FILE NAME: Phenolic Resins (PHR)

DATE: 1993 Sept 27

DOC#: PHR064

DOCUMENT DESCRIPTION: Legal - Deposition of James Hammond with Barry Castleman Notes; from Exxon File

+ Shamrock
n Rice Hotel program annually
on IH 1948-1959 300 people
27 (1947) tried to substitute ϕ or eliminate exp to it.
30 Ex. P-3 is Hammond's history of ϕ control
written in 1991 by him
31 Ex P-4 1935 Div Labor Stds. publ.
32 Ex P-5 1938 or 39 " " " " NSC-1931 is P-6
33 Ex P-7 1946, 1948, 1956 MCA Chem. Data Sheets ϕ
44, 81 precautions he rec in 1948: first, education of the worker
45 " (1948): med exam at hire + after suspicious exposures
46 " : respirators air monitoring
48 Knew Dr. Hunter at Mass. General in 1941 knew of ϕ article
49 Knew Ethyl Browning's 1937 book in 1941 while in Boston
50 Hunter taught him in Boston, JH agreed only safe exp. was O
54 P-12 Harrison 1950 Principles of Internal Medicine
chapter on chemical agents by Marshall Clinton, fellow student at Harvard
55 McClinton said in above chapter as in API (1948) only safe level's O
56 P-15 Esso Toxgram 1958
57 insidious because it's inoffensive (smell) at harmful levels
58 Toxgram said only abs. safe level is zero
59 only safe level zero also expressed by WCH by implication 1942
62 JH also attended WCH's APHA speech noted by Clyde Berry 1948
68 NY State Cancer Comm. 1949 incl. API docs, WCH, Ochsmann Ex P-16
69 JH accepted also in 1949 that ϕ was an established carcinogen
72-73 Shell 1943, 1950 docs. (latter says ϕ has " carc. properties)
76-78 P-19 A. Dooley Texaco 1/54 document on ϕ emphasizes individual susceptib.
78 JH said zero limit in his 1948 program
84 API 8/30/60 version of 1948 ϕ API tox review
P-21 1970 Cities Service memo to customers had med mon. info
85 P-22 is 1955 JH memo on practices then used
86 looked for ϕ exp. in workers' exp. to petrol. streams w ≥ 2.5% ϕ
87 incl. meas. urinary phenols
91 Walsh-Healy Act req. knowledge of exposures ⇒ sampling (1960)
92 even contractors got classroom training, enforced by Exxon
94-95 IH did refinery IH studies for Std Oil NJ in late 1940's P-23 (1949)
96 ϕ odor threshold exceeded TLVs of 35, 50 ppm
100 zero exp. to protect susceptible workers - JH didn't accept TLV as acceptable
100-105 TLV/MAC limited by what could be enforced on industry (MA, 1941)

104.1 Blue

JOSEPH L. HEBERT AND MARIE HEBERT	]	14TH JUDICIAL DISTRICT
vs. No. 92-6203	]	PARISH OF CALCASIEU
HIGMAN BARGE LINES INC., ET AL	]	STATE OF LOUISIANA

VIDEOTAPE DEPOSITION OF

PROFESSOR JAMES HAMMOND

Between the hours of 9:50 a.m. and 1:50 p.m.

September 27, 1993

Marriott, Houston Intercontinental Airport

Houston, Texas

RECEIVED OCT 1 1993

Shawn Kelley, Texas CSR No. 3448

Nell McCallum & Associates Inc.

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Also present:

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VIDEOGRAPHER: On the record, it's 12 minutes before 10 o'clock, September 27, 1993, 92-6203, Joseph L. and Marie Hebert versus Higman Barge Lines, Inc., et al, 14th Judicial District Court, Parish of Calcasieu, State of Louisiana. We're here for the deposition of Professor James Hammond. If the court reporter will swear in the witness, we'll have counsel state their appearances and we'll begin with this deposition.

[The witness was sworn]

MR. BAGGETT: This is William B. Baggett, and I represent the Plaintiffs Joseph Hebert and his wife.

MR. FREEMAN: This is Mark Freeman, and I represent Higman Barge Lines.

MR. SPEARS: This is Kenneth Spears, and I represent all of the oil company defendants in this case with the exception of Koch Industries.

MR. MYERS: And my name is Robert Myers. I represent Koch Industries.

MR. BAGGETT: Ken, for the -- for the record, I really think I need you to -- here's a list of the companies that are involved in the litigation, and I'd like for you to state for the record -- here's some more of them -- your appearances.

MR. SPEARS: All right. Again, this is Ken Spears, and I'm listing the oil company defendants whom I represent in connection with the Joseph Hebert case. First of all is Amoco Oil Company; Atlantic Richfield Company; Oxy Oil & Gas USA, Inc.; Canadian Oxy Offshore Production Company; Coastal Corporation; Crown Central Petroleum Corporation; Gulf Oil Corporation; Koch Industries; Marathon Oil Company; Mobil Corporation; Phillips Petroleum Company; Shell Oil Company; Sun Oil Company; Texaco, Inc.; Union Oil Company of California; Conoco, Inc.; Monsanto Company; ARCO Chemical Company; with the understanding that these names may have changed since we filed the pleadings, and I'm not verifying that these are -- these are the correct names of these companies as they are known.

MR. BAGGETT: Fine.

MR. SPEARS: Okay.

MR. BAGGETT: Thank you.

Gentlemen, is this deposition -- can we agree that this deposition is being taken pursuant to notice and that it's to be governed under the rules of the Louisiana Code of Civil Procedure, and can we stipulate that -- that in accordance with those rules that all objections are reserved except those relative to the form of question or the responsiveness of the answer?

MR. MYERS: That's agreed on behalf of Koch.

MR. FREEMAN: That's fine.

MR. SPEARS: That's fine with me.

MR. BAGGETT: And I ask that a copy of the notice of the deposition marked Plaintiff 1 for identification be attached and made a part of the deposition.

PROFESSOR JAMES HAMMOND,

being first duly sworn or affirmed, testified as follows:

EXAMINATION BY MR. BAGGETT

Q. Professor Hammond, state your full name, please, sir.

A. James William Hammond, Sr.

Q. And where do you reside, sir?

A. I live at -- in Houston, Texas, and that's located 1010 Townplace.

Q. And what is your profession, sir?

A. I'm an industrial hygienist.

Q. Would you tell us, if you would, what is an industrial hygienist?

A. An industrial hygienist is a scientist that recognizes potential hazardous materials in industry, and then he developed methods of evaluating the degree of hazard and then designs the control measures that may be required to protect employees that are handling these substances or materials.

Q. Would you tell the Court or jury how old you are today, sir?

A. Well, I am over 80 years of age.

Q. All right, sir. And where were you born?

A. I was born in Winona, Mississippi.

Q. You're retired, are you not, sir?

A. I am retired, yes, sir.

Q. Did you ever teach?

A. Yes, I have taught for many years. Beginning back with the university system, I was teaching as early as 1936.

Q. And could you tell us some of the places where you taught?

A. Well, for the University of Tennessee and University of South Carolina, Georgia Tech, and I taught then at Baylor School of Medicine here in Houston, I taught in Oklahoma at the University of Oklahoma at Norman, and I taught at Wichita State University.

Q. That's in Kansas?

A. That's in Kansas, yes, sir. And then I retired and began teaching for nine years in the Medical Center at the University of Texas in Houston. And I retired from there in 1987, I think.

Q. You retired from the University of Texas, Medical Center teaching in 1987?

A. That was my memory, yes, sir.

Q. And that was preceded by nine years as a teacher there?

A. Yes, because I retired from the Humble Company in 1978.

Q. All right, sir. Now, if you would, and I'm not going to make this long as I could, because of your distinguished past, but if you would, would you tell us something about your education and training, Professor?

A. Yes. Well, I have two degrees from Mississippi State University. One of them's in the field of physics and chemistry, the other one's a chemical engineering degree. Then I have a masters degree in biochemistry and toxicology from LSU. Then I did graduate work at MIT and I did graduate work at the University of South Carolina, Rice University, University of Houston and probably one or two other universities that I've forgotten the names, which ones.

Q. Well, did you do any -- did you have -- further your education at Harvard?

A. Yes, I did. I never registered as a full-time student there, because I was working an internship under the teachers of the Harvard University, particularly I recall Harvey Elkins, Dr. Elkins, and also Wesley Hemeon, and they both taught at -- and also I took courses at -- in -- I sat in courses that were taught by Phil Drinker, among others.

Q. Phil Drinker, is he recognized in any particular field as one of the leading experts?

A. Yes, he was -- really started degree giving in the University of -- Harvard University in the field of industrial hygiene, and he himself was a chemical engineer. He's most noted, I guess, worldwide because he developed the artificial lung for polio victims. It was his department that did it.

Q. Professor, after your education period, when did you begin work?

A. Yes, I did -- I began work for the chemical engineering department of the University of Tennessee July the 1st, 1936.

Q. Okay. And what was the nature of that work?

A. That work was associated with the toxic gases and fumes that were being produced by the Muscle Shoals operation under the Tennessee Valley Authority in their electric furnace decomposition of apatite, which is one of the forms of the phosphates that was being converted into soluble and edible materials, and they lost to the air fluorine, particularly was the hazardous materials, and I was working on a method of capturing those materials as well as protecting the employees in the plant, to remove it from the air because it was -- it was harmful to vegetation that came downwind from that plant. It would cause --

Q. So your first employment commenced in 1936 and to -- would you, if you could, briefly, and I know this is covered in your resume, which I'm going to ask be attached to the deposition, but would you carry us briefly through your employment after you had worked -- went to the University of Tennessee to work?

A. Yes, after being there five years I accepted a commission in the United States Health Department and went to the Institute of Health at Bethesda, Maryland, and started in the Division of Industrial Hygiene there under the public health service activities and with -- associated with the people that were working industrial hygiene there, and then they shortly assigned me to the Division of Occupational Diseases in the Department of Labor for Massachusetts, where I spent 1941 and 1942, and that gave me an opportunity to work for and with the teachers at Harvard, such as Dr. Elkins and Hemeon and Drinker and so forth.

Q. Now, was that -- Harvard University in the early 40's, was that the seat of industrial hygiene engineering and industrial hygiene training in the United States?

A. Yes, it was recognized as one of the

pioneers, if not the outstanding pioneering school worldwide. It was the school that all of us had ambition to attend if we wanted to make a career in this field.

Q. Did you -- did you further your education then under recognized experts such as Hatch and Drinker?

A. I did. Hatch had already left there as a professor at the time, but I had many associations and contact with him, because he moved into the army development of controlled conditions and tanks and army equipment, and that's where he spent the next four or five years during the world war, but then later on I met him up again when he began to teach at the University of Pittsburgh and worked for the -- that school and university as well as Malone School of Technology.

Q. Sir, how did you get into the petroleum industry?

A. Well, I was the associate director of industrial health in the state of Georgia in the Department of Public Health there in Atlanta, and I was called one day by a medical director of Exxon, which was then Humble Oil & Refining Company, and asked -- and that was the last of

March of 1947, and he asked me to come over here, Dr. Baird, and he was a member of the medical advisory committee, and I came over in the first part of April of 1947 and then accepted the position that he offered me.

Q. And that was at --

A. Humble.

Q. -- Humble Oil over here in Houston where you went to work as an industrial hygienist and sanitary engineer?

A. I did.

Q. I think that you have heretofore furnished everybody with your curriculum vitae or resume. And for the -- because it's customarily done and because it will complete the record, I ask that this be marked Plaintiff's Exhibit No. 2 for identification and attached to the deposition.

Sir, in this resume is there a list of -- list of all of the articles that you've written over the years?

A. It's a list of almost all of them, but there were some that are missing from that, and sometimes they were like the lack of publication publicly, but I had all of my publications with me at the School of Public Health at the University of Texas here, and I left them there after I retired, because I had about 18 boxes of them and I didn't have time to remove them. I went back a few months later to get them and move them to my home where my office was, and somebody had found those and over the bookcase that I had them on and taken every one of the publications, so I don't have any other than the ones that are listed off. I don't even have all the copies of those maybe.

Q. How many -- about how many articles, just for completeness of the record, have you written over the years?

A. In counting them, I believe I've estimated that I've written more than -- well --

Q. It's over a hundred?

A. Well, a hundred. I would say that I have surely written more than 80 that's available, have been available, but it was more than that, but I don't remember how many more, but we'll say over 80.

Q. Sir, you served at Humble Oil, what, in the capacity as industrial hygienist and sanitary engineer from about '47 to '57 -- or '59, rather?

A. Before I was promoted?

Q. Yes, sir.

A. Yes, and I -- yes, and then I was made director of the division --

Q. Now, could you just --

A. -- for the last --

Q. -- briefly tell us about the history of Humble and Exxon and bring us up to your retirement? What was the -- what was your job with those companies?

A. I inherited these other companies that were affiliates of Standard of New Jersey when the name became -- well, Humble for a while. In 1960 or '61 we became countrywide -- nationwide as Humble, and I inherited all of the staffs that were with these other companies as well as the responsibility for the health exposure or the occupational exposure problems that were associated with the manufacturers in these other refineries and --

Q. At some --

A. -- chemical plants.

Q. At some point in time is it correct that you became the head of the industrial hygiene program and chief industrial hygienist for Exxon USA?

A. Yes, in all 50 states.

Q. And how many facilities, roughly, were there in that -- in Exxon USA?

A. I'd have to estimate. One time we had well over 60,000 employees. I don't remember the number of employees. There were more than 60,000. And they represented so many plants and so forth I just couldn't estimate for you the -- with any accuracy the number of actual plants there were.

Q. All right, sir. And one of them was over in Baton Rouge, was it not, sir, that was in your --

A. The Baton Rouge refinery, yes. And then there were several gas plants and other plants of that nature that were out -- scattered throughout the production area in Louisiana as well as Mississippi and Alabama and Florida and Texas and Oklahoma.

Q. Sir, when was it that -- did you hire for that plant in Baton Rouge an industrial hygienist to go to work there?

A. Yes, I did, and he was a graduate of Harvard school under Phil Drinker, and his name was Fred Venable.

Q. And what year did you do that?

A. Well, I had to wait on him until after I had located him and he was with the Texas State Department of Health, and he was obligated to work for them for so many years after he had finished his graduate work at Harvard, and so he came onboard about 1950 or '51.

Q. And one of the -- one of the facilities that was under your supervision was over at the Baytown refinery in this area?

A. Yes, it was.

Q. Sir --

A. Beginning in 1947 I had the responsibility over Baytown and all the other plants that Humble Oil & Refining Company had throughout Texas.

Q. Sir, to move on, you were a member of the American Petroleum Institute, were you not?

A. I was a member of the medical advisory committee and never had a membership as such individually in the API, but I began to attend the medical advisory committee as advisor and consultant to my member, which was Dr. Baird in 1947.

Q. All right, sir. Now, I'll show you a document that I've marked 2-A for identification and ask you if that reflects your American Petroleum Institute assignments, this first one from 1947 to 1965, and then the second page covers it from 1965 to '67? Does that reflect your memberships in the American Petroleum Institute? I ask that that be attached to the deposition as 2-A for identification.

A. I recognize all of these.

Q. As positions that you held?

A. Operations that I participated in, yes.

Q. Sir, tell me this, Professor, and just briefly what are some of the professional associations that you belong to?

A. I belong to the Texas Public Health Association here in Texas, and we joined it in 1947. I belong to the National Public Health Association from earlier than that. I had joined that in 1942. And I had membership, of course, in the American Industrial Hygiene Association from beginning in 1942 -- 3, I'm not clear right now which of those years, but anyway, from that time on. Then, of course, I was medical advisory committee of the API group and -- as you see, and then I was also representative on the Chemical Manufacturing Association for precautionary labeling, and I represented the company beginning -- and attended those meetings as early as 1950 to '55, and beginning in 19 -- associated with the representative from the Esso group. I was -- also became the company representative on the Manufacturing Chemical Association for writing a manual on precautionary labels in 1958 and remained in that capacity for the rest of my career.

Q. Professor, your resume that's attached to the deposition marked Plaintiff's Exhibit No. 2 for identification, sets forth, does it not, the professional associations that you belong to?

A. It does.

Q. Does it also set forth the awards and honors that you received in your professional work?

A. It does.

Q. Just briefly, the Henry Case award, what is that, sir?

A. Henry K. Smith award, well, that -- he was an outstanding authority in the field of industrial hygiene from the University of Pennsylvania back in the early 1920's, nine, twenty -- I'm not sure which year he began, but in that range of the late 1920's. And he actually did a survey of the Baton Rouge refinery. I've seen copies of his survey made in 1928 or '29 for the Baytown -- for the Baton Rouge refinery. So he would then join the University of Pittsburgh school and taught industrial hygiene there and was a -- also a consultant to the Malone School of Technology in this field.

Q. Sir, is there any -- the Henry F. Smith --

A. And then -- yes, and that was the association of -- American Industrial Hygiene Association recognized him as one of the pioneering authorities, so they established an award for him, and I was fortunate enough to be selected to receive that award, the second one given in the nation, and that year was in eighty --

Q. Your -- your resume says '82.

A. In '82.

Q. Was that --

A. That's the second one.

Q. In your opinion is that the greatest honor that you can receive as an industrial hygienist in America?

A. It is, in my profession.

Q. Now, after your teaching career here at the University of Texas School of Public Health, did you -- did they establish a James W. Hammond award to the outstanding graduate of Texas A&M or the University of Texas public school in your honor?

A. They did, and it's continued on, even this year. That award is presented every year by the Gulf Coast section of the American Industrial Hygiene Association.

Q. The reference has been made to the American Petroleum Institute during this earlier testimony. Could you tell the Court or jury what is the American Petroleum Institute?

A. Well, that is a member of all of the companies that are concerned with the commercial production of gas and oil, and many of the other companies that have joined or are eligible are the people who manufacture equipment or methods that are used by that industry.

Q. Is that recognized as a trade association for the petroleum industry?

A. It is, and the affiliate companies would be concerned with making -- supplying either materials or mechanical equipment or chemicals to the production and operation of the petroleum industry.

Q. Sir, have you participated extensively throughout your professional career in educational seminars, lectures in an effort to spread the word about industrial hygiene?

A. Yes, beginning in 1947 I was invited to be on an advisory board to the Houston Chamber of Commerce Industrial Committee, and the interest was in both the air and water pollution as well as in industrial health and safety, and so I was elected to be the chairman of a committee that put on a program beginning 1948 at the Rice Hotel and invited all of the people that are concerned with the industry throughout this area that ran a -- the publicity went out all the way from we'll say New Orleans and as far north as Chicago and as far west as old Mexico. And we had 11 of those conferences annually along about this time of year or a little later, in October, that met first at the Rice and then later at the Shamrock that ran for 11 years, and we'd have an average attendance of 300 people. Most of these persons were concerned with either occupational health and medicine and hygiene, and they were also concerned with public health. They were concerned primarily as safety, industrial safety, and they were members of the -- of the -- and they were all invited, and they usually came. And in addition there was an organization of personnel managers and nurses as well as doctors. They were all invited, and that made up about an average of the 11 years for three -- attendance, 300. It ran generally from Thursday, Friday and Saturday, three days a week, and we invited the best authorities nationwide and even we had them to come from the Department of Labor and from England and visited our -- visited our conference more than once. It would be what would be the equivalent of our Secretary of Labor.

MR. BAGGETT: Gentlemen, I tender Professor Hammond as an expert in the field of industrial hygiene with extensive experience in the petroleum industry.

MR. SPEARS: Well, this is Ken Spears. I deposed Mr. Hammond, and we've been involved with him on several cases, and I accept his qualifications. I think he's very well respected as a former industrial hygienist in the petroleum industry.

MR. BAGGETT: Thank you, sir.
Anybody else have any questions?
MR. FREEMAN: It's my understanding we're reserving all objections except as to form and responsiveness, so I'll abide by that agreement.

VOIR DIRE EXAMINATION BY MR. MYERS

Q. I'll just have a couple of questions. Professor Hammond, did you ever receive your Ph.D.?
A. No, I never did. I had the three degrees I had, and I had a certificate from MIT, and I had a certificate from Rice University, but never actually concentrated on getting a Ph.D.
Q. Have you been out of the field of industrial hygiene since your retirement?
A. No, since my retirement I taught for nine years industrial hygiene, I taught about a hundred graduate students. There were 130, I believe, attended my course and classes. And then I -- as I am involved today, I kept up with the developments of the field.

Q. You have testified as an expert previously in this particular field?

A. Several times, yes, sir.

Q. When was the last time you testified in court?

A. I've given depositions recently, but I think most of the cases I've been involved in have not reached court stage. Most of them have been settled outside of court, I believe.

Q. Have you ever been denied qualification in a field of expertise for which you have been tendered? And I realize you said you've been qualified as an expert in industrial hygiene, but have you ever been tendered as an expert in chemistry or any other field?

A. I have never been accepted as an expert in that field, no.

Q. All right. I take it that you've been tendered as an expert in and you hold yourself out as an expert in industrial hygiene?

A. I do. I remember a court -- a case that John O'Quinn brought against Monsanto in 1987 or 6 or somewhere like that, and I did testify in that particular case, I recall.

MR. MYERS: Okay. That's all I have.

Thank you.

CONTINUED EXAMINATION BY MR. BAGGETT

Q. Professor Hammond, in the conduct of the industrial hygiene program that you participated in with your first employer starting in the 40's, did you have a goal to develop a program designed to eliminate any benzene exposure?

MR. FREEMAN: Objection as leading.

MR. BAGGETT: That objection is --

MR. SPEARS: I object to the form of the question.

MR. MYERS: Join in.

MR. BAGGETT: Fine.

Q. You can go ahead, Professor, and tell us when you first started to work, what did you do, if anything, about the industrial hygiene program as relates to bone -- to benzene exposure.

MR. SPEARS: Again, I object to the form of the question. You're talking about where, Bill?

MR. BAGGETT: I'm talking about when he said he started to work in 1947 and in his capacity as an industrial hygienist. So I wanted to know what he did, if anything, with reference to benzene -- the benzene program, exposure program.

MR. SPEARS: At Exxon or Humble we're talking about?

MR. BAGGETT: Yeah, at Humble.

A. In 1947 I was clearly sat upon a program to eliminate any exposures at all to our employees in the Humble Oil & Refining Company and substitute other materials where possible or those that did have necessary exposure to control them carefully to come up with the zero level of occupational exposure.

MR. BAGGETT:

Q. Professor, how did you -- how did you accomplish -- accomplish a -- accomplish a program that was designed to eliminate exposures to benzene to zero?

A. First and foremost, there were many operations that were commonly used in both the laboratory and also associated with purification of petroleum products in which we could substitute other materials, nonasbestos -- nonbenzene and get rid of the potential exposures completely as we did in many places. And then next was that we enclosed all operations that they have to use it, for example, as a chemical process in the laboratory by enclosing and putting it under the hood that was well-exhausted with adequate air flow-through to protect the employees. And when we couldn't do that, the short-term exposure outside we used an approved type of respiratory protection such as respirators and gas masks or air supplies to supply them.

Q. All right, sir. Sir, you have prepared a report for me, have you not, or at my request that's been furnished to opposing counsel that's dated back in January 16th, 1991, entitled, "The history of recognition, evaluation, control, chemistry of industrial toxicology of hazards of benzene (benzol) vapors and liquids in the petroleum, petrochemical and related industrial activities," have you not, sir?

A. I have.

Q. And, Professor, in connection with that report, did you review some of the safety, labor and industrial hygiene literature that was used early on in your professional career?

A. Yes, in a way, but I didn't find it

necessary to review any extensive literature, because this was my program, and I had had a part in developing the program with the various agencies I had been associated with beginning 1941 with the Division of Occupational Diseases with the Department of Labor up in Boston, and I was familiar with all of the knowledge and foundation that had been prepared at that time. And so I wrote this more or less from my own knowledge as I have of the field.

Q. Sir, could you tell us whether or not by 1947 when you went to work with Humble there was extensive literature available in medical, safety, industrial hygiene, labor, governmental and occupational medicine fields that concerned the relationship between benzene exposure and disease?

MR. SPEARS: I'd object to the form of the question as being -- not only is it vague, it's compound. I'm not sure what he's going to answer to.

MR. BAGGETT:

Q. Well, I'll repeat it, Doctor -- Professor, subject to that objection, so that there's no misunderstanding. By 1948 was there extensive literature available in medical, safety, industrial hygiene, labor, governmental and occupational medicine that concerned the relationship between benzene exposure and disease?

A. There was.

Q. And did that -- did that literature address such things as the toxicity and the precautions that should be taken to protect one from -- who had potential exposure to benzene vapors?

A. It did.

Q. And in your report, which I will mark as P-3 for identification and ask that it be attached to the deposition, this is the report dated January 16th of 1991 --

MR. MYERS: I'm going to make an objection to the attachment of the report to the deposition in that I believe he's going to testify on it, and his testimony will be the best evidence of his opinions.

MR. SPEARS: I'd join in that objection, Bill. I'd like to ask the professor a question about this report before you introduce it.

MR. BAGGETT: Well, you'll have an opportunity on cross-examination. I just ask that it be attached in case somebody -- as part of the record. And if you want to ask him questions about it, whether or not it goes into evidence, that objection has been preserved by Mr. Myers.

MR. SPEARS: Right. I preserve my objections, and I do object to it being attached to the deposition.

MR. BAGGETT: Fine.

Q. Professor, to substantiate your statement about 1948, that there was literature available that concerned the relationship between benzene exposure and disease, have you not furnished us with a report from the Division of Labor Standards, Department of Labor, dated 1935?

A. I have.

Q. I ask that this -- is this a copy of the report that I will mark as P-4 for identification? Is that a copy of the report that you have furnished to us?

A. It is.

Q. Also, to illustrate the availability of literature, did you furnish us with a report dated 1938 from the Industrial -- from the Division of Labor Standards, U. S. Department of Labor, which I will mark as P-5 for identification and ask you if that is the document that you supplied us?

A. Yes, this is the document, and I think the date may be 1939.

Q. All right, sir. Fine. Sir, also did you furnish us with the National Safety Counsel pamphlet No. 14 that I will mark as P-6 for identification, and this is dated in 1931 that concerns benzol, and ask you if that's a copy of the document that you furnished us to illustrate the type of literature that was available at that time set?

A. Yes, and this seemed to be a very comprehensive discussion of the problems associated with handling benzene and the medical surveillance and the other matters that were associated with it.

Q. All right, sir. P-7 for identification can best be described as a Chemical Safety Data Sheet SD No. 2 dated -- well, adopted '46, revised '48, second edition revised 1956, entitled properties and essential information for safe handling and use of benzene published by the Manufacturers Chemical Association, Inc. I've marked that P-7 and ask you if that is one of the types of literature that was available that concerned the relationship between benzene exposure and disease?

A. It is.

Q. Sir, these -- these documents that have just been described and are marked P-4, 5, 6 and 7, did they have a common thread running through each of them, and that is that they address the toxicity of benzene, the nature of the disease and precautions to be taken to limit exposure?

MR. SPEARS: Object to the form of the question. The documents are going to speak for themselves, and it's a compound question again, Bill.

MR. FREEMAN: Same objection.

MR. MYERS: Join in.

MR. BAGGETT: Fine. Gentlemen, I'll agree with y'all that objection by one is considered to be objection for all, and we can then avoid that.

A. Yes, it did, and they usually all stressed the importance of recognizing exposures and responses by certain individuals was based upon susceptibility to this material, and that was one of the bases that I decided that in early times, 1940's, it was necessary to have zero concentration for everybody, because of its susceptibility --

MR. SPEARS: I object to the answer now as being nonresponsive to the question.

MR. BAGGETT:

Q. Sir, was there literature such as this widely known and commented upon in the petroleum industry when you went to work with the company?

A. It was.

Q. Was this literature by the Chemical Manufacturing Association, the National Safety Counsel and the Department of Labor, were those easily acceptable and available to anyone desiring to obtain that information -- type of information?

A. They were readily available.

Q. Sir, these documents that have -- these are copies of them that have been attached to the deposition. When you rendered your report and when you testified in the Ellis case, these same documents were identified, were they not, sir?

A. They were.

Q. And at that time you had the originals of those documents that had been maintained in your files, did you not, sir?

A. I did.

Q. And these are copies of them?

A. They are.

MR. MYERS: I will make a general objection to the attachment of those documents. Granted I'll probably be able to see some other documents that will change my position, but at this point, since I haven't seen them before.

MR. BAGGETT: Gentlemen, I'll assure you that any document that's produced will either be authenticated in this production or will be authenticated before trial.

Q. Professor, is there any -- to your knowledge is there any publication that is more circulated or certainly -- let's put it this way, is not the Journal of the American Medical Association one of the most widely circulated medical journals or journals in the world?

A. It is.

Q. I want to show you a document that I will mark as P-8 for identification, which purports to be an editorial from the Journal of the American Medical Association dated November 1944, and ask you if you would -- dealing with environmental cancer, and ask you if the statement that is contained here that the agents known or suspected to cause occupational cancer are arsenic, chromates, nickel, carbon, radium, mesothorium, asbestos, crude and possessed mineral oils and, on over up at the top here, benzene?

