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Fact Sheet for the Chairman, Environment, Energy, and Natural Resources Subcommittee, Committee on Government Operations, House of Representatives

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TOXIC SUBSTANCES

Status of EPA's Reviews of Chemicals Under the Chemical Testing Program

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Resources, Community, and
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The Honorable Mike Synar
Chairman, Environment, Energy,
and Natural Resources Subcommittee
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

More than 60,000 chemicals are used in commerce in the United States. Some of these, such as polychlorinated biphenyls (PCBs), have been shown to cause tumors, birth defects, or cancer. Other chemicals may be just as harmful, but adequate data do not exist to make that determination. Under the Toxic Substances Control Act of 1976 (TSCA), the Environmental Protection Agency (EPA) may require manufacturers and processors of chemicals in use in commerce to test these chemicals for health and environmental effects and to submit the test results to EPA for review. TSCA authorizes EPA to assess the test results and regulate those chemicals found to present unreasonable risks.

We previously reported to you on our overall findings, conclusions, and recommendations concerning EPA's review of industry's data submissions for the chemicals for which the agency had received complete test data.[1] Our report noted that since TSCA's enactment in 1976, EPA had received health and environmental results for only 22 chemicals. As of June 1991, EPA had reviewed these results for 16 of the 22 chemicals. As requested, this fact sheet provides more detailed information on the 16 chemicals, including (1) testing and review time frames, (2) the results of EPA's review of the test data, and (3) the actions of EPA in response to its findings.

In summary, EPA's Office of Toxic Substances, established to carry out the agency's TSCA responsibilities, has decided to take no further action on 8 of the 16 chemicals reviewed. Of the remaining eight chemicals, four have been referred to other federal agencies and EPA offices for possible regulatory action, two are being considered for additional testing, and two are awaiting the results of further ongoing testing.

[1]Toxic Substances: EPA's Chemical Testing Program Has Not Resolved Safety Concerns (GAO/RCED-91-136, June 19, 1991).

The TSCA Chemical Testing and Review Process

Most of the chemicals tested under TSCA are nominated by the Interagency Testing Committee (ITC), which was established by TSCA to recommend semiannually to EPA chemicals that should receive priority consideration for testing. Within EPA, the Office of Toxic Substances receives testing nominations from other organizations, such as other federal agencies, and has instituted testing programs in response to these nominations. However, for ITC nominations alone, EPA is required under TSCA to respond to the nomination within 1 year by initiating rulemaking to require testing by industry or to explain its reasons for not doing so in the Federal Register. All of the chemicals discussed in this fact sheet were nominated by ITC.

Chemical testing rulemaking is initiated when EPA develops and publishes in the Federal Register a proposed test rule. Industry sometimes initiates a testing program voluntarily after issuance of the proposed test rule. If EPA determines that industry's voluntary testing program is adequate, EPA may announce a "decision not to test" in the Federal Register. If industry does not conduct voluntary testing, EPA may issue a "consent order," under which industry agrees to test a chemical according to a set plan and time frame. However, if industry does not agree with the testing plan and time frames, EPA has the authority to issue a final test rule, under which industry is required to conduct the testing program according to EPA's specifications.

Once industry completes testing, it submits data to EPA, and EPA reviews the data for indications of potential adverse effects on health or the environment. If EPA finds potential adverse effects, it assesses whether these effects indicate a threat to health or the environment and plans a course of action to reduce the threat. A more detailed description of the process is contained in section 1 of this fact sheet.

The chemical testing process is lengthy. As shown in section 2, the average time required for testing the 16 completed chemicals, from their nomination for testing through the completion of EPA's review of test data, was 8 years. The required time varied by chemical, from a low of 4.5 years to a high of 13.2 years.

Results of EPA's Review of Test Data

If EPA's review finds that a chemical poses a significant risk of causing cancer, gene mutations, or birth defects, or an unreasonable risk to health or the environment, TSCA authorizes the agency to regulate the use of the chemical through such actions as banning the chemical or requiring warning labels on the chemical or on products containing the

chemical when they are offered for sale. In addition to using its regulatory authority under TSCA, EPA can take other actions, such as issuing advisories to warn the public of chemical dangers.

As of June 1991, EPA had completed its review of test results for 16 of the 22 chemicals for which industry had met data submission requirements. A chemical-by-chemical summary of the results of EPA's review of these chemicals appears in section 3. The results of EPA's preliminary assessment of the other six chemicals appear in section 4.

Test results were negative for 7 of the 16 chemicals for which EPA has completed its review of the test data, and EPA plans no further action. In addition, EPA plans no further action on an eighth chemical, despite test results indicating potential adverse effects, because exposure to people or the environment was expected to be low. Four of the eight remaining chemicals showed adverse effects, and EPA's Office of Toxic Substances has referred them to other agencies or to other EPA offices for possible regulatory action. As a consequence of the Office's referral, the Occupational Safety and Health Administration could decide to impose new limits or revise existing limits on exposure to a chemical in the workplace. For two of the four chemicals not referred to other agencies or offices, EPA's review of the test results did not indicate potential adverse effects, but the results were of sufficient concern that agency officials are planning additional testing for them. EPA is waiting for the results of further ongoing testing before deciding what action to take on the final two chemicals. Actions taken on the individual chemicals as a result of EPA's reviews are summarized in section 5.

Brief descriptions of the history of each of the 22 chemicals, from their nomination for testing by ITC to EPA's review of the test data and actions taken in response, are contained in section 6.

Our work to update the status of EPA's reviews of 22 chemicals with complete test data was conducted between April and June 1991. As requested, we did not obtain official agency comments on this fact sheet. However, we discussed the information with agency officials, and they agreed with the facts as presented. We incorporated their comments where appropriate.

Unless you publicly announce its contents earlier, we will make no further distribution of this fact sheet until 30 days after the date of this

letter. At that time, we will send copies to other appropriate congressional committees; the Administrator, EPA; and the Director, Office of Management and Budget. We will also make copies available to other interested parties.

Please call me at (202) 275-6111 if you have any questions about this fact sheet. Major contributors to this fact sheet are listed in appendix I.

Sincerely yours,

Richard L. Hembra
Director, Environmental Protection
Issues

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Abbreviations

AOIA	Antimony Oxide Industry Association
ATSDR	Agency for Toxic Substances and Disease Registry
EPA	Environmental Protection Agency
ITC	Interagency Testing Committee
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyls
PVC	polyvinyl chloride
TMB	trimethylbenzene
TMBP	4-(1,1,3,3-tetramethylbutyl)phenol
TOTM	tris(2-ethylhexyl)trimellitate
TSCA	Toxic Substances Control Act

The TSCA Chemical Testing and Review Process

More than 60,000 chemicals are in commerce in the United States. Although laws existed before 1976 to control hazardous chemicals in food, drugs, air, water, and soil, they did not address all chemicals. Consequently, chemical substances—such as polychlorinated biphenyls, commonly known as PCBs, and asbestos—went unregulated. PCBs and asbestos have been shown to cause tumors, birth defects, or cancer.

Recognizing the need for legislation to address chemicals not covered by existing legislation, the Congress passed the Toxic Substances Control Act (TSCA) in October 1976. One important section of TSCA—section 4—authorizes the Environmental Protection Agency (EPA) to require chemical manufacturers and processors to test potentially harmful chemicals used in commerce for the purpose of developing data on their health and environmental effects. EPA's Office of Toxic Substances, in carrying out this provision of the act, receives nominations for chemicals to test from several sources, including other EPA offices, such as the Office of Solid Waste and Emergency Response; other government agencies; industry, through submissions of substantial risk notifications required under TSCA section 8(e);[1] interested parties outside of government; and the Interagency Testing Committee (ITC).

TSCA established ITC for the purpose of semiannually recommending to EPA chemicals that should be given priority consideration for testing. ITC consists of representatives from eight federal entities involved in environmental and health issues: EPA, the Department of Labor, the Council on Environmental Quality, the National Institute for Occupational Safety and Health (NIOSH), the National Institute of Environmental Health Sciences, the National Cancer Institute, the National Science Foundation, and the Department of Commerce. The representatives meet monthly to review available chemical data and select likely candidates for testing from EPA's inventory of chemicals. The inventory, created under TSCA section 8(b), lists all chemical substances manufactured or processed in the United States.

Every 6 months, EPA publishes in the Federal Register its list of chemicals recommended for testing. TSCA requires EPA to respond to the recommendations within 1 year by proposing a test rule or explaining in the Federal Register its reasons for not doing so. As of June 1991, EPA was

[1]TSCA section 8(e) requires that manufacturers, processors, or distributors of chemical substances or mixtures immediately notify EPA when they possess information indicating that a substance presents a substantial risk of injury to health or the environment.

supervising testing programs for 151 chemicals, which included 68 chemicals recommended from sources other than ITC.

To require industry to test a chemical under section 4 of TSCA, EPA must determine that (1) the chemical may present an unreasonable risk, or is produced in substantial quantities and may result in substantial or significant human exposure or environmental release; (2) existing data are insufficient for determining the chemical's effects; and (3) testing is necessary to develop adequate data. EPA notifies companies of testing requirements by publishing proposed test rules in the Federal Register. If industry agrees with EPA on the need for and scope of testing requirements, EPA may issue an enforceable consent order— an agreement between industry and EPA to conduct testing according to a set plan—to expedite the testing. If agreement with industry cannot be reached, EPA publishes final test rules in the Federal Register ordering industry to perform certain types of tests in accordance with EPA-established laboratory procedures by certain dates.

EPA looks for chemical effects in three areas: (1) human health, (2) environment, and (3) chemical fate. Testing for human health effects includes testing for acute and chronic effects, gene mutations, cancer, birth defects, and harm to the central nervous system. Environmental testing primarily focuses on the chemical's effects on aquatic life. Testing for chemical fate assesses characteristics of the chemical, such as its ability to be absorbed in water, and identifies its ultimate disposition in the environment.

Companies manufacturing or processing chemicals are responsible for conducting the testing and submitting the test results to EPA. In some cases, these companies have received assistance from the Chemical Manufacturers Association. The Association has supervised the formation of a panel composed of manufacturers of the particular chemical substance under investigation. The panel manager, appointed by the Association, maintains awareness of pertinent regulations, communicates with EPA, and monitors progress of ongoing research projects.

When EPA receives test data from industry, it publishes a Receipt of Data Notice in the Federal Register. The agency's Office of Toxic Substances has primary responsibility for implementing the provisions of TSCA. The Existing Chemical Assessment Division's Chemical Testing Branch, in addition to writing test rules, reviews test data submissions initially to determine whether data were submitted in compliance with the test rule requirements.

After the Chemical Testing Branch has completed its preliminary review, the Office of Toxic Substance's Health and Environmental Review Division conducts a technical evaluation of the test data. Following that, the Existing Chemical Assessment Division's Risk Analysis Branch assesses the risk that the chemicals pose to human health and the environment. This process, called risk assessment, translates laboratory test results into likely effects on human health and the environment at levels of exposure to chemicals.

