Protection Agency's response to these comments, and a summary of the health, environmental and economic impacts of the final standards.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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