A. Yeah.

Q. Substances -- this was an early recognition by the AMA in 1944 that benzene could cause occupational cancer --

MR. SPEARS: I object to the form of the question.

MR. BAGGETT:

Q. -- is it not, sir?

A. It is true.

MR. BAGGETT: I ask that that be attached to the deposition as P-8.

MR. MYERS: Same objection as previous.

MR. BAGGETT:

Q. Sir, moving on, P-9 for identification can best be described as the API toxicological review on benzene dated September of 1948. Have you seen and studied that document before, sir?

A. I have.

Q. Actually in -- after your employment could you tell us whether or not that -- that publication was widely circulated within the petroleum, safety and health community?

A. It was available and publicity was given to its availability, because the API medical advisory committee was commissioned at Harvard under Dr. Drinker's supervision to prepare these reports. And benzene was just one of many different substances that were --

Q. Professor, I -- at the time that this is displayed to the Court or the jury, I'm going to either have a blowup or have it on video, the forward here, and I'd like for you to read that into the record here, the forward on P-9.

A. All right. "This review summarizes the best available information on the properties, characteristics and the toxicology of benzene. It offers suggestions intended to recommendation pertaining to medical treatment, medical examination and precautionary measures for workers who are exposed to benzene. It was prepared at the Harvard School of Public Health, Boston Massachusetts, under the direction of Professor Phil Drinker. The review has been accepted for publication by the medical advisory committee of the American Petroleum Institute. Anyone desiring to submit additional information or proposed changes for consideration prior to reissuance of this review is requested to send them to the American Petroleum Institute. This review was prepared by Marshall Clinton, M.D."

Q. Did you know this is the Phil Drinker that you studied under and worked with at Harvard?

A. Yes, and also happened to know Marshall Clinton as a friend, associate, peer.

Q. Sir, in this document that we've just referred to, would you please tell me, sir, if at the time that this was published was it known within the safety and health community of the industry that you were involved in that chronic benzene poisoning resulted from repeated or continuous exposure to relatively low concentrations of benzene vapors?

MR. SPEARS: Object to the form of the question if you're asking this man to testify about what somebody else knew other than himself.

MR. BAGGETT: Well, fine. Your objection is noted, sir.

A. It was well accepted by me as well as others in the field as being a very hazardous material.

MR. BAGGETT: Professor, what, if

anything, did this document or did the -- strike that. Let's go off the record just a minute.

VIDEOGRAPHER: Off the record, 20 minutes before 11 o'clock.

[Discussion off the record]

VIDEOGRAPHER: On the record, 15 minutes before 11 o'clock.

MR. BAGGETT:

Q. Professor Hammond, the American Petroleum Institute toxicological review on benzene that was published in September of '48, while the document will speak for itself, for the record would you tell us whether or not that document addressed the properties and characteristics of benzene?

A. It did.

Q. Was one of those characteristics that it had a pleasant odor?

A. It did.

Q. Sir, the toxicology of it, the acute effects and the chronic effects, was that also a matter of information that was passed along by this review?

A. They were.

MR. SPEARS: Object to the form of the question.

MR. BAGGETT: Y'all keep objecting to the form of the question. If you would, would you please articulate what's wrong with the form of my question so I can try to correct it?

MR. SPEARS: The question was vague. I didn't understand it.

MR. BAGGETT:

Q. Okay. Sir, when your dealing with chronic affects of an exposure to benzene, what influence of the -- what part of the organs of the body did the benzene have effect upon, if any?

A. The chronic effects were generally associated primarily with the bone marrow.

Q. And in that would be a part of the blood-forming organs of the body?

A. Yes, that is the organ that forms the blood.

Q. Okay. Sir, did -- is there any characteristic of benzene and its health effects that relates to individual susceptibility?

A. It is related to susceptibility on the part of the employees or the persons exposed to it, yes.

Q. And was that any factor that you considered in adopting an industrial hygiene program or enforcing one with your employer starting in '47?

A. It certainly was.

Q. Did you recognize in your practice the statement that is obtained -- that is contained on page 4 of P-8 at the bottom, left-hand side, "Inasmuch as the body develops no tolerance to benzene and there is a wide variety in individual susceptibility, it is generally considered that the only absolutely safe concentration for benzene is zero"?

MR. SPEARS: I object to that question, Bill, as being vague, and also the document speaks for itself. Now you're asking him to read -- repeat into the record what's already printed in those documents.

MR. BAGGETT: I think the objection is wrong, because what I asked him is if in his practice and in the program at your company or with your employer did you recognize this in trying to put in a program?

A. I did.

MR. BAGGETT:

Q. Sir, even at that time, what if anything -- and, here again, the document does speak for itself, but I want you to state for the record, because I will have this section No. 3 dealing with safe limits shown to the Court, if you will, please read what it says here in paragraph 3 under safe limits.

MR. FREEMAN: What exhibit is that, please?

MR. BAGGETT: This is P --

THE WITNESS: 9.

MR. BAGGETT: P-9, yeah.

MR. SPEARS: That's the API tox review?

MR. BAGGETT: Yeah, uh-huh.

MR. MYERS: Let me make a general objection to him repeating whatever the exhibit is itself as not being a form of basis of his opinion, but yet an opinion of someone else.

MR. BAGGETT:

Q. Would you go ahead and read for the record paragraph 3 entitled "Safe limits"?

A. "The American Standards Association and most of the states has set an arbitrary limit of 100 parts per million as a maximum permissible benzene concentration to workers exposed to this substance during an eight-hour period. Massachusetts and Oregon has set limits of" --

it's a blank here -- "parts per million, whereas New York considers 50 parts per million as the highest permissible level. Inasmuch as the body develops no tolerance to benzene and as there is a wide variation in individual susceptibility, it is generally considered that the only absolutely safe concentration for benzene is zero. The inadequacy of a limit of a hundred parts per million are indicated by well authenticated reports of at least two cases of benzene poisoning following exposure to only 75 parts per million. A limit of 50 parts per million or less is strongly recommended, particularly where exposures are recurrent. Skin contact should be avoided."

Q. All right, sir. Professor, tell me what -- at this time what did you consider that the API Toxicological Review was recommending so far as medical examinations?

A. It seemed to be fairly adequate and would be what I would recommend primarily even today.

Q. And that was preemployment physicals and also regular examinations of those people with potential exposure to benzene?

A. A regular basis or periodic reexamination of the people.

Q. What precautionary measures were recognized in your profession by people in petroleum industry, precautionary measures were recognized to assist in limiting benzene exposure?

MR. FREEMAN: I'm going to object to the form of the question as the term petroleum industry -- do you, by that term, refer to marine transportation industry as well?

MR. SPEARS: I join in that objection and add to that another objection is I'm not sure if you then indicated what time frame he's talking about.

MR. BAGGETT:

Q. I'm talking about in 1948 when this bulletin came out, sir, what were the precautionary measures that were recommended be taken to limit or prevent the exposure to benzene poisoning that -- that were utilized in your profession as an industrial hygienist?

A. I would start out by listing first education of the workers as to the hazards associated with benzene.

Q. Would the -- would the fact that there is a latency period involved in the development of disease following long exposure to low dosages be one of the facts that you think would need to be -- the employee would need to know about?

A. That should be emphasized, yeah.

Q. Would one of the safety measures that -- that was recognized in 1948 be that for the prevention of benzene poisoning that the -- all of the measures should be designed to prevent the inhalation of benzene vapors?

A. That would be the only method that could be used to protect the employees, yes.

Q. And how would you do that? Would that involve engineering, sir?

A. That would involve the enclosure and preventing of escaping of any gas into the breathing zone of the employee.

Q. If excessive concentrations were unavoidably encountered in any operation, what was done by -- recommended by your company that you worked for in the period 1948?

A. By both preemployment examination of each employee that was going to be potentially exposed and then reexamination whenever they had a suspicious, supposedly exposure that came to the employee.

Q. All right, sir. Was there a respiratory protection program in place or recognized in the 40's where you might have an excessive exposure?

A. To prevent any exposure to the employee, then respiratory protection of approved respirators and approved masks would be used thoroughly and enforced.

Q. Sir, in the -- in the 30's and the 40's would you tell us whether or not there was equipment available that could measure the concentrations of benzene vapors in the air?

A. There were analytical procedures that could be used and were being used by evaluation of these concentrations in the air.

Q. When you went to work in 1947, was that equipment available to measure the concentrations of benzene vapors in the air?

A. It was.

Q. Was it used at your facility where you worked?

A. We did.

Q. And that way were you able to keep up with the -- well, is there any way that you can -- strike that.

Was there any way, without measuring the concentrations of benzene vapor in the air, that you could determine the level of exposures?

A. Yes, we used that biological testing of the urine by determining the urinary sulfate ratio in the urine, and that was directly related to the concentration of benzene in the air that he had been exposed to, whether he knew he was being exposed or not. But we could detect that, and we used that until 1960's, and then it became a more -- an easier and more accurate procedure to use the phenolic concentration in the urine for that evaluation.

Q. Was that medical examination in addition to the measuring of benzene vapors in the air?

A. It was.

Q. Sir, attached to this report from the American Petroleum Institute is a bibliography of some 25 articles. I assume that that summarizes the best -- that is the best available information on the properties, characteristics and toxicology of benzene as referred to in the forward of this document. Do you recognize any of the authorities that are cited in this bibliography?

A. Of the Americans, I recognize approximately 50 percent of these people that I knew personally.

Q. E. T. Hunter, Chronic Exposure, 1939 in the Journal of Industrial Hygiene, which is item No. 11 on this bibliography, were you familiar with that? Did you become familiar with that in your professional work in the 40's?

A. I knew Dr. Hunter. He was an internist that worked in the Massachusetts General Hospital in 1941 and 2 when I was there, and I got to know him personally and knew about this article as well.

Q. Okay. In the bibliography, article No. 1 by E. Browning, "Toxicity of industrial organic solvents," published in the Industrial Health Research Board report No. 80 in London in 1937, was that a document or the type of document that you would have reference -- have reference to in the performance of your work?

A. Yes, and Ethyl Browning was an English physician, and she published a book which contained this information about benzene, and it was available to me back in 1941, too.

Q. Sir, as a result of this report published by the API, did you consider that it was essential in -- strike that. Not as a result of this report, but even by the time this report came out in 1948, did you consider that it was essential that you try to maintain absolutely safe concentration of benzene at a zero level?

A. That was my goal throughout my career, beginning in 1941.

MR. BAGGETT: Sir, do you, in connection with -- I ask that P-9 be attached to the deposition.

MR. MYERS: Same objection as previously noted.

MR. BAGGETT:

Q. Sir, P-10 for identification can best be described as the article referred to in the bibliography by Francis T. Hunter entitled "Chronic exposure to benzene, benzol," No. 2, "The clinical affects," published in the Journal of Industrial Hygiene and Toxicology in 1939. Were you familiar with this work that I'll show you that's marked P-9 for identification, sir?

MR. FREEMAN: P-10?

MR. BAGGETT:

Q. P-10, I'm sorry. Were you familiar with that when you started your practice in '47 at Humble?

A. Oh, yes, I was familiar with it after I met him and was associated with some of his coworkers, daily almost, in 1941.

Q. Well, this was published, it shows here, in July of 1939. Do you know whether or not Dr. Hunter was of the opinion that the only safe exposure -- safe concentration to benzene was zero?

MR. MYERS: Object to the form of the question. Asking for an opinion of someone else.

MR. BAGGETT:

Q. Well, I ask you then to look at page 344.

A. He gave that in his papers.

Q. On page 344 of this report, "Since the respired benzene is carried by the bloodstream and reaches the marrow before going to the liver, it would seem that the only really safe concentration is zero." That was an opinion that you shared, was it not?

A. Yes, it was. He was one of my teachers.

Q. That's P-10 for identification. P-12 for identification -- I'm sorry, P-11 for identification, I want to show you is entitled "Occupational Tumors and Allied Diseases," by

W. C. Hueper, M.D., dated 1942. Are you familiar with that piece of literature, sir?

A. I am.

Q. Is it not correct that -- that this is the same Dr. Hueper who was a member -- worked with the American Petroleum Institute?

A. He did. He also was with the United States Public Health Service, of which I was associated.

Q. Sir, I'd like for you to look at page 598. This was the type of literature, and this shows on the front of it that it came from the library of the American Petroleum Institute, a document dated in 1942, and I will want this to be shown to the Court or jury by a blowup; therefore, I ask that you read, if you will, for their benefit, from page 598, this paragraph that I will point to here, sir, on --

A. The second paragraph on this page says, "The combined clinical and experimental evidence presented concerning the causative interrelationship between occupational exposure of benzol and the development of leukemia seem to indicate that such a connection is merely" --

Q. Is not.

A. "Is not merely possible, but a great probability and even an actuality. There occurs evidently a marked variation in the individual susceptibility and reactivity to benzol. This fact may account in part for the different types of hemopoietic tissue response to this substance. The dose, the duration of exposure and interval between the individual exposure are obviously of great significance."

Q. For the benefit of the court, would you go ahead and read the next paragraph dealing with preventive, precautionary, technical and sanitary effects, the first sentence or two?

MR. MYERS: Let me make a general objection as to him reading from another report if he has not adopted it and to the authenticity of the report. Go ahead, subject to the objection.

A. "From the evidence presented and the conclusion drawn, the indication for strict medical supervision of a large group of workers' occupational exposure to benzol is inescapable. This surveillance should be constant and unremitting and should include periodic blood examination for the presence of quantitative and qualitative changes of the various blood consistencies. It may be advisable to examine the urine for the presence of etherosulfates or benzol utilizing the Obermayer method for indication and determining the inorganic sulfate portion according to the procedure Schrenk, Yant and Sales."

MR. BAGGETT:

Q. Thank you, sir. Sir, what I want to ask you is was the recommendations that are contained in the American Petroleum Institute 1948 Toxicological Review on benzene consistent with what Dr. Hueper was recommending in this paper or periodical back in 1942?

A. They were comparable.

Q. And did you recognize and carry out these preventive, precautionary, technical aspects that -- of surveillance, medical surveillance on the workers at your refinery that had potential benzene exposure?

A. With the cooperation of my medical staff we were able to accomplish all of this as a team.

Q. Fine.

MR. FREEMAN: Could I see that last exhibit, please?

MR. BAGGETT: Yeah.

Q. Sir, P-12 for identification can best be described as portions of a book from Principals of Internal Medicine in which T. R. Harrison was the editor in chief published in 1950 and will be authenticated as coming from the University of Buffalo library. I'll show you this. Have you seen this before, sir?

A. I have.

Q. P-12? If you will, Professor, would you turn to page -- the section dealing with page 731 of that book, chemical agents, page 92 -- chapter 92 by Marshall Clinton?

A. Yes.

Q. Who was Marshall Clinton?

A. Well, he was a student at Harvard when I was there, and he was the one that prepared the review for the API on toxic -- toxicity of benzene and that we have now in the exhibits.

Q. Sir, on page 738 under the subject benzene poisoning, if you would, look at that section and tell me if you accepted this principal in the performance of your duties, and that was that benzene is cheap and is an excellent solvent, it has been used extensively in the rubber, paint and printing industry and may be present in motor fuels. Did you understand that?

A. I do.

Q. And did you also understand that and accept that the hazards that benzene presents were now well-known and its use curtailed or controlled by statute; unfortunately, however, occasional cases of benzene poisoning continue to occur? You recognized that, did you not, sir?

A. I practice that in my own program, to prevent that type of exposure.

Q. On down on page 738, he comments on chronic benzene poisoning. Is it not correct that this is another authority that at that time, in 1950, stated, "Inasmuch as the body develops no tolerance to benzene, it is generally considered that the only absolutely safe concentration for benzene is zero"?

A. Yes, and that's in agreement with his earlier publication with the API.

Q. And that's in agreement with your practice as an industrial hygienist at -- at Humble and at Exxon, is it not, sir?

A. It is.

Q. Sir, in that -- in that connection, is it correct that in 1958 that Exxon issued a -- or

Esso issued a Toxigram on benzene, which has been heretofore identified by you? And I'll mark this as P-13 and ask you if you recognize that exhibit, sir?

A. I do.

Q. Professor, does -- is this -- were you involved in any way in the approval or -- of this Toxigram?

A. I was given the opportunity to review it and make comments before it was published, yes.

Q. Among other things, you were -- you were aware when this was published in 1958 that the greatest hazard associated with benzene exposure is an insidious destructive effect on blood and blood-forming organs?

A. I did.

Q. And that's reported here, is it not?

A. Yes, it is.

Q. What was meant by insidious as used with benzene in reporting on its toxicity or chronic toxicity?

A. There are several factors, physical characteristics of it, such as the fact that it is very volatile, it can be in concentrations without easy detection that would be very harmful to the employee. It has no -- and physiologically it has no particular offensive odor or irritating effect on the worker, and he's quite satisfied to work in concentrations that could be very dangerous and very harmful to him.

Q. Unless he knows that he is being exposed to it and has been educated on this characteristic of it; is that correct?

A. That's right.

Q. Did you -- in the performance and adoption of a benzene control program in 1940's and early 50's, did you recognize this insidious nature of the benzene?

A. I did.

Q. And this was recognized in your training programs?

A. It was.

Q. Sir, this document -- incidentally, what, to your knowledge, was the Toxigram which is marked P-13? How was it utilized by Esso?

A. Primarily to educate our purchasers or our clients that were buying the products from us.

Q. Was this -- was this the -- was it the custom and practice as you know it of Esso to send this Toxigram along with any purchase of benzene?

A. It was, and actually it was usually sent prior to the time in which we sent it, enclosed it at the time of a quotation of a purchase price before we sold it to them.

Q. Sir, as a part of this, was this Toxigram consistent in your opinion with the 1948 API toxicological review on benzene?

A. It is.

Q. Did you also still continue to report in 1958 that most authorities agree that in light of the present knowledge the only level which can be considered absolutely safe for prolonged exposure is zero?

A. I did.

MR. BAGGETT: I ask that P-13 be attached to the deposition. I ask that all of the exhibits up to this point that have been identified and numbered be attached to the deposition, if I haven't previously asked that.

MR. MYERS: And I'll make a general objection to all of those as previously mentioned as to authenticity of the documents.

MR. SPEARS: Same objection.

MR. BAGGETT:

Q. Professor, so that there's no

misunderstanding, we have Exhibit No. 9 recognizing that the only safe concentration for benzene exposure was zero. That was confirmed by Hunter in 1939, it was confirmed by Hueper in 1942, it was confirmed in the Clinton Marshall in his article in '50, and it was also confirmed by Esso in your Toxigram; is that correct, sir?

MR. SPEARS: I object to the form of the question. That's not what he said, and that's not what you asked him earlier. Your question earlier was the only absolute safe concentration was prolonged exposure to the benzene, not just -- you forgot to mention prolonged.

MR. BAGGETT: The record will speak for itself.

Q. Doctor, were these -- Professor, were these authorities, Hunter, Hueper, Clinton Marshall and the Esso Toxigram consistent with the API recommendation, and that is that -- that in light of the present knowledge the only level which can be considered absolutely safe for prolonged exposure is zero?

A. They are consistent.

Q. All right, sir. Now, Professor, the -- who was Clyde Berry?

A. Clyde Berry was a peer of mine, and he was an associate -- he worked with Exxon -- Esso Eastern Petroleum Division of the same company, the Standard of New Jersey, and he also was an associate of mine in periods when I was -- we were both commissioned in the United States health public -- Public Health Service and in the Division of Industrial Hygiene together.

Q. Was he an industrial hygienist that you knew to be associated with the American Petroleum Institute?

A. He was.

Q. Who was Dr. Woody?

A. Dr. Woody was the medical director that he reported to in the area or the particular division called the Esso Eastern.

Q. Sir, I want to show you a document that's marked P-14 for identification, which can best be described as a memorandum dated November 22nd of 1948, subject, paper read by Dr. W. C. Hueper on the subject of occupational cancer before the APHA. The letter is from Clyde M. Berry, Industrial Hygienist, to Dr. Woody, and ask you, sir, if you've seen that document before?

A. Yes, I have.

Q. Sir, I ask you to assume that this was authenticated by the deposition of Dr. Eula Bingham, who has testified in the Allen case and the -- and authenticated the minutes and records of the Medical Advisory Committee of the American Petroleum Institute, and subject to that authentication I'm going to ask you some questions about this. Would the delivery by Dr. Hueper of a paper before the 76th annual meeting of the APHA --

A. That's the American Public Health Association.

Q. This reports, does it not, that there was an audience of 200 to 300 people were in attendance in November of '48, does it not?

A. It does.

Q. And, sir, at that time is not -- 1948, is not the industrial hygienist Clyde Berry writing to Dr. Woodard reporting on -- Woody reporting on this speech by Dr. Hueper and recognizing that there was a strong link between environmental and cancer incidents?

A. That's his report, uh-huh, Dr. Hueper's paper.

Q. And among other things, does he point out the idealistic approach to the control of the problem and set out the points that should be utilized in the industry, the petroleum industry, to help control the problem of benzene exposure?

MR. MYERS: I'm going to make an objection. I don't believe he's ever identified when he saw that paper, whether he saw it last week or last year, whether or not he saw that paper in 1948, whether or not it was transferred among members in 1948.

MR. BAGGETT: Fine.

Q. Professor, you saw this yesterday, did you not?

A. Yes, I had seen it in 1948.

Q. All right, sir.

A. And possibly I was present, because I had heard Dr. Hueper give this paper, and I might have been present at that same meeting, but I don't recall for sure.

Q. The point that I want to make, sir, is that in November of 1948 these controls that he mentions in this paper, in this letter that is confirming what Hueper had reported in the presence of two or three hundred people, are the type of controls that you recognized in setting up a benzene exposure control program at Exxon?

A. They do.

MR. BAGGETT: I'd ask that that be attached as P-14.

MR. MYERS: Same objection.

MR. BAGGETT:

Q. Incidentally, sir, I'll show you another document that -- a series of pages of documents that I will mark P-15 for identification, which could best be described as a letter to members and associates of the Medical Advisory Committee on American Petroleum Institute letterhead dated January the 18th, 1949, from D. V. Stroop, S-t-r-o-o-p, Director, with copies going to the safety committee of the board of directors and naming one, two, three, four, five, six, seven, eight such people, attached to it bearing -- this document bears Bates number 000997 through 01302, and ask you if this is not a document that you saw yesterday for the first time?

A. I did see this yesterday, but I don't recall whether I saw it when it was issued in 1949.

Q. All right, sir.

A. Because I was active in this organization at that time.

Q. Professor, what I'd like for you to do is tell us out of -- I ask you to assume that this document was authenticated in the deposition of Dr. Eula Bingham in the Hicks and Allen case pending in Jefferson County as the custodian of the American Petroleum Institute minutes of the Medical Advisory Committee. Sir, attached to this is a list of different physicians, different industrial hygienists that were membership -- that had membership on the Medical Advisory Committee of the American Petroleum Institute in the years 1949, 1950 and 1959. Did you know many of the members of that Medical Advisory Committee?

A. I did, a majority of them.

Q. Dr. Bill Crookshank from Lake Charles, did you know him?

A. I knew him well.

Q. Burt Delon, a safety man from Lake Charles, did you know him?

A. I didn't know him personally, but I knew of him.

Q. Dr. W. O. Armstrong from Continental Oil Company, did you know him?

A. Well.

Q. Dr. Clinton Marshall, Sohio Vacuum out of

Buffalo, did you know him?

A. I did. He prepared that report from Harvard.

Q. Did you know Dr. T. J. Kelly from Shell Oil in Wood River, Illinois?

A. I did.

Q. Sir?

A. Yes.

Q. Did you know Dr. W. R. Levis with Sun Oil out of Pennsylvania?

A. I didn't know him very well, but I knew he was on the committee.

Q. Did you know a doctor J. W. Long from Gulf Oil Corporation in Port Arthur?

A. I did.

Q. Did you know Dr. W. A. Morrison, an M.D. From Union Oil Company in California?

A. I don't remember him, but -- I don't recall him.

Q. Did you know a Dr. Allan E. Dooley from The Texas Company?

A. I did. I knew his background, field of industrial hygiene.

Q. Sir, consistent with your knowledge of the customs and practices that prevailed in the

American Petroleum Institute concerning distribution of relevant documents, such as the API 1948 Toxicological Review on Benzene, do you know of any reason why members of the Medical Advisory Committee wouldn't have been furnished with those type of documents?

A. No, I -- it's my impression they were all furnished that was members of any of these committees that you've named and the persons on them were -- all received a copy when they were published.

Q. Sir, in the field of safety, occupational medicine and industrial hygiene was it well recognized by 1948, by the time of that review, that there was a causal relationship between exposure to benzene and a serious disease or injury to the blood-forming organs?

A. In all cases wherever the people in my category or the medical directors, yes, it was well available. How far down it went in the company, I wouldn't happen to have that information.

Q. Sir, I want to show you another document that I will mark as P-16 for identification, which could best be described as a New York State

Occupational Safety -- I'm sorry, New York State Occupational Cancer Committee paper entitled "Occupational Cancer, a Challenge to the Physician," copyrighted in '49 by the New York State Department of Health and ask you if back in that time set, in the 40's and 50's, were you familiar with, No. 1, that committee, and, No. 2, this particular type of literature?

A. I was familiar with it and the activities of this committee at that time, but I did not participate personally.

Q. Sir, the membership that is shown on page -- of the New York State Occupational Cancer Committee that's shown on page 5, if you would --

A. Yes.

Q. Did you happen to know Conrad Dobriner, D-o-b-r-i-n-e-r, an M.D. with the Sloan Kettering Institute?

A. What number is that? Dobriner? Sloan Kettering? I didn't personally know him, no.

Q. Okay. What about --

A. He was an authority on cancer, medical authority on cancer.

Q. What about Dr. G. H. Germen, Manufacturing Chemists Association?

A. Yeah, he was at that time chairman of the Medical Advisory Committee to the Manufacturing Chemists Association, and Dr. Germen was associated with one of the major national petroleum -- no, excuse me, chemical manufacturing companies, but I don't recall which one he was.

Q. All right, sir. What about Arthur E. Hogg, M.D., member of the American Petroleum Institute?

A. Yes, and Dr. Hogg was medical director for one of the major oil companies, and I think it was Amoco.

Q. What about W. C. Hueper, U.S. Public Health Service, that's the doctor we've referred to earlier, is it not?

A. Yes.

Q. Sir, at this -- at this time of publication, on page 9 they refer to a table as a guide to the physician who for purposes of prevention is interested in investigating the role of occupation in cancerous and precancerous lesions presented by a patient. They list two tables there. And table No. 2 lists alphabetically, for reference purposes, some of the more common substances or conditions in the occupational environment which are recognized as being cancer producing or suspect. I ask you to look at -- they go ahead and point out there that those that are designated with an E are established relationship, and I ask you if you could tell me on page 13 if in table 2 -- not page 13.

A. Yes.

Q. On page 14 under table 2, under benzol, do they not report that benzol is a substance that attacks the blood-forming organs or system and they report that as an E, which means established causal relationship?

A. Yes, and I see that same information on the bones and bone marrow diseases discourages benzol and derivative radioactives and so forth are causing blood dyscrasia.

Q. By the time that this article was published in 1950, sir, did you accept in the -- '49, did you accept in your work at Exxon the fact that benzene was recognized to be an established carcinogen so far as damage to the blood-forming organs?

A. I did.

Q. And you enacted -- put in a benzene

control program consistent with that recognition?

A. I did.

Q. P-16 for identification, I'd ask that it be attached. Incidentally, attached to that, is it not, a bibliography of many articles to support these findings, is it not, sir?

A. There is a -- there's references.

MR. MYERS: Same objection as to the admissibility of the document.

MR. BAGGETT:

Q. Sir, the next document that I will present to you is Plaintiff's Exhibit No. 17 dated September the 7th, 1943, authored by M. H. Soley, University of California Medical School, entitled "Report to Shell Development Company on Benzene, Nitrobenzene, Anilines and Xylenes (They're Toxic Effects and Suggested Safeguards in Manufacturing Practices)." Page 2 bears the stamp "received, Shell Development Corporation, September 7th, 1943." I ask you if you've ever seen that before yesterday, sir?

A. I don't recall this particular publication, having seen it, until yesterday.

Q. Subject to this document being authenticated by Shell Oil Company -- and for the record, I can state that this was delivered to me and Herschel Hobson at a restaurant two years ago in Beaumont by Shell's attorney. This may have to be taken out of the deposition, but it was pursuant to considerable motions to compel.

MR. FREEMAN: Who was their attorney, Bill?

MR. BAGGETT: I think --

Q. Sir, this article is entitled, on the second page, "Report to Shell Their -- on Benzene, Their Toxic Affects and Safeguards," and it's labeled "confidential." I ask you if this article, as an industrial hygienist, to you, does it not support the recognition by this researcher in 1943 that exposure to benzene vapors is dangerous, particularly if the exposure is prolonged?