The Risk Analysis Branch circulates the Chemical Testing Branch's summaries of test results and technical evaluations of data to other Office of Toxic Substances divisions, including the Exposure Evaluation Division and the Economics and Technology Division. The summaries are circulated in preparation for meetings of the managers of the various divisions and branches within the Office of Toxic Substances, known as prerisk management meetings. The purpose of these meetings is to discuss test results and potential human and environmental risks and to recommend a course of action to the Office of Toxic Substances director. Among the types of actions that the Office of Toxic Substances can take or have taken are banning or requiring labeling of the chemical, referring the test results to other government agencies for consideration, issuing letters of concern to producers or users, issuing advisories to the public warning of chemical dangers, or not taking any action on the chemical.

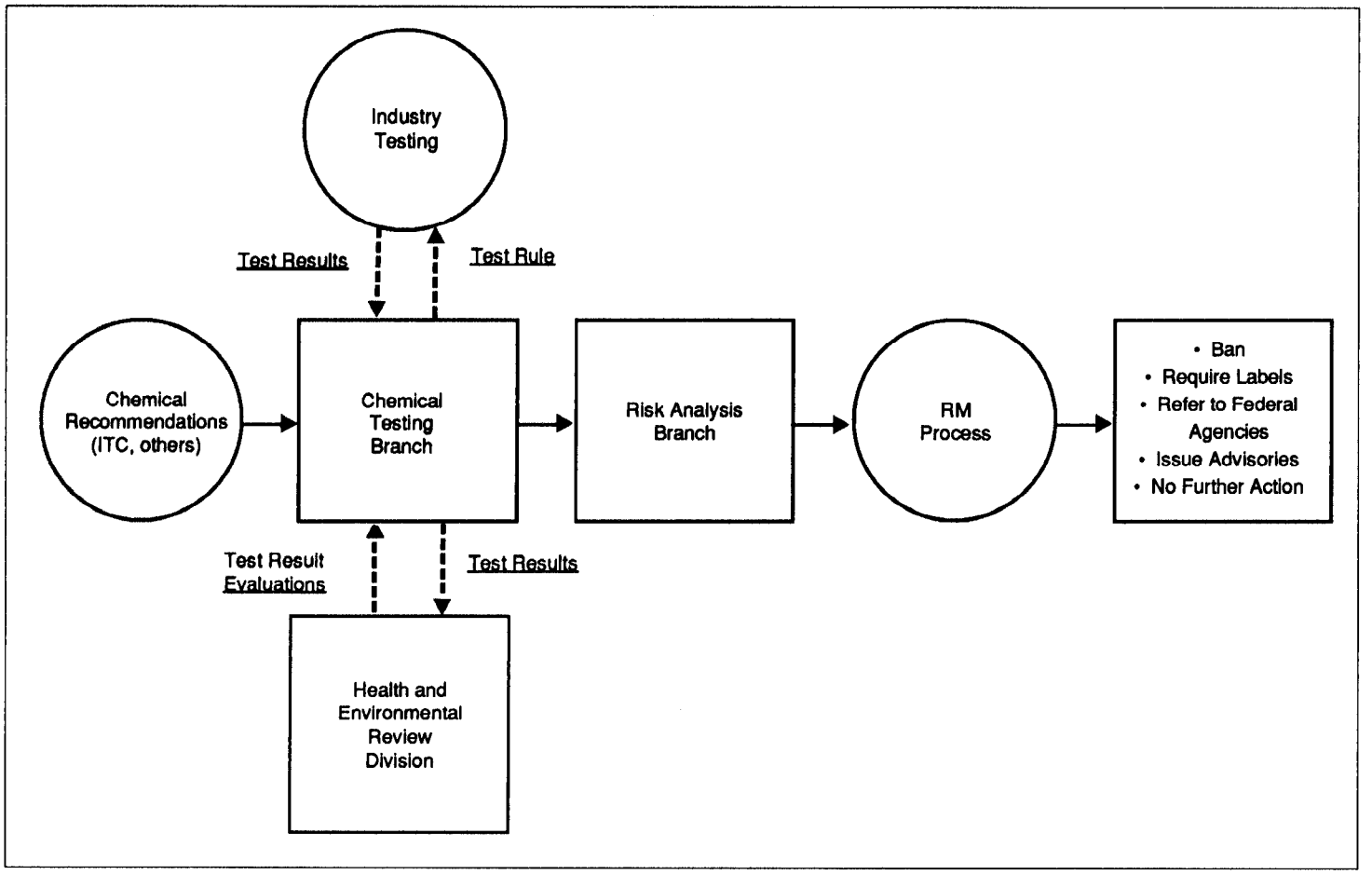
The Existing Chemical Assessment Division holds risk management meetings to discuss chemical test results and recommended courses of action. The meeting is designated "risk management 1" (RM1) for chemicals that are recommended for nonregulatory actions, such as dropping the chemical from further consideration or informally referring test results to other government agencies. Existing Chemical Assessment Division officials told us that they believe that these agencies, acting as members of the Interagency Testing Committee and/or as recipients of the final test results, should share with EPA the responsibility for reviewing and taking action on these results.

Chemicals recommended for regulatory actions are evaluated by Office of Toxic Substances division directors in meetings designated as "risk management 2" (RM2) meetings. The Director of the Office of Toxic Substances finally decides on the appropriate course of action at risk management meetings.

Officials of the Existing Chemical Assessment Division pointed out to us that the existing chemical testing and review process is currently undergoing a management review to identify program areas in need of improvement. The officials call this review a revitalization program. They believe that the improvements resulting from the revitalization program, many of which have already been made, will enhance the Division's performance and productivity.

EPA's existing chemical testing and review process is illustrated in figure 1.1.

Figure 1.1: EPA's Existing Chemical Testing and Review Process



Source: GAO presentation of information provided by EPA.

Testing Time Frames for the 16 Assessed Chemicals

Time frames in years

Chemical	Nomination to test rule[a]	Test rule to test receipt[b]	Test receipt to EPA review[c]	Total
Acetonitrile	4.3	0.7	5.8	**10.8**
Antimony trioxide	4.3	6.5	1.2	**9.0**
Biphenyl	5.0	1.8	0.4	**7.2**
2-Chlorotoluene	1.0	3.0	0.5	**4.5**
Cyclohexanone	4.6	2.9	1.9	**9.4**
2-Ethylhexanoic acid	2.4	1.6	2.2	**6.2**
Methyl ethyl ketone	4.3	1.1	1.3	**6.7**
Methyl isobutyl ketone	4.3	1.1	1.3	**6.7**
Hydroquinone	7.5	2.5	0.4	**10.4**
Isophorone	4.6	1.0	5.9	**11.5**
Metal naphthenates	1.0	1.2	4.2	**6.4**
Octylphenol	1.6	3.6	0.6	**5.8**
Oleylamine	5.0	1.0	1.5	**7.5**
2-Phenoxyethanol	1.0	3.4	2.4	**6.8**
Propylene oxide	10.1	0.2	2.9	**13.2**
TOTM	1.5	2.5	1.5	**5.5**
Average	3.9	2.1	2.1	**8.0[d]**

[a]Time required to issue a test rule after the Interagency Testing Committee recommended the chemical for testing.

[b]Time required to receive test results after the test rule was issued.

[c]Time required to assess the test data after receiving the final test results from the chemical industry.

[d]The sum of the average time frame for each test phase does not equal the average shown in the total column because of rounding.

Source: GAO analysis of EPA data.

EPA's Evaluation of Test Results for 16 Assessed Chemicals

Chemical	Harmful effects[a]		No harmful effects identified
	Health	Environmental	
Acetonitrile			X
Antimony trioxide	X	X	
Biphenyl			X
2-Chlorotoluene			X
Cyclohexanone	X		
2-Ethylhexanoic acid	X		
Isophorone	X		
Methyl ethyl ketone			X
Methyl isobutyl ketone			X
Hydroquinone			X
Metal naphthenates			X
Octylphenol		X	
Oleylamine	X		
2-Phenoxyethanol			X
Propylene oxide			X
TOTM			X

[a]Although chemicals may test positive for health or environmental effects, these risks must be assessed in order to determine whether human beings or the environment are exposed to a chemical in dangerous quantities or concentrations. For example, laboratory testing may show that a chemical produces positive adverse health effects in laboratory animals at relatively high doses. The risk assessment, however, may find that humans are exposed to the chemicals at levels that are not harmful to them.

Source: GAO analysis of EPA data.

EPA's Preliminary Evaluations of Test Results for Six Chemicals Being Assessed

Chemical	Potential effects	
	Health	Environmental
Bisphenol A	X	
C9 Aromatic hydrocarbons[a]		
Cumene		X
3,4-Dichlorobenzotrifluoride[a]		
1,2-Dichloropropane[a]		
Tetrabromobisphenol A		X

[a]Test results do not clearly indicate potential effects.

Source: GAO analysis of EPA data.

Action Taken on Assessed Chemicals

Chemical	Referred to other agencies	Additional testing planned	No further action planned
Acetonitrile			X
Antimony trioxide[a]	X		
Biphenyl			X
2-Chlorotoluene			X
Cyclohexanone[a]	X		
2-Ethylhexanoic acid[a]	X		
Methyl ethyl ketone			X
Methyl isobutyl ketone		X	
Hydroquinone			X
Isophorone[a]	X		
Metal naphthenates		X	
Octylphenol[a]		X	
Oleylamine[a]			X
2-Phenoxyethanol		X	
Propylene oxide			X
TOTM			X

[a]Chemicals identified in section 3 as having test results showing harmful health and/or environmental effects.

Source: GAO analysis of EPA data.

Chemical Histories

The following are brief histories of each of the 22 chemicals with complete test data. Each history follows the chemical through ITC's testing nomination, EPA's subsequent response to the ITC nomination, and EPA's review of the test data to EPA's final decisions on the chemical. If EPA has not made a final decision on a chemical, the agency's most recent actions are discussed.

Acetonitrile

Acetonitrile is used as an industrial solvent and in manufacturing pharmaceuticals and pesticides.

Testing Chronology

ITC designated acetonitrile for priority testing on June 1, 1979. Testing was recommended to determine whether the chemical caused cancer, malformation of fetuses, or genetic changes, or had other long-term effects. Epidemiological studies were also recommended to determine whether the chemical might be the cause of outbreaks of disease in human communities.

In 1980, acetonitrile's annual production was reported to be 25.2 million pounds. The National Institute for Occupational Safety and Health estimated that 25,671 workers might be exposed to acetonitrile through inhalation of vapor or aerosols, or through contact with the skin.

EPA responded to the ITC recommendation on December 29, 1982. In the notice, EPA said that it was not initiating rulemaking to require testing because the National Toxicology Program was testing acetonitrile for long-term effects, including cancer and gene mutations, and industry had already agreed to do additional testing for gene mutations and testing for effects on fetuses and embryos. EPA did not believe epidemiological testing was warranted because it could find no documentable health hazard on which to base an epidemiological study. EPA said that if the National Toxicology Program testing showed a health hazard, the agency would consider the need for additional epidemiological tests. EPA subsequently announced in the Federal Register that it had decided to use the National Toxicology Program testing results to shape further actions on acetonitrile. By July 13, 1984, EPA had received the final results of the industry test program.

Chronology of EPA's Reviews of Test Results and Actions Taken

The chief of the Chemical Testing Branch told us that acetonitrile was dropped from further review sometime after the industry had completed its test data submissions in July 1984. However, no records were found to indicate when reviews of the test data were completed. He said that the test results were negative but was not able to provide any documentation.

Antimony Trioxide

Antimony trioxide is one of three substances in a group—antimony, antimony sulfide, and antimony trioxide—that cannot be distinguished from each other in human tissue or environmental samples. Antimony trioxide is used as a flame retardant in plastics and textiles.

Testing Chronology

On June 1, 1979, ITC recommended the three antimony substances for testing. ITC noted that production of antimony in 1976 was 29 million pounds from ore and 40 million pounds from recycled metal. In its recommendation, ITC cited a number of possible effects from exposure to the substances, including chronic respiratory disorders and degradation of the heart, kidneys, and liver. ITC also cited evidence of the substances' ability to cause cancer and noted that several studies conducted in the Soviet Union pointed to potential effects on the reproductive system and to effects on fetuses and embryos. In addition to recommending testing to address these concerns, ITC wanted an evaluation of chronic human health effects, including reproductive effects, from exposure to antimony and the antimony compounds.

In response to EPA's interest in the antimony substances, the producers formed the Antimony Oxide Industry Association (AOIA) and developed a proposed testing program for EPA's consideration. AOIA reported that between 230 and 240 production workers were exposed to antimony substances, plus a minimum of 1,000 to 2,000 workers using the substances.

On January 6, 1983, EPA responded to the ITC recommendation by announcing the tentative acceptance of the proposed AOIA testing program and entering into a negotiated test agreement rather than issuing a test rule. EPA said that the industry association was to evaluate human health and environmental effects. However, EPA stated that it was unable to conclude that exposure to antimony compounds might present an unreasonable risk of gene mutations and effects on fetuses and embryos. Also, in EPA's opinion, the studies conducted in the Soviet

Union and cited by ITC as the basis for recommending tests for reproduction were flawed.

EPA estimated production of antimony metal at 6 million pounds in 1976 and 5 to 7 million pounds in 1980, substantially lower than the 69 million pounds from ore and recycled metal combined that ITC had estimated. In addition, a consulting firm doing research on antimony compounds for EPA estimated that a maximum of 2,249 employees at three domestic facilities were exposed to antimony metal. The firm also estimated that between 1,710 and 1,880 employees at domestic facilities were exposed to antimony trioxide. Information about the production of antimony compounds provided by the consulting firm suggested that 200 to 2,000 workers were exposed to antimony sulfide and that many of these workers might also be exposed to antimony trioxide.

EPA accepted the negotiated testing program with AOIA on September 2, 1983. All test results were in by February 26, 1990.

Chronology of EPA's Reviews of Test Results and Actions Taken

The Office of Toxic Substances' review of the study of antimony's mobility in soil indicated positive results but also pointed to problems with the data. The Chemical Testing Branch asked AOIA on April 6, 1987, to repeat the study or conduct an alternative test for this one effect. On January 22, 1988, AOIA resubmitted the test results with a number of changes, saying that there was no need to repeat or extend the study.

On May 25, 1988, officials of the Existing Chemical Assessment Division met with AOIA representatives, reporting that certain other test results indicated to them that antimony trioxide was mobile in soil and that the results of AOIA's soil mobility test were inadequate. It was agreed that another test examining antimony's ability to be transformed into other chemical substances could be used to evaluate additional needs for information about mobility in soils. The AOIA representatives argued that if the results of this test were negative, the soil mobility test might not need to be repeated. This test, known as a biotransformation test, was being performed and was to be completed within 2 months.

On September 28, 1988, the final report of the biotransformation test was submitted. By October 27, 1988, the Exposure Assessment Branch of the Health and Environmental Review Division had reviewed the study and reported that antimony trioxide was transformed by organisms into other chemical substances but that rates and quantities of transformation could not be determined from the data. The Division also

suggested to the Chemical Testing Branch project manager for antimony trioxide what additional information was needed.

In April 1990, the Health and Environmental Review Division reviewed the results of a study that EPA had received from industry in February 1990 concerning antimony trioxide's ability to cause toxic effects through long-term inhalation. The Division indicated that although some adverse effects on the eyes and lungs of the test animals had occurred, limitations in the study design precluded a definitive conclusion as to the chemical's potential to cause cancer.

An Existing Chemical Assessment Division meeting to discuss the antimony substances was held on April 24, 1991. It was decided to drop the chemicals from further review and refer the test results to the Occupational Safety and Health Administration (OSHA) through a standing committee called the ONE Committee, composed of representatives from OSHA, the National Institute for Occupational Safety and Health, and EPA. It was noted that, according to the test data, the Permissible Exposure Limit (an OSHA-developed standard for measuring maximum safe chemical exposure in the work place) provided no margin of safety to workers. Although no exposure from consumer products was expected, EPA officials suggested to the ONE Committee that antimony's potential use as a lead substitute in solder might present some consumer exposures. As a result, the ONE Committee is presently considering recommending to OSHA a revision of the antimony trioxide Permissible Exposure Limit.

C9 Aromatic Hydrocarbons

C9 aromatic hydrocarbons include several different chemicals. Ethyltoluenes, which are produced during one of several petroleum refining processes, are used in blending gasoline as well as in manufacturing paint thinners, printing inks, pesticides, and lubricating oils. Trimethylbenzenes (TMB) occur in three forms. 1,2,4-TMB is a raw material used in the manufacture of a chemical subsequently used in the production of resins, polyesters, and other chemicals. The 1,2,3-isomer (hemimellitene) is used to make a musk for perfumes, and the 1,3,5-isomer (mesitylene) is used to produce an antioxidant for plastics, adhesives, and specialty rubbers, such as spandex.

Testing Chronology

ITC designated C9 aromatic hydrocarbons for priority testing on May 25, 1982. The recommendation was based on the potential for widespread exposure to the chemicals and lack of information on their health and

environmental effects. Production of ethyltoluenes and trimethylbenzenes was estimated at 30 to 50 billion pounds and 30 billion pounds per year, respectively.

Ethyltoluenes were recommended for gene mutation and metabolic effects testing. Trimethylbenzenes were recommended for testing of various health effects, such as effects on the central nervous system, reproduction, and the development of embryos and fetuses. Both were recommended for environmental effects testing and testing for their ultimate disposition if released in the environment.

EPA conducted its rulemaking for C9 aromatic hydrocarbons in two phases; each of the two phases resulted in the issuance of a proposed rule and a final rule. The Phase 1 proposed rule allowed EPA to submit its C9 aromatic hydrocarbons testing proposal for public comment. The Phase 1 final rule required industry to submit its proposal for a C9 aromatic hydrocarbons test program, developed in response to EPA's proposal, within 90 days. The Phase 2 proposed rule allowed public comment on industry's proposed test program as modified by EPA, and the Phase 2 final rule issued the testing requirements and schedules to industry, following further public comment and additional EPA modifications. For Phase 1, EPA issued its proposed rule on May 23, 1983, and the final rule became effective on July 1, 1985. For Phase 2, the proposed rule was issued on March 27, 1986, and the final rule became effective on March 9, 1987.

EPA's final Phase 2 rule required testing for effects on the central nervous system, on reproduction, on the development of embryos and fetuses, on the production of gene mutations, and on the ability to cause cancer. A major factor in requiring the testing was the belief that a substantial number of workers and consumers were exposed to the chemicals. For example, EPA said that the presence of C9 aromatic hydrocarbons in gasoline meant that an estimated 300,000 service station attendants, as well as consumers pumping their own gasoline, were exposed to the chemicals.

Chronology of EPA's Reviews of Test Results and Actions Taken

The test results were submitted to EPA between October 1987 and August 1989. On April 1, 1988, the Health and Environmental Review Division reviewed results from a gene mutation test required under the test rule, concluding that the results were negative and that no further tests were needed in that area.

On December 15, 1988, an Office of Toxic Substances consulting firm reviewed a required study of the effects of inhaling C9 aromatic hydrocarbons on the central nervous system of rats and concluded that it was impossible to draw scientifically valid conclusions from the data in the study report. A February 14, 1989, memorandum from a Health and Environmental Review Division toxicologist also stated that the data were inadequate. According to the memorandum, the data had been reviewed by at least six neurotoxicologists employed by EPA and the contractor, and all had agreed that the data were inadequate. However, a memorandum dated February 7, 1990, from the Health and Environmental Review Division's Toxic Effects Branch to the Chief of the Chemical Testing Branch stated that there was no basis for requiring additional testing for effects on the central nervous system because the tests had been performed in accordance with the test plan submitted by the testing contractor and approved by the Division. A related memorandum also said that a study of effects on the development of embryos and fetuses of a second animal species, in addition to the testing already performed on a single animal species, was still called for, in accordance with the test rule requirement. According to Division officials, the requirement for a developmental study on a second species was waived because the data already in hand were sufficient to characterize the chemicals' effects.

On May 22, 1991, an Existing Chemical Assessment Division meeting was held to discuss C9 aromatic hydrocarbons. A decision was made to verify the use of trimethylbenzenes in consumer products. If it can be verified that 1,2,4-trimethylbenzene is used in consumer products, then a letter of concern about the possible risk to consumers and the need for exposure information will be written to its producers and the Consumer Product Safety Commission.

Biphenyl

Biphenyl is used to produce components of dyes, heat-transfer fluids, and other chemicals.

Testing Chronology

On May 25, 1982, ITC recommended testing biphenyl for environmental effects and for its ultimate disposition in the environment. ITC cited various reasons for its recommendation, including substantial domestic production (37 to 47 million pounds in 1981, although later declining to 13 million pounds in 1984), use/disposal patterns in dye applications, the potential persistence of biphenyl and its by-products in aquatic environments, and its already regulated use as a fungicide.

EPA responded to the ITC recommendation by issuing a proposed test rule on May 23, 1983. EPA concluded that the use and disposal of biphenyl might present an unreasonable risk of injury to aquatic organisms. According to EPA, measurable concentrations had been found in several U.S. rivers, and existing studies showed biphenyl, which may persist in sediment, to be toxic to organisms in the aquatic and sediment environment. EPA's proposed test rule required all of the ITC-recommended tests, plus two additional tests on oysters, to determine the chemical's toxicity to organisms that live at the ocean bottom.

EPA called for the testing program to be conducted in two phases. The first phase, proposed on May 23, 1983, and made final on September 12, 1985, required testing for, among other things, short-term and long-term toxic effects on a variety of aquatic organisms. In the second phase, proposed on July 15, 1986, and made final on June 3, 1987, EPA specified reporting schedules and accepted with certain modifications the study plans submitted by industry.