MR. MYERS: I'm going to make a general objection, since he did not rely on that at the time he was formulating his opinions many years ago. He just recently seen this -- had an opportunity to see the document.

MR. BAGGETT: Fine.

Q. Go ahead, if you will. I'm saying does not a review of this document indicate under benzene --

A. Yes.

Q. -- that there is a recognition that exposure is particularly dangerous if it's prolonged? Sir --

A. This -- may I summarize by saying this paper is in agreement with what I know about it and have seen in many other publications.

Q. Okay. While you didn't rely on this paper in putting in your program, is this not a confidential -- indicated, if it's authenticated, to be a confidential communication to Shell recognizing the toxicity of benzene and reporting that while prolonged exposure to any concentration to benzene is dangerous, there is a marked variation in susceptibility of individuals so that some, for unknown reasons, are particularly resistant while others are quite susceptible?

A. This is in keeping with Hunter's and the other exhibits that we have before us and no conflicts.

Q. In fact, this article, this paper, this document, sites Hunter with approval, does it not?

A. It -- he's given as a reference.

Q. Sir, P-19 for identification, which can best be described as a document dated April 28th, 1950, on the letter -- having the letterhead of Shell Development Company, "To: K-r-e-d-l-u" -- blank, blank, I can't make that out, "from C. H. Hine, M.D., Consulting Toxicologist, subject: Certain problems of environmental cancer in the petroleum industry." First let me ask you, did you know Charlie Hine?

A. I did, well.

Q. C. H. Hine?

A. Socially as well as professionally.

Q. Sir?

A. I knew him not only professionally but also socially.

Q. You have had an opportunity to review this document dated April the 28th, 1950, have you not, sir?

A. I have.

Q. And --

MR. MYERS: If I could ask when, sir.

THE WITNESS: Back in the early days of Dr. Hine came on the -- on the committee about 1952, or 1 or 2, in that period, and he -- we discussed this paper at that time.

MR. MYERS: Okay. Thank you.

MR. BAGGETT:

Q. Sir, on the first page did you agree with his report that only relatively few instances can the origin of environmental cancer be traced to contact with well-defined chemical agents possessing established carcinogenic qualities. Among such compounds are arsenic, benzol and aromatic amines, in addition to radioactive elements?

A. Those were ones that were recognized as being directly related to workers' exposure.

Q. Sir, attached to this report -- incidentally, he sites with approval -- on the second page of the report, he sites Hueper with approval, does he not?

A. He does.

Q. As an authority?

A. He does.

Q. And in a table attached to this, does he not present all of the known and commonly suspected chemical agents causing cancer that are presented in the oil industry?

A. He has that list.

Q. And in those tables attached do they not list benzol as a substance and benzol derivatives as a substance causing damage to the blood-forming organs?

A. He does.

Q. And also attached to there is another table dealing with precancerous reactions, and in this table does he not indicate that benzol and derivatives could -- are responsible for blood conditions and disorders to the bone marrow that are precancerous lesions?

A. He does.

Q. Was this consistent with the state of the art knowledge that existed in the 1950 period in the field of toxicology, industrial hygiene and occupational medicine?

A. It was.

Q. Sir, the next document that I will mark as P --

MR. FREEMAN: I think you skipped 18.

MR. SPEARS: Do you have an 18, Bill?

MR. MYERS: Yeah, you skipped 18.

MR. SPEARS: The last one you're talking about is a Shell document. It was 19. I see a 17.

MR. BAGGETT: Let's go off the record.

VIDEOGRAPHER: Off the record, 18 minutes before 12.

[Discussion off the record]

VIDEOGRAPHER: Beginning of tape No. 2, we're on the record, 14 minutes before 12 noon.

MR. BAGGETT:

Q. Professor Hammond, I've renumbered the document from -- on Shell Oil Company from Charlie, C. H. Hine, M.D., with certain problems of environmental cancer in the petroleum industry. It should be P-18, and I ask that that be attached to the deposition.

P-19 for identification can best be described as a document dated January 1954 entitled "Benzene Physiological Properties," from Allan E. Dooley to Dr. W. E. Kuhn, K-u-h-n. Professor, you saw that yesterday for the first time, did you not?

A. I did.

VIDEOGRAPHER: Mr. Baggett, your microphone, please, sir. I'm hearing you fine, but let's hear you better.

MR. BAGGETT:

Q. Subject to this being authenticated as being a document of Texaco -- or Texas Company, you did know Allan E. Dooley to be a toxicologist for --

A. He was the chief industrial hygienist for --

Q. Industrial hygienist.

A. For Texaco.

Q. Sir, this document that I've just presented to you, among other things, recognizes that chronic benzene poisoning can result from repeated and continuous exposure to relatively low benzene vapor concentrations, does it not, sir?

A. It does.

Q. Does it not also, among other things, recognize that you can have chronic poisoning by subthreshold exposure?

A. It does.

Q. I will want the Court or jury to see this as a blowup. Would you please read what Allan Dooley reports here to Dr. Kuhn concerning chronic poisoning by subthreshold exposure

MR. MYER: Object to this witness commenting on correspondence from one party to the other which he obviously did not see at the time that it was written.

MR. SPEARS: Same objection?

A. "Threshold limit values represent the highest concentration of material to which groups of physiologically normal workers should be exposed for prolonged periods with reasonable expectation that as a group they would not suffer health damage. A threshold limit value does not imply warranty of a safe working environment. The difficulty is that there are no adequate means of determining who are the physiologically normal person insofar as exposure to a particular toxic material is concerned. Deviation from the physiological norm will constitute individual susceptibility." End of paragraph.

Q. Do you agree and did you agree with and recognize this when you were in charge of the industrial hygiene program at Humble in '47 through the years that you were employed by Esso?

A. I took all of these characteristics into consideration when I established the zero limit as being the only safe one for all people.

MR. SPEARS: Object to that question -- I mean, object to the answer as not being responsive to the question.

MR. BAGGETT:

Q. Well, let me ask the question again then.

Did you accept this principal that chronic poisoning by subthreshold exposures can occur in the adoption of your program at Humble and at Esso?

A. I did.

Q. Sir, this is a recognition, is it not, by Dooley and yourself that there's no warranty of safe working conditions simply because you comply with the threshold limit value?

MR. SPEARS: Objection. That question is -- now you're characterizing somebody else's statements as to Dooley, who I don't think this witness can testify to.

MR. BAGGETT: Would you read back my question, please, sir?

MR. SPEARS: My objection is based on the fact that you're asking him about Mr. Dooley.

MR. BAGGETT: Okay.

Q. Is that your interpretation of what Dooley is saying here?

A. I find no objection to what Dooley says, and I would say that this factor of many conditions were taken into consideration by myself regarding benzene as well as some other five or six hundred materials that we had to evaluate.

Q. Sir, looking -- well, let me ask you this. When you adopted a program that has been spelled out here early on in your deposition and in the Toxigram where you recognize that most authorities agree that in light of the present knowledge the only level which can be considered absolutely safe for prolonged exposure is zero, is one of the reasons because you can have chronic poisoning by subthreshold exposures?

A. I do.

Q. Now, the last paragraph of Mr. Dooley's letter or memo dated January of '54 refers to the API toxicological review on benzene, gives a good summary of the physiological affects of this material. I believe that sets of these reviews are at Port Arthur, at Beacon and in your library. I'm asking you this, at the time that these reviews were rendered by the American Petroleum Company, were copies of the reviews in your offices and in the offices of Humble Oil Company and Esso?

A. Yes, they were.

Q. And would one of the reasons be because that such articles as that were widely circulated in the American Petroleum Institute?

A. They were available to the petroleum industry broadly.

Q. Sir, does good -- skipping to another subject, but it may be referred to in this memo, does good employee education program involve educating them on the delayed effects that can result from chronic exposure?

A. It's particularly important to do that for employees on insidious materials.

Q. It's because they could be exposed at a time and not really if -- incidently, particularly one that is -- that the vapors are pleasant, their respiratory system doesn't act as an alarm to protect them from -- or set off an alarm that they're smelling an irritant, does it?

A. That's true. That's true.

Q. And if they go through pleasant experiences with smelling benzene or a pleasant odor, they could be being injured and not even know it?

A. They could.

Q. And that is the reason why you felt it was important to educate your people to that fact?

A. It was.

Q. Sir, the -- one of the -- P-20 for

identification can best be described as a memorandum from E. W. Midlam, dated August the 30th of 1960, to several people, one of which was W. M. Cock, the other one was J. W. Crookshank, another one was H. R. Smith, bearing Bates numbers EW 0037252 through EW 0037259, and I ask you if -- well, I doubt that you've seen the first page of that before yesterday, but attached to that do you recognize the API toxicological review on benzene dated in 1960?

A. This was the second edition of the one we had in 1948, I believe, yes.

Q. Well, I'm not going to go into the contents of the second edition of the API, but basically did it also cover the toxicity, the toxicology, the chronic effects, the precautionary measures and the medical examinations that were recommended for benzene-potentially-exposed employees?

A. Yes, it did.

Q. Do you know who H. R. Smith was back in 1960?

A. Yes, he was a medical investigator for the Kettering laboratory in Cincinnati, and we gave him remedial projects to review for us, some of them which was a carry-forward from the work that was done by Harvard under Dr. Drinker and Dr. Clinton.

Q. Sir, I want you to know that evidence will show that H. R. Smith was the plant manager for Cities Service that was involved in other litigation that you've been in. Was there a Mr. Smith that was at the Kettering Institute?

A. No, it was a Dr. Smith that --

Q. Dr. Smith. This is an H. R. Smith. You did not know him?

A. I did not know him.

MR. BAGGETT: Okay. P-20, I ask that it be attached to the deposition.

MR. MYERS: Same objection.

MR. BAGGETT: Well, I don't understand what your same objection is.

MR. MYERS: Same objection is that the documents have not been authenticated. And I realize that you may have done it on another proceeding, but I'm not familiar with that.

MR. BAGGETT: Okay. Fine. Sir --

MR. MYERS: And that would hold true for all the objections that I've made on this.

MR. BAGGETT:

Q. Sir, I want to show you a document I will mark P-21 for identification dated November 16th, 1970, entitled "Essential Information for the Safe Handling and Use of Benzene by Operating, Maintenance and Laboratory Personnel," Cities Service Oil Company, Lake Charles Operation, bears Bates numbers EW 0009900 through EW 0009912. This is a document that's been authenticated in other litigation involving Cities. I ask you if you have not seen that document previously, maybe in connection with the Ellis case?
A. I also saw this document yesterday.
Q. All right, sir. Sir, the point that I'd like to ask you about is, is not this a document setting up a benzene exposure program in 1970 that was consistent with what was known and knowable by the mid, early 50's or by the mid-50's, insofar as safety and health was concerned?
A. I did not find any new material in here that wasn't available in the early 1950's to the petroleum industry.
Q. In fact, sir, I'll show you a document that you've heretofore identified and produced with your deposition in the Ellis case, a three-page document entitled "Benzene Exposure

Control" -- excuse me just a second. Let me get my --

MR. BAGGETT: Mr. Court Reporter, could you give me a stamp there?

MR. MYERS: 22, I think.

MR. BAGGETT:

Q. I'm going to mark this document P-22 for identification and ask you if you recognize that document entitled "Benzene Exposure Control"?

A. Yes, it was one that I or my assistant prepared, and it was distributed to all people involved.

Q. It says in the corner here, and it looks like that it might be --

A. That's my --

Q. -- your writing, "This control program was in operation by 1955 for Baytown Refinery of Humble Oil & Refining Company."

A. It was.

Q. Is that a fact, sir?

A. Yes, it is.

Q. And this program addressed control measures in the manufacturing units?

A. It did.

Q. They're spelled out and numbered in this document, are they not, sir?

A. They are.

Q. It spelled out control measures for limiting exposure in the shipping areas?

A. It does.

Q. Did it also spell out in the refinery streams that you determined the benzene percentage in selected streams?

A. We did.

Q. Did you also, by 1955, determine for streams with 5 percent or more benzene that you recommended the control items that are set forth here for the benzene unit?

A. I did.

Q. Did you also for streams with 2.5 to 5 percent benzene investigate and determine exposure potential?

A. We did.

Q. And then, of course, you directed -- as a part of this control you had routine control of samples in the laboratory, and you spelled out how you did that, did you not?

A. We did.

Q. When it came to medical and industrial hygiene, you spelled out, did you not, the physical examinations, the preemployment and the periodic examinations afterwards?

A. All of those employees was on that list for a special examination.

Q. And that included urinary phenols and who was subjected to those type of regular studies?

A. They were.

Q. And also you had air monitoring in the different areas, and you covered the frequency that that would be done and how it would be done?

A. It was.

Q. Sir, I guess what I'm asking you is, is this, in your opinion -- did it represent a state of the art program for the control of benzene exposure that was in effect and that you had put in effect by 1955?

A. It did.

Q. Do you see anything -- a reason why or do you know of any reason why any person involved in the refinery business would not have been able to comply with those practices and standards that you've set out in that document?

MR. SPEARS: I object to that question, Bill. That's calling for speculation to what persons you're talking about. You're asking him to speculate about what other companies could or could not do.

MR. BAGGETT:

Q. Well, based on the state of the knowledge that was available through the American Petroleum Institute and in the petroleum industry, do you know of any reason why any refinery wanting to protect their employees from benzene exposure could not have adopted a program as set forth there?

A. I do not know any reason why they couldn't have adopted it.

Q. Sir, in your opinion by 1955 was the type of program that you have set forth in this document -- did it comply with the industrial standards that were recognized in your profession?

A. Yes, those -- they did comply.

Q. Were they state of the art standards?

A. They were state of the art, yes.

Q. Now, is this -- this program that is set out there, in addition to that, did it involve education?

A. It did.

Q. And it certainly, as you said while ago, it involved measuring the concentrations of vapor in the air, that that should be checked regularly in locations where the possibility of excess exposures may have been encountered?

A. Yes, it does.

Q. And in your opinion, sir, if a company did not educate its employees of the adverse health effects of benzene and the hazards of benzene by the mid-50's, did they fail to comply with the recognized health and safety standards of that time?

A. I do not know of any method they could have complied with this state of the art without being -- carrying out this much of a program for the control and education of the employees.

Q. All right, sir. If the -- if a company, in your opinion, did not do measuring of air concentrations of vapor in the -- I mean, of benzene vapor in the air regularly in locations where the possibility existed of excessive exposures, in your opinion were they -- did they fail to comply with the recognized health and safety standards of that time?

A. They were in -- yes, they were in fault or error not doing that. And also I would like to emphasize that it's necessary to do urinary sulfate ratios or urinary phenols to be able to make sure that there wasn't some unknown sources of exposure.

MR. MYERS: I'm going to object to his comment as to fault and comment as to what he believes should be the standard. The fault is up to the trier of fact.

MR. SPEARS: I agree with that. The same objection, and I also object to the nonresponsiveness of the answer.

MR. BAGGETT:

Q. Well, let me just ask you this. You have set out what your benzene control program was in 1959 at the Baytown Refinery, and that included design, that included determination of benzene percentage in selected streams, it included control measures for the laboratory, it included medical and industrial hygiene, which included the phenols and the air monitoring. Sir, in your opinion if any company did not do those things set forth in P-22 by the mid-55's were they failing to comply with the state of the art knowledge that existed in the petroleum industry?

A. They were deficient.

Q. Now, and by 1960 if a company were

subject to the Department of Health -- Department of Safety and Health regulations of the Walsh-Healey Act, if they were not complying with these benzene exposure controls that you had in 1950, in your opinion were they failing to comply with the provisions of the Walsh-Healey Act?

MR. SPEARS: I'll object to that question as being extremely vague as to -- Bill, you're not indicating what part of the Walsh-Healey act is he talking about. You're not indicating that this man even knows what the Walsh-Healey Act is.

MR. BAGGETT:

Q. Sir, do you know whether or not the Walsh-Healey Act required air monitoring in places where people have potential exposure to benzene?

A. They required that you be completely aware of all exposures and the extent of the exposure which would require air monitoring.

Q. And if you didn't do air monitoring and didn't have the facilities or equipment to do it, didn't have the personnel to do it, then you couldn't comply in 1960 with those provisions of the Walsh-Healey Act, could you?

A. In my opinion I don't see how they could have.

Q. And the same thing would comply in 1972 with the Walsh -- with the OSHA regulations, if you didn't have air monitoring of potentially exposed people, there was no way that you could know what they were being exposed to, could you?

A. There was no other method I could think of.

Q. Sir, did you warn business guests of the presence of benzene vapors in areas where they may be encountered at your facility?

A. We actually put them in the classrooms if they were going to come in to work for us as contract employees and gave them the same type of education that we gave our own employees. And our safety inspectors also enforced that type of action and safety precautions on that -- on the part of the contractor.

Q. This Toxigram dated in 1958 marked Plaintiff's Exhibit No. 13, was that the type of warning that you issued to purchasers of benzene product?

A. This was primarily made for the education of the purchasers that were inquiring about buying benzene from us.

Q. Finally, sir, I'd like your opinion based on the American Petroleum Institute data, the safety data, the chemical manufacturing data that we've referred to, did you -- do you have an opinion whether or not those are notices that should have triggered warnings to the users and manufacturers of chemicals containing benzene that there was a hazard associated with those products?

A. It's very clearly pointed out by those organizations that it's -- as well as many others, such as governmental agencies, that it's a very dangerous operation.

Q. And back before 1955 that literature was readily accessible and widely distributed among the American Petroleum Institute members, was it not?

A. It was.

MR. BAGGETT: I have no further questions.

MR. FREEMAN: Are we going to get lunch, or what's you gentlemen's pleasure? It's 12:11.

MR. BAGGETT: We're off.

VIDEOGRAPHER: Off the record, 12 minutes after 12 noon.

[Discussion off the record]

VIDEOGRAPHER: On the record, 20 minutes

after 12 noon.

MR. BAGGETT: Gentlemen, I've got two other questions I need to ask the professor that I thought of before I --

Q. Professor, back in the 40's was industrial hygiene audits or surveys available to members of the American Petroleum Institute or to anyone, so far as that's concerned, that you know of?

A. I assume they would be consultant firms.

Q. Yes, sir.

A. Such as the Industrial Hygiene Foundation that was established at Malone Institute by Dr. Drinker, and they had some qualified people. One of my former teachers from Harvard, Wesley Hemeon, was there, and he headed up that group. And associated with him was several good industrial hygienists, and they did extensive surveys of the petroleum industry. For example, they did the surveys for the Standard Oil of New Jersey, not only for the American refineries, except for ours in Baytown. They did it for Baton Rouge and Bayonne and Everett and Charleston that I know about, and those publications are available. And some of them, the last one I suppose that was done was in the year of 19 -- Baton Rouge in 1949.

Q. Sir, in that connection have you not previously furnished to us a copy of the industrial hygiene survey of the Baton Rouge refinery dated April of -- February and April 1949 rendered by the Industrial Hygiene Foundation of America for your company?

A. Yes, for the Esso Eastern Company.

Q. I ask that that be marked P -- what's the next document?

MR. FREEMAN: 23.

MR. MYERS: 23.

MR. BAGGETT:

Q. P-23 for identification. You recognize that, sir, as being a voluminous --

A. Comprehensive.

Q. -- comprehensive industrial hygiene survey that was made before -- this was probably before you were able to hire or had a resident industrial hygienist at --

A. This was before Mr. Venable reported there. Now, the individual who came down because they were friends as well as peers of mine, Hemeon and Morgan, they came down and spent two or three weeks with me regarding industrial hygiene problems that I had uncovered in the Baytown refinery and how I was handling them before they started out in 1948, to make the survey.

Q. Sir, the point I want to make is, is that anybody -- was it known by you that the services of industrial hygiene audits or surveys was available through -- through the American Petroleum Institute?

A. The Medical Advisory Committee discussed these individual surveys from time to time.

Q. All right, sir. Sir, finally in connection with the insidious nature of benzene as a toxic product, is there a recognition on your part as an industrial hygienist that even utilizing a TLV, whether it be -- that the odor threshold before one can even begin to detect the presence of benzene, that the odor threshold is higher than the TLV's were, say, in the 50's when they were 35 parts per million or 50 parts per million?

A. Yes, that was true, that they were dangerous exposures without the workers being in any way alerted to the fact that they were being exposed to dangerous concentrations.

MR. BAGGETT: Thank you. I have no further questions.

MR. FREEMAN: Before we start, can you read back that last answer? I had a little difficulty following it, please.

[The record was read as requested]

EXAMINATION BY MR. SPEARS

Q. Professor Hammond, I introduced myself earlier. I'm Ken Spears. I represent several of these oil companies in connection with this case. First of all, Professor Hammond, let me -- let's go back a bit in your work history. I'd like to ask you some questions. And I have -- I've read all the depositions that you've given before, Professor Hammond, so I'm somewhat familiar with your work history, but I want to ask you in Massachusetts, when you worked in Massachusetts, what year was that?

A. '41 and '42.

Q. And who were you working for?

A. I was working for the Division of

Occupational Diseases in the state labor department.

Q. All right. And in connection with working for that company, there was established --

A. It was a state organization.

Q. I'm sorry. In connection with working for that state organization at that particular time, there was established, was there not, a TLV for benzene of a hundred ppm; is that correct?

A. That was suggested, yes, by an organization of the American Standards Association and others that had looked at the these values. And particularly down in Connecticut there was a fellow by the name of Warren Cook and you'll find that he had issued a list of chemical substances and suggested TLV for them, and that -- that was the prevailing value.

Q. For the benefit of the Court, the jury or the Court, would you tell us what a TLV is, sir?

A. TLV stands for threshold limit value that is described as being the concentration of vapor in the air that should not ever be exceeded by -- to exposure to any employee.

Q. Okay. And it's your testimony that when you went to work for this agency in Massachusetts, the general recognized TLV in the industry as such among people like yourself was 100 ppm for benzene; is that correct?

A. That was the goal that we had in working there. I was just telling you that it was hard to get the industry to attain those levels.

Q. All right.

A. Even then.

Q. Okay.

A. At that time.

Q. Nevertheless, that was your goal and the goal of the agency that you worked for, to get to a TLV of 100 ppm; is that correct?

MR. BAGGETT: Jim, we're talking about in 1937.

MR. SPEARS: When he went to work --

A. 1941.

MR. SPEARS:

Q. '41?

A. No, because my supervisor was Dr. Harvey Elkins, and he had made enough measurements both in terms of air concentrations and also the urinary sulfate ratio that he was suggesting a maximum of 75 parts per million. And also Dr. Hunter worked with us and because we did some of his field work investigating exposure, and he was already written that for susceptible people it had to be down to zero to protect them. I was aware of it, and that is when I formed my foundation and my position on concentrations. So I didn't accept the TLV value as being acceptable.

Q. All right. Professor Hammond, just for clarification, when you went to work in the 1940's for this agency in Massachusetts, am I correct in stating that the agency's position on acceptable TLV's for benzene was a hundred ppm; is that correct?

A. That was the lowest value that the state department of labor could enforce.

Q. All right, sir. And someone you mentioned had indicated in an article that a hundred ppm was too high and perhaps 75 ppm would be more acceptable; is that correct?

A. Yeah, just from reasoning that they had seen some -- he had seen some cases where in measuring the concentration in the plants he had also seen some damage that had occurred where the average concentration had only been 75 parts per million, but he saw -- Dr. Harvey Elkins and his -- and I was one of his members of his team --

had actually measured 75, but we also found some medical cases where there had been injury by that concentration.

Q. All right, sir. And when -- again, for the benefit of the court and for laypeople on the jury, when you're talking -- when we're talking about a hundred ppm TLV or 75 ppm TLV, we're talking about an eight-hour work exposure; is that correct?

A. That's a concentration that's really valued on an average throughout a 40-hour week.

Q. All right. It's based on a 40-hour week of continuous exposure of a certain ppm; is that correct?

A. Not to exceed that amount. Now, this exposure, as you know, in practice would vary up to 75 and then also wave on down so that your average -- we found that if you should analyze it average would be about 60 percent, would be more likely the actual 40-hour week.

Q. Okay.

A. Because of the variation in the concentration.

Q. Again, and I guess I'm not making myself very clear, Professor Hammond, but correct me if

I'm wrong, it's true, is it not, that when we're discussing threshold limit values, TLV's and ppm's for workers in the workplace, we're talking -- at least in the 40's when you were working in Massachusetts we're talking about individuals who came into contact with benzol on a regular basis for a 40-hour week; is that correct?

A. That's right.

Q. All right, sir. In other words, even in 1947 when you were working in Massachusetts, whatever year that was --

A. '42.

Q. '42. Thank you, sir.

A. Yeah.

Q. A person such as myself or you or any ordinary individual, if he happened to walk -- walk near an area where there had been a benzol spill and for one or two minutes was exposed to say a hundred ppm and then walked off and did the rest of his job, that was not the type of exposure that would give you any concern, was it?

A. It would not have if he had no further exposure.

Q. Okay. In other words, the TLV and the ppm deals with chronic exposure, as opposed to acute exposure; is that correct?

A. Ordinarily the chronic exposure produces this irreversible damage to bone marrow, whereas you don't get that effect in just one short-term exposure.

Q. Okay. After you left the agency in Massachusetts, is that when you went to work at Humble?

A. No, I didn't go there. I was a commissioned officer in the United States Public Health Service, and I served during the years of -- the war years at assignment, and usually I was assigned to some state or some agency such as that to enforce -- help them enforce the regulations that they had pertaining to control of exposure.

Q. All right, sir. Can you tell me -- tell the Court, please, how the TLV of benzene evolved, please, from a hundred ppm when you went to work in Massachusetts to what it was when you -- what was accepted in the industry, what was the standard when you went to work for Humble?

MR. BAGGETT: Excuse me, Ken. This may be of help to you, this document, but you're referring to a TLV in '46 and in the 40's when there was no such thing. It was a maximum allowable concentrate, I believe.

THE WITNESS: Well, maximum is what I'm speaking of, because that was a maximum concentration.

MR. BAGGETT: This may be of some help to you if you want to use it. It sets out the history of the threshold limit values.

MR. SPEARS: But -- thank you, Bill.

MR. BAGGETT: And I'm sorry if I'm interrupting you.

MR. SPEARS: That's okay.

MR. BAGGETT: I'm just trying to be of help.

MR. SPEARS:

Q. And when I asked you the question about in Massachusetts, when I used the term TLV, that's how you understood it in Massachusetts in the 40's, is it not?

A. No, I answered more M.A.C., maximum allowable concentration. That was what we -- now, this is very important, because the state department of labor could not enforce a concentration less than what they have there, and it was therefore -- the importance was in pollution -- I mean, in enforcement, such as you would have with setting a speed limit and enforcing it as being one or another. Now, they might -- as you know, it might be that you wouldn't be able to drive as fast as your -- as the speed limit would be, but they couldn't -- and if you drove faster than what was actually safe, but they couldn't enforce that patrol, and that's the same way with the state department of health.

Q. Well, Professor Hammond, when you went to work with Humble --

A. 1947.

Q. -- what was the generally accepted TLV or M.A.C. for benzene among your peers, any agency that you recognize among your peers? What was that?

A. Does that not show you the year that it was reduced to 35?

Q. I'll show you the document.

A. Let's see, I think it's taken from the TLV.

MR. BAGGETT: I'll ask that this be marked P-24 for identification.

MR. MYERS: Let's identify what it is.

MR. SPEARS:

Q. Do you recognize that document?

A. Threshold limit values, TLV's, and this was the Occupational Safety and Health Administration, and it was established by the American Conference of Governmental Industrial Hygienists.

Q. All right, sir.

A. And in 1947 it would have been 50 parts per million, and 1948 it was cut to 35 parts per million.

Q. All right, sir. The document that's been marked 24, I believe, by Mr. Baggett makes reference to the ACGIH, does it not?

A. American Conference of Government Hygienists, yes.

Q. All right. The American Conference of Governmental Industrial Hygienists, also known as the ACGIH, is a very well-respected organization, is it not?

A. It was the best -- best of the industrial hygiene group organizations, yes.

Q. In other words, this organization was made up of people like yourself. Weren't you a member?

A. Yes, I was a member after I had gone to teaching in the last -- so that would have been in the year of 19 -- I became eligible, and these were all governmental or educational, nonindustry members, and I became eligible in 1978 and took part in it.

Q. Okay, sir. But when was the American Conference of Governmental Industrial Hygienists formed?

A. It was formed in 1936, I think, or '37.

Q. All right, sir. And those -- those individuals who formed that agency and today, up until today, are industrial hygienists; is that correct?

A. Along with -- let me supplement to say there a lot of physicians that are members of that, and they're looking at it from a medical standpoint, and there are a lot of strictly toxicologists who are experimenting and they are not industrial hygienists inasmuch as they do not go out into plants and fields and make tests. They actually work with animals primarily.

Q. Is it safe to say that the ACGIH was composed of individuals who were dedicated to informing industry about the dangerous propensities of various chemicals or toxic agents?