Chronology of EPA's Reviews of Test Results and Actions Taken

The test program for biphenyl began in July 1987, and EPA received the last test report in March 1989. In July 1989, the Existing Chemical Assessment Division dropped biphenyl from further consideration for possible regulatory action. Because the Division staff's review of the test results had indicated relatively high breakdown levels for biphenyl in water and river sediment, biphenyl was not viewed as harmful compared with other commonly evaluated chemicals. It therefore warranted a low level of concern.

Bisphenol A

Bisphenol A is used primarily in the manufacture of polycarbonate, epoxy, and phenoxy resins. There are presently only four manufacturers of bisphenol A nationwide.

Testing Chronology

On May 29, 1984, ITC recommended testing of bisphenol A for its ultimate disposition in the environment, health effects, and ecological effects. Production of the chemical totalled 576 million pounds in 1979 and increased to 785 million pounds in 1984. Up to 33,000 people in the chemical industry were potentially exposed to it. Insufficient data were available to predict effects on the lungs of workers and on aquatic species.

EPA responded to the ITC recommendation by issuing a proposed test rule on May 17, 1985. The proposed rule recommended up to three tests: a test in which animals would inhale the chemical in the form of dust over a 90-day period, a test measuring harm to aquatic creatures over short periods of time, and, if criteria for that test were met, another test measuring harm to aquatic creatures over longer periods of time. The final rule, issued on September 18, 1986, required only the dust inhalation test. After issuing the proposed rule, EPA received test data from the Society of the Plastics Industry, which had conducted the other two tests on its own. EPA stated in the final rule that the data from these tests were adequate and that it would not require further environmental effects testing, estimated to cost between $117,700 and $147,100.

Chronology of EPA's Reviews of Test Results and Actions Taken

By April 1988, the results of the inhalation test were submitted to EPA. In May 1988, EPA's Health and Environmental Review Division completed its review of the study, determining that repeated inhalation of bisphenol A caused mild damage to the nasal cavity in rats. However, Division officials said that it was not known if repeated exposure to bisphenol A would produce permanent injury.

In a June 16, 1988, meeting to determine the course of action on bisphenol A, the Director of the Existing Chemical Assessment Division recommended sending the study results to the National Institute for Occupational Safety and Health for their guidance. On July 8, 1988, EPA sent a letter to the Institute requesting their opinion on the need for further testing of bisphenol A and inquiring as to regulatory concerns for this chemical. However, EPA files contained no indication that the Institute had responded to the letter. When we asked Institute officials whether the letter had been answered, they replied that the Institute had lost track of EPA's inquiry. EPA officials told us that they would contact the Institute and obtain their views on the need for further testing of bisphenol A.

2-Chlorotoluene

2-Chlorotoluene is used in herbicides and textile dyes. It is also used as a paint stripper and a general solvent and cleaner. Only one U.S. company produces the chemical.

Testing Chronology

In April 1981, ITC recommended priority testing of 2-chlorotoluene for a wide variety of health and environmental effects, including the ability to cause cancer and gene mutations, effects on reproduction and fetal

development, long-term effects on fish and aquatic invertebrates, and other general long-term health and environmental effects. This recommendation was in part based on studies that had led ITC to conclude that the chemical might indirectly cause cancer.

From 8 million to 60 million pounds of 2-chlorotoluene were being produced annually, and as much as 100 pounds per day might have been entering the Niagara River. In addition, an estimated 200 workers were exposed through inhalation during production of the chemical and an estimated 2,000 to 3,000 workers were possibly exposed during use of the chemical or of formulations containing the chemical.

At a public meeting held by EPA on July 16, 1981, the chemical's manufacturer announced that it was planning additional testing of 2-chlorotoluene. A detailed scheme for health effects and aquatic toxicity testing was submitted to EPA and announced in the Federal Register in January 1982.

EPA announced a negotiated test agreement with the chemical's manufacturer on April 28, 1982. On October 3, 1985, EPA issued in the Federal Register its decision not to issue a rule to test the chemical because of the ongoing testing done by the manufacturer.

Chronology of EPA's Reviews of Test Results and Actions Taken

The manufacturer submitted the results of the required testing between August 1982 and April 1985. EPA's review of the test results, published on October 3, 1985, indicated that 2-chlorotoluene was unlikely to produce either gene mutations or other genetic or reproductive effects, nor did it cause harm to developing fetuses or embryos. It was also predicted not to persist in the environment long enough to cause any long-term health and environmental effects. EPA concluded that no further testing was needed and no further action should be taken.

Cumene

Nearly all of the cumene produced in the United States is used to manufacture phenol, a compound used to make explosives and other items, such as synthetic resins. The remaining amount is also used, among other things, as a high-octane aviation fuel additive and as a solvent in perfumes and pharmaceuticals.

Testing Chronology

On November 6, 1984, ITC recommended testing cumene for health and environmental effects. It based its recommendation on the high production levels, potential for widespread exposure, and insufficient data on the chemical. For example, annual production of 4 billion to 5 billion pounds and importation of 339 million pounds (during 1984) were cited. According to industry data, production, maintenance, marine dock, and shipboard workers have been exposed to cumene. In addition, there was evidence that suggested a potential for widespread release of cumene to aquatic environments.

EPA responded to the ITC recommendation on November 6, 1985, by publishing a proposed test rule for various health effects tests and tests to determine cumene's toxicity to saltwater and freshwater fish and invertebrates, the chemical's biodegradation in an aquatic system, and other effects of cumene on the environment. In commenting on the proposed rule, the Chemical Manufacturers Association's Cumene Program panel challenged EPA's exposure data and disagreed with a number of health and environmental testing concerns. The panel also disagreed with EPA's proposed requirements for testing to determine the ultimate disposition of cumene in the environment. EPA rejected most of the panel's concerns and, on July 27, 1988, issued the final test rule.

Chronology of EPA's Reviews of Test Results and Actions Taken

By December 1989, EPA had received all test results. After reviewing the test data, EPA officials concluded overall that there was some potential for harm to developing fetuses and embryos and to the central nervous system and that the chemical might cause formation of cataracts. Also, the test data indicated that cumene could have moderate to high acute toxicity to aquatic species, but if the chemical was present in water, concentrations were expected to be too low to warrant concern.

The test data did not identify the health effects of exposure to cumene on workers and consumers. The extent of exposure to workers involved in the use, mixing, and transportation of cumene was unknown. Consumers could be exposed to it while using paint products or pumping gasoline at self-service stations.

On January 10, 1991, EPA officials decided to refer cumene to OSHA, the National Institute for Occupational Safety and Health, and the American Conference of Governmental Industrial Hygienists for consideration of the current permissible exposure level for workers and other permissible exposure limits. Cumene would be added for review to a study currently being designed by the Office of Toxic Substances of possibly toxic

ingredients found in paints. EPA officials noted that an industry group had conducted studies in which cataract formation had followed exposure to cumene. When the studies' data on cataract formation become available some time in the fall of 1991, the Office of Toxic Substances will review them and will reconsider cumene if the data warrant further study.

Cyclohexanone

Cyclohexanone is primarily used in the manufacturing of nylon. It is also used as an ingredient in some pesticide formulations and as a solvent for various resins, lacquers, and dyes.

Testing Chronology

On June 1, 1979, ITC designated cyclohexanone for priority consideration, recommending both health and environmental effects testing. ITC's recommendations were based on the chemical's substantial production; its widespread use as a solvent, which was expected to result in high exposure to workers and the general population; and the potentially large quantities released into the environment.

In the spring of 1981, EPA began discussing testing needs with representatives of the cyclohexanone industry. In response, the manufacturers organized a cyclohexanone study group and submitted a testing proposal to EPA. On January 3, 1984, EPA responded to ITC by announcing that it would not initiate a rulemaking to require testing because the manufacturers' testing was addressing the health effects concerns raised by EPA and ITC. According to EPA, sufficient data already existed to indicate that cyclohexanone did not present an unreasonable risk to the environment; consequently, environmental effects testing was not needed.

EPA's response to ITC noted that 1981 production of cyclohexanone was reported to be 766 million pounds. Of this, 730 million pounds were used in the manufacture of nylon, and 36 million pounds were sold for other uses. According to National Institute for Occupational Safety and Health estimates made in 1980, 839,200 workers may be exposed to cyclohexanone. Other research noted that consumers could be exposed to cyclohexanone solvents found in spot removers, metal degreasers, lacquers, stains, and paint removers.

Chronology of EPA's Reviews of Test Results and Actions Taken

Testing was completed by November 1986, and EPA reviewed the results by October 1988. On February 2, 1988, Chemical Testing Branch staff, in a meeting with Risk Analysis Branch staff, recommended that no further testing be performed. The Risk Analysis Branch staff agreed but said that an additional test examining the possible toxic effects on fetuses, referred to as a developmental toxicity test, would be helpful.

On May 4, 1988, a Health and Environmental Review Division scientist sent a memorandum to the director of the Existing Chemical Assessment Division, stating that a developmental toxicity study for cyclohexanone should be performed. According to the memorandum, existing data suggested developmental and reproductive effects from exposure to cyclohexanone and, at the very least, this information should be communicated to the affected parties.

On April 25, 1988, the Health and Environmental Review Division scientist suggested notifying workers of the chemical's hazard, whether or not the Existing Chemical Assessment Division decided to require additional testing. In a May 26, 1988, memorandum to the Risk Analysis Branch, the Chemical Testing Branch chief said that his unit was not planning any further testing. He stated that the Risk Analysis Branch seemed to be in a position to issue a chemical advisory without additional data and indicated that such a course of action seemed prudent.

On October 4, 1988, the Director of the Existing Chemical Assessment Division wrote a memorandum to the files outlining the Division's rationale for requiring no further testing. He said that results from testing for effects on fetuses had already shown that the chemical was harmful to both embryos and fetuses, but that no physical birth defects had been noted. The memo also stated that, to protect workers adequately, the OSHA standard should be lowered from the current 50 parts per million to 6.5 parts per million. The Director concluded that because EPA could reasonably determine or predict the chemical's risk from available data, industry could argue that further testing was not needed.

In a draft March 2, 1989, memorandum to other Office of Toxic Substances division directors, the Director of the Existing Chemical Assessment Division said that his division would immediately refer the available study data on cyclohexanone to the National Institute for Occupational Safety and Health and to OSHA. (According to the Chemical Testing Branch project manager, the memorandum was never issued and the chemical was not referred to either agency.) On March 13, 1989, the

Chemical Testing Branch told industry that no further testing would be required.

On June 11, 1990, the Chief of the Chemical Testing Branch notified the Chief of the Risk Analysis Branch that his project manager for cyclohexanone had found that the Risk Analysis Branch had placed a low priority on cyclohexanone since 1988. At a July 19, 1990, meeting to review activity on the chemical, the Existing Chemical Assessment Division branch chiefs were asked by the division director to provide updated information, such as new exposure data and studies, to the Risk Analysis Branch. In a July 30, 1990 memorandum, the Health and Environmental Review Division scientist reviewing a number of cyclohexanone test results suggested to the Chief of the Risk Analysis Branch that, from a scientific standpoint, additional tests might be desirable. The scientist further suggested, as an alternative to testing, that EPA convey its concerns about the chemical's toxicity and effects on development to industry, workers, consumers, and relevant agencies.

In May 1991, the Office of Toxic Substances transmitted the information on cyclohexanone, which included results of the industry's reproductive and developmental tests, to the Consumer Product Safety Commission, OSHA, and the American Conference of Governmental Industrial Hygienists. The Commission and OSHA may consider possible regulatory action, and the Conference may consider making its own recommendations to OSHA on permissible levels of exposure to cyclohexanone for workers.

3,4-Dichlorobenzotrifluoride

3,4-Dichlorobenzotrifluoride is used to make two herbicides, acifluorfen and oxyfluorfen. It is manufactured domestically by two firms and imported by three firms.

Testing Chronology

On May 29, 1984, ITC recommended testing 3,4-dichlorobenzotrifluoride for its effects on health, its ultimate disposition in the environment, and its effects on the environment. (ITC did not designate the chemical for priority consideration, which would have required EPA to respond within 12 months.)

No data on exposure to the chemical in the workplace were available. Although 3,4-dichlorobenzotrifluoride is manufactured and processed in closed systems, approximately 40 workers may be exposed to it through the skin while collecting and disposing of wastes and loading and unloading the chemical. The extent of environmental releases was not

known; however, the state of New York was limiting releases of 3,4-dichlorobenzotrifluoride to a combined total of 3 pounds per day and requiring monitoring of discharges.

Available tests had shown that 3,4-dichlorobenzotrifluoride was very toxic to at least one species of underwater vegetation, but the data were inadequate to fully characterize aquatic toxicity. Otherwise, available data showed that the chemical's toxicity in the short and medium term to animals and humans was low.

On July 18 and September 3, 1986, EPA held meetings with interested parties to discuss appropriate means of testing 3,4-dichlorobenzotrifluoride. On June 10, 1987, a consent order was signed between EPA and one of the two major manufacturers of the chemical to conduct a number of tests to determine possible harmful effects to the environment and aquatic creatures.

Chronology of EPA's Reviews of Test Results and Actions Taken

EPA's Health and Environmental Review Division reviewed the test results. The summary of its review, dated February 20, 1990, disclosed that results of the environmental toxicity tests were not reliable because of a number of deficiencies, particularly noncompliance with the test guidelines specified in the consent order. The Division recommended that a toxicity test for rainbow trout be repeated because it was the single most important test and would yield the most significant overall results.

After the manufacturer refused to repeat the test, EPA's Office of Compliance Monitoring and Enforcement (now the Office of Enforcement) initiated an action against the testing firm for not complying with the consent order. According to EPA, this was the first such action ever taken. The Office of Enforcement audited the firm's testing operations on July 30, 1990, and EPA's Good Laboratory Practices Review Committee reviewed the audit report in February and March of 1991. On March 20, 1991, the case was referred to the Pesticides and Enforcement Division within the Office of Enforcement for possible penalty assessment. Office of Toxic Substances officials have told us that the Division has not yet taken action but that a violation of the consent order appears to have occurred. In the meantime, action on 3,4-dichlorobenzotrifluoride has been delayed pending the case's outcome.

1,2-Dichloropropane

1,2-Dichloropropane is used as a solvent in the manufacture of ion exchange resins and of perchloryethylene, or dry-cleaning fluid. It is also used in photographic film manufacture, paper coatings, and furniture finish removers. All 1,2-dichloropropane in the United States is produced by one chemical manufacturer.

Testing Chronology

ITC designated 1,2-dichloropropane for priority testing on October 30, 1978. It recommended testing to determine whether the chemical caused cancer, gene mutations, or birth defects or had effects on the reproductive and central nervous systems. It also recommended testing for the chemical's long-term toxicity to fish and invertebrates, effects on bird and mammal reproduction and behavior, and effects on soil invertebrates and terrestrial insects. ITC based its recommendation on high production, the potential for substantial exposure to the chemical, and insufficient data on the effects of this exposure.

According to the data available to EPA, a substantial number of consumers who used paint, varnish, or furniture finish removers might be exposed to 1,2-dichloropropane. The chemical was a component of 10 of these products produced by nine manufacturers. In addition, according to a National Occupational Hazard Survey conducted between 1972 and 1974, approximately 700,000 workers were exposed to the chemical during its manufacture. Furthermore, substantial quantities of 1,2-dichloropropane were released into the environment. An estimated 1.4 million pounds and 4.9 million pounds were released into the air and water, respectively, per year. The chemical has been identified as a contaminant of ground water and drinking water.

EPA issued a proposed test rule for 1,2-dichloropropane on January 6, 1984, calling for various human health and environmental tests, including genetic, nervous system, reproductive system, and birth effects tests, and environmental effects tests on soil invertebrates, terrestrial insects, and aquatic plants. Also proposed were tests for long-term toxicity to fish and invertebrates.

In commenting on the proposed rule, the manufacturer stated that testing was not needed because exposure to humans was neither substantial nor significant and there was no substantial release to the environment. According to the manufacturer, only 3 million pounds of the chemical were marketed in 1982. However, EPA disagreed, citing differences with the manufacturer's interpretation of a number of studies and surveys of 1,2-dichloropropane's potential release to the environment.

With regard to production, EPA said that production capacity was between 41 million and 144 million pounds. EPA issued a final test rule on September 9, 1986, pointing to the need to develop data on 1,2-dichloropropane in order to reasonably determine or predict risks to human health and the environment resulting from exposure and environmental release.

Chronology of EPA's Reviews of Test Results and Actions Taken

From November 1988 to May 1989, EPA received test results on 1,2-dichloropropane, as required by the test rule. After some initial difficulties with the test data, including problems with the original test procedures and problems with the laboratory's compliance with some of the test standards, the Existing Chemical Assessment Division reviewed the test data with the assistance of the Health and Environmental Review Division and found evidence of adverse effects in rats. However, environmental effects tests were judged unacceptable.

By June 1991, the Office of Toxic Substances had referred 1,2-dichloropropane to the National Institute for Occupational Safety and Health and the American Conference of Governmental Industrial Hygienists for review of the test results and had placed the chemical on a list of substances scheduled for detailed review after receipt of the Institute's comments. In addition, the agency's concerns about 1,2-dichloropropane were communicated by letter to the chemical's manufacturer and users.

2-Ethylhexanoic Acid

2-Ethylhexanoic acid is used as a raw material in the manufacture of other industrial products. It is used in the production of heavy metal salts, which are used in oil-based paints to promote drying. In combination with other chemicals, 2-ethylhexanoic acid is also used in the manufacture of synthetic greases and lubricants.

Testing Chronology

ITC designated 2-ethylhexanoic acid for priority testing on May 29, 1984, recommending testing for long-term health effects, including cancer. It identified but did not specifically recommend testing for several other biological effects, including short-term harmful effects, harmful effects on fetuses, and the action of substances in the body over a period of time, or pharmacokinetics. ITC's recommendation was based on estimates of annual domestic production ranging from 11 million to 61 million pounds and potential exposure of over 16,000 persons to the chemical.

On May 17, 1985, EPA issued a proposed rule to test 2-ethylhexanoic acid's general health effects, including its ability to cause cancer. Although ITC had identified a large number of persons potentially exposed, EPA indicated that more recent information showed that only about 400 workers were potentially exposed to 2-ethylhexanoic acid. EPA also said that consumers were not exposed to the chemical as a raw material and that environmental release was negligible. However, EPA said that exposure through the skin during manufacturing, handling, and processing might be a significant concern if gloves and other protective equipment were not worn. EPA noted that not all workers who might come in contact with the chemical were required to wear gloves.

The manufacturers and principal users of 2-ethylhexanoic acid formed a panel under the auspices of the Chemical Manufacturers Association and commented on the proposed test rule. The panel stated, in essence, that EPA lacked authority to require testing because the chemical had insufficient exposure potential to cause unreasonable risk of injury. The panel said that a questionnaire survey showed that safety procedures to protect against any of 2-ethylhexanoic acid's effects were in place in their plants and that EPA's worst-case skin exposure estimate was excessive. The panel also questioned the scientific validity of a study indicating that 2-ethylhexanoic acid administered during pregnancy resulted in fetal toxicity in rats.

In issuing the final test rule on November 6, 1986, EPA cited a number of reasons for requiring further testing. The agency contended that industry's survey of safety procedures was biased because its questions were addressed to management and not to workers. EPA also pointed to the results of a later survey of practices for handling 2-ethylhexanoic acid conducted by the panel, which showed that use of protective gloves was voluntary and that workers did not always wear them. EPA further argued that, despite design limitations, a pregnancy study further supported a need for more testing. EPA also agreed that the worst-case skin exposure estimate was excessive and reduced it from 500 milligrams to 60 milligrams of 2-ethylhexanoic acid per kilogram of body weight per contact. The final test rule required industry to perform tests for short-term toxic effects, toxic effects on fetuses, and pharmacokinetics.

In December 1986, the 2-ethylhexanoic acid manufacturers sued EPA to obtain a stay in testing and to dismiss the final test rule. A U.S. district court denied the stay and heard the case in September 1988. In October 1988, the court ruled in favor of EPA. The first required test results were

submitted to EPA in December 1987, and the balance were submitted in June 1988.

Chronology of EPA's Reviews of Test Results and Actions Taken

The Health and Environmental Review Division reviewed the studies submitted by industry and determined that they were conducted according to approved test guidelines. However, on July 27, 1988, the Division noted a number of inadequacies in the pharmacokinetics studies. In addition, on August 1, 1988, the Division said that its review of some of the studies showed that 2-ethylhexanoic acid was harmful to pregnant rats. Tests performed at EPA's Health and Environmental Research Laboratory in Research Triangle Park, North Carolina, confirmed the chemical's potential harm. In the tests, pregnant rats were fed various doses of 2-ethylhexanoic acid. EPA scientists were able to show evidence of severe harm to the mothers and were also able to identify a marked increase in the incidence of offspring deaths and, in the surviving offspring, physical alterations and abnormalities, such as missing neck bones, missing tails, and fused ribs.

The Risk Analysis Branch held two meetings on 2-ethylhexanoic acid in 1988. The first, on October 17, was to brief the other Office of Toxic Substances branch chiefs on the 2-ethylhexanoic acid test data. The meeting summarized several possible courses of action, including referring the chemical to OSHA, deciding that the risks met TSCA regulatory criteria, preparing a chemical advisory, obtaining more data on the chemical's effect on rats, or obtaining more data on the effects of exposure to the chemical through the skin. Those present also noted that the latest test data raised concern about 2-ethylhexanoic acid salts in various products, which EPA had previously dismissed as not being a problem.