A. They were the best authorities we had.

Q. All right. And this 100 M.A.C. that we referred to when you were working in Massachusetts in the 40's, that was established based on input from the ACGIH, was it not?

MR. BAGGETT: Well, I think to be precise we would have to refer to 1946. And this is a document that will be authenticated by Frank Parker.

MR. SPEARS:

Q. Well, my question, Doctor -- Professor Hammond, you understood what I was asking you, do you not?

A. Not in terms of -- you were giving them certain authoritative -- giving them authoritative type of government enforceable limits, and these are the limits that would be enforceable by the -- a state agency, whether it's the department of health in some states and department of labor in some states, that they could actually take an employer to court and force him to reduce the concentration if it didn't come down to a hundred parts per million, and that was for that particular year. Then as it came on down, the more restrictive, then that was what the inspectors from the government agency could enforce, and that's where it came about.

Q. Professor Hammond, what I'm trying to emphasize, and correct me if I'm wrong, but the -- either the threshold limit value or the maximum allowable concentration for benzene vapor for a worker in a 40-hour week has evolved downward since 1941, has it not?

A. It surely has, down to zero now.

Q. All right, sir. Well, I want to ask you that, sir. What does the American Conference of Governmental Industrial Hygienists recommend as of today, sir, for threshold limit value ppm for benzene on an eight-hour day?

A. In the 1993 booklet it's one part per million.

Q. All right. So it's not zero, is it?

A. Well, you've got --

Q. Is it zero?

A. Well, it's not zero, because that cannot be detected in -- normally in the air such as this room or out there in the street we're going to have around one part per million.

Q. The fact of the matter, Professor

Hammond --

A. It's the least detectable amount.

Q. The fact of the matter, you cannot reduce benzene exposure to zero in any work environment, can you, sir?

A. No more than the fact that we still have some cases of leukemia and people don't have any record of having ever worked in benzene exposures.

MR. SPEARS: I object to the answer as not being responsive.

Q. I'm going to ask you again, Professor Hammond. In the workplace, and I'll give you the Exxon refinery as the workplace that you're very familiar with, is it possible to reduce benzene exposure to zero to every worker in that work place, based on the technology that you know of?

A. You have just stated a basic fact, and the other answer to that is that's the reason you have to have medical surveillance of these employees, because there's so much difference in their susceptibility, and if you find a person that has none detectable exposure as far as the instrumentation is concerned, and he shows changes in the blood picture and he's an employee where he might have some benzene around, unusual, then you have to remove him to some other position, and we did that regularly.

MR. MYERS: Let me object to the responsive nature of the question.

MR. SPEARS: With all due respect, sir, I would object to the responsiveness of the question. I'm going to ask you --

MR. BAGGETT: Well, gentlemen, I've got to say if y'all are going to put that type of comment onto the record, I think it is responsive and I think he's entitled to explain his answer.

MR. SPEARS:

Q. Professor Hammond, I'm going to ask you to give me a yes or no.

MR. BAGGETT: You don't have to do that.

A. I can't do that. I can't do that.

MR. BAGGETT: I want to object to that instruction.

A. I can't do it.

MR. BAGGETT: He can give a yes or no and then explain it, and that's just what he did.

MR. SPEARS: Well, let me explain it -- let me get this on the record. Are you telling this witness not to answer me yes or no, Bill?

MR. BAGGETT: I'm saying that he doesn't

have to, that he can answer you yes or no and then explain it.

MR. SPEARS: Under what provision of the Louisiana Code of Civil Procedure are you telling me that this witness cannot answer yes or no?

MR. BAGGETT: I didn't say that he doesn't have to answer you yes or no.

MR. SPEARS: Thank you.

MR. BAGGETT: I'm saying that he's entitled to explain it.

MR. SPEARS:

Q. Professor Hammond, if the question is capable of a yes or no answer, will you give me a yes or no answer, sir?

A. If that's the only thing required without an explanation.

Q. All right, sir.

A. The jury must understand what we are discussing and what the problems is, and I'm trying to think of them and --

Q. Well, Professor Hammond, you just answer my questions, please, and we'll let the jury decide what they want to be decided. Try not to be an advocate, if you would. Just answer the questions.

MR. BAGGETT: I'm going to object to your comments.

MR. SPEARS: All right.

Q. Professor Hammond, when you went to work at Exxon -- and what year, sir, was it?

A. 1947.

Q. All right, sir. Was there benzene present in the Exxon operations when you went to work at Exxon?

A. There was.

Q. All right, sir. Tell me every place that benzene was in at the Exxon facility when you went to work. List them for me.

A. When I went through making a reconnaissance survey, which is a walk-through, I discovered that the benzene was being used in dewaxing of oils, and that was the method at the ketone benzene procedure that had been developed by Texaco. And to do that, use their method, we had to use whatever they recommended or else they wouldn't guarantee it. So, but I immediately saw it, and I went directly to my management and said we cannot use that benzene as a product, because we're not going to be able to control it.

Q. All right, sir.

A. And so, let me tell the you the rest of the story. It's real important. They began in research and they found out that toluene would do just as effective as benzene and even better.

Q. I'm going to stop you now, Professor Hammond, because my question --

A. And we never --

Q. Professor Hammond, listen to me.

A. I'm just saying --

Q. No. No, sir.

A. I'm giving you the answer.

Q. I understand. My question to you was where in the Exxon refinery was benzene? I'm not asking you about toluene or what you did. Do you understand my questions?

A. I told you.

Q. Am I -- am I not being clear when I ask you? Tell me if it's not clear. Okay, sir? Where was benzene present at the Exxon refinery when you came to work?

A. I've already answered you.

Q. You said the dewaxing unit?

A. That's right.

Q. Is that the only place, sir?

A. That's the only place that was

detectable.

Q. All right, sir. Did Exxon refine crude oil, sir?

A. They did.

Q. Was there benzene in crude oil when you went to work for Exxon, sir?

A. I'm sure that there was. It depended on the particular field you produced it from.

Q. How would you know if there was?

A. Well, we measured and we developed techniques to measure it everywhere.

Q. When you went to work at Exxon, were you aware that there was benzene in crude being refined by Exxon?

A. Not in any concentration that would be where it -- because it was internal and inside or enclosed equipment it wasn't vented out in the air.

Q. I didn't ask you whether it was vented in the air, sir. I'm asking you were you aware when you went to work for Exxon for the first time that Exxon crude oil products contained benzene, yes or no? Were you aware of it?

A. Oh, I was.

Q. How were you aware of it, sir?

A. Because I talked to the laboratory people that were making an analysis of these crudes, and they could tell me --

Q. All right, sir.

A. -- which one was higher and which one was lower or which one was negative.

Q. And what was the benzene content of the crude oil being used by Exxon at the refinery, say, in Baytown?

A. I don't have any answer to that. We used crude from hundreds of fields and foreign crude as well as domestic crude, and you'd have to ask me which particular field, which particular -- and if that record would be back in the laboratory, I would refer you to go back there.

Q. Well, do you recall what percent of benzene was contained in any particular crude being used by Exxon at the time that you started working there?

A. It would never be measured in percent. It would be measured in terms of parts per million.

Q. All right, sir. Do you recall any of those?

A. No, I do not.

Q. Would a -- when you went to work for Exxon, did you consider an individual working in the refinery who may be handling the crude oil as being a person potentially exposed to benzene, sir?

A. Not unless I was aware of the area he was working in, how he could have been working with fractions of the crude oil and all that, but we went through the refinery and analyzed all that and you'll find it in my -- my publication there that I summarized.

Q. Well, I looked at your publication, but that's dated 1955.

A. I say we were doing that already in 1955 and before, but I just brought it together in about that time to say these are definitely what we wanted all employees to know and all management to know at that time. That was for their education, not for mine.

Q. All right. There was -- when you went to work at Exxon, Exxon was using benzene as a solvent?

A. Never been used as a solvent except for this patented process that Texaco put in, and we didn't do it after I went in and went through the plant. We didn't buy any more benzene.

Q. When you arrived at Exxon --

A. That's right.

Q. -- you determined that Exxon was using benzene as a solvent in its operations and you eliminated it, is that what you're saying?

A. Yeah, and that was a brand new unit, probably hadn't been operating over a month or so when I got there.

Q. So the people that -- the people that initiated that process of using benzene as a solvent before you got there were doing something that you thought was dangerous; is that correct?

A. I put a stop to it, too.

Q. So Exxon was acting dangerously before you got there; is that what you're saying?

A. Well, yes, and I contribute that to the people who developed the process, which is Texas Company, Texaco.

Q. But who was the industrial hygienist that was there when you got there, sir?

A. There was none. I started the first industrial hygiene program in the world in the petroleum industry.

Q. Well, who was acting as that, as an

industrial hygienist?

A. E. Q. Camp had a group of chemical engineers and chemists that worked on these problems, because during the war we produced a lot of toluene, we produced a lot of xylene and synthetic rubber and so forth and all of those people had a potential exposure to aromatics, and to cover the case they were all included in the same program that we had now for benzene, because they thought all aromatics, such as toluene and xylene and related materials, were as dangerous as benzene.

Q. All right, sir.

A. And I straightened them out on that.

Q. Okay. When you started work for Exxon -- I'm going to go back to this -- you mentioned the dewaxing unit as being a source of benzene. Is this the process that you're talking about that Texaco initiated or gave to Exxon?

A. That's right. That's correct.

Q. All right, sir.

A. But if you go through the world today and look at those units, none of them use benzene, because we demonstrated that you could substitute a safe material for that.

Q. Okay, sir. How many employees are employed say at the Baytown refinery when you were working for Exxon, sir?

A. At one time there were in the range of fifteen to sixteen thousand employees.

Q. All right, sir. Now, other than office personnel, sir, I'm not asking you about office personnel, of the fifteen to sixteen thousand of them, how many of those people actually worked what I would call inside the area of the refinery at any part of the refinery?

A. It would be strictly a guess on my part.

Q. Approximately how many, sir?

A. I'd estimate at three-fourths of those would have been in the plant from day to day, 24 hours a day, seven days a week.

Q. About 10,000 people roughly?

A. 12,000, I would say.

Q. All right, sir. In your opinion, sir, while you were working for Exxon, were all 12,000 of those individuals who worked inside your refinery exposed to unsafe levels of benzene?

A. I would say there would be -- the group that was working in the dewaxing program would have been -- the maximum would have been 25 people.

Q. Okay, sir.

A. That's the only ones that had any hazardous exposure.

Q. Okay, sir.

MR. FREEMAN: Excuse me, you said 25 people?

THE WITNESS: 25 people.

MR. SPEARS:

Q. And that's -- thank you, Professor Hammond. That's the point I was making, of the ten or twelve thousand people working in the Baytown refinery, the people that you would be concerned with as far as for exposure to benzene were the 25 some-odd people working in the dewaxing unit; is that correct?

A. At that time, yes, but we expanded the operations so that it became several hundred.

Q. Okay, sir. At no time did you feel that all ten or twelve thousand people working in your refinery were exposed to unsafe levels of benzene, did you?

A. I'll go back to my original statement, that these were the only ones I detected by walk-through.

Q. Okay, sir. When you walked through your refinery, who were the people that you determined might be exposed to benzene vapors? Now, you mentioned the people in the dewaxing unit. Who were the people or what work craft would you consider as being a craft that would be potentially exposed to benzene vapors as you walked through a refinery? And I'm talking about your refinery, the Exxon refinery.

A. Only that one unit.

Q. All right, sir. And which unit was that?

A. A dewaxing unit.

Q. You were not concerned, were you not, with, say, pipefitters or boilermakers who were working in other units other than the dewaxing unit about their levels of exposure to benzene, were you?

A. To answer you to say that to be able to walk through and make an evaluation of an exposure you have to be professionally trained in this field.

Q. Yes, sir. Yes, sir. My question --

A. So I was trained in the field, and I knew what to -- what to look for and what to expect, and I knew the operations of the plant, what the intermediate compounds were, what the finished products were and where the original exposure or the feed products came from, and I was able to evaluate them.

Q. All right, sir. In layman's terms, Professor Hammond, and tell me if I'm not being clear, what I'm trying to get at, and tell me if that's not correct, is that everyone who worked in your refinery -- not everyone was exposed to benzene; is that correct?

A. I think that's -- doesn't even deserve answering.

Q. Well, I want an answer.

A. Well, no, they didn't.

Q. Okay.

A. They didn't have any exposure to benzene.

Q. All right. Fine.

A. How would a boilermaker or a shop worker and so forth who never even had any solvent --

Q. All right, sir.

A. -- in the place -- let me explain it to you, and you can put this down as my answer. I walked through the plant, I looked at the operations and materials they were handling, how they were being exposed. If I was not satisfied that I would be willing to work for a career of 35, 40 years in that particular location where they were working, I then took measurements, and I took measures to improve it to the point where I would.

Q. Yes, sir.

A. Okay?

Q. I understand that. When you walked through the refinery at Exxon, did you feel safe walking through that refinery?

A. Perfectly safe, and if I didn't, then just like I did in this room and there was some operations that I wasn't pleased with and I wouldn't be willing to work in for the rest of my life, and I got busy and we tended to them.

Q. All right, sir.

A. And I used that policy all the way through until my son came about 15 or 16 years old and I began to worry about his occupation, I began to apply that same judgment to whether or not I'd want my son to go to work in that job for the rest of his life. And that was the criteria I used. That's the reason zero was a natural thing for me for benzene.

Q. Does your son work in a refinery?

A. He never did work in a refinery, no.
Q. Did you ever take him in the refinery with you?
A. As a visitor.
Q. All right, sir. Were you concerned when you took him in as a visitor that he might be exposed to benzene by just being in the refinery?
A. I was -- I had already been in there, and I was not exposed to -- I was not -- I was not concerned about my own exposure, and I said that was my first criteria, but when he came along he was so precious to me --
Q. Sure.
A. -- I wouldn't want to expose him to say now you go to work in this plant or that plant or this operation or that operation, you see?
Q. Sure.
A. The TLV's didn't mean a thing to me.
Q. I've been in many refineries, Professor Hammond. Not nearly as many as you, sir. But when I walk through a refinery I get a smell. It's just a -- I can't tell you what it is. I just call it a hydrocarbon smell of a refinery operation. Do you know what I'm talking about?
A. Yes, I do, surely do.

Q. Is there any danger in breathing that when you're walking around in a refinery?
A. I don't see how you would be exposed to any more than just passing through, no.
Q. In other words, just walking through a refinery, whether it's Exxon's refinery or anybody else, and getting a smell of -- a hydrocarbon smell doesn't necessarily mean you're being exposed to benzene, correct?
A. Well, today, because of the control group about air pollution and so forth, you wouldn't have that smell anymore. You don't get that.
Q. Are you telling me you could walk through Exxon's Baytown refinery today and not smell any hydrocarbons, Professor Hammond?
A. Yes, I do.
Q. You could do that today?
A. Yes, you can.
Q. And you could do that when you retired?
A. Oh, not -- not that long ago, but within the last ten years they've had to tighten it up. I'll just give you some idea about how important this is. When I retired professionally there were 15 of us looking after all the refineries and some 60,000 or more employees throughout the 50

states. Today they have like 80 to 90 industrial hygienists doing the same job with less employees than we had --

Q. Okay.

A. -- when I was working for them.

Q. Okay, sir. Professor Hammond, what I'm saying is that when you retired, which was in what year, sir?

A. '78.

Q. Okay. So when you retired, at least up in that point in time if you walked through the Exxon refinery you would smell a hydrocarbon smell, would you not?

A. I could detect it, yes, at certain locations.

Q. But it was not something to be concerned about, was it?

A. Not at all.

Q. All right, sir. Likewise, a boilermaker or a pipefitter or any other craft who is not working in the units, the dewaxing unit or the benzene unit, has nothing to fear about the fact that he is working in the refinery about being exposed to benzene, does he?

MR. BAGGETT: You're talking about at his refinery?

MR. SPEARS: Yes, sir.

A. Well, I think I can answer that by saying after 1948, by that time we had controlled exposures to lead among the painters, we've never had any symptoms or any complaints of an occupational disease among our many employees over that 30-year period.

MR. SPEARS:

Q. Were you answering my question, Professor Hammond, or just talking?

A. I was just giving you an answer to your question about not being -- not -- people not getting any danger or not being necessarily afraid to be in the refinery.

Q. Okay. So it's nothing -- there's nothing unusual about a boilermaker just doing his job in a refinery. As long as he's not around the dewaxing unit or the benzene unit he's not going to be exposed to benzene, is he?

MR. BAGGETT: Excuse me, you're still confining your questions not to Cities Service --

MR. SPEARS: I'm talking about his refinery.

MR. BAGGETT: -- but to his refinery.

MR. SPEARS: Yes, sir.

A. I would limit it to the fact that he could work in any of our facilities, including the benzene plant, without any danger of exposure.

MR. SPEARS:

Q. All right, sir. All right. Likewise, did Exxon have vessels, ships?

A. They had -- they had tankers.

Q. All right, sir. Did they have tug boats?

A. In what particular facility and which operation?

Q. Did Exxon have any tug boats that you were aware of that plied the inland waters of the Gulf Coast?

A. I don't know that we had any tug boat operators. We had tanker operators, and they came in for special examinations and so forth, but tug boats, I think we contracted most of them.

Q. Okay, sir. All right. Did -- have you been told by Mr. Baggett or anybody else what this particular case is about that we're here today for, that being the Joseph Hebert lawsuit, sir?

A. No, I'm not familiar with it.

Q. All right, sir. No one told you that Joseph Hebert was a boat captain, a tug boat captain for most of his life who plied the waters of the Gulf Coast?

A. I didn't know any more than he was a captain on what I would call marine operations and so forth.

Q. Were you aware, sir, that he picked up and loaded and off-loaded crude oil products, condensate and sometimes gasoline from various ports of call all along the Gulf Coast?

A. No.

Q. Were you aware that he also visited the Exxon facility in Houston, sir?

A. No.

Q. No one told you that?

A. No.

Q. Were you aware that Higman did business with Exxon's refinery in Baton Rouge and picked up crude oil products?

A. No, I didn't know where they operated. I haven't -- haven't looked into any of that field operations.

Q. All right, sir. The whole time that you were an industrial hygienist up until the time that you retired, sir, did you know of any need to warn people like Mr. Hebert who might be tug boat captains picking up Exxon crude oil products from the dangers of benzene?

A. Well, let me ask that and say our practice was to have our tug boat employees that were loading or unloading -- we'll say loading products of ours into the barges were under our supervision and they wore the respirators when they needed them. If it was topping off or doing some job of that type or closing a hatch, things of that type, well, they did wear -- and they were under the medical surveillance program, too, as far as benzene was concerned.

Q. All right, sir. I understand that. And maybe I got off track again. Were you aware, sir, that Mr. Joseph Hebert, in his entire career, never hauled benzene?

A. No, I -- I didn't know anything about his operation and products.

Q. All right, sir. Well, take this as a given. Based on the information that we know, Professor Hammond, Mr. Hebert was a tug boat captain for most of his life plying the waters of the Gulf Coast. Okay, sir? You understand me so far?

A. I hear you.

Q. All right. And the products that he pushed or pulled in the barges consisted of crude oil, condensate and sometimes gasoline or like products but no benzene. Okay? Do you follow me so far?

A. So far.

Q. All right, sir. And he was not an employee of Exxon, sir. Do you understand that?

A. Yes.

Q. If Mr. Hebert had arrived at an Exxon dock, and he said he did, to pick up crude oil --

MR. BAGGETT: Wait a minute, who said he did?

MR. SPEARS: Mr. Hebert did, he said he visited the Exxon dock.

MR. BAGGETT: Whereabouts.

MR. SPEARS: In Houston.

Q. If he arrived at the Houston dock to pick up crude oil products, just crude oil, would he have received any sort of warning from you or any Exxon official about the products that he was about to load into his barge, if it was crude oil?

A. I do not know about his operations enough to be able to help you on that.

Q. All right. Professor Hammond, you were the chief industrial hygienist for Exxon; is that right?

A. I was.

Q. You were responsible to determine if there was any exposure to harmful chemicals or substances to any employee or visitor at the Exxon refinery; is that correct?

A. Not -- not in -- not in that type of detail, individual. I'm just speaking for the maintenance and the safety measures from an industrial hygienist's standpoint that we took and I -- all of our employees that worked at the docks were all trained and trained by classes in a lecture room type as to the dangers of having all of the products that we had, when to wear respirators or approved types of masks.

Q. All right, sir. Were you --

A. And so they would have been a good example for any contract barge operator and so forth to have seen them if they had been handling any materials that were hazardous.

Q. Well, I'm asking you now based upon your work experience at Exxon, sir, did you initiate any type of program to warn tug boat operators or crew members about the dangers, if any, of Exxon crude products that they may be loading or unloading?

A. I do not know of any for the crude oil. If he just stuck to crude oil, that would have been less likely that we would have taken him apart for -- taken him aside for that particular training.

Q. And the bottom line, Professor Hammond, do you know of any danger of contracting acute myelogenous leukemia from anyone who handles crude oil products only?

MR. BAGGETT: That, of course, hypothetically is not consistent with the evidence in this case and is therefore objectionable.

A. I do not know enough about his work and the materials that you mentioned earlier, what concentration of benzene that might have contained and so forth.

MR. SPEARS:

Q. Well, what -- what concentration of benzene were in your Exxon crude oils, sir?

A. We didn't have any concentrations to speak of. The crude oil had other types of gases that would have been diluted with the benzene so as to reduce it. It's very unlikely that there would have been very much benzene coming out per se from the -- you see, the more volatile materials in crude than those found in benzene would have been predominantly in the vapors that come out, and that kind of a fractionation-type evaporation and very little of the thing is high boiling as that. Your propane, butane, pentane and so forth would have been the gases that you'd have been concerned about, and you'd have been concerned unless you control it that you might have a fire problem, fire hazard, or explosion.

Q. Well, it was a very long answer, Professor Hammond.

A. Well, it was necessary.

Q. Yes, sir. And I'm asking you. Now you said there was -- in your answer you said your crude oil did not have much benzene in it --

A. Not coming out, that would have been exposed to the air. Just pure benzene -- just pure petroleum crude, I don't know of any situation where you would have had hazardous concentration of benzene per se.

Q. That's what I'm asking you, sir.

A. I just don't -- I just don't know what materials he handled.

Q. Right.

A. But I'm sure that the investigations of these materials, because we know that when we were handling products containing benzene we had to put in very strict control measures, including medical surveillance, including urinary phenols and other control measures, but just the uncertainty of what type of product you're talking about, but crude oil only is not -- I'm not able to help up with that.

Q. Well, I'm going to ask you, sir, Professor Hammond. As an industrial hygienist, based on your work experience, do you know of any incidents where acute myelogenous leukemia has been associated with handling crude oil products only?

MR. BAGGETT: That, of course, is irrelevant in this case.

A. Well, not only --

MR. SPEARS:

Q. Do you know that, sir?

A. I know that we had none --

Q. All right, sir.

A. -- in all of our people.

Q. Have you ever heard of any?

A. I have not heard of any, and I have not had one case, because we had a good control program --
Q. All right, sir.
A. -- all this time. Unless you had that, I'd say you were negligent in knowing what exposure he might have been having.
Q. Who's negligent?
A. Anyone who had the supervision over the potential exposure that he had.
Q. What exposure did he have, Professor Hammond?
A. I don't know.
Q. Well, why did you make a statement like negligent, Professor Hammond?
A. Well --
Q. You don't even know his exposure.
A. Because I don't know how you'd know that he didn't have exposure unless you had him under --
Q. Why --
A. -- surveillance.
Q. -- in the world --
MR. BAGGETT: Wait a minute.
MR. SPEARS: -- would you make a statement

like that?

MR. BAGGETT: Wait. Wait a minute. I object to you interrupting the professor.

MR. SPEARS: All right.

Q. Professor Hammond, why would you make a statement about he was negligent or somebody was negligent when you don't even know what the man's exposure was? Tell me.

A. That's right, I don't know what his exposure was.

Q. Well, why do you make a statement about --

A. Had he been working for us, I'd have known about it.

Q. If he had been working for you, you'd have known what?

A. I'd have known if he had any exposure or not to benzene.

Q. And how's that, sir?

A. Because of the medical surveillance and testing -- testing urine and other means of determining it.

Q. Exxon did not test every employee in that refinery, did they, sir?

A. I don't see how that had any relation to a --

Q. Yes or no? Did Exxon --

A. -- barge operation.

Q. Did Exxon test every employee of their refinery, urinary or phenol or anything?

A. No, because we had a good, intelligent program going --

Q. Okay.

A. -- to protect them.

Q. All right, sir. So not every employee was exposed to benzene; is that correct?

A. Unfortunately not every industrial operation by -- has been evaluated by other people, professionals.

Q. Professor Hammond, not every employee at Exxon was exposed to benzene; is that correct?

A. I don't -- I don't think so. I don't see what that has to do with this particular case.

Q. Well, I'm asking you, was every employee at Exxon exposed to benzene, yes or no?

A. Well, no.

Q. All right, sir. So if Mr. Hebert was handling crude oil products and he was a boat captain, do you have any knowledge about whether he would be exposed or not?

A. I do not know.

Q. Would you expect him to be exposed if he was a captain of a vessel?

A. I wouldn't know what products he's handling.

Q. Crude oil products, Exxon crude oil products.

A. Show me an analysis of the crude oils that he handled, and then I'll be able to give it to you --

Q. Well, I'm going to give it back to you, Professor Hammond. Is there -- was there, on your watch at any time while you were working for Exxon, was there any crude oil products -- I'm talking about crude oil now, that was considered hazardous in the sense that individuals who handled, loaded or unloaded your crude off and on a barge had to be medically monitored?

A. Depending on what other products that might have been handled --

Q. I'm limiting it to crude oil.

MR. BAGGETT: I'm going to object to you interrupting the doctor --

MR. SPEARS: Well, go ahead and object. I'm trying to get the guy to answer a question.

[Court reporter stopped proceedings]

MR. BAGGETT: Extend to this man, please, the courtesy of letting him answer before you interrupt.

MR. SPEARS: I'll extend him the courtesy if he extends the same courtesy of answering my question. We won't be here very long, Professor Hammond, if you'd just answer my question, quit trying to be an advocate and simply answer the question.

MR. BAGGETT: I object to your side bar comments on this record.

A. I guess you've been to the docks and you know that there are many products being handled sometimes at the same time.

MR. SPEARS:

Q. You're not answering the question now. I've not been to the docks.

A. I'm --

Q. Don't assume I've been to the docks. Okay?

A. All right. Well --

Q. My question --

A. All I'm saying is that --

Q. Let me ask -- let me ask you a question and you give me an answer. Did you monitor -- while you were at Exxon did you medically monitor all of your employees at the Exxon docks in Houston, yes or no?

A. Has no relation to any matter of whether they were in danger or not whether I monitored all of them or not. The main thing was --

MR. SPEARS: Professor Hammond, it was a simple question.

No, Bill, I'm not. He's going to go off on something else.

Q. At your dock at Houston, at your dock on your watch did you medically monitor all of your Exxon employees working at your docks, yes or no?

A. No.

Q. All right.

A. But it depends on --

MR. BAGGETT: You can explain it.

A. What else they were handling at the same time, even though crude oil was on one barge, but were they putting some product that contained benzene on other barges.

MR. SPEARS: I object to that question -- that answer as not being responsive to my question.

MR. BAGGETT: Well --

A. It's the only way to explain your --

MR. SPEARS:

Q. No, sir, it's not.

A. -- situation.

Q. It's not.

A. It depended on what else that were happening at that dock at the same time. I don't know. I wasn't ever with Mr. Hebert and procedure --

Q. I'm not talking about Mr. Hebert, Professor Hammond. I'm talking about your job --

A. Well, I thought you said you wanted to talk about him only handling crude, but he could have handled only crude and been exposed to benzene.

MR. SPEARS: I object to this line of just talking, Professor Hammond. I'm not interested in you reciting what Mr. Baggett's may have told you yesterday about this case.

MR. BAGGETT: Well, I'm not interested in hearing you testify either. And if you -- you asked him a question about monitoring people at the docks of his refinery, and he is telling you situations where he would do that.

MR. SPEARS: That's not the question. I'm not asking about situations. The question was, did you monitor all of your employees at the docks, yes or no?

MR. BAGGETT: And he's entitled to explain.

MR. SPEARS: Right.

A. Yes.

MR. SPEARS:

Q. Yes, you did?

A. Yes. Yes, I did.

Q. You monitored -- you monitored all the Exxon employees at the docks?

A. Yes, I did.

Q. When did that start, sir?

A. All the time, because I could look at the operations and know what was going on around about them, whether it was a particular material or whether it was other materials and know whether they needed to be monitored.