At the second meeting, on November 10, 1988, the branch chiefs decided on a number of actions, the most important of which was to develop a proposed chemical advisory and bring it and a summary of the current findings to a division directors' meeting in January 1989. Concern was again raised about the effects of the chemical's salts, which are found in many consumer products, such as oil-based paints and enamels. A follow-up with the Health and Environmental Research Laboratory regarding the collection of data on the potential toxicity of 2-ethylhexanoic acid salts was ordered.

From the November 1988 meeting until August 1990, EPA took no action on the results of 2-ethylhexanoic acid testing. According to the Risk

Analysis Branch project manager, there were many other important tasks to be done, and 2-ethylhexanoic acid was forgotten. The follow-up study at the EPA laboratory was also not done, according to the project manager. He noted that neither the Risk Analysis Branch nor the Office of Toxic Substances has any type of system for tracking the status of chemicals under review.

On April 18, 1989, the Chemical Testing Branch chief sent a memorandum to the Risk Analysis Branch urging action on the November 1988 meeting agreements. The chief noted that industry had been publishing reports claiming that tests had shown that 2-ethylhexanoic acid was perfectly safe.

2-Ethylhexanoic acid was considered again in a branch managers' meeting held on August 30, 1990. At that meeting, the project manager characterized the chemical as producing severe effects and causing birth defects at relatively modest doses. The group decided to refer 2-ethylhexanoic acid to OSHA. The consensus was that if OSHA did not warn workers of the dangers of the chemical, then another meeting would be held to discuss possible further EPA action.

2-Ethylhexanoic acid was once more considered in a meeting of branch managers held on April 10, 1991. The group referred the chemical indirectly to OSHA through the ONE Committee, a standing committee composed of representatives of EPA, OSHA, and the National Institute for Occupational Safety and Health, for possible referral to their respective agencies for regulatory action.

Hydroquinone

Hydroquinone is used as a photographic developer, in the manufacture of dyes and other chemicals, and as a substance that prevents oxidation. It is also approved by Food and Drug Administration for use in dermatologic preparations and in over-the-counter cosmetics as a skin bleach.

Testing Chronology

ITC designated hydroquinone for priority testing on December 7, 1979. Extensive production of the chemical and the probability of substantial exposure to it led ITC to recommend various types of testing, including tests for its ability to cause cancer.

In its proposed test rule of January 4, 1984, EPA cited annual U.S. production of an estimated 26 million pounds. EPA also cited exposure through the skin and through inhalation by an estimated 470,000

workers. In addition, approximately 2.2 million photohobbyists were thought to use the chemical for developing black-and-white film.

According to EPA, hydroquinone appeared to be moderately toxic, producing effects on the nervous and reproductive systems as well as developmental effects. Although tests had shown that its carcinogenic effects on animals were limited, EPA thought that the results of these tests should not be extrapolated to humans. Therefore, EPA believed that further testing was necessary to assess the human risk.

EPA developed a two-phase test rule; the first phase, adopted on December 30, 1985, sought to establish test standards and reporting requirements. In the second phase, adopted on May 28, 1987, the final rule specified test standards and reporting requirements and accepted the study plans submitted by industry as modified by EPA for the prescribed testing. The latest test was due in December 1989. In the rule, EPA decided not to propose testing to determine whether hydroquinone caused cancer because the National Toxicology Program had been studying the question for 2 years.

Chronology of EPA's Reviews of Test Results and Actions Taken

EPA received the final test results on December 12, 1989, and preliminary results from the National Toxicology Program's cancer study on May 1, 1990. After completing its review of all the data, the Chemical Screening Branch of EPA's Office of Toxic Substances held discussions during April and May of 1990. The conclusion was that, despite limited evidence of hydroquinone's ability to cause cancer and some concern for its effects on the central nervous system and its potential to cause birth defects, exposure to the general population as indicated by exposure estimates was extremely low. Therefore, the Branch recommended that EPA discontinue its assessment of hydroquinone under TSCA. On May 17, 1990, the Office of Toxic Substances accepted the branch's recommendation but concluded from the test results that some follow-up actions would be appropriate. Such actions would include following the efforts of the chemical's producers to modify worker exposures and sending the test results to the Food and Drug Administration, which had approved the use of hydroquinone in cosmetics. The agency did not, however, take action on a proposal to affix warning labels to materials containing hydroquinone.

Isophorone

Isophorone is used chiefly as a solvent in the formulation of lacquers and other surface coatings. It is also used in solvent mixtures for finishes, certain types of resins, pesticides, and stoving lacquers. An excellent solvent for many oils, fats, gums, and resins, it is also used in the production of alcohols and other chemicals.

Testing Chronology

ITC designated isophorone for priority testing on June 1, 1979, recommending a study on the spread of any effects through a population and testing for the chemical's ability to cause cancer, cell changes, or harm to fetuses and embryos, plus other long-term effects.

At the time of the ITC recommendation, production of the chemical was estimated at 20 million to 30 million pounds per year. In addition, the National Institute for Occupational Safety and Health (NIOSH) had estimated that about 1.5 million workers were potentially exposed to it. Reporting in the American Industrial Hygiene Association Journal, NIOSH had recommended that the exposure limit be reduced to 4 parts per million as the result of a report that workers experienced fatigue following exposure to isophorone at the level of 5 to 8 parts per million. Another study in the same publication reported that workers exposed to isophorone vapors were exposed at nearly five times the threshold limit value of 5 parts per million set by OSHA.

Other studies had also shown that short-term exposure of animals to high-vapor amounts and short- or long-term exposure of animals to high doses by mouth cause inactivity, coma, and death or a shortened lifespan. In addition, some studies were inconclusive but suggested that isophorone might have caused birth defects and growth retardation in the offspring of rats and mice that breathed the vapors during pregnancy. Some harmful health effects were also seen in adult female animals in these studies. Furthermore, in a long-term study in which rats and mice were given high doses of isophorone by mouth, the male rats developed kidney disease and tumors in the kidney, a reproductive gland, the liver, connective tissue, and the lymph glands.

There did not appear to be any significant consumer exposure to isophorone. However, the chemical was found in drinking water in Cincinnati, Ohio, and New Orleans, Louisiana, and in extremely small amounts in water samples in the Delaware River and in wastewater from tire manufacturing, latex processing, and chemical plants.

In its January 6, 1983, response to ITC, EPA stated that in view of a recently initiated long-term study of isophorone by the National Toxicology Program and a promise from the U.S. manufacturers of isophorone to carry out some of the recommended tests, it would not write a rule to require testing. Instead, on January 17, 1984, EPA and the Chemical Manufacturers Association entered into a negotiated testing agreement that industry would conduct these tests.

Chronology of EPA's Reviews of Test Results and Actions Taken

EPA received the test results between February 1984 and February 1985. After reviewing the results, agency officials in charge of isophorone met on August 20, 1985, and discussed the adequacy of the tests. The results of the National Toxicology Program's study suggested that isophorone caused cancer in male rats and male mice, but not in females. On the basis of this information, the officials decided that there were enough data to conduct a risk assessment on isophorone. In addition, they suggested that data were needed on how the chemical behaved in organisms, particularly on how it was absorbed through the skin. However, EPA files do not indicate whether any of these studies were ever carried out or whether a risk assessment was ever done.

As part of its mandate under the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), the Agency for Toxic Substances and Disease Registry (ATSDR) was required to identify a list of hazardous substances found at National Priorities List sites, prepare profiles identifying the toxic properties of these substances, and ensure the initiation of a research program to fill identified priority data needs associated with the substances. Isophorone was identified on the second priority list of substances, published on October 20, 1988. The 225 chemicals on the list have been determined by ATSDR and EPA to pose the most significant potential threat to human health. With regard to isophorone, in a Federal Register notice of March 28, 1990, ATSDR identified the need to design analytical methods to determine levels of the chemical in human tissues and fluids. In addition, ATSDR called for the collection of data monitoring exposure to the chemical in humans and in the environment as well as studies of the chemical's ultimate disposition in the environment.

On January 16, 1991, EPA officials concluded that the data on kidney tumors in male rats might not be relevant in predicting isophorone's ability to cause cancer in humans. Nevertheless, because isophorone appeared on the ATSDR hazardous substances list, the officials decided to forward the information on isophorone to OSHA, NIOSH, the American

Conference of Governmental Industrial Hygienists, and the Consumer Product Safety Commission for their information and possible consideration of changes to permissible exposure limits. In addition, the officials decided to forward the information within EPA to the Office of Solid Waste and Emergency Response, the Office for Air and Radiation, and the Office of Water for their information in future regulatory initiatives.

Metal Naphthenates

Lead, cobalt, and calcium naphthenate, collectively identified as metal naphthenates, do not exist commercially as a pure chemical substance. Instead, they are available in a petroleum-based solvent or in a mineral spirit solution. They are used as paint and ink driers, in lubricants, and as an anticorrosion agent, primarily in nonautomotive, heavy-industrial uses where extreme-pressure applications exist.

Testing Chronology

ITC designated metal naphthenates for priority testing in May 1983. It recommended testing for various health effects, including the chemicals' ability to cause cancer, cell changes, and birth defects. It also recommended testing for the chemicals' ultimate disposition in the environment, and, depending on these results, testing for environmental effects. ITC based its recommendations on the large quantities of metal naphthenates produced and the consequent likelihood of their release to the aquatic environment; the wide variety of uses for the chemicals; the potential for exposure to consumers and workers through paints, varnishes, lubricants, greases, and printing inks; and the potential for health effects indicated by the known toxic properties of certain derivatives of the chemicals known as metal salts.

In 1982, domestic manufacturers produced an estimated 5.5 million to 6.5 million pounds of metal naphthenates. In addition, about 1.2 million pounds of calcium naphthenates were imported to be used as an additive in marine diesel fuels.

EPA considered the ITC recommendation and decided not to require testing at that time. The reasons for this decision were set out in the Federal Register of May 24, 1984. Agency officials wanted to wait for an industry-sponsored study of how cobalt and lead naphthenates were absorbed by the skin before deciding whether to require health effects testing. In addition, EPA thought that its evidence was insufficient to conclude that the metal naphthenates presented an unreasonable risk to the environment. Because of the way that metal naphthenates are produced, processed, and used, EPA believed that releases of the substances

were not substantial. Furthermore, production was declining; the 1982 production of 5.5 million to 6.5 million pounds of metal naphthenates had declined to 4.1 million pounds by 1985.

Chronology of EPA's Reviews of Test Results and Actions Taken

On August 20, 1985, the Chemical Manufacturers Association submitted the results of industry's dermal absorption study to EPA. The study said that dermal absorption of lead and cobalt naphthenates was "minimal" and that no further analysis was necessary. After reviewing the study, EPA's Health and Environmental Review Division disagreed, concluding that further testing was needed to determine the concentrations of metal naphthenates in the tissues of organisms. However, the Existing Chemical Assessment Division raised technical objections to the Health and Environmental Review Division's analysis and did not require further testing. In October 1989, the Office of Toxic Substances dropped metal naphthenates from further consideration for regulatory action. Use of the chemical was declining and the National Toxicology Program of the Department of Health and Human Services had scheduled testing that would resolve EPA's concerns about tissue concentration. As of June 1991, the National Toxicology Program had not begun the testing.

Methyl Ethyl Ketone and Methyl Isobutyl Ketone

Methyl ethyl ketone is used primarily in industrial operations as a solvent for industrial coatings, in adhesives, and in petroleum refining. Methyl isobutyl ketone is also used primarily in industrial operations as a solvent for industrial coatings, in rust inhibitors, and in various other ways, such as lube oil dewaxing, rare metal refining, and as a component of agricultural insecticides and of adhesives.

Testing Chronology

ITC designated both methyl ethyl ketone and methyl isobutyl ketone for priority testing on June 1, 1979. Annual production of methyl ethyl ketone was estimated at 396 million pounds and imports at an estimated 55 million pounds. ITC recommended testing for long-term effects, with special emphasis on central nervous system effects, and epidemiology, or the spread of any effects through a population. ITC's basis for testing for central nervous system effects was a study in which numbness of the skin was noted.

ITC's recommendation of methyl isobutyl ketone was based on high exposure, estimated by the National Institute for Occupational Safety and Health at between 1.5 million and 1.8 million workers. Annual production was estimated at 150 million to 210 million pounds and imports an

estimated 6 million pounds. In addition to the same types of studies recommended for methyl ethyl ketone, ITC recommended tests for cell changes and effects on the unborn as a result of exposure to the chemical.

On December 29, 1982, EPA responded to the ITC recommendation by announcing that it would not initiate a rulemaking to require testing because existing data were sufficient to evaluate some of the effects recommended for testing by ITC, and industry had agreed to test both chemicals. According to EPA's response, consumer exposure to methyl ethyl ketone primarily occurs during the use of paint thinners and removers, varnish removers, stripping compounds, paint brush cleaners, various glue and adhesive products (particularly the fast-drying and epoxy glues), and automotive carburetor cleaners and engine degreasers. EPA was unable to estimate the magnitude of exposure to products containing methyl ethyl ketone, but the National Institute for Occupational Safety and Health had estimated that 3 million workers were exposed in 1977. The Institute's estimate of 1.5 million to 1.8 million workers exposed to methyl isobutyl ketone was questioned by industry, which indicated that only 10 percent of these workers actually came in contact with the chemical.

EPA also said that releases of methyl isobutyl ketone to the air could occur through vapor emissions and venting of gases by facilities using the chemical. Methyl isobutyl ketone is also released to the water. Methyl ethyl ketone has been detected in wastewater from manufacturing facilities and synthetic fuel plants, in the ground water near synthetic fuel plants, and in drinking water. However, EPA also stated that both chemicals degrade and have a short life in the environment.

After an extensive literature review of the health effects of methyl ethyl ketone, EPA concluded that any harmful or toxic effects to the central nervous system, including the effects of reported "glue-sniffing," were not a result of exposure to methyl ethyl ketone alone. According to EPA, data from previously performed experiments clearly showed methyl ethyl ketone not to be toxic to the central nervous system.

On September 30, 1983, EPA announced adoption of a negotiated testing program with the Ketones Program Panel. The testing agreement called for a number of tests to be completed by the end of October 1984. The studies were completed and submitted to EPA by mid-October of that year.

Chronology of EPA's Reviews of Test Results and Actions Taken

Between January and August 1985, EPA's Health and Environmental Review Division reviewed the test results. On the basis of the review's generally negative test results and of the National Toxicology Program's plans to test methyl ethyl ketone as part of its reviews of toxic waste cleanup efforts, the Existing Chemical Assessment Division recommended that EPA discontinue any further activity under the existing chemical testing program, and send the test results to the National Toxicology Program. Furthermore, on the basis of a program review of the test results in March 1988, the Existing Chemical Assessment Division decided to recommend no further review of methyl ethyl ketone and methyl isobutyl ketone.

Officials of the National Toxicology Program told us that they never received the test data from EPA. In 1988, the Program started a phase of testing that it presumed was not covered by the TSCA testing program; however, similar testing of methyl ethyl ketone had been performed. Officials responsible for the testing at the National Toxicology Program told us that the testing, which was carried out at a cost of about $500,000, might not have been necessary if EPA had sent the test data.

In July 1990, the Office of Toxic Substances added methyl isobutyl ketone to a list of chemicals covered under newly proposed rules that would test for toxic effects on the central nervous system. As of June 1991, the proposed rule is still being written.

Octylphenol

4-(1,1,3,3-Tetramethylbutyl)phenol, also known as octylphenol and TMBP, has a variety of uses in manufacturing. For example, it is used in adhesives, varnishes, marine paints, and printing inks. It is also used in the rubber curing process in tire manufacture and may be found in synthetic rubber products such as tires and rubber belts. Other forms of octylphenol are used as detergents—mainly in industrial and institutional cleaners, and to a lesser extent, in consumer products—aromatic solvents, and pesticides. At least 95 to 98 percent of all octylphenol used in the United States is chemically altered before reaching the consumer market.

Testing Chronology

On the basis of several findings, ITC designated octylphenol for priority testing on November 3, 1982, recommending tests for both short-term health effects and environmental effects, the latter including toxicity to fish, aquatic invertebrates, and plants. Production was estimated at around 40 million pounds annually.

ITC noted that a study of Japanese workers in a plant manufacturing octylphenol and other chemicals found octylphenol in their urine. In another Japanese worker study, loss of skin pigmentation was noted. In addition, a number of other animal studies observed physical effects, such as drowsiness, decreased motor activity, local burns, irritation, inflammation, rashes, scab formation, eye irritation, and loss of skin pigmentation. Octylphenol was also found to be toxic to a species of marine shrimp. As further reason for recommending testing, ITC noted the absence of data indicating the chemical's short- and medium-term effects, reproductive effects, mechanisms for absorption into any species, and behavior in the body over a period of time, or pharmacokinetics.

On July 20, 1984, EPA adopted an environmental effects testing program negotiated with the Octylphenol Program Panel, acting on behalf of the octylphenol producers. The program called for acute toxicity testing on four test species. If EPA found that these test results indicated a need to test for longer term effects in one or more of the test species, the panel agreed to sponsor that testing.

EPA did not require the health effects testing recommended by ITC. The manner in which octylphenol is produced and handled led EPA to consider both the potential for worker exposure and the number of workers likely to be exposed quite small. EPA learned from octylphenol manufacturers that a total of 200 employees worked in positions where exposure might occur and that the chemical was not produced every workday of the year, which further limited their chances for exposure. Other possible worker exposures were deemed to occur only intermittently, possibly as the result of accidents or during sampling and maintenance as the chemical was manufactured. Although octylphenol had been identified in a chemical plant's wastewater discharges and in a major city's drinking water supply, EPA stated that there was no reason to believe that the levels of exposure presented a risk to human health.

Chronology of EPA's Reviews of Test Results and Actions Taken

EPA received the last of the test results in October 1986. In two memoranda dated January 15, 1987, the EPA scientist reviewing the test data noted that octylphenol was very toxic in the short-term to aquatic organisms, but that a study to estimate the chemical's longer term effects had not been performed. Once this omission was noted, the industry agreed to have the additional testing done. The results were submitted to EPA in February 1988.

Around the time of this additional testing, EPA's Office of Water noted that the existing data were sufficient to consider issuing an advisory to all producers of octylphenol warning of the chemical's impact on water quality. The Office expressed an interest in obtaining additional data on the chemical's effect on saltwater organisms. The Office of Water also expressed an interest in having industry perform this additional test. However, the industry test sponsors would not voluntarily perform saltwater testing as either additional or substitute testing. They were concerned about the Office of Water's involvement in an Office of Toxic Substances program and wanted to know the rationale for the saltwater testing. The sponsors were beginning to develop a TSCA testing program that included saltwater testing for nonylphenol, a similar compound.

The Octylphenol Program Panel reached agreement with EPA to conduct environmental effects testing of nonylphenol in February 1990, and EPA decided to wait for these test results. However, EPA scientists in the Health and Environmental Review Division told us that although the two chemicals were similar in structure, they were different in effect, and therefore the test results for nonylphenol could not be used with octylphenol for regulatory purposes.

We discussed octylphenol test results and the EPA scientists' statements about octylphenol and nonylphenol with Office of Water officials in November 1990. We found that the Office had not moved further on issuing a water quality advisory on octylphenol because it was still waiting for the outcome of the test results on nonylphenol. However, in January 1991, Office of Water officials told us that they had reconsidered octylphenol since our November 1990 discussion and believed that existing data on the chemical were sufficient for an advisory, which would be issued by the end of 1991.

Oleylamine

Oleylamine is used as an additive in petroleum lubricants or as an intermediate in producing these additives. It is also used as a concrete mold release agent, as a collector agent in ore flotation, in asphalt preparation, and in the manufacture of paper, paperboard, and glues.

Testing Chronology

ITC recommended oleylamine for priority consideration for health effects testing on November 25, 1983. ITC based its recommendation on industry production estimates for 1982, which ranged from 5.5 million to 6.5 million pounds, while the United States International Trade Commission reported 1982 production to be about 5 million pounds. ITC also based its

recommendation on total potential worker exposure, which was estimated by the Bureau of Labor Statistics to be in excess of 2.8 million, primarily through oleylamine's use as an additive in lubricating oil. In addition, a 1982 National Occupational Exposure Survey estimate indicated that 3,073 workers were potentially exposed to oleylamine in the workplace, most of them in the general building contractor industry. Available animal studies at the time of the ITC recommendation indicated oleylamine might adversely affect developing fetuses and embryos at high dose levels.

On November 19, 1984, EPA issued a proposed test rule covering all areas of health effects testing called for by ITC, plus others. In April and August 1985, EPA received voluntary submissions of various test data from industry through the Chemical Manufacturers Association. On August 24, 1987, EPA proposed a revised test rule, requiring testing only for effects on developing fetuses, gene mutations, and cancer. On December 1, 1988, EPA issued the final test rule.

Chronology of EPA's Reviews of Test Results and Actions Taken

In response to the test rule, EPA received four studies. A test for gene mutation dated September 26, 1989, and a study of oleylamine's effects on the genes and chromosomes of mice, received on November 28, 1989, were found to be reliable. The results of these tests were negative.

The other two studies, of effects on fetuses of rabbits and mice, were received on November 29, 1989. Both were found to have been conducted in full compliance with the test rule. Both indicated harmful effects to the mothers but showed no signs of harmful effects to the fetuses.

At a May 22, 1991 meeting, Existing Chemical Assessment Division officials decided to drop oleylamine from further review. They believed that oleylamine was not likely to cause harm to humans because the chemical did not easily vaporize and was therefore unlikely to be inhaled. Still, the officials noted that oleylamine was extremely irritating to the skin and suggested that protective equipment be used in working with the chemical to prevent exposure through the skin.