Q. When did you start the monitoring program?

A. 1947.

Q. All right. From 1947 until the time you retired all of the Exxon employees who worked at

the docks were medically monitored, sir?
A. If they needed to be.
Q. And how did you determine if they needed to be?
A. By being professionally trained to know how to recognize the materials that may lead to exposure.
Q. All right, sir. And if they were -- and which materials were that, sir?
A. Any type of material that you were -- depending on what particular hazard you were looking at. Benzene would be a good example.
Q. That's the one I'm looking for, benzene.
A. All right.
Q. How did you determine whether an employee should be monitored at the docks in relation to benzene?
A. Well, any products on the docks are being handled or loaded or unloaded at the same time that you were handling crude oil might contain benzene.
Q. All right, sir. That would be the only time, sir?
A. Sure.
Q. How about if you were just handling crude

oil that did contain benzene?

A. I do not know the situation where you'd just be handling crude oil without other operations going on.

Q. You've never heard of a situations where a barge pulled up at your dock and off-loaded crude oil?

A. I cannot answer you on a particular problem. I never was there every moment.

Q. I understand that.

A. Okay.

Q. But you were responsible for the industrial hygiene at that plant, weren't you?

A. Well, we have never had any occupational health hazard and diseases after I went to work and had the situation under control.

Q. Say that again.

A. Never did have any occupational diseases develop in our employees after I went to work in 1930 -- 47 and got the few conditions we had under control.

Q. Are you telling me that Exxon has never been sued for occupational disease occurring while you were working for Exxon?

MR. BAGGETT: I object to -- that isn't

his -- that's an improper and an unfair summarization of his prior testimony and is, therefore, objectionable as to form. Whether they've been sued since then has no relevancy to the answer that he gave you, which was an answer to your question.

MR. SPEARS:

Q. Has Exxon been sued, sir, that you know of -- has Exxon been sued for occupational illnesses occurring while you, sir, were chief industrial hygienist?

A. I never heard of it.

Q. You never heard of any?

A. No, not while I was industrial -- director of industrial hygiene.

Q. Is there any asbestos suits pending against Exxon, sir?

A. Well, that's not the question you asked me.

Q. You don't consider asbestosis an occupational disease?

A. Oh, I'm -- I'm -- if you want to get into that field, I'll tell you I was trained by Dr. Kenneth Lynch, and he was the first American to write about cancer from asbestos.

Q. Do you consider asbestosis as an occupational disease, yes or no?
A. Yes, never had -- we never had a case of symptoms -- we took x-rays of all of our potentially-exposed people, but never one of them had any evidence of asbestosis.
Q. Professor Hammond, we're going to be here a long time if you don't answer my questions.
A. Yeah, I'm not going to answer them like you want them. I'm going to tell you the truth. That's all I'm --
Q. That's what I'm asking, sir.
A. You want to get me --
Q. No.
A. -- to break down --
Q. No.
A. -- and tell you --
Q. No, I'm not.
A. -- anything that is not true.
Q. No, I'm not. Do you consider --
MR. BAGGETT: Excuse me. For the record, I want to object to the basic principal that you're proceeding on. He has testified that during his employment there there was no

occupational disease, and you're trying to refer to occupational disease that may have been discovered since he worked there, and, therefore, you're being unfair to him unless -- unless you delineate what period of time you're talking about.

MR. SPEARS:

Q. Professor Hammond, do you consider asbestosis as being an occupational disease, yes or no?

A. Well, that's been known for 45, 50 years.

Q. All right, sir. It is an occupational disease?

A. Why, sure. Silicosis is an occupational disease.

Q. All right, sir. Has --

A. And lead poisoning is an occupational disease.

Q. Has Exxon been sued, that you're aware of, for -- by people saying they contracted an occupational illness called asbestosis as a result of working at the refinery and their work was on your watch?

A. Not to my knowledge, no.

Q. So you are not aware of any such suits?

A. No, no, I don't believe there have been any asbestosis cases filed against us.
Q. Against Exxon?
A. Yeah.
Q. You're not aware of any asbestos cases filed against Exxon?
A. I didn't say asbestos. I said asbestosis.
Q. All right, sir. You're not aware of any asbestosis lawsuits filed against Exxon as we sit here today?
A. Not at all.
Q. Is that correct?
A. Not at all.
Q. And you never have been; is that correct?
A. That's right.
Q. All right, sir. You're not aware of any lawsuits filed by any former employees of Exxon alleging mesothelioma, are you?
A. I know that there have been some, but I don't -- they're all since I left the company.
Q. All right, sir.
A. I heard about that.
Q. Okay.
A. But asbestosis and mesothelioma are

entirely two different diseases.

Q. Yes, sir. Yes, sir. Professor Hammond, we got off track here, sir, but you testified, did you not, in the Skeen case, did you?

A. Yeah, I did.

Q. You testified by deposition and at trial, did you not?

A. I did.

Q. All right, sir. That was a benzene exposure case, was is it not, sir?

A. Yes, it was.

Q. All right, sir. And in that case, sir, isn't it true that you testified that at the time of your testimony 10 parts per million, ppm, is a satisfactory and safe level of exposure to benzene?

A. Under some conditions.

Q. All right.

A. For some people.

Q. All right. So under some conditions and for some people you believe that 10 ppm would be a satisfactory and safe level; is that correct?

A. That's right.

Q. All right, sir.

A. But to some people that are

hypersensitive, it's not.

Q. All right. And what was the T -- the time-weighted average for exposure to benzene vapors established by the ACGIH in 1960, sir?

A. Right here we have that. In -- the last one we had was '58, and that was less than 25 parts per million M.A.C. Now, as I said, the M.A.C. would indicate a TLV of somewhere like 60 percent of that.

Q. All right, sir. Well, what was the TLV accepted by the ACGIH, sir, in 1960 for ppm levels of --

A. 25 parts per million.

Q. 25 parts per million --

A. That's right.

Q. -- benzene? That was accepted by the ACGIH, sir; is that correct?

A. That was -- that was the number they published, yes.

Q. All right, sir. And, again, you feel that the ACGIH is a very well-respected world-renowned organization; is that correct?

A. They're not the ultimate authority on the matter, as they will tell you that you shouldn't try to interpret these matters except by a professional industrial hygienist. Now, if you tried to interpret --

Q. My question is they are a well-respected organization, correct?

A. They certainly have recognized status, yeah.

Q. Do you feel that you know more about the safe level of exposure to benzene, you as an individual, than the entire compilation of the ACGIH, sir?

A. I certainly do. In fact, I was on the committee that voted against it, 25 parts per million. Because it's a democratic group and the majority wins, I couldn't get my level to --

Q. So you feel that you know more about it than --

MR. BAGGETT: Wait a minute. You just let him finish, please. I object on the record to you continuing to interrupt Professor Hammond.

MR. SPEARS:

Q. Professor Hammond, do you feel like you know more about the safe level of exposure to benzene as an individual than the ACGIH itself?

A. Very definitely.

Q. All right, sir.

A. And not only that, but, see, we have in our records a letter that I wrote Mr. Wrightman saying in 1948 we discussed this matter, and I said that zero level was the only one that was acceptable unless you put the men -- people under medical surveillance.

Q. All right, sir.

A. In 1947 I was -- '48 I was discussing and disagreeing with the TLV.

Q. All right, sir. Now, you had -- you wrote a paper on how to design a benzene unit, did you not?

A. I did.

Q. And you're very proud of that paper, aren't you? You're very proud of that paper, aren't you?

A. Well, no one had ever written one before.

Q. No, are you very proud of that paper?

A. Well, I'm not apologizing for it.

Q. Okay, sir. All right. And in that paper that you wrote, did you design that system so that there would be absolutely zero level of exposure to benzene for everybody who worked in that -- that unit?

A. So far as practical, we did, but we also said that that's not enough, you've got to have all of these other comporting programs to go with it, medical surveillance, urinary phenols and blood counts and all of those matters had to be part of the program and had to do that periodically to find out whether or not you had everything under control.

Q. Right, sir.

A. And we published the results after four or five years of operation and showed you where in the beginning we had some operations that had more than we wanted, more than zero.

Q. Right.

A. And then we got it all worked out, and we feel very satisfactory that we have no significant exposures to anyone in that -- in that plant.

Q. Well, you know, Professor Hammond, you used two different terms. And correct me if I'm wrong, we're talking about -- when I asked you earlier if you could design and operate a benzene unit or benzene plant so that there was absolute zero exposure to individuals, we got off on a tirade, and I apologize if I started on the tirade, but my question was, and tell me, it's not possible, is it, not possible to design and to operate a benzene unit so that there will be zero level of exposure at all times to all of your employees, is there?

MR. BAGGETT: For the record, before you answer that, I want to object to the testifying of counsel, to his sidebar comments and to his summary of prior testimony which is objectionable as to form.

MR. SPEARS:

Q. Okay, sir.

A. What was your question?

Q. All right, sir. Is it possible, sir, to design and operate a benzene unit so that there is zero exposure to the individuals working in that unit?

A. Well, my answer to you is why do we go to try to -- get to that type of expensive control when outside the air you have to breathe in this room and elsewhere contains one or two parts per million of benzene.

Q. We're on the same unit now, sir. Now we're working together. In other words, everybody in the world --

MR. BAGGETT: I'm going to object to your comments about where we were, because I don't think you are on the same units, and I can make that statement, too.

MR. SPEARS:

Q. Professor Hammond, what I'm saying is that you cannot design a unit, nor can you operate a benzene unit which would prevent exposure and bring it down to zero of benzene from the unit itself?

A. Well, just from a professional standpoint, how ridiculous would I have looked in trying to design something where the air that you have in this room and everywhere else contains some benzene.

Q. All right, sir.

A. And I look at the people smoking cigarettes --

Q. Right, sir.

A. -- and I know that every puff they take will have up to a hundred parts per million of benzene in it.

Q. Professor Hammond, you're getting way ahead of me, but you're absolutely right. As you face this camera today, every lawyer sitting in this room and every one of us as we leave here is going to breathe in a certain amount of benzene because they're in Houston; is that correct?

MR. BAGGETT: Objection to your testimony instead of a question that was preceded by a question.

A. I don't know why you'd have to go to Houston, because if you went up in the hill country around Kerrville and that area where the cedar trees are, you'd have more than you would have in Houston.

Q. All right, sir. In other words, every American, every living, breathing American on this planet who takes a breath is going to have some exposure to benzene; is that correct?

A. And we have resistance to those types of concentrations, because over the centuries and all the people have developed a tolerance to that type of an exposure. And so it's not significant, what you're talking about.

Q. I'm going to ask you again. Does every American who lives and breathes on this planet breathe in benzene as he takes -- he or she takes a breath, yes or no?

A. Well, they -- I've already answered it.

Q. No, sir, you haven't.

A. That you can't live in an atmosphere

that's not some benzene, period.

Q. All right.

A. I've never heard of it.

Q. So when you breathe in, when you take a breath, you take in benzene; is that correct?

A. That requires no professional --

Q. I'm asking you; is that correct?

A. Well, I'm not going to answer that question.

Q. Well, I'm asking you the answer. When you breathe in today, are you breathing in benzene vapors?

A. You're not breathing in vapors. You may be breathing in benzene in some small amount, but it's not of significance.

Q. All right.

A. Now, you don't want to add -- what I'm saying is you do not want to add any amount to that what you naturally have and you've developed it.

Q. All right, sir, but when you took -- when you drink water from Houston, the water that we're drinking here today contains some amount of benzene, does it not?

A. Possibly.

Q. You're not aware of that, sir?
A. I haven't ever tested the water for benzene.
Q. Do you believe there's any benzene in the water that you drink in Houston?
A. I have no proof of it being there.
Q. All right, sir. Now, what's -- what is the major source of benzene exposure in our environment today, Professor Hammond, other than a petrochemical or occupational exposure? What is it, sir?
A. I don't know what -- I never have looked into that part, that extensive part.
Q. It's smoking, isn't it, Professor Hammond?
A. Could be smoking, but also it should be combustible products from stacks.
Q. From stacks or automobiles?
A. Well, I imagine that there's some benzene in that, too.
Q. Tell me what you know, sir, about benzene exposure to someone who smokes.
A. Very little.
Q. What kind of -- benzene is part of the chemical that comes off of the smoke in cigarette

smoke?

A. Yeah, there was experiments that were carried out at Harvard where -- and discovered that it would run up to a hundred parts per million, but I didn't do the tests. I depended on my teachers to tell me about it.

Q. You're aware then of some experiments dealing with cigarette smoke that indicated there were a hundred parts per million exposure to the person smoking the cigarette; is that correct?

A. That's right.

Q. All right, sir. And, of course, secondhand smoke, in other words, if someone is not smoking but in a room with someone who is smoking, would also be exposed to benzene, would he not?

A. I assume he would.

Q. All right, sir. And every day as you and I drive along the interstate or the highways and byways of this country, we're exposed to some benzene coming from the exhaust of the automobile, are we not?

A. I assume we are.

Q. Okay, sir. That's true, is it not?

A. I'm not saying it's true, because I

haven't made the tests.

Q. All right, sir. When you or I or any member of -- John Q. Public goes up to a self-service station and pumps gasoline, that person is going to be exposed to some levels of benzene from the vapors of the gasoline; isn't that true?

A. I assume they would.

Q. And you would expect that?

A. In a short-term exposure of five minutes or so OSHA has never seen necessary to put up any restrictions on self-service stations and never has set a standard on that --

Q. And short --

A. -- for combustible engines.

Q. I'm sorry.

A. Fuel for combustible engines are not controlled.

Q. Right. But short-term exposure to benzene has never been considered a serious health hazard, has it?

A. How often are these short term occur. Depends on how often.

Q. All right. I'll give you an example. That's a fair comeback. Someone who would, say, be exposed to benzene in a paint solvent or a paint thinner as he washed out his brush or something and his tools and then went back to work, maybe did that once a week or something like that or once a month, would you consider that to be a serious exposure?

A. It could be, yeah. I had a secretary who's father was a barber, and he had decided to refinish the furniture in his house, and so he got some solvent that contained, say, 15 percent benzene, and he died from leukemia and problems associated with the benzene. That is all he did, he was just a barber, but he -- his hobby was refinishing furniture, and he used some benzene on his -- it's a very hazardous, dangerous material, and the doctors couldn't tell him what was wrong until I went and evaluated all the materials he had used and discovered this substance.

MR. SPEARS: I'll object to the nonresponsiveness of that.

Q. Are you finished? Professor Hammond, are you finished?

A. Yeah.

MR. SPEARS: I'll just object to the

nonresponsiveness of the question.

Q. But does Exxon gasoline products contain benzene, sir?

A. I'm not familiar with the concentrations. If so, what they are and where they come from, which ones do and which ones not. I don't know.

Q. Well, I know you may not know now, because you've left Exxon, but surely as a chief industrial hygienist for Exxon part of your duties would be to know whether or not Exxon gasoline contained benzene; is that correct?

A. I would recommend that you read on the pumps of every gasoline station, Exxon, what the warning is about your health hazards.

Q. Well, you didn't put those pumps until 1958, those warnings, did you?

A. Was it 1958?

Q. Yes, sir.

A. You mean 1968 or 1978 or what?

Q. When did you first put -- Exxon first put a warning on the gasoline pumps about the content of benzene in its gasoline?

A. It was after I left there. I don't know when it was.

Q. And you left when?

A. '78.

Q. Okay, sir. But you were aware while you were at Exxon that the gasoline products contained benzene, were you not?

A. I was aware that you didn't have any hazardous operations if you just filled the gasoline tank occasionally like we do once a week or once a month or whatever time you have to buy gasoline.

MR. SPEARS: I object again, Professor Hammond, to the nonresponsiveness of my question.

Q. I'm going to ask you again. Were you aware as chief industrial hygienist of Exxon, while you were working, that Exxon gasolines contained some amount of benzene?

A. I knew -- I knew they had some amount.

Q. All right, sir. Now, why, sir -- while you were chief industrial hygienist, why did you not initiate a program to put warnings on the pumps so that the public would be aware that when they pumped Exxon gasoline that they might be exposed to this benzene?

A. Well, I didn't have overall authority throughout the company to do that type of thing. I just had to protect the employees, and I did, and that was my main job. And so the public also was under the supervision of the United States Public Health Service the state health departments and many other agencies, and they never saw fit to warn the public about that.

Q. Are you saying basically you were worried about Exxon employees but the public be damned about the products?

A. I didn't say that at all.

MR. BAGGETT: I object to your summarization of what he just said. It speaks for itself.

MR. SPEARS:

Q. Well, Professor Hammond, were you -- did you feel that the public who was pumping Exxon products into their pump would or would not be exposed to some amount of benzene?

A. That's not a clear question.

Q. All right. While you were chief industrial hygienist at Exxon, we've already established that you were aware that the Exxon gasolines contained some amounts of benzenes. You knew that?

A. Right.

Q. And you knew that that gasoline --

A. Trace.
Q. -- was going out to the public and was being pumped into cars as self-service gasolines, true?
A. I brought it myself.
Q. All right, sir. All right.
A. I was not under any concern about my health from buying it to go in my car and using it at the -- at self service in my car.
Q. Did you feel that any person in the public should have a right to know and determine whether he or she wants to pump that gas, should know that there's benzene in that gasoline?
A. Well, that wasn't my duty to make that type of decision about the public.
Q. Well, whose duty was it?
A. The health department and the states and the EPA and others.
Q. But it was Exxon products, Professor Hammond.
A. Yeah, I know.
Q. Are you saying that if Exxon products were hazardous and they went out into --
A. I didn't say they were hazardous. I would say that if you went to the Exxon pump

you've got less likely to have benzene in it than the other pump across the street.

Q. Why is that, sir?

A. Because we extracted all of our benzene we possibly could get and sold it as benzene in concentrated form rather than letting it get in gasoline which sold for much cheaper. For example, one time we could get $2 a gallon for benzene, and we could only get 20 cents for the gasoline. Why should we let that go out if there's any amount of benzene in it?

Q. Isn't it true that the benzene content of Exxon gasoline increased precipitously when the lead was taken out of gasoline?

A. That was all after I left. I do not know that.

Q. Okay. I don't want to talk about what Exxon did or didn't do after you left, Professor Hammond.

A. That's right.

Q. I just want to talk to you about what you did and what your duties and responsibilities were at Exxon.

A. Well, let's talk about Exxon employees and what I did to protect them.

Q. Professor Hammond, we're not going to -- we're never going to get out of here if you start asking questions and directing this. You let me ask the questions, please. If you want to take a break, I'll be happy to give you a break, but we're not going to get anywhere if you start trying to tell me what I should ask. Okay, sir?

MR. BAGGETT: I'm going to object to your comments.

A. I didn't say you didn't have that right, but I just said my duties were to protect the employees of Humble and Exxon, and I did a good job, and I dare anyone to show me where I failed.

Q. Did your duties also include protecting people who went into your refinery who were not your employees?

A. I don't know what you mean. You mean a salesman go to the office?

Q. Well, we're going to start off with your duty was to protect Exxon employees. I understand that. My question is, was it also your duty to protect the safety and health of anybody who went into your refinery?

A. No, it wasn't.

Q. It was not part of your duties, sir?

A. Not -- not my duties. I know we've been -- you're talking about people bringing suits, I'll tell you, a salesman came into our --

MR. SPEARS: Professor Hammond, I'm going to object again. This is nonresponsive.

A. Well, I have to explain to you --

MR. SPEARS:

Q. I'm not talking about --

A. -- so we can confine ourselves to the problems I was responsible for.

MR. SPEARS: I'm going to object to the responsiveness of the question. Go ahead, sir.

A. And this salesman came in maybe once a month, maybe once every few months and went to the purchasing department, and he came back and brought a suit against us for having exposed him to some condition in the refinery.

Q. Okay. Professor Hammond, what do you envision or what did you envision your duty as chief industrial hygienist for Exxon was to, say, contract workers who worked in your refinery? They were not Exxon employees, but they were contract workers. What duty did you have to protect them from toxic substances?

MR. BAGGETT: You're asking him what he

considered. Of course, the duty is a question of the law --

MR. SPEARS: Yeah, I'm asking his duty.

MR. BAGGETT: -- in all of this.

MR. SPEARS: Right.

Q. What duty did you have, Professor Hammond, to protect contract workers from exposure to toxic substances if they worked in the Exxon refinery?

A. That -- that's not a pertinent question in my profession.

MR. BAGGETT: It may -- it may be more relevant, and I object to you asking him what was his duty. You may think it would be more appropriate to ask him what he did in the performance of his work.

MR. SPEARS: Well, Bill, you certainly can ask him the question if you want to.

Q. But you were chief industrial hygienist for Exxon; is that correct?

A. You said that a dozen times.

Q. Right. And as chief --

A. I don't disagree with you.

Q. And you had a duty and that job to protect the employees of Exxon to make sure that they didn't come into contact with toxic substances or certain levels of toxic substances; is that correct?

A. That's my duty.

Q. All right, sir. Now --

A. Let's leave it at that.

Q. No, I'm not, sir. What was your duty in regard to a contract worker who was working side by side with the Exxon employee?

A. They had to comply with all of our rules. The -- I'm just telling you what we did, I'm not saying my duty, but I'm saying that they had to comply with all the regulations in regard to control as far as exposure that any of our employees had.

Q. All right, sir.

A. And our safety inspectors were there on the job, and if a contractor was going into an area where our people needed protection, extra protection, we took them into the classroom and explained to them what they had to do and what they had to wear and how they had to perform. And also our employees made sure that they didn't do anything differently that would expose them without warning.

Q. Did you -- as chief industrial hygienist for Exxon, did you or were you aware of any program that Exxon had in place while you were there to monitor -- medically monitor contract workers?

A. Not regularly, no.

Q. I'm sorry?

A. No, because we had employees -- the contract worker come in and maybe work for us for a few months, but we had the employees doing the same job we let them do that worked there 40 years without any problem. Why should we worry about a person who wasn't overexposed more than our own employees, should be worried about him working a week or day or ten days or so.

Q. Okay. All right. So -- and maybe I got this in a roundabout way -- what you're saying is that any of your employees who worked in the refinery on a regular basis and were not monitored, medically monitored, because of their job, then you didn't do any more when the contractor came in to do that same type of job?

A. We just saw that this contract worker didn't violate our regulations and rules over doing it. If he did, he didn't stay in there very long. He was dismissed.

Q. Did you, as chief industrial hygienist for Exxon, or at any time while you were there, did Exxon implement any type of program, random checking -- for lack of a better description, I'm going to call random checking of contract workers to see if maybe they had been exposed to some products and, you know, phenol testing of some sort like that? Did you do anything like that?

A. We didn't have to do that.

Q. Why is that?

A. Because we had workers that we were checking regularly, and we found they had no exposure, and if the contractor helper would help working with our people and doing the same job, they had no chance of being exposed doing that.

Q. Okay, sir. All right. And so if an individual -- if an individual like Mr. Hebert, Joseph Hebert, pulled up to your dock at Exxon and just so happened that it was his shift change, and he walked through the refinery with his wife or drove through the refinery to go back home, would you monitor those types of people?

A. Why would I do?

Q. All right. Would you expect them to be exposed to any levels of chemicals that need monitoring?

A. How could they be when our own people were there 24 hours a day and never had any exposure?

Q. Okay, sir. At the docks?

A. Wherever you're talking about Exxon people work.

Q. Okay.

A. You pick out your place.

Q. Okay, sir. The literature --

A. My time's about up for you now, I'm telling you. I don't usually stay on deposition longer than four hours at each -- at a time.

Q. Well, Professor Hammond --

A. Do you want to come back tomorrow?

Q. -- I want you to know -- no, sir, I don't want to come back tomorrow, and I want you to know in all honesty and candor to you, sir, there was never represented to me that there was going to be a time limit on this deposition. If it was represented to you, it wasn't represented to me.

MR. BAGGETT: Then I've let -- I've let the professor down, because he asked me to do that before we started, and I thought that there was no way that we'd be here over four hours and I should have let you know at the half --

THE WITNESS: If you want to come back tomorrow, I'll be glad to --

MR. SPEARS: No, sir.

THE WITNESS: -- come back and discuss these matters with you.

MR. BAGGETT: Well, we'll see. How far are we along?

MR. SPEARS: I just want to go over some of his testimony in the Skeen case and a couple of others, and then I'll be finished with him.

THE WITNESS: What about the other people?

MR. MYERS: I don't expect to be more than about 20 minutes.

MR. FREEMAN: I've got probably 20 minutes, 30 minutes maybe.

THE WITNESS: Well, let's have a little lunch. Can we?

MR. SPEARS: Sure.

THE WITNESS: Because it's 2 o'clock.

VIDEOGRAPHER: End of tape No. 2, we're off the record. It's about 2 o'clock.

[Recess]

MR. SPEARS: The parties have agreed that --

MR. BAGGETT: Wait a minute. While we're all here, I want us to agree when to continue it.

MR. SPEARS: I don't have any calendar here now, Bill. I can't give you that. I mean, if I give you a date, I swear I don't have any calendar with me, so --

MR. FREEMAN: I wouldn't be adverse to doing it on a Saturday.

MR. SPEARS: No, no more Saturdays.

MR. BAGGETT: All I want is an agreement that we will do it within the next 30 days.

MR. SPEARS: No problem.

MR. MYERS: That's an agreement. I will agree to that.

MR. SPEARS: We will do this again within 30 days. Mr. Baggett will contact Professor Hammond and will arrange a convenient time and place to do it. Meanwhile, the deposition is recessed.

SIGNATURE OF WITNESS

I, Professor James Hammond, solemnly swear or affirm, under the pains and penalties of perjury, that the foregoing contains a true and correct transcript of the testimony given by me at the time and place stated, with changes, if any, and the reasons therefor noted on a separate sheet of paper and attached hereto, and that I am signing this before a Notary Public.

____

Professor James Hammond

THE STATE OF TEXAS]

Subscribed and sworn or affirmed to before me, the undersigned authority, by Professor James Hammond on this the _____ day of _____________, _____.

____

Notary Public in and for
the State of Texas

STATE OF TEXAS]

COURT REPORTER'S CERTIFICATE

I, Shawn Kelley, a Certified Shorthand Reporter within and for the State of Texas, hereby certify that the foregoing proceedings occurred before me.

I further certify that the foregoing is a true and correct copy of the transcript of the proceedings to the best of my ability.

I further certify that I am neither attorney for, related to nor employed by any of the parties or any attorney of record in this cause, nor do I have a financial interest in the matter.

Witness my hand September 30, 1993.

Shawn Kelley, Texas CSR 3448*
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*My Certificate Expires January 1, 1995

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Hammond Deposition

Volume 2

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No. 92-6203

JOSEPH L. HEBERT AND	] 14TH JUDICIAL DISTRICT COU
MARIE HEBERT	]
v.	] PARISH OF CALCASIEU
HIGMAN BARGE LINES,	]
ET AL.	] STATE OF LOUISIANA

VIDEOTAPE DEPOSITION OF

PROFESSOR JAMES HAMMOND

VOLUME 2

November 18, 1993

Between the hours of 10:00 AM and 2:00 PM

Houston Airport Marriott Hotel

Houston, Texas

Wanda G. Kelley, Court Reporter

Nell McCallum & Associates Inc.

2900 Smith, Suite 104

Houston, Texas 77006

(713) 523-3767

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MR. BAGGETT: Gentlemen, by agreement -- this is a different date, and by agreement, is it understood that this is a continuation of the previous deposition taken -- started on September 27th, '93, and that the same stipulation pertains to this continuation?

MR. MYERS: Agreed.

MR. SPEARS: It's agreed.

MR. FREEMAN: Yes.

MR. BAGGETT: And all parties are represented that were here at the previous deposition.

MR. SPEARS: That's correct.

MR. BAGGETT: Only thing that I would say, representing the plaintiff Joseph Hebert and presenting Professor Hammond to you or having taken his deposition, is that I reiterate our position of the previous tender that we made, acknowledge that he is not a medical doctor, that he's not an epidemiologist, that he's not a toxicologist, he's not a hematologist, that the purpose of his testimony was to present state-of-the-art evidence concerning what was known and knowable about benzene and when it was known and knowable.

VIDEOGRAPHER: On the record, 10:12.

THE WITNESS: I'll have a chance to review all of this, will I?

MR. BAGGETT: Yes. The original he has not had a chance to review, but he did catch one error that I want to call to your attention. And it's an error apparently in the typing where they typed millions instead of billions. And it was on page -- I think it was on page 156 of the -- and you may want to look at that, where he was talking about ambient air, they made a mistake of putting per million when it was per billion, b i l l i o n.

MR. FREEMAN: I don't see it on 156.

MR. BAGGETT: It's on page 156. On line 19, page 156 of his original transcript. Otherwise, I will submit the entire deposition to him for reading and signing. It hasn't been done as yet.

PROFESSOR JAMES HAMMOND,

being previously duly sworn, continued to testify as follows:

EXAMINATION BY MR. SPEARS

Q Professor Hammond, just continuing in my line of questioning, I've got a few questions I want to ask you to follow up, please, and then I'll tender you to these other lawyers here.

Can you tell me, what is an MSDS sheet? If you're familiar with that terminology.

A Material -- material data safety -- it is a material safety data sheet pertaining to the health and safety hazards of product.

Q All right, sir. On the MSDS sheet, what kind of information is usually contained therein?

A Information, data, is what the chemical and physical properties and characteristics of a substance, and then it deals with the problems associated with safety, handling and use of the material from the standpoint of fire and combustible qualities. And then it has the health aspects as far as chronic and acute exposure, concentrations that would be important.

Q All right, sir. And an MSDS sheet is usually sent out when?

A It's generally sent out in the time of when a customer expresses an interest in the product, and it goes along with other pertinent sales information dealing with the cost and so forth. But it goes out early to the customer.

Q All right, sir. In your work experience working for Exxon, did Exxon utilize MSDS sheets?

A We had our own, yes, we did, and we started this before it became a legal requirement.

Q All right, sir. And you've previously testified, and I won't go back over that, but you previously testified when you started work for Exxon. But my question to you, sir, is when you started work for Exxon, at that point in time was Exxon utilizing an MSDS sheet or anything similar to that?

A I'm trying to remember. Yes, there were sheets that were already prepared and available when I arrived in 1947.

Q All right, sir. Did you -- in your capacity as an industrial hygienist for Exxon, did you take part in creating additional MSDS sheets or updating the MSDS sheets that presently existed at the time that you came to work for Exxon?

A Yes, I did. I was chairman of that committee that was responsible for those sheets.

Q All right, sir. Did you -- when I said "you," I meant Exxon. Did Exxon send out an MSDS sheet for all of the products that it sold in the stream of commerce while you were employed at Exxon?

A That's too broad for me to tell you that we did but we tried to get them all and I'm not aware of any omissions that we had.

Q All right, sir. For example, take benzene, for example. At some point in time Exxon sold benzene -- and benzene we're talking about is pure benzene -- to various customers. Is that correct?

A Not in small containers that would be of consumer product, no.

Q All right, sir. And I didn't mean to limit it to small containers, Professor Hammond. At some point in time, did Exxon sell benzene to other oil companies or industrial customers in large volumes?

A We did.

Q All right, sir. And at what point in time, to the best of your recollection, did Exxon begin selling these large volumes of benzene to industrial customers?

A At the completion of our benzene extraction plant, and that was in the early parts of 1950, we began to sell the products.

Q All right, sir. Immediately upon selling this large volume of benzene to industrial customers, did Exxon also accompany those shipments with what we talked about earlier, MSDS sheets?

A The MSDS sheets were not appropriate because these went out in volumes, such as pipeline operations, and there were letters in all of the pertinent materials that we knew about from a health standpoint sent along with that, early letters before we sold any of these products to the customer.

Q And I'm confused, Professor Hammond, and perhaps it's the awkward way I've asked the question. And clarify for me, will you. When Exxon sold -- and I'm just using an example. If Exxon sold benzene through a pipeline to, say, Shell, for lack of a better word, would Exxon send an MSDS sheet to Shell or any of its customers at some point in time after the sale of the benzene even if it was transported in pipeline?

A We did that beforehand. Whenever they inquired as to availability of benzene or interest in purchasing benzene, we generally had a very close conference with them and shipped it to them with their full understanding of all the hazards and how to use it.

Q Okay, sir. Are you telling me -- and I don't want to put words in your mouth, but you tell me if I'm wrong here. Are you saying that when Exxon sold benzene to industrial customers that they did not always send what is known as an MSDS sheet to those industrial customers? Is that correct?

A No, that's not right.

Q All right, sir.

A We included the material safety data sheets along with it, but that was not sufficient selling benzene. We generally had to have a one-to-one customer contact with us as the seller, by oral and telephone and letters, and we were very careful not to sell it to anyone who didn't understand all the hazards and being capable to adopt the measures that needed to be made.

Q Okay, sir. Well, then the opposite would be true, then, so that when you did sell benzene, pure benzene to industrial customers, is it your testimony that Exxon always sent out an MSDS sheet along with other letters to those industrial customers?

A The material safety data sheets was just part of the whole package that we sent to them and did not reflect the conferences we had with them, and we were very careful not to sell to anyone that didn't have the knowledge, the technical and medical knowledge, industrial hygiene knowledge to be able to handle it safely.

Q All right, sir. But if we can limit it just to the MSDS sheet, an MSDS sheet from Exxon always went to the customers of Exxon who were buying benzene in large volumes? Is that correct?

A There were also -- in additional to the MSDS sheets, there were also the precautionary labeling that went along to them, and it covered the same area but not as much in detail as we felt was necessary, so we always had to have either telephone or personal conferences with them or send them additional letters and materials.

VIDEOGRAPHER: We need to go off the record for a second. Off the record 10:24.

[Recess]

VIDEOGRAPHER: On the record, 10:40.

MR. SPEARS:

Q Professor Hammond, I was asking you about an MSDS sheet. And I don't want to belabor the point here, but what I would like -- and I certainly don't want to be argumentative with you. But if it's possible, if you can give me a yes or no answer to my question, if it's possible I would ask that you please do that. You have a right to explain it, but if you can give me a yes or no answer to this question, I would appreciate it. And what I'm asking you is: Yes or no, did Exxon send out an MSDS sheet to all of the customers who purchased benzene during your time at Exxon?

A Yes, they did. If someone missed it, it was purely by accident and some problem that I wouldn't know about.

Q All right, sir. And your knowledge of benzene, Professor Hammond, and the dangers of benzene, have you learned anything in the last few years that you didn't already know?

A I'm not aware of anything that was pertinent to the control and use of benzene.

Q All right, sir. Did -- who made the decision at Exxon -- and if it was one person or a committee, I would like for you to tell me. Who made the decision to either send out an MSDS sheet or not send out an MSDS sheet, depending upon the product that was being sold? In other words, who made the decision whether an MSDS sheet was appropriate for a particular product that Exxon was marketing?

A That would be too wide because we were involved with several hundreds of people, salespeople, and if someone should violate the rules of the standard, I wouldn't know about it for that particular person and that product.

Q All right, sir. Is it safe to say that at least while you were working for Exxon, the company always sent out an MSDS sheet accompanying a product that you thought the customer needed to be aware of about the dangers and health hazards and stuff?

A That was a company-wide policy and we did that and if there was any violation it was a violation and not known to the company itself.

Q All right, sir. Let me ask you, among some of the products that Exxon sold to various industrial customers, was crude oil a product that Exxon sold?

A I'm not in a position to answer you about that. That was already established before I came, and it was handled by the marketing department early on and I wouldn't know.

Q How long did you work for Exxon, Professor Hammond?

A From April of 1947 until February 1978.

Q And it's your sworn testimony today that during that time frame that you worked for Exxon you were not aware of the fact that Exxon was selling crude oil?

A No, you misstated me. I didn't say they didn't sell it. They had their customers long before I came; and what they told them in the beginning, I couldn't answer it for you.

Q Yes, sir. Professor Hammond, what I want to know, sir, is while you were working for Exxon, between the time you went to work and the time that you retired, were you, Professor James Hammond, aware of the fact that Exxon was selling crude oil to various customers?

A Yes, I was.

Q All right, sir. Did Exxon send out an MSDS sheet to the various customers who purchased Exxon crude oil?

A Not that I'm responsible for. I did not prepare one.

Q All right, sir. If an MSDS sheet would have accompanied a sale of a product, an Exxon product, would you have had any input on how that MSDS sheet was phrased, during your time frame with Exxon?

A Yes, but I don't know of any situation where that might have occurred.

Q While you were working for Exxon, sir, between the time that you went to work there and the time that you retired, were you aware of any need to send out an MSDS sheet with a crude oil shipment?

A No, not any particular shipment specifically, I would not have been aware of that.

Q All right, sir. It's true, is it not, Professor Hammond, that crude oil contains some trace of benzene? Is that correct?

A That, I'm not able to answer, no, because there is such a wide variation in the fields in which crude oils are produced, it's not practical for me to tell you as a firsthand knowledge of just how much and where it was. I didn't look into that part for any particular customer.

Q Professor Hammond, maybe I misphrased my question. I wasn't asking you to be specific about the percent, the trace percent of benzene in various crude oil products coming from various fields. I was just asking you, based on your knowledge and your experience while working for Exxon, were you aware that crude oil contained a trace amount of benzene in general?

A Yes, I know most crude oils have trace amounts of benzene as well as many other.

Q All right, sir. How did Exxon ship its crude oil to various customers, Professor Hammond? Was it by pipeline, barge, or both?

A Yes, by all means. Much of the crude oil was brought from overseas in tankers.

Q All right, sir. Would it also mean that there were times when Exxon employees in various job classifications would be called upon to handle the transportation of Exxon crude oil?

A Yes, there would have been those occasions.

Q All right, sir. While you were working for Exxon, did you ever feel that your employees who were engaged in the transportation of crude oil, Exxon crude oil, were being exposed to levels of benzene that could be considered as a health hazard?

A No, because we measured the operations, and we knew what they were handling, our employees, and we protected them.

Q All right, sir. The employee for Exxon who was driving a tanker truck during your watch while you were working for Exxon, the employee who was driving a tanker truck just loaded with crude oil and nothing else, what safety measures did Exxon take to protect that employee, if any, from exposure to the crude oil?

A I cannot answer you, no, I do not know.

Q Would that be something that was part of your job, Professor Hammond, to know what rules and regulations were being implemented by Exxon to protect the health and safety of its employees?

A No. That individual tank driver and his knowledge of the crude oil would not have come to my attention.

Q All right, sir. My question, sir, was: How would the driver of the tank truck who was hauling Exxon crude oil, how would he be informed by Exxon, if at all, that the crude oil which he was transporting carried some percent of benzene?

A No, I wouldn't have had that type of intimate knowledge of the driver and his load.

Q Well, did Exxon make it a policy -- while you were working for Exxon, did they make it a policy to notify all of their drivers who were transporting crude oil products of the fact that there was some trace amount of benzene in the crude?

A No, not to my knowledge, I do not know.

Q All right, sir. The individuals who were handling the transportation of crude on barges for Exxon, what information, if any, would be conveyed to those Exxon employees who were handling crude oil for Exxon on barges about the fact that the crude may have some trace amounts of benzene?

A It was covered by our policy that all of the employees associated with dock operations, including barges and tankers and so forth, were under the medical surveillance program all the time.

Q All right, sir. And I gather that the drivers of the tank trucks who were carrying crude oil were not under a medical surveillance program similar to the one that you had for the dock workers. Is that correct?

A No, not to my knowledge. However, their truck drivers all were subject to periodic physical examinations to determine if they had any changes. It would have been indicated that they were being exposed.

Q Are you saying that all of the Exxon truck drivers who transported crude oil were periodically tested for exposure to benzene?

A They had medical examinations that did cover the blood picture, and any changes in the blood picture would have been detected for them.

Q Professor Hammond, throughout your career -- and it's been a very distinguished career, and I agree -- throughout your career with Exxon, were you aware of any literature indicating that a person could contract a leukemia because of exposure to trace amounts of benzene?

A I cannot answer, no, I cannot answer you positively.

MR. BAGGETT: Unless you define trace amounts. And I think you do need to define that, for that question to have any relevancy. If it's synonymous with low dosage exposure, then it becomes relevant in '48 or earlier. So I'm saying that you've got to define that, for it to be relevant.

MR. SPEARS:

Q Professor Hammond, did you understand my question?

A No, I did not. I don't know what you mean by trace amounts, nor the condition in which the worker was working. I do know that they were all under medical surveillance for any changes that would have been significant for that product, benzene, or for any other chemical that they might be handling.

Q Professor Hammond, have you yourself ever used the word trace amount of benzene in any testimony, in any deposition?

A I may have, and that would be referring to materials that were less than one part per million or less than detectable amounts.

Q Do you consider the amount of benzene in crude oil that Exxon marketed to be trace amounts of benzene?

A I cannot answer that, no.

Q Would that be something that was within your job classification to know whether there was -- what percent of benzene was in Exxon crude?

A No, it surely would not have been because of the thousands of sources of the crude oil and including overseas operations.

Q Well, Professor Hammond, you stated earlier in your deposition that you never considered any level of benzene exposure as being safe. Is that correct?

A That's true, zero for everybody because of susceptibility. But you can collect those people, identify those people easily by a good program, medical surveillance, every annual examinations.

Q My question was: If you felt, while you were working for Exxon, that there was no safe amount of exposure to benzene except zero, are you telling the court today that you were not aware of the percent of benzene in the various Exxon crudes that was being marketed by Exxon?

A Yes, I would want the court, the jury, to understand that we didn't take any chances on letting crude or any other product be handled by our employees without knowing its effect upon them, and we could detect that because we had a good medical surveillance program that was ongoing with all of these employees.

Q Well, what percent -- don't you need to know the percent of benzene in crude in order to make a reasonable determination of whether that percent of benzene constitutes a health hazard, Professor?

A No, you do not. You have to be backed up by the medical surveillance examinations that would detect any sign of benzene exposure and to warn you because of the thousands of different locations of fields and different composition of the crude oil you might run into.

Q So it's your testimony as a chief industrial hygienist for Exxon, you were not concerned with the various percents of benzene in crude oil? It didn't concern you to even know whether it contained a certain percent or not?

A I would restate, my position was to protect all employees from exposures that would be significant. And the way that I had, the method of detecting that was by the physical examinations that were being performed on these individuals every year as to whether or not there was any blood changes that could be associated with benzene. That would be the practical and only way you could really set up a program as I set up to handle the protection of the employees.

Q Professor Hammond, tell me if I'm stating this awkwardly. And if I am, I'll try to rephrase it. My question to you is: In order to determine if a product constitutes a health hazard -- and I'm talking about an Exxon product -- isn't the first thing you have to know is what percent of benzene is in that product before you can determine if it is or is not a health hazard?

A Yes, you are talking about products that we would be selling to the public or to the market. We analyzed every potential material, that would go out, for benzene concentration. And there must be 25 or 30 of those, and we tabulated that in terms of the quantity of benzene in them, and that was mailed out with our material safety data sheet. And I thought possibly you already have a copy in your files. I would hope you might have.

Q Okay. Professor Hammond, while you were working for Exxon, did you ever consider the percent of benzene in Exxon crude to be of any concern from a health and safety standpoint?

A No, because there is no safe concentration of benzene that you can handle in the field without control; and you have to be able to detect the employees, whether or not they are being exposed, by some other means than going out and sampling every batch of crude oil that you might be shipping. And if you don't have that types of means of medical surveillance, you really are not meeting your requirements of protection of the employees. We did have that program established and we worked at it very earnestly and very hard and as a result we never had any problems with benzene.

Q Did Exxon do blood tests on all of the employees of Exxon, every single one of them, every year?

A Not every single one. If they were young and had no potential exposure to chemical products of any nature of that type, we didn't do that, but about once every three years we would give the physical. But all the people who were handling products that you have enumerated here would be under that program at least once a year.

Q It's your testimony today that all of the Exxon employees who handled the transportation of Exxon crude oil products regularly took blood tests as part of their physical?

A They did.

Q All right, sir. At what percent -- and I'm going to use Exxon crude for an example. At what percent do you consider the benzene content to be trace amounts, if we're talking about Exxon crude?

A Anything above zero.

Q All right, sir. So you're saying that any benzene content at all in crude oil products constitutes a trace amount?

A I did not say that. Anything above zero in the crude, and there may be products of crude oil that do not have any benzene in them.

Q Are you saying that Exxon had crude oil products -- we're talking about crude oil. I misspoke. Did Exxon have crude oil in its process that contained no benzene at all?

A I do not know.

Q The term Toxigram has come up a few times, Professor. What is a Toxigram?

A That was a name we gave to our precautionary labeling sheet and where we explained the reasons for the cautions that need to be taken in handling a product or need to be made aware to the customer or to the employee to protect them.

Q What's the difference -- and tell me if there is a difference -- between an MSDS sheet Exxon and a Toxigram Exxon?

A The sheet is really described legally by the federal, state people, and that just briefly outlines the particular characteristics of a product that would cause you to be safety conscious or healthwise concerned about their product, but it doesn't tell you anything more than the very basics. Whereas, the material safety -- our Toxigram went into full details to disclose all that were known, in a very brief summary, of the hazardous nature of the material and how to protect it and how to prevent it and much else.

Q Can you tell me what point in time the Exxon Toxigram appeared in correlation with the Exxon MSDS sheet? Which one came first?

A The precautionary labeling came first.

Q That would be the Toxigram?

A And that would -- and the Toxigram became available about 1951 or '2 --

Q All right, sir. So the MSDS --

A -- to my knowledge.

Q The MSDS sheet came first, and then the Toxigram came about in the Fifties?

A Early Fifties, yes.

Q All right, sir. Professor, as part of your job description as an industrial hygienist, is it fair to say that you try to keep up with the literature dealing with health hazards in the industry?

A Yes. And I don't know what particular health hazards you're looking for.

Q I didn't try to make it too broad, and I apologize if I did, Professor. I was saying that in your job capacity as chief industrial hygienist for

Exxon, did you feel it part of your job duties to keep up with the medical literature in general dealing with health and safety hazards in the petroleum industry?

A I did.

Q All right, sir. Are you aware of any study written by any individual indicating that a person who handles crude oil, in the transportation of crude oil, is susceptible to leukemia or any disease at all?

MR. BAGGETT: I'm going to object to that unless you make the hypothet complete and say crude oil containing percentages of benzene because the benzene is where the warning has been made. I object. And certainly it will be proven, if it hasn't been proven already, that it's common knowledge in the industry that crude oil contains benzene. So I object to your hypothetical question as being incomplete.

MR. SPEARS: Fine. Your witness indicated earlier that not all Exxon crude oil contained benzene, Bill.

A No, I did not. I'm not aware of any that did not contain benzene.

Q I'm sorry. Are you saying that all of

Exxon crude oil contained benzene? Is that your statement today?

A There may be -- not to my knowledge, but it may be that there was some field or some area where benzene didn't occur.

Q Is it a safe assumption to assume that most, if not all, crude oil that comes from the ground contains some percent of benzene?

A Contains some amount of benzene?

Q Some percent.

A Any percent? I'm not sure where your percent starts and stops.

Q I wasn't trying to quantify it, sir. I just asked you: Is it a fair statement to say that most, if not all, crude oil contains some percent of benzene?

A The reason it's so difficult, I might explain to you that one percent benzene is 10,000 parts per million, and certainly that would be considered a very hazardous material, if not handled properly.

Q I'm going to ask you again, Professor, and tell me if you can answer this. Is it fair to state that most, if not all, crude oil contains some percent of benzene?

A To my knowledge, I would not know which particular product, and I can't be specific to you to tell you with all authority of the world that I would like to, yes, there is some materials in the form of crude oil that does not contain benzene, but I don't know of those.

Q All right, sir. Is it fair to state that while you were working for Exxon and your knowledge of the crude oil that Exxon marketed, that all of the Exxon crude contained some percent of benzene?

A No, no, I cannot tell you that.

Q You cannot say that?

A No, I cannot tell you.

Q So are you saying, then, there is some crude oil products that does not contain benzene?

A I do not know of them, and I would want -- wouldn't want to exaggerate. I'm not aware of any benzene-free products.

Q All right, sir. Going back to my original question, then, and Mr. Baggett has made his objection. Are you aware of any articles written in the literature indicating that a person who handles crude oil, in the transportation of crude oil, is at a higher risk of contracting leukemia?

MR. BAGGETT: I still come back and say

it's not a complete question unless you enumerate whether or not it contains benzene and the percentages that it contains.

MR. SPEARS: The objection is made.

Q Professor, can you answer my question?

A Repeat your question.

Q Yes, sir. Are you aware of any literature while you were working for Exxon or any literature that you have read up until today indicating that a person or persons who handles the transportation of crude oil is at a higher risk of contracting leukemia?

A Yes, I would just relate to you what we considered was a minimum safe program to have all of our dock workers and other handling, loading and unloading cars, trucks, and so forth, with any regularity or with any routine practice to be under the benzene control program.

Q I'm going to respectfully object to your answer, Professor Hammond, as not being responsive to my question. My question to you, sir -- and tell me if I'm not being clear. I'll try to be clear. Are you aware of any literature, medical articles, while you were working for Exxon or any articles that you have read since leaving Exxon, indicating that a person or persons who handles crude oil, in the transportation of crude oil, is at a higher risk of contracting leukemia?

MR. BAGGETT: Same objection I made earlier.

MR. SPEARS: All right, sir.

Q Are you aware of any such literature, Professor?

A To my knowledge, it was necessary to consider these people handling any crude oil or any other petroleum products that there were benzene present and we needed to take the precautions to have them on the program.

Q Professor, we're going to be here a long time, sir, if you don't answer my question. And I don't want to be argumentative with you. I'm asking you about literature. Do you understand what a medical article is?

A Yes, I do, and we prepared our materials out in advance of any other. So I already knew what you were asking as being necessary to be done.

Q I'm going to try to take it step by step.

MR. BAGGETT: Ken, I'm going to object to you pursuing this line unless you tell him whether or not the crudes involved contains benzene or not.

You are trying to delineate it to crude, quote, and you can't do it without knowing what the components of crude are for it to have any relevance to this litigation.

MR. SPEARS: Bill, I appreciate your objection. I really don't believe the professor is answering my question, so I'm going to try to pursue that.

Q While you were working for Exxon, Professor Hammond, did you read medical articles or literature from various medical publications? Yes or no.

A No. In regard to what you're getting at, I do not understand the question. But, no, I didn't read any such articles.

Q Now, tell me how you can operate as a chief industrial hygienist for Exxon without reading medical articles and literature.

MR. BAGGETT: I think his answer, you missed -- your question is objectionable to form because you misstate what he has responded, and you missed -- you are not articulating it correctly. He said which you are referring to, which is crude, whether or not it contains benzene. It's the same argument we're facing.

MR. SPEARS:

Q My question didn't say anything about crude, Professor. I want to take it step by step with you. While you were working for Exxon as chief industrial hygienist, did you or did you not read medical articles and medical literature dealing with the safety and health hazards of products in the petroleum industry? Yes or no.

A Yes. And I think that I should explain that. It would average between 30 and 40 journals a month and covered all hazardous materials in the nature of occupational diseases.

Q All right, sir.

A There were none, neither English, nor French, nor Italian, or German that came to my attention that I didn't get a translation and read, if it was something new.

Q All right, sir. Now -- excuse me. Are you finished?

A As well as English.

Q All right, sir. Now, referring to all of those articles that you just articulated, all of the articles that you have read during your career with Exxon, do you recall reading any article indicating that a person or persons who are in the business of transporting crude oil are at a higher risk of contracting leukemia?

A No, I don't remember that detail.

Q All right, sir. In the articles that you have written -- I mean read and just articulated, are you aware of any articles from that literature indicating that a person or person who transports gasoline is at a higher risk of contracting leukemia?

A No, at this time I don't remember any specific article.

Q All right, sir. When you were working for Exxon, did Exxon send out an MSDS sheet to the customers who purchased gasoline, sir?

A Yes, we did, regularly, and it was a well established program.

Q Was that something that was established after you came to Exxon, or was that something that was already implemented when you came to Exxon?

A It was already an ongoing program.

Q So each customer who purchased Exxon gasoline would have received an Exxon MSDS sheet. Is that correct?

A I cannot answer that, no, because there were millions and millions of people buying gasoline that I wouldn't know about. And I haven't taken an interview with all of them.

Q I understand, sir, and it wasn't -- maybe I didn't articulate my question. It was Exxon's policy, then, to send out an MSDS sheet accompanying all gasoline shipments to customers. Is that correct?

A Again, that's too broad for me to be able to answer it, because all shipments, and it might have been some that were shipped that they did not follow the policy of the company.

Q Did each product that Exxon used an MSDS sheet with, did each such product also have a Toxigram accompanying it when the Toxigram policy came into effect?

A No.

Q How would you make a determination about whether a particular product had an MSDS sheet that went with it but not a Toxigram?

A By knowledge of the particular hazardous nature of the material. If it was just strictly limited to explosion and fires, we would not put out a Toxigram on it.

Q Did Exxon send out a Toxigram on crude oil that it marketed to its various customers, to your knowledge?

A I can't remember that we did.

Q All right, sir. Would that be something that would have been within your department to know if such Toxigrams were or were not being sent while you were working for Exxon?

A No, it was never brought to my attention. But had it been a material of a hazardous nature other than the ones I mentioned, I'm pretty sure that my committee would have been the one to devise such a Toxigram if we needed it.

Q As part of your work with Exxon, did you from time to time actually go out into the various physical plants belonging to Exxon or Humble to do surveys?

A I did.

Q All right, sir. Did you go to the Baytown facility on occasion?

A I did.

Q All right, sir. When you went to the Baytown facility, did you take readings of, for example, benzene in the atmosphere?

A In some time, where it was indicated.

Q All right, sir. When you visited the Exxon facility in Baytown and specifically took readings for the benzene content in the atmosphere, do you recall if you ever found any benzene present at 20 to 30 ppm?

A I don't think I was ever there when that type of concentration was created, no.

Q Would you consider that to be a high concentration of benzene in the atmosphere, sir, or a low concentration?

A Anything above zero levels of benzene persisting in the air where employees might be exposed is entirely too high.

Q All right, sir. If there were readings at the Exxon facility in Baytown of 20 to 30 ppm of benzene at various times, would you consider that to be a violation of Exxon policy?

A It would be very strictly a violation, and the individuals that had a potential exposure would always be under our medical surveillance program and the biotesting program of urinary phenols and other measures that we take.

Q All right, sir. You consider, Professor Hammond -- and correct me if I'm wrong. You consider the benzene facility that was constructed at Baytown, when it was constructed, to be, quote, state of the art as far as safety?

A It was an advanced pioneering plant that was constructed with the best procedures we could devise and think of. And all of this was published and you have copies, I'm sure.

Q Yes, sir.

A But no secrets about any of our exposures nor how to control them that we knew about. That was clearly brought out to me the first two or three months I was with the company, that we had no secret on health and safety matters, from our competitors or anyone else.

Q All right, sir. I want to show you a document, Professor, that I'm going to mark as D-1. It's dated February 13, 1958, addressed to Mr. T. S. Howell at Baytown. Who was Mr. T. S. Howell?

A Dr. Howell, he was a physician in the medical department.

Q All right, sir. Take a second to read that, Professor.

A All right.

Q All right, sir.

MR. BAGGETT: Excuse me. May I see that?

MR. SPEARS:

Q Professor Hammond, specifically with Exhibit D-1, dated February 13, 1958, this indicates to me that this was a written -- you memorialized one of your visits to the Baytown facility at which time you participated in some air sampling. Is that correct?

A I don't recall the details of that safety trip, no.

MR. BAGGETT: Of course, I object to what it appears to you. The document speaks for itself, once it's authenticated.

MR. SPEARS:

Q Professor Hammond, this document which is D-1, and I'll quote from it, indicates that -- it said: We found that the concentration at the eye wash fountain near the oil separator at breathing level was 20 to 30 ppm. Is that what the document says?

A Yes.

MR. BAGGETT: Excuse me. Just so my objection is reserved until that document has been authenticated to be what it purports to be, and then it would speak for itself. I just want to reserve my objection.

MR. SPEARS: Do you have any reason to believe that this is a false document?

MR. BAGGETT: I have no reason to believe anything about it because the proper foundation hasn't been laid for reference to it. And you can question him about it; but until it's authenticated, then I've got to object, Ken. I'm sure you will do what you've got to do to get it into evidence, if it's relevant.

MR. SPEARS:

Q All right, sir. This document that is Exhibit D-1 indicates that the ppm concentration of benzene at the breathing level near the eye wash fountain was 20 to 30 ppm. Is that correct?

A No, it doesn't tell me how long it had been 20 to 30. A leak had just developed, apparently, at that area and they had to do some plumbing to correct it, to close the leak.

Q Let me read it to you, Professor, and tell me if I'm reading this wrong. It says: We found that the concentration range at the eye wash fountain near the oil separator at breathing level was 20 to 30 ppm. Is that what it says?

A It says more than that, to me. It says that we were on the job, and as soon as the leak had developed that we were on top of it to take care of it. And it was an ongoing program, and we didn't -- as you see, we didn't tolerate it to be there. And the people that were exposed to that, potentially exposed to that, was under medical surveillance, and it tells me that we run urinary phenol on the people and make sure, medically supervision of it, that they would be examined to make sure they hadn't been exposed to any benzene. It just further expands what I've been trying to tell you. We had an airtight, gastight ongoing program for our company. We were very proud of that letter. Glad you brought it up. The jury would understand that we were on the job and we had a program to take care of any situation that might develop.

Q Then you recognize this letter as a letter that you would have generated as part of your surveillance of the Baytown refinery?

A I generated that letter and am very proud of it.

MR. BAGGETT: Then I withdraw the objection.

MR. SPEARS:

Q Okay. Professor Hammond, then, this -- and correct me if I'm wrong, but -- and I would like for you to tell me, if you can, in a yes or no answer, does this letter state, yes or no, that a concentration of 20 to 30 ppm of benzene was found at the eye wash fountain near the oil separator at breathing level? Yes or no.