2-Phenoxyethanol

2-Phenoxyethanol, also known as 2-PE and ethylene glycol phenylether, is used in latex paints, paint removers, inks, and dyes. A small amount (5 to 10 percent) is also used as a antimicrobial cosmetic preservative and/or fragrance.

Testing Chronology

ITC designated 2-phenoxyethanol for priority testing in May 1983 on the basis of consumer and worker exposure, the chemical's structural similarity to alkyl glycol ethers that had been shown to have adverse reproductive and developmental effects, and lack of data on other effects. ITC had examined a number of studies that had indicated, although at low levels, a potential for widespread human exposure.

Production is estimated to be about 5 million pounds annually. The National Occupational Hazard Survey estimated that 9,560 workers are potentially exposed to 2-phenoxyethanol; machine operators, sewers and stitchers, pressmen and printers are the most likely to be exposed. Consumer exposure to 2-phenoxyethanol may result from the chemical's use in latex paints, paint removers, and inks. For example, when 2-phenoxyethanol is used in paints, it constitutes 0.6 percent by weight, and release is expected to occur during application and subsequent drying and curing of the paint.

2-Phenoxyethanol can cause mild irritation to the eyes and skin. After ITC made its recommendation, the domestic producers of 2-phenoxyethanol formed an ad hoc group and began a program to test the chemical. EPA found the industry's test program, combined with existing data on the chemical's effects, to be acceptable and decided not to issue a rule to require testing. The agency published its rationale for this decision in the Federal Register on May 21, 1984. The testing program was conducted from 1985 to 1987 in two phases and showed evidence that, at high dose levels, 2-phenoxyethanol could cause a decrease in the number of red blood cells—an effect known as hemolytic anemia—in pregnant rabbits.

Chronology of EPA's Reviews of Test Results and Actions Taken

After reviewing the test results in 1988 and 1989, the Office of Toxic Substances' Health and Environmental Review Division concluded that the industry studies were adequate. In April 1990, the Division further concluded that although test results showed that 2-phenoxyethanol caused hemolytic anemia in animal studies at high dose levels, exposure was expected to be low. Moreover, exposure data did not reveal any cases in which the chemical might be expected to present a substantial risk. On this basis, in May 1990, EPA determined that no immediate action was needed on 2-phenoxyethanol. However, the chemical would become part of a proposed study to fully examine the environmental and human health risks associated with the manufacture and use of paints. EPA's present plans still call for no immediate action to be taken,

but work will begin on a multi-chemical information-gathering rule for paints in 1991.

Propylene Oxide

Propylene oxide is used in the manufacture of methylene chloride, which is used in the manufacture of urethane foam plastic. The chemical is also used to sterilize plastic medical equipment and foodstuffs.

Testing Chronology

Propylene oxide is one of several alkyl epoxides, which ITC recommended for priority testing on October 12, 1977. ITC recommended testing for various health and environmental effects. ITC's primary concern was that propylene oxide might cause malformation of embryos and fetuses. According to a 1974 survey conducted by the National Institute for Occupational Safety and Health, an estimated 247,314 people were exposed to the chemical. The Institute estimated in the 1980s that approximately 40,000 people were exposed to propylene oxide in the urethane industry. In 1980, two major domestic manufacturers produced 1.77 billion pounds of the chemical.

In considering the ITC recommendation, EPA decided that data from already completed and ongoing studies were sufficient to predict many of the chemical's effects. However, EPA believed that testing for effects on embryos and fetuses was needed. In January 1984, EPA issued a proposed test rule and later promulgated a two-phase final test rule requiring tests for propylene oxide's effects on embryos and fetuses. The first phase of the final test rule, issued on November 27, 1985, proposed test standards and sought establishment of reporting requirements. In the second phase of the final test rule, adopted on September 23, 1987, EPA specified test standards and reporting requirements and accepted study plans submitted by industry and modified by EPA for the prescribed developmental toxicity testing.

Chronology of EPA's Reviews of Test Results and Actions Taken

EPA received the required test data on July 7, 1987, and December 22, 1987. The test results showed evidence of harm to mothers and possible harm to fetuses and embryos in rats exposed to the chemical.

The Existing Chemical Assessment Division branch chiefs met on August 30, 1990, to review data and decisions made by the Occupational Safety and Health Administration on the chemical. At the meeting, the chiefs decided that no additional action was needed. Two major factors entered into the decision to take no further action: first, more recent

data indicated that no more than six people were exposed to the chemical outside of the workplace and second, in January 1989, OSHA had tightened its regulations by reducing its maximum exposure limits from 100 parts per million to 20 parts per million. OSHA is closely monitoring the test data on the chemical but believes that its lowering of the maximum exposure limit has reduced the risk from propylene oxide.

Tetrabromobisphenol A

Tetrabromobisphenol A is used primarily as a flame retardant in the manufacture of a wide variety of resins, plastics, paper, and textiles. It may be found in such products as printed circuit boards, simulated marble, floor tiles, bowling balls, furniture, sewer pipe coupling compounds, automotive patching compounds, buttons, electrical and electronics equipment, automotive parts, pipe and fittings, refrigerators and other appliances, business machines, telephones, packaging, disposables, and building and construction materials.

Testing Chronology

ITC designated tetrabromobisphenol A for priority testing on May 2, 1985. Specifically, it recommended testing for the chemical's ultimate disposition in the environment, its ability to be dissolved in water and absorbed in soil, and its ability to persist in the environment. ITC further recommended environmental effects testing for short-term and long-term harm to fish, aquatic invertebrates, and algae and for the chemical's potential to concentrate in the tissues of fish.

At the time of the ITC recommendation, approximately 6 million to 8 million pounds of tetrabromobisphenol A were being used annually alone or mixed with other compounds to form flame retardant coatings. The chemical is thought to enter the environment mainly through wastewater released from processes where it is made and used. A limited amount is likely to enter the environment as a result of its release into the atmosphere from activity in the packaging area of plants and from its use as an additive flame retardant.

Acute effects studies had indicated that tetrabromobisphenol A was highly toxic to fish. The chemical was expected to be chronically toxic to fish and aquatic invertebrates at very low concentrations. However, similar data for invertebrates, as well as for algae, were not available. On the other hand, tetrabromobisphenol A had been found to cause little harm to animals that had ingested or inhaled it. Tests for harm to the genes of microbes were negative, and the potential for human exposure was considered low.

EPA's test rule for tetrabromobisphenol A was proposed on May 15, 1986, and issued as a final rule on July 6, 1987. The final rule for tetrabromobisphenol A required testing for the chemical's ultimate disposition in the environment and environmental effects only. EPA received the last of the required tests on October 23, 1989.

Chronology of EPA's Reviews of Test Results and Actions Taken

The Health and Environmental Review Division reviewed the test data between January and October 1989 and indicated that some tests were conclusive but others should be repeated. A review of tetrabromobisphenol A is scheduled to be held sometime in the fall of 1991, at which time the need for repeating tests will be considered.

Tris (2-ethylhexyl)-trimellitate

Tris(2-ethylhexyl)trimellitate, also known as triocytltrimellitate and TOTM, is used primarily in the manufacture of polyvinyl chloride (PVC). More than 90 percent of the amount produced is found in high-temperature insulation for industrial grade electrical wire and cable. Other significant uses are in refrigerator gaskets, roofing membranes, and automotive crash pads.

Testing Chronology

ITC designated TOTM for priority testing on November 10, 1982. ITC initially recommended screening tests to observe the way the chemical reacted with various substances produced in living organisms. If certain reactions occurred, testing for reproductive effects and short-term effects was recommended.

No information was available on the environmental effects of TOTM, and little information was available on its ultimate disposition after being released into the environment. Given its properties, TOTM was thought likely to be resistant to rapid breakdown from other chemicals, organisms, or sunlight. According to ITC, short- and long-term effects to fish and aquatic invertebrates should be considered in testing, as well as harmful effects to plants. ITC further recommended testing to determine in what quantities the chemical was likely to be found in organisms when released into the environment.

After the publication of ITC's recommendation in the Federal Register, the principal producers of the chemical formed the Trimellitate Esters Panel, under the sponsorship of the Chemical Manufacturers Association, to provide EPA with information on the chemical. The panel reported that worker and consumer exposure to TOTM was expected to be

limited. For example, the chemical was manufactured through a closed system batch process. Controls limiting worker exposure to one of the chemical's ingredients also limited exposure to TOTM.

EPA's investigations had found that the consumer market for the jacketed wire whose insulation contained TOTM was very specialized, and most of the wire was bundled and enclosed either in metal conduits or in plastic jackets made with a different plasticizer. EPA also found that a number of tests had been performed on rats and mice showing minimal toxicity and irritation (except at high concentrations when TOTM was lethal). Ames tests, which indicate cancer-causing potential, had also proved negative. The Food and Drug Administration had reported that two tests conducted to investigate gene mutations were also negative.

In 1983, the National Toxicology Program selected for testing 13 compounds having in common the molecular structure 2-ethylhexyl (TOTM is such a compound but was not one of those selected) and discovered that two of the compounds caused cancer. The Program also planned testing for genetic harm for 10 more 2-ethylhexyl compounds, including TOTM.

The Trimellitate Esters Panel presented to EPA a test program proposal for TOTM that included testing for health effects, environmental effects, and the ultimate disposition of the chemical in the environment. EPA accepted the Panel's proposed test schedule and issued a decision in the Federal Register on November 14, 1983, not to develop its own test rule. EPA received no adverse public comments on its decision not to issue a test rule or the proposed test program. On June 4, 1984, EPA adopted the Panel's proposal and entered into a negotiated testing agreement.

The industry program included seven different tests; the last report was to be submitted to EPA by October 1985. EPA received the last of the final reports on March 21, 1986, but most were submitted closer to their promised dates.

Chronology of EPA's Reviews of Test Results and Actions Taken

EPA's Chemical Testing Branch conducted a program review of TOTM after receiving the last data submission and on October 2, 1987, concluded that the chemical did not present an unreasonable risk of injury to health or the environment and that consumer or occupational exposures were minimal. The Branch stated that no additional action by the Office of Toxic Substances was warranted and recommended that the Existing Chemical Assessment Division close out the program.

However, a disagreement occurred between the Chemical Testing Branch and the Health and Environmental Review Division over some of the TOTM test results. The Division scientists said that existing data were not adequate to characterize the potential of the chemical to cause gene mutations and recommended repeating the gene mutation tests. The Chemical Testing Branch scientists said that repeating the tests would be unproductive because the chemical was difficult to test and would probably yield the same results and the environmental effects testing had proven negative. On February 10, 1988, the Office of Toxic Substances accepted the Branch's recommendation and formally closed out the testing program. The gene mutation tests were not required to be repeated.

Major Contributors to This Fact Sheet

Resources, Community, and Economic Development Division, Washington, D.C.	Peter F. Guerrero, Associate Director Edward A. Kratzer, Assistant Director Raymond H. Smith, Jr., Assignment Manager Peter J. Espada, Evaluator-in-Charge

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