MR. BAGGETT: Ken, that letter speaks for itself. I've already said that. If you're trying to attach some significance to it because of taking something out of context, not listening to the doctor's -- professor's testimony, then that's not fair to him. And he's explained that letter, what it means to him, and you're taking something out of context which speaks for itself.

MR. SPEARS:

Q Can you answer my question, Professor?

A Repeat your question.

Q Does the letter, that you said you are very proud of, indicate that you participated in air monitoring and found a 20 to 30 ppm level of benzene at the breathing level at the Baytown refinery near the oil separator?

A Yes, and it illustrates how alert we were to be on the job to make sure that no one was exposed to that. And we have no proof until we run our medical surveillance and urinary phenol whether anyone might have been exposed to any concentration. And the matter of them drinking water at that fountain would be maybe not long enough for them to show up in any picture, but we corrected it without any assurance that anybody had ever been exposed.

Q Does this letter that I have marked as Exhibit D-1 indicate also that there were two or three other locations where you found leaks, such as dripping sampling cocks?

A It does. And that, again, it tells you how strong and strict our program was, how thorough it was, how we were on the -- daily we were on the job, and we just didn't let people be exposed to benzene. We felt that zero level was the only one that was safe for them.

Q How many times did you go to the Baytown facility to take such tests as exhibited in D-1, on a weekly basis, Professor?

A Entirely depends upon the need for my presence.

Q Did you have to be there for this sampling, air sampling to take place, or somebody else could do it?

A I had a Ph.D., Dr. Herman was there on the job 24 hours a day, as far as the need, and he was thoroughly capable of -- as well as several other people in the refinery -- to make samples and take samples.

Q Well, thank you, Professor.
Who is J. A. Allen, Mr. Hammond?

A Where did you find out Mr. J. A. Allen, and what occasion?

Q I'm asking you, do you know a J. A. Allen?

A Well, I know Allens. I don't know if it's J. A. specifically, but there are a lot of Allens in this world.

Q You do not recall the name J. A. Allen?

A I do not recall that individual.

Q Do you recall a Mr. E. F. LeBrocq?

A Yes.

Q Who is he, sir?

A He was an assistant industrial hygienist that worked at the Baytown refinery some, as well as other locations, yes.

Q And who was Mr. B. G. Simpson, sir?

A He also was an associate for Mr. LeBrocq, and they worked together. And I have it in mind they were stationed for a while at the Baytown refinery.

Q All right, sir. I'm going to show you a document, Professor Hammond, that I've marked D-2, which on the cover sheet indicates it's an Exxon p227 is missing from BC's original

Q But on page 1 of the document, Professor Hammond, does it not indicate that there was significant potential for exposure to benzene to some of Exxon employees?

A It does not say anything about whether were really exposed, it just said potentially exposed. And also, they probably had to be wearing respiratory protection while they were doing that, as a general practice.

MR. SPEARS: I'm not finished. I want to ask him some more questions.

MR. BAGGETT: Has that been marked for identification?

MR. SPEARS: D-2.

Q These type of surveys were done routinely within the Exxon plant, were they not?

A That's right. It illustrates -- what year was that?

Q 1975, sir.

A Well established program had been running for more than 20 years, and those individuals were tested regularly.

Q Professor Hammond, again on page 1 of Exhibit D-2, which is the industrial hygiene study of the aromatics extraction unit at the Baytown chemical plant, dated October 1975, does it not indicate that high concentrations of benzene were found coming from open sewer grates in the facility and that this study recommended that introduction of aromatics to the sewer should be eliminated? Is that not what it says?

A It does that. And, again, it illustrates how carefully we were monitoring at the refinery and all the operations ongoing because the people who worked at that unit had been on our medical surveillance program for at least 20 years and it was probably due to -- and that had been surveyed many times without finding a condition. Indicates that there had been somewhere a cross connection or a leak that developed and needed to be corrected, getting into storm sewers.

Q All right, sir. And does the report indicate how long this particular problem was allowed to go on?

A You have the report. That was a violation of our rules if it was knowingly allowed to go even for one day, that would have been in serious violation of our standards. And that was the reason it was so interesting to me that they had found probably a brand new leak, a development shortly after it had developed and never did show up in any of the medical finding and medical surveillance that was ongoing for our people. Those persons working in that unit had been on -- about 1975, they had been on 30-odd years at least, maybe 40, of the medical surveillance for indications of benzene exposure.

Q Professor Hammond, in 1975, what did you consider to be the threshold limit value of exposure to benzene?

A Zero.

Q All right, sir. And was that a company policy, sir?

A That was a company policy since 1947.

Q All right, sir.

A That I know about.

Q All right, sir. Let me show you page 6 of Exhibit D-2 where there is a specific date of October 7, 1975, indicating a sample location and benzene being found, and there is a threshold limit value put next to it in another column. What is the threshold limit value of benzene in that document, sir?

MR. MYERS: What is it?

MR. SPEARS:

Q Yes, what number is it, sir?
A 10.
MR. BAGGETT: And he can explain that if he wants to.
A And they talked about the air contamination level, parts per million. We measured one part per million, see, it shows here, but 10 would have been legally acceptable if the NIOSH people or the OSHA people, they come in, or the State Department of Health, anyone in enforcement. That's the only reason that's put there. Just shows how much better we ran our company. I'm very proud of that.
MR. SPEARS:
Q All right, sir. And this document, if one would look at it, it's an Exxon document and it does say on its face the threshold limit value of 10 ppm for benzene. Is that correct?
MR. BAGGETT: Ken, that's misstating and that's really misleading. The man has said that was the legal TLV, but he said Exxon's TLV was zero by their policy. And that's been spelled out. And what you are trying to do is put something contrary in the record. The document speaks for itself, and it's been explained. So I object as to the form of the question because it's an improper summation of

what's previously been said.

MR. SPEARS:

Q All right, sir. Professor Hammond, subject to that objection, this Exxon document D-2, does it not state, where my finger is, Threshold Limit Value (ppm)? Is that correct?

A The purpose of that is not that we were using that value as a health measure, but to let the supervisors and management know that if someone came in, an officer came in from either NIOSH or from the State Health Department or the County Health Department, that we would not be charged with a legal violation of the OSHA or the State Department of Health. That's all, just for management and supervisors' knowledge. They maybe didn't know what it might be, whether that one part per million was in violation or not.

Q All right, sir. I'm going to ask you the question again, Professor Hammond. The document at page 6, Exhibit D-2, does it not state Threshold Limit Value? Is that correct?

A No, it only states what the legal enforcement level of the product would have been.

Q I'll ask it this way, Professor Hammond. Would you read to me what I've highlighted in yellow on page 6 of the document?

A No, I see no purpose in my reading that.

MR. BAGGETT: It speaks for itself. He's explained it a thousand times.

MR. SPEARS: Well, he's done a lot of things, but explaining it he's not.

MR. BAGGETT: He has explained it. He's explained that the paper has a threshold limit value of 10, why it's there, for management, and what it is, is the legal limit. And it's not inconsistent for him to say that Exxon's adopted standard was zero.

MR. SPEARS: We're going to get to that in a minute, but right now I want to talk to him about what the document says.

Q Does the document say threshold limit value 10 ppm, Professor Hammond?

A I agree he read that into the record.

Q And I read it from the document? You can't read that, Professor Hammond?

A I see no purpose in my reading it.

Q Can you read it?

A What part?

Q The part that I have highlighted in yellow.

MR. BAGGETT: Sir, we'll stipulate that subject to his explanation which has been given umpteen times that the document says threshold limit value 10. We'll stipulate to that.

MR. SPEARS: All right, sir.

THE WITNESS: Very proud of that.

MR. SPEARS:

Q I'm going to show you -- refer you to page 12 of this document, Professor Hammond, which is the 1975 industrial hygiene study of the aromatics extraction unit at the Baytown chemical plant. I'm going to ask you if it does not state that the allowable standard for short-term exposure to benzene is 25 ppm?

A The allowable standard for law enforcement, yes, is 25 parts per million.

Q Is that what the document states?

A Not necessarily, but that's there because we have basically the zero control for our standard, and everyone knew it, even a new employee like Simpson and LeBrocq.

Q On page 6, where you and I got into an argument, and I apologize for you, you wanted to tell me that 10 --

A You don't need to apologize to me.

Q Well, when I asked you what the threshold limit value was of 10, you said the significance of that was 10 was the legal limit. And on page 12 of the same document, it says the allowable standard is 25 ppm, does it not?

A Let me explain to you. For short-term exposure is five, from five to 15 minutes. And that is part of the problem with you not being professionally trained trying to interpret the ACGIH standard. And that has definite meaning of the purpose of having it 25 parts per million.

Q Well, are you telling me that there was a 10 ppm legal limit that you understood and then there was a 25 ppm allowable standard? Is that what you are saying?

A Do you know what the 10 parts per million covers, what period it covers, and how you go about determining that?

Q Let me ask the questions, Professor Hammond, please.

A Well, I'm trying to get you to understand what I'm saying. We had a zero level, and we were putting down here the OSHA and the State levels that would be enforceable by law if you violated them.

Q Well, the level that you were concerned about enforcement, was it 10 ppm or 25 ppm, in 1975?

A Neither one for our purposes. This is an internal report that was going to people who were knowledgeable and knew what the program was.

Q Does this document at page 12, which is the industrial hygiene study of the aromatics extraction unit, Baytown chemical plant, dated October 1975, indicated that one of the practices that you discovered or was discovered in this survey was exposure to benzene caused by flushing sample lines to the pad in the unit?

A That says that should be corrected, that be stopped. Who set up the method of flushing sample lines, I do not know. But anyway, my industrial hygienists detected it, and they put a practice, a stop to it.

Q Okay, sir.

A Again, we had an alert team, and we didn't let any of those type of conditions exist. So it's another proof of our good program.

Q Well --

A And all of those -- point out again, all of the operators that worked around that unit were on our benzene exposure medical surveillance list.

Q Professor Hammond, while you were working for Exxon, certainly in the early years, say, in the Forties, Fifties and Sixties, Exxon had or the company had company-owned service stations, did they not, throughout the country?

A They did.

Q All right, sir. And most of those what we used to call full-service service stations have just about disappeared by now, have they not?

A I am not able to make any intelligent evaluation of that.

Q What I meant was that there seems to be a proliferation of self-service service stations now; but back in the Forties and Fifties and Sixties, there were very few self-serve service stations, weren't there?

A I'm not aware of the numbers. Today most would have several pumps that might be full service; you can get all of the red carpet treatment you want if you stop in there, sir.

Q While you were working for Exxon during the time frame when they had full-service Exxon service stations, did you consider the person or persons who were pumping gas in the cars on a regular basis to be at a risk of contracting a leukemia or a cancer?

A I did not because that had been studied by the United States Public Health Service and various state organizations, and they did not ever classify it as being hazardous.

Q Okay, sir. Were you aware, when these self-service service stations were using Exxon gas in the Forties and Fifties and Sixties, that those Exxon gasoline products contained some amount of benzene?

A No, I could not give you any amount or help you in that question.

Q I didn't ask you an amount, Professor, and maybe I awkwardly phrased my question again. While you were chief industrial hygienist for Exxon, during your watch, were you ever aware that Exxon gasoline contained any amount of benzene?

A No, I was not.

Q You were not aware of that?

A No, because we had extracted every drop of benzene we could possibly get from these potential gasoline products before they got to the gasoline stage, and selling them as fuel was a money losing proposition if we could extract it out.

Q So it's your testimony here today that to the best of your knowledge, the Exxon gasoline that was sold during your tenure contained zero percent of gasoline -- of benzene?

A No, I could not say that. I never did see an analysis of all the gasolines that we sold.

Q Well, were you aware of the fact that Exxon gasoline, in the Forties, Fifties and Sixties, contained any amount of benzene whatsoever, Professor Hammond?

A No, I was not aware of it.

Q Is that something that you should have been aware of?

A No, it would not have been my responsibility. That was a public health problem.

Q Why would you consider it a Public Health problem?

A Because they were all over the outside and many owned their own stations and we had no either privilege nor authority to investigate them; whereas, the Public Health people were responsible for that.

Q It's true, is it not, that many of the service stations that Exxon owned in the Forties and Fifties and Sixties were owned by Exxon?

A They were.

Q All right, sir. And the employees at those service stations were Exxon employees?

A Some of them were.

Q All right, sir. You did not consider the fact that those Exxon employees were pumping gasoline that contained some amount of benzene as being a possible safety hazard?

A No, and I doubt if they ever had any exposures.

Q Why do you say that, Professor?

A Because the nature of the material we sold.

Q I thought you weren't aware of the benzene content at all of the gasoline that you sold.

A I'm not aware of all of them, and I'm only speaking for the Public Health aspects of it that they were never brought to anyone's attention that it was a hazardous operation.

MR. SPEARS: Take a break for a second.

VIDEOGRAPHER: Off the record, 11:48.

[Recess]

VIDEOGRAPHER: On the record, 11:54.

MR. SPEARS:

Q Professor Hammond, I was asking you, just before the break, about the Exxon service stations in the Forties and Fifties and Sixties that were owned by Exxon and run by Exxon employees, and if we can limit my question just to those service stations. Did you consider the fact that those Exxon employees were pumping gas on a daily basis into cars as being a source of potential health hazard for those employees?

A That was not my responsibility.

Q All right, sir. And why was it not your responsibility? And I'm limiting it just to the Exxon service stations owned by Exxon, run by Exxon employees.

A Those particular individuals came under our contract -- I mean usual program and were examined every year or more often.

Q The individuals whom I'm speaking of would be Exxon employees. You understand that?

A Yes, I do.

Q And they would be pumping gas into cars. Do you understand that?

A I do.

Q All right, sir. Based on your knowledge and experience, do you consider the fact that these individuals pumped gas in cars on a daily basis as being a source of a potential health hazard?

A No.

Q All right, sir. And the literature,

Professor Hammond, that we spoke about earlier in your deposition, I'm talking about the literature in the Forties and Fifties and the Thirties and Forties, back then, that dealt -- that spoke in terms of low concentrations of benzene. It's true, is it not, that 40 years ago a low concentration of benzene was close to 100 parts per million?

MR. BAGGETT: I'm going to object to that unless you can point me to something that says that, that's in the API, which is completely contrary. I don't know how you can define low concentration without defining it for him.

MR. SPEARS: I appreciate your objection, Bill, but I believe the Professor understands what I'm asking. And if you don't, you can tell me, Professor.

Q But it's true, is it not, that the literature that spoke in low concentrations, 40 or 50 years ago, the low concentrations that they were talking about were in the neighborhood of 100 ppm? Is that correct?

A No.

Q Sir?

A No.

Q That's not correct?

A No.

Q All right, sir.

A I do not know what the definition for low concentration was.

Q Let me show you an exhibit, Professor, that I'll mark as Exhibit D-3 which is an excerpt from your testimony under oath in the case of Skeen versus Monsanto. Do you recall testifying in that case, Professor?

A I do.

Q You did testify?

A I did.

Q All right, sir. At page 13 of the transcript, the question was asked of you:

"What is a small amount, 40 or 50 years ago, what was a small amount of the low concentration of benzene?"

And your answer was: "Forty or fifty years ago, the criteria was that we would get it down to below a hundred parts per million."

A That was the legal value.

Q Was that your answer in the Skeen case, sir?

A It was, and it applied to a legal responsibility.

MR. BAGGETT: Taking something out of context, I'm going to object to it until I review the entire deposition, but the Professor has explained it.

MR. SPEARS:

Q All right, sir. Let me ask you again, sir, and this is at page 14 of the transcript of the Skeen testimony. And I'll read you the question verbatim, Professor, from the Skeen transcript.

"So in the literature 40 or 50 years ago, if they discussed low concentrations or small amounts, you could safely assume that they are talking about something in the range of a hundred parts per million; isn't that right?"

And your answer, under oath, was, "Yes." Correct, sir?

A The legal application did not apply until you had gotten above a hundred parts per million. That's what my answer to that is. It doesn't ask what my personal threshold limit value.

Q No, sir. The question that was asked of you is the same question I'm asking of you --

A It was a legal question.

Q 40 or 50 years ago, when you read the documents that are 40 years ago and they talk about low concentration, 40 or 50 years ago, low concentration back then was a hundred parts per million?

A Less than a hundred parts per million.

Q Around that area, right?

A No, not necessarily.

Q Between 75 and a hundred?

A I cannot answer you any better than it was less than a hundred parts per million, legally. Some of the states had adopted 75, and some had adopted 50 --

Q Well, Professor Hammond --

A -- at that time. But legally, Texas, I don't know what it was at that time, I wasn't here.

Q I'm going to refer you again, in the Skeen testimony, under oath at trial --

A That's right.

Q -- you were asked: You could safely assume, 40 or 50 years ago when they were talking about low concentrations, they were talking about something in the range of a hundred parts per million; isn't that right? And your answer was yes. Is that correct?

A Yes, legally, yes, that was right. And --

Q Are you aware, based on your experience, knowledge, Professor Hammond, of any article indicating that benzene is a human leukemogen at a level of 10 parts per million or below?

A Yes, there is a great deal in the literature about that.

Q And how long have you known that, Professor?

A Since 1942.

Q All right, sir. Again, Professor, I'm going to refer you to page 20 of the transcript of the Skeen testimony where this question was asked of you:

"Is benzene a human leukemogen; that is, does it cause leukemia in humans at the level of 10 parts per million?"

And your answer, under oath, was: "I'm not aware of any experiences or cases where it was proven that 10 parts per million caused that."

MR. BAGGETT: I'm going to object to the manner in which you have approached that because your prior question does not allow or serve as a foundation for approaching him with a document that way. What you've asked him a question on and what you just read to him are entirely two different things. So I object to the manner and foundation.

MR. SPEARS: All right, sir.

Q When you testified in the Skeen case, you testified under oath that you were not aware of any cases or anything in the literature proving that benzene was a leukemogen at 10 parts per million. Is that correct?

A I did not have information personally, and that was a medical question I would rather somebody else answer.

Q You have already testified that everything you have known about benzene you have known in the last 40 years, 50 years?

A 50.

Q You haven't learned anything new in the last few years. Is that correct?

A Not that changed my zero concentration necessary to keep --

Q So when you testified under oath in the Skeen case that you were not aware of any experiences or cases where it was proven that 10 parts per million caused leukemia, you were testifying truthfully, were you not?

A I did not know of any tests where they had air samples or any other proof of the exposure level, and I still don't have that information.

Q My question was: When you testified that you were not aware of any experiences or cases where it was proven that 10 parts per million caused leukemia, were you testifying truthfully?

A Yes. You would have to have the case leukemia and you would have to have his work period and concentrations as to how much he was exposed for 40 hours a week throughout his lifetime, maybe 40 years, and I didn't know of any case like that.

Q What is the ACGIH, Professor?

A American Conference of Governmental Industrial Hygienists.

Q Are you a member, sir?

A No, not today.

Q Were you a member?

A I was.

Q Is it a very well respected organization?

A It has its good membership. And in what way or where, who respects it and so forth, would you ask me the question?

Q Just generally in the industry, is the ACGIH respected as being consisting of people like yourself, when you were a member, of knowledgeable people in the industry?

A Generally that was a value that was adopted legally and enforced by some states, counties, cities and nation, is what I know about it.

Q Well, when you were a member of the ACGIH, sir, is it true that the ACGIH classified benzene as a suspected human carcinogen?

A I remember that term and I objected to it but I was just one member of the team. Like all committees, everybody had a vote, and I was outvoted.

Q But my question to you, sir, was, the ACGIH, while you were a member, classified benzene as a suspected human carcinogen. Is that correct?

A I explained it, yes, that's correct. And I explained what it was, where it got there, not that I approved of it. And we didn't have it in Exxon Company. Another good illustration of how we just stepped out ahead and began, in 1947, to enforce a one -- zero concentration as far as our work period.

Q Are you saying, Professor, that the ACGIH -- and I don't want to put words in your mouth, you tell me -- but the ACGIH classified benzene as a suspected human carcinogen, but that was not your opinion? Is that what you're saying?

A I thought it was very definitely a carcinogen.

Q So when in the Eighties, in '86, when the ACGIH classified benzene and kept the classification of benzene as being a suspected human carcinogen, your opinion was it was a known human carcinogen. Is that what you are saying?

MR. BAGGETT: I object to the form of that question until the statement counsel has made is proven.

MR. SPEARS:

Q What was the classification of the ACGIH for benzene, sir, in 1980? Wasn't it suspected human carcinogen?

A As I recall that criteria was behind the 10 parts per million, and a question mark was raised.

Q And it was still called a suspected human carcinogen by the ACGIH, is that correct, in the Eighties?

A Not the entire membership.

Q No, sir.

A But a majority of the members.

Q The membership -- I understand there were votes taken, and the ACGIH had to have a policy. And the statement made by the ACGIH in the Eighties was that benzene was a suspected human carcinogen. Is that correct?

A That was in the TLV handbook, yes.

Q All right, sir. But it's your opinion that despite the fact that the ACGIH said suspected, you knew all long that it was a human carcinogen. Is that what you are saying?

A I had enough information in 1942, by the diagnosticians, to indicate that some people were susceptible at any concentration above zero and would be subject to leukemia and other diseases.

Q Is it your testimony, Professor Hammond, that by the mid 1970s, certainly, or I think -- correct me if I'm wrong -- scratch that.

Is it a correct statement to say that by the time you went to work for Exxon, the very first time, that you were of the opinion that benzene was a known human carcinogen?

A I was.

Q All right, sir. And that has always been your policy?

A No exception.

Q All right, sir. In 1977, Exxon had a material safety data sheet for benzene, did it not, sir?

A It did.

Q All right, sir. And it's true, sir, is it not, that in that material safety data sheet, which you signed, it states that benzene is a suspected human carcinogen?

A That is the term that was used with the threshold limit value.

Q All right, sir. Now, you're telling me under oath that you knew most definitely that benzene was a known human carcinogen since 1940, and yet you allowed a 1977 Exxon material safety data sheet, which you authored, to go out with the term suspected human carcinogen? Is that what you're saying?

A I did.

Q So you just followed what the ACGIH had been doing, suspected human carcinogen. Is that correct?

A That was going out to be utilized by people in the legal manner, that they did not violate the TLVs that had been approved by the ACGIH. I had no authority to override them on these material safety data sheets.

Q Who sent out the material safety data sheet for Exxon? Was it the ACGIH or Exxon?

A Exxon.

Q And who was in charge of the policy

implementing MSDS sheets? Was it Jim Hammond or the ACGIH?

A Our Toxigrams speak for themselves on that matter. Do you have a copy of that?

Q Professor Hammond, who was in charge of the MSDS sheets and the language contained therein for Exxon in '77? It was Jim Hammond, wasn't it?

A Not Jim Hammond alone. We had a committee. And I had to, again, have the problem of being a minority member that believed it should be definitely spelled out, but I didn't have the vote on the committee to see that it was.

Q Well, once you got away from the committee, when you were allowed to send out an MSDS sheet to the people who were buying benzene, in 1977, you put suspected human carcinogen. Is that correct?

MR. BAGGETT: Wait a minute. You have said an awful lot there that I object to the form of the question, until that is proven that until he got away from the committee, et cetera. I don't know that that's a fact, so I object to the form of the question.

MR. SPEARS:

Q Answer the question, Professor.

A My answer is that the sheet went out that way, and it went out because it had legal obligations to meet and that was in compliance with the legal. But the people who interpreted that should be qualified professional people who knew the background and the knowledge. And it was quite plainly in literature that susceptible people were not to be exposed to anything above zero. And that was our internal company policy.

Q But if someone were to read your 1977 MSDS sheet authored by Jim Hammond and it said on there suspected human carcinogen, would they be allowed to assume that Jim Hammond was telling them the truth?

A You surely would because that should alert them to go and make the investigation to find out how, why and what risk they would be taking by adopting that susceptible --

Q But --

A That's a weasel word.

Q But truth and fact, Jim Hammond was not saying the truth in that 1977 --

A I was not -- I was saying -- I was saying susceptible is acceptable in that particular case, but it wasn't my opinion.

Q You were saying, in the 1977 MSDS sheets sent out by Exxon, which you signed, that benzene is a suspected human carcinogen, while at the same time you knew, in your own mind, you were convinced it was a known human carcinogen. Is that correct?

A I applied the known wherever I had the authority to do it. But only -- as I said, the only thing that ACGIH 10 parts per million told you was susceptible but not that I approved of it.

Q Professor Hammond, it's true that while you were working for Exxon, you never recommended or worked towards a goal of zero exposure to benzene. Is that correct?

A Wrong. Do you have a copy of my letter of 1953 to Mr. Wrightman? It should be part of all of our exhibits here. Wrightman and I told them in 1948, and if you didn't have zero concentration you must put in all the medical surveillances and monitoring and so forth to make sure the people wasn't susceptible to it.

Q Professor Hammond, my question to you, in the real world it was not practical to work towards a zero exposure level of benzene, was it?

A Yes, it was. We did.

Q And that's always been your position?

A That's been my position ever since I have been -- 1942.

Q Professor Hammond, I'm going to refer you to page 74 of your sworn testimony under oath in the Skeen case. You recall testifying in that case, sir?

A I do.

Q All right, sir. And the question was asked of you at page 74:

"'The statement has been made informally that the maximum allowable concentration for benzene should be zero.' Do you remember that?"

And your answer was, "I heard that."

And the question was, "You don't agree with that," do you?

And your answer was, "I don't think that's practical that you can live that way."

"No. I don't recommend zero as a limit."

MR. BAGGETT: Wait just a second. You asked him a question and then propose to present him a document. You asked him one question which is not contrary at all, and you're suggesting that now he said something different. He hasn't. The proper foundation hasn't been laid for the way that you have proceeded here. You asked him one question and then present an answer to the other.

MR. SPEARS: Thank you, Bill.

MR. BAGGETT: And so I object to the form of your question.

MR. SPEARS:

Q Under oath, when you testified in the Skeen case in 1986, you testified under oath that you did not recommend zero ppm as a limit. Is that correct, sir?

A No, not that way you have stated it, no.

Q Read it, sir.

MR. BAGGETT: That's great, read it because, Ken, you are saying that you recognize maximum as a limit, and that isn't what he says.

MR. SPEARS: No, no.

MR. BAGGETT: It speaks for itself. Go ahead, and I'll straighten it out when I get him. It doesn't matter.

MR. SPEARS:

Q Professor Hammond, I want to refer you to your testimony that you gave in the Skeen case. Did you say that, "I do not recommend zero as a limit"? Yes or no.

A Under what conditions? Why didn't I recommend it?

Q I'm just reading the question and answer to you.

A No, you didn't read all of it. You just read part of it.
Q I'll start again, Professor.
A Read the whole thing.
Q The statement -- this is a question to you.
"'The statement has been made informally that the maximum allowable concentration for benzene should be zero.' Do you remember that?"
And your answer was, "I heard that."
Are you following me so far, sir?
A Go ahead.
Q And the next question was, "You don't agree with that?"
And your answer was, "I don't think that's practical that you can live that way."
Next question, "And you weren't trying to tell the jury that Monsanto should have known that zero was the exposure level in '50 or even today?"
"No. I don't recommend zero as a limit."
"I think 10 parts per million and less is sufficient."
Is that what you testified to --
A I did.
Q -- in 1986?

A And with that, I had already testified that they had to have medical surveillance programs and control, and you just read part of it. But the jury already knew that I recommended if you didn't have zero, then you had to put all these medical surveillance programs into the program to be sure you took care of the susceptible people. And you never know who is susceptible. And all of that had been explained to the jury.

Q What we do know --

MR. BAGGETT: Excuse me just a second. I want to articulate my objection on the record right now.

MR. SPEARS: Objection to what?

MR. BAGGETT: My objection to the -- to what you are improperly inferring in the record by the method in which you have proceeded. You refer to legal limits and adoption of legal limits and suggest to the jury that the doctor -- Professor has testified to something different than that, which is completely erroneous. What he has testified to is there is a difference between legal limits, enforceable limits in the work place and the policy which he had of attempting to be zero, which is the same policy that I'll show that Conoco had in 1953 that they announced, it's the same policy that he has -- that the API suggested in 1948, is that you, because of individual susceptibility, that you shoot for zero. You may have different maximum allowables or TLVs for legal enforcement. And there is a difference and you have not -- you have tried to avoid that distinction in the way that you have proceeded with your interrogation. And the whole form of your interrogation has been misleading and confusing to the jury. And I will ask that it be stricken.

MR. SPEARS: Bill, for the record --

MR. BAGGETT: I just want to -- while I'm thinking about it.

MR. SPEARS: For the record, of course, I object to your pontificating and stating -- it's not an objection, you were testifying. So for that -- the court will figure out whether the objection is valid or not, but I object to your statements in the record.

Q It's true, Professor Hammond, that in 1986 you thought 10 parts per million of benzene was sufficient?

MR. BAGGETT: Sufficient for what? I object. Sufficient for what? I object. It's not a complete question.

MR. SPEARS:

Q The question was, in the light of this ridiculous statement about zero, absolute zero, Professor, truth in fact, you never worked for an absolute zero because you knew that absolute zero is just not attainable. Is that correct?

A If you had used part of the exhibit there -- do you have Wrightman, the letter I wrote to Mr. Wrightman in 1953, discussing what we decided upon as policy in the company in 1948, that we would have said that if you do not have zero, you have to put all of these medical surveillance and monitoring programs such as urinary sulfates, urinary phenol, and you have to do medical examinations on all these employees periodically, starting out frequently, to see which one is susceptible so you can remove those susceptible individuals out of further exposure. And you just have part of your -- my testimony in that particular --

MR. SPEARS: Professor, thank you, but I object to your answer as not being responsive to my question, with all due respect to you, sir.

Attach Exhibit D-3 to the deposition.

That's all I have, Professor. Thank you

for your patience.

MR. BAGGETT: Do you want to break for lunch?

THE WITNESS: I guess we better. It's now 12:20.

MR. FREEMAN: I've just got a few questions, probably 10 or 15 minutes worth.

MR. BAGGETT: Have you got many, Bob?

MR. MYERS: About 15.

MR. BAGGETT: You want to go ahead, and then we'll have lunch afterward?

THE WITNESS: Sure.

VIDEOGRAPHER: Off the record, 12:20, to change tape.

[Recess]

VIDEOGRAPHER: On the record, 12:22. Tape number two.

EXAMINATION BY MR. FREEMAN

Q Mr. Hammond, you have mentioned a couple of times, in response to Mr. Spears' questions, a 1953 letter that you wrote to a Mr. Wrightman?

A Yes.

Q Do you have a copy of that letter with you here today? It was not attached as an exhibit.

MR. BAGGETT: I hope it's attached to one of the earlier depositions. And I may have it out in the car. I'll try to get it as soon as you finish here.

MR. FREEMAN: Good.

Q But as far as you're concerned, Professor Hammond, you don't have it personally with you here today?

A No.

Q You have indicated several times about a medical surveillance program that you were involved in some fashion with initiating at either Humble or Esso or Exxon at some point in time. As far as those Exxon employees that were working on the dock that were involved in the marine transportation aspects as well as those employees that were the truck drivers of the Humble tanker trucks, can you detail for me what exactly that medical surveillance program included for those type of workers?

A Yes, but I would refer you to one of my publications in which I spelled that out very clearly. And it's about seven, eight different items. And if you have any of my exhibits, in 1958, '59, Dr. Herman and I published a report covering that. So I would rather refer you to that, if you will accept the reference.

Q This is a document other than your 1955 benzene exposure control document?

A Yes.

Q So it's a separate piece of paper?

A It came out after we had five years of experience with controlling benzene and the way we did it.

Q Just so as I understand, Exhibit 22 to your deposition is what I understand to be a three-page or a four-page document that you put together in 1955. Mr. Baggett is showing you a copy of Exhibit 22. You authored Exhibit 22?

A On page 3 beginning with V, Medical and Industrial Hygiene --

COURT REPORTER: I'm sorry, beginning with V --

A V.

MR. FREEMAN:

Q Roman Numeral V?

A On page 3 and Roman Numeral, yeah, Medical and Industrial Hygiene.

Q So are these the details of the medical surveillance programming?

A That's right.

Q If you would, Professor Hammond, just explain what those are or list those for the court so we don't have to refer back to this exhibit necessarily.

A I think most of them speak for themselves. And the medical examination would be a preplacement. And covering the preplacement on the potential employee to work at the plant would be a complete blood count, exclude the people with evidence or history of simple anemia or other blood cell diseases, C, consider any chronic condition involving liver or kidneys for exclusion.

Q Preplacement examination, that is before they're employed?

A Before they go to work on a benzene unit or a unit that has benzene concentrations.

Q And then at least once a year to do some sort of a urinary phenol examination of the urine?

A We then began down there measuring phenol.

COURT REPORTER: I'm sorry. I can't understand you.

A Measure phenol in urine by the G.C. That's a gas chromatograph, is really what it is, but G.C., according to the method of Haaften & Sie, and he gives a volume of second Industrial Hygiene Journal, Volume 26, No. 1, pp 52-58, January-February of 1965.

Q So do I understand, then, that as far as the medical testing itself, the primary test is a urinary phenol examination?

A No. This is done in industrial hygiene laboratory where we have specialists that know how to handle the analysis of these samples.

Q Again, these questions are very basic, but is the urinary phenol a test that's performed on an employee's urine?

A That's right, and it reflects a way of monitoring the potential exposure that the employee might have had during the period of eight hours before the sample was collected.

Q Any other industrial hygiene or medical biological testing on the individual employee other than the urinary phenol, pursuant to this program in 1955?

A Not from that standpoint of being able to evaluate their prior exposure to the last work shift, for example.

Q You indicated that the preplacement

physical examination would be before an individual is placed into some sort of a unit or some sort of a possible exposure location?

A Where he might have a potential exposure, yes.

Q If an individual is going to be hired to work on the docks loading and discharging barges or hooking up hoses, would that require such a preplacement physical examination?

A It did. We do.

Q How about for a truck driver that's carrying crude oil?

A Not unless we knew that he had had exposure to the area, but he would be picked up also by the medical surveillance program because when he came up for his physical examination, of course, the complete blood count is part of that examination, and that would detect any potential change in the blood.

Q Same question for a gasoline pumper at an Exxon retail gasoline station in the Fifties or Sixties. Would he be required to go through a preplacement physical examination?

A If he was an Exxon employee, he would.

Q If you would, Professor Hammond, flip over to the Esso Toxigram which has been marked as Plaintiff's Exhibit 13 in that volume you have there.

A Yes.

Q You were employed or with the company known at this particular time known as Esso?

A No, not that particular time. It was 1958, I see, and at that time we had not united between Humble and Esso to form the Exxon Company.

Q Were you involved in any fashion with review or authoring this particular Toxigram at about the time it was being put together either by Exxon or Esso?

A I was.

Q At that time in the spring of '58 or preceding that period, at that time you knew in your mind, it was your opinion, was it not, that benzene was a known human carcinogen?

A Yes. I think that justified this statement. May I read it?

Q Yes.

A "Most authorities agree that in light of present knowledge, the only level which can be considered absolutely safe for prolonged exposure is zero."

Q It doesn't say anything in there about your opinion that it causes cancer?

A That reflects my opinion.

Q You had indicated earlier today that the legal standard for short-term exposure at some point in time to benzene was 25 parts per million?

A I remember that was the acceptable TLV listed by the ACGIH.

Q For short-term exposure, and I believe you defined short term to be five to 15 minutes?

A I did.

Q How many times per day would an individual be allowed to be exposed to that short-term concentration for that short amount of time and still be within the eight-hour TLV?

A Oh, that would only allow the person to be exposed -- they have spelled that out. I don't remember whether it was three times a day or so many minutes, but it was probably expressed in that term, either the number of minutes in an eight-hour time or the number of times at, we'll say, less than 15 minutes for that period. But it's all spelled out in the ACGIH standard.

Q So it is likely, then, that an individual could be exposed to the short-term limit more than one period a day and still be within the time-weighted average for an eight-hour day?

A Yes, for legally speaking that, again, permitted them to transfer some benzene from one container to another, for example, in the laboratory or something.

Q You had earlier indicated that you chaired Exxon's committee that had the oversight responsibilities for the MSDS sheets. Do you recall that testimony, sir?

A Yes, I do.

Q At what period of time did you chair that committee?

A I was secretary in 1948, and then that same year I became chairman in 1948, and I was still chairman when I retired in 1978.

Q 1970?

A '8.

Q 1978? So for 30 years, you chaired that committee?

A I did.

Q Again, in response to some of Mr. Spears' earlier questions concerning what Exxon may or may not have done when Exxon was selling large quantities of benzene to Exxon's industrial customers, you had indicated that when that shipment occurred through a pipeline, that in addition to the MSDS there would be a -- and you used the words a very close conference with that benzene customer, and then paraphrasing it, to make sure that they understood the dangers. Do you recall that testimony?

A Yes, I do, and that means that we would confer with the physician, if they had a physician on board, or if they had an industrial hygienist we would bring him into it. And also, if not, we sometimes dealt with the head of the safety department, safety engineers.

Q I'm assuming that your reference to pipeline transportation was merely an example of the various types of transportation modes when Exxon utilized this sort of communication between Exxon's customers and Exxon.

A Yes, but actually at Baytown, for example, across the ship channel, we had, and probably still do, an arrangement with Du Pont to use our product.

Q Excuse me. Go ahead.

A Before they built the unit down at the Monsanto chemical plant in Texas City, we had a line that ran directly that was just dedicated to benzene to them and others such as that. I don't remember whether Carbide, Union Carbide had that arrangement with us or all of them. I don't remember all of them, but the principle was the same.

Q So the same policies or the same Exxon procedures would be in effect if the delivery route did not involve a pipeline but involved a ship?

A Barge.

Q A barge? So the same arrangement would have occurred for maritime transportation?

A Would have occurred for marine operation.

Q Can you recall any instance where you were involved for Exxon with one of these large customers involving bulk sales of benzene where the shipper was involved within this Exxon notification procedure to the Exxon customer?

A I don't recall any particular shipper. We did tests on our own people that were loading the barges that were measuring, sampling the degree of filling and so forth. We had them, and they would very much come under the same control program we had for the employees in the plant, the medical surveillance, medical selection.

Q Mr. Hammond, are you aware today, sitting here, of any warnings that were issued by Exxon to

Higman Barge Lines or Higman Towing Company concerning the dangers of benzene?

A I don't recall that name, no, in any details. I am not -- I was not familiar with them coming and receiving our product, personally, I don't know.

Q That's all I'm asking is your personal knowledge, your personal opinions here today. Same question as far as Humble warnings to Higman Towing Company?

A No.

Q Same question as far as Esso's warnings concerning benzene to Higman Towing Company?

A I don't have any individual knowledge of that.

Q Those questions related specifically to benzene warnings. Do you have any knowledge concerning the same type of warnings given either by Exxon, Humble or Esso to Higman Towing Company concerning the dangers of crude oil exposure?

A No, I do not. The signs and warnings that were posted for our own people were available to them on the docks and in that area, and our requirements in regard to the use of gas masks and other type respiratory equipment would apply to them as far as any information that they received from our people using the right devices and so forth. And again, our people working on those areas, the docks areas, were under our medical surveillance and testing program.

Q You mentioned some warnings, apparently a sign or some sort of a physical board on the dock?

A Yes.

Q Do you recall what those said?

A Most of them pertained to explosive and fire hazardous nature, but sometimes we had them there that referred to the particular compound that would be like in the classification of benzene.

Q Do you recall any of those warnings, those placards placed on the dock referring explicitly to the dangers of inhaling crude oil vapors?

A No, I do not have that detailed information in front of me. I don't have it in my mind.

Q Are you aware today of any warnings, any warnings that were issued either by Exxon, Humble or Esso to Higman Towing Company or Higman Barge Lines concerning the dangers or the possible exposure dangers of crude oil? I've already asked you the crude oil, but gasoline, aviation gas or diesel?

A No, I don't have any knowledge of field operation.

Q Earlier in your testimony you had indicated that the Exxon employees that were working on the dock wore respirators or breathing protection when it was necessary. When, in your opinion, Mr. Hammond, was it necessary for those type of employees to wear a respirator?

A It was necessary whenever they had to open the hatch on a barge or on a tanker and also particularly when they were sampling the level of filling or measuring the quantity of benzene in the tank at the time or gasoline at the tank.

Q So anytime when an Exxon employee would open the hatch of a barge carrying benzene, they were required to wear respirators?

A They were. And also even gasoline and other volatile material such as benzene.

Q Did those other volatile materials, in your mind, include crude oil?

A It could, depending upon the oil, but I don't know of any specific field operation where I saw them wearing them.

Q When they were handling crude oil?

A Yeah, I don't remember. I just wasn't on the barges that much.

Q So, as a general statement, the usual, customary practice of the Exxon employees on the dock would not be to wear a respirator when they were opening the hatches of a barge carrying crude oil?

A Oh, you had very hazardous material there, in many cases sour crude, for example, hydrogen sulfide, and that certainly was deadly poison that had to be protected. And anytime the safety and fire department people thought that we needed respirators, they were always available and used by the people.

Q If we remove the H_2S danger, the hydrogen sulfide danger, the sour crude from that type of cargo -- my question is a general type question, Professor Hammond -- as a general statement, wasn't it true that when the Exxon employees popped open the hatch covers, dipped or gauged the tanks, checked the ullages on a barge carrying normal crude oil, that they were not required by your department to wear respirators or other respiratory protective equipment?

MR. BAGGETT: I want to object to that until you define what is normal crude oil and specify whether or not it contains benzene and the percentages of benzene.

MR. FREEMAN:

Q Normal crude oil, anything other than sour crude containing excessive amounts of hydrogen sulfide?

MR. BAGGETT: Object to form. It's not a complete hypothet.

MR. FREEMAN:

Q You can go ahead and answer the question, Mr. Hammond.

A I cannot imagine them opening up any barge on sampling or else measuring without the person wearing a full respiratory protective equipment because of the volatile materials that normally would be there, the other materials that might be generated in the barge by content or what it had had before in it before it was an empty barge, a filled barge. They wore respiratory protection until they had monitored the tank or the barge and tanker, yes, it was general practice. And also had a combustible gas indicator to determine what the danger from fire and explosion was.

Q Assume with me, Professor Hammond, that there is not going to be entry into a tank by man. Assume with me further that there is not going to be any hot work performed in a tank. Under any of those circumstances, is there any reason to sniff it with a combustible gas meter?

A Absolutely.

Q There is?

A Yes, and that's just a quick overall test for presence of gas of any nature that might be there that's combustible.

Q I need to make sure I understand your testimony, Mr. Hammond. So it's your testimony today that as a general matter, Exxon employees working on the dock when they checked the tank tops or opened up a barge containing crude oil, normal crude oil, excluding excess amounts of hydrogen sulfide, that they wore full protective gear including respirators?

MR. BAGGETT: I think the testimony was that they should have. I don't know whether -- you're asking him to testify as to what they did for 30 or 40 years. I think it's objectionable.

MR. FREEMAN: I'm asking about his understanding of the general practices of the Exxon employees.

MR. BAGGETT: That's different.

A It was our general practice they did wear respirators.

MR. FREEMAN:

Q For crude oil barges?

A For crude oil barges.

Q Even if the Exxon personnel were satisfied the benzene content of that crude oil was less than 2.5 percent?

A No, we had no such tests made on the product before in terms of benzene concentration.

Q Would it have made any difference to you as chairman or head of the industrial hygiene department if you knew for certain that each crude oil coming in on that barge, each load of crude oil contained less than 2.5 percent benzene by volume?

A No. The other materials, all the hydrocarbons that would be there, all of the volatile material would be respiratory -- dangerous to be inhaled or to be breathed, and so it put no criteria that we had to analyze every batch before we did anything. We just took precautions in the beginning.

Q My question was not what you did to actually determine it, but would it be important to you as the head of the IH department to know if it was below that certain level of 2.5 percent benzene?

A No, it would have had no effect. I've assumed it was bad from the beginning.

Q Do you recall participating in some sort of a study at the request of either Union Carbide or an attorney representing Union Carbide in the mid to late Eighties?

A I do.

Q What was the subject of that particular study, the workers or the employees that were the subject of that study?

A Those particular barges was hauling products up to their companies' plants in West Virginia, and they had to go through some locks on the Ohio River. So I flew up there and rode the barges through and made measurements to see if there was any particular occasion where inside the locks that the vapor pressure -- the vapors themselves might have moved above the normal. And these particular barges were all sealed and there was no gas leak and there was no occasion or no way for them to have lost gases. Their question was just a safety measure to make sure that there wasn't some -- because it was in that lock and in a closed system that there wasn't some way gas could build up in there. But in my particular case, I didn't find any leaks around the barges, and the seals were all good and tight and so on. There was no exposure.

Q Do you recall what year you did your field work for that study?

A I don't recall for sure, but it was in the 1980s. I don't recall the year, '85 or '87, somewhere in that period.

Q Who retained you to do that work?

A The Union Carbide people did. That was for Union Carbide products, wasn't it? I thought you had the name of the company there that I worked for. It was Union Carbide, I believe.

Q Do you recall whether or not the contact came to you from West Virginia or --

A No, it came from locally here, from the medical department or the personnel department for the company.

Q Did you prepare a written report and then forward that report to the same person that hired you to do the study?

A I wrote him a letter. That was all the -- no formal report other than just a letter telling them that the barges were all sealed and I didn't find, detect any gases.

Q Do you recall that man's name you sent that letter to?

A No, I don't recall.

Q But he was with Union Carbide here in the Houston area?

A Yes, he was.

Q In the medical department?

A I don't know. It might have been the personnel department that handled safety and medical for the company.

Q Were you in the field only for that one occurrence to see what was going on on those barges through the particular Ohio locks?

A That particular one, yes, was the only time I rode the barge.

Q What was the cargo in the barges at that time?

A I don't recall.

Q You don't recall if it was crude oil?

A No, I don't recall what it was.

Q Could it have been benzene?

A It was some of their products that they generate in Texas City and went for utilization in the plant in West Virginia. But I don't recall. It was a volatile material, but what it was, I don't recall.

Q Do you have a copy of that letter or that report that you sent to whomever hired you?

A I don't think I have. I think it's been maybe used in some exhibits, some trial or something, but I don't have a copy.

Q Can you recall where that report was used, either at the courthouse or in a deposition?

A No, I don't. It's beyond me. I don't recall.

Q Do you recall any of the lawyers that may have been involved in that litigation involving that study?

A There wasn't any lawyers involved. This was a precautionary measurement, evaluation and monitoring before they had any problems. I understood there were no problems, no personnel problems.

Q Have you participated in any other studies, examinations, industrial hygiene surveys in any fashion at any time in your career, other than this one that you have just mentioned, involving marine transportation workers?

A No, I don't recall. I had several associates and assistants that rode the tankers and rode the barges, but I didn't personally do that.

Q That was when you were still with Exxon?

A Yes. It was back at the beginning of 1950s, and over a period of 20 years until I retired we did that several times.

Q If you would, Mr. Hammond, turn over to Exhibit No. 3 in that volume in front of you. I believe that's your letter to Mr. Baggett at some point in 1991.

A Oh, yes, all right.

Q You have already --

A I remember this.

Q You've already gone over that letter in some detail when Mr. Baggett was asking you the questions. Even though that letter was written several years ago, almost four years ago, three years ago now --

A What, this letter?

Q Is it dated in 1991?

A Oh, yes. Oh, yes. Excuse me, go ahead.

Q Is it still -- does it still fairly state your opinions as detailed in that letter, or has anything occurred since you wrote that letter that would cause you to modify any of the statements contained in Exhibit 3?

A No, I think this letter is still pretty much sound, and I haven't made any --

MR. BAGGETT: Gentlemen, I see that attached to the -- to this Exhibit No. 3 was the February 23rd, 1953 letter that came from the safety department's file, and it described in summary recommendations for hazard to benzene exposures and their control in certain operations in the petroleum industry in '48. I see that I did not bring that as an exhibit. It may be in my car. I'm going to go try to get it when we take a break, if I've got it.

MR. FREEMAN:

Q Mr. Hammond, if you would, turn over to Exhibit 9 in that same volume, which I understand to be the API Toxicological Review concerning benzene. Again, a great deal of time was spent going over this document with you earlier. But as far as a general statement, would you agree that at the time this document was written, at that time API was strongly recommending 50 parts per million as an allowable safe exposure limit?

MR. BAGGETT: Wait a minute. The document speaks for itself as to what the -- and what you refer to as allowable safe limit is misleading, unless you describe what you're talking about.

MR. FREEMAN:

Q Professor Hammond, would you agree that the general majority view among the API members was that 50 parts per million should be, at the time the document was written, 50 parts per million?

A Again, that goes back to the regulatory agencies that was trying to enforce some level of exposure.

Q I appreciate that response, Professor Hammond, but I need to object to the responsiveness of it. Again, the question was: Do you agree that it was the majority view of the API members in 1948 that 50 parts per million was the strongly recommended safe allowable limit?

A No, I don't know what the persons, the group there, the people's opinion was. I didn't talk to any of them individually.

Q You were a member of a number of API committees, were you not?

A I was.

Q You were active in the API for many years?

A Yes.

Q You chaired certain committees or subcommittees at specific times in your distinguished career, did you not?

A I did.

Q And you are unable to give us your opinion as to what the majority view of the API members were in 1948 concerning allowable limit of benzene exposure?

A No, I wouldn't be able to even estimate that for you.

Q There on the first page past the cover page, which is a Bates stamp of triple ought two, 0002, there is a Section 3, Roman Numeral III, where this API documents talks about probable sources of contact. Do you see the section of the document I'm referring to, Mr. Hammond? Lower --

A I see under that, yes.

Q It talks about the extensive use of benzene in the petroleum industry, talks about how it's blended into gasolines. Do you have any explanation today, Professor Hammond, why that a probable source of contact such as inhalation of crude oil fumes is not discussed here in this document?

A Benzene was used in that period, apparently, but not in the United States as it was commonly used in Europe where they had a lot of distillation of coal. The source at that time was primarily in the coking operations where they collected the vapors from coke and condensed it down into benzene, and it was blended with petroleum products into gasoline, particularly in Europe, but not much that we knew about in the United States. I think that applied to the European practice.

Q A couple of last questions, Professor Hammond. If you can turn over to Exhibit 22, which, again, is your 1955 benzene exposure control document. I believe you have already explained to us, when either Mr. Baggett or Mr. Spears was asking the questions, that this document applied to processes involving, number one, pure benzene?

A Yes.

Q Like 1-A, the benzene plant?

A Yes.

Q There on the first page. But did it apply to other process streams or other possible sources of exposure?

A Yes.

Q I believe those are detailed at Roman Numeral Section III on page 2 of this document?

A Yes.

Q Particular concern is detailed for those streams at the refinery containing 5 percent or more of benzene. Do you agree?

A I see that is with five or more, recommend appropriate control --

COURT REPORTER: I'm sorry. Five or more --

A Five percent or more benzene, recommend appropriate control items under 1-A unit and VB, capital VB, medical.

MR. FREEMAN:

Q So for process streams involving 5 percent or more by volume of benzene in that product steam, you're recommending the same engineering practices, the same medical surveillance practices as the benzene unit?

A As pure benzene.

Q Then for those process streams, refinery streams involving 2-1/2 percent to 5 percent benzene, you were requiring some particular investigation to determine the type and the quantity of exposure. Is that true?

A As you see there, investigate and determine the potential exposure.

Q But in 1955, you were not recommending either a full medical surveillance program, such as was in place for the benzene unit workers, nor were you recommending investigation for those people that were exposed to the process streams or the refinery streams less than 2-1/2 percent by volume of benzene? Agree?

A This applies to 2-1/2, investigate and determine exposure potential for all of those particular ones. Some of them was so locked in and gastight that there wasn't any particular -- you didn't find any potential exposure. You would maybe -- you would ignore those that are inside, and some of them would even be destroyed. The streams would be destroyed before they came out into a finished product that might be released.

Q You said a lot right there, and I didn't quite follow. But you indicated you would ignore those, and is it my understanding that you would ignore those employees exposed to less than 2-1/2 percent benzene concentration?

A No. All of those streams were carefully investigated and a potential exposure were determined on them and the employees were being examined and checked periodically.

Q So for the employees that were exposed to refinery streams containing between 2-1/2 percent and 5 percent benzene by volume --

A Well --

Q It was your -- let me finish the question. It was your recommendation in 1955 that those employees would be investigated, the exposure routes, the concentrations were to be investigated to determine additional data? Is that a correct statement?

A No. We had at least a dozen streams that are not recorded here, and many of them were below the 2-1/2 percent. And they were also treated, employees were treated if they were exposed to 100 percent benzene, anything where there was benzene that could get in the air. But we required first and foremost that the higher streams be the ones that we would investigate and determine first.

Q You've already testified, Mr. Hammond, that the benzene unit that was brought on-line by Exxon at the Baytown facility in the mid Fifties was a state-of-the-art production facility? Correct?

A It was a production facility for benzene manufacturing.

Q It was also state of the art as far as engineering controls which you had a direct hand in implementing as far as to reduce the possible benzene exposure to those employees that worked at that state-of-the-art production unit. Agree?

A It did, and it's spelled out in this exposure control manual.

Q And your benzene exposure control which you had a direct hand in authoring, which is identified as Exhibit 22, Plaintiff's Exhibit 22, that also was a state-of-the-art exposure control policy procedure or protocol? You agree with that statement?

A It was for that purpose.

Q And there is nothing in Exhibit 22, this document, indicating any special treatment for those employees of Exxon that are exposed to refinery streams of less than 2-1/2 percent benzene component?

A That decision was made after we had investigated the operations, and sometimes even a tenth of a percent was not permitted without putting them under medical surveillance programs. We just worked it from the top down, that we worked from 5 percent down and treated 5 percent as a pure benzene and worked it on down, depending on how they were handling it, how much exposure potential it had, and put the men under the medical surveillance and phenol biology examination, depend on what we saw out there in the field.

Q The first page of my copy of Exhibit 22 has a handwritten note up in the upper right-hand corner. Does your copy also have that handwritten note? Is that your handwriting, sir?

A Yes, it is.

Q Could you read it for me? I can't quite read it.

A This control program was in operation by 1955, Baytown refinery and HO&R, Humble Oil & Refining Company.

Q What's the word separating 1955 and Baytown?

A "In," just the word in Baytown refinery.

Q You testified earlier, Mr. Hammond, about some opinions concerning the Walsh-Healey Act. Do you have an opinion today, sir, whether or not the Walsh-Healey Act applied to either Higman Towing Company or Higman Barge Lines?

A I wouldn't be qualified to answer that.

MR. FREEMAN: Thank you. I don't have any other questions.

EXAMINATION BY MR. MYERS

Q Professor Hammond, have you met Joseph Hebert, the plaintiff in this case?
A Oh, no.
Q No?
A No.
Q Have you read his deposition?
A No.
Q Do you know what type of work he did?
A No, I don't know what he did. I'm leaving that up to someone else.
Q You have no indication at this point as to the type of employment he was engaged in for the, oh, 37 or so years he worked for Higman Barge Lines?
A I understand he was an operator on the barge.
Q During your period of employment with Exxon, you were concerned about potential exposure of benzene to employees of Exxon?
A I was.
Q Did you ever write or author any article, paper, internal memorandum with Exxon, when you were the chief industrial hygienist for that company,

specifically addressing Exxon employees handling of crude oil?

A I don't remember any publication. I participated in seminars within the company on that subject, but I didn't write it up. No, I don't have anything written.

Q Did you ever address any memorandums, any directives to subordinates within the company concerning potential exposure to benzene products to Exxon employees that were handling crude oil products?

A The letter that I referred you to, Mr. Wrightman was addressed on that matter. It was a pipeline handling of crude oil in Wyoming in which they were making tests on that oil to determine how much BS&W it had in it, and I wrote -- that letter would explain my position on that.

Q What was your position?

A That any amount of benzene that was present would require that the employee be placed under a medical surveillance test and the program that we had for benzene handlers.

Q Did you implement any program while at Exxon so that the products, the crude oil products that the employees of Exxon were handling would be tested to determine how much benzene was contained in those products?

A I never did that type of examination.

Q How would you know that an employee was exposed to benzene by handling Exxon crude oil if the crude oil was not tested?

A The crude oil was tested by other individuals and by the laboratories that -- service laboratories that did that type of work.

Q Did you get the results of those tests?

A I did, whenever they contained any --

Q Did you ever, after receiving the results of those tests, implement any program to have the employees that were handling the crude oil placed on medical surveillance?

A I did.

Q You are certain about that?

A I do.

Q All right. And when we talk about medical surveillance, sir, what are we talking about? How often?

A At the first, for example, the concentrate, we started out on a weekly basis, and then we expanded that for these employees as we had more confidence that they did not show any deterioration or any hypersensitivity. And finally with that, three months range, and then later on it was a half -- six months, and then a year, once a year, but never longer than a year afterwards, so long as they worked in potential exposure to benzene.

Q Do you have any opinion, sir, as to how much exposure to benzene it takes to have a positive result in the urine test that you would give, for example?

A I don't have that value in mind, but it has been determined.

Q And what is it?

A I say I don't have it.

Q You don't know?

A Well, I knew at the time, but right today I don't remember.

Q You have gone over the history of the identification of problems associated with exposure to benzene and you have given your opinions based on your participation in the petroleum institute, as a member, and also a member of the ACGIH. Is it correct to say, sir, that as early as 1940, when the knowledge of potential problems with benzene first became discussed in the industrial hygienist community, that the acceptable level at that period of time for exposure was 100 parts per million?

A Federally, I don't remember that there was any established. The State of Massachusetts and the State of New York about that period developed a recommended level for their department of labor to enforce, and I don't remember the exact concentration.

Q But suffice it to say, and I think you will testify to this, that from that point, whatever it was, it became lower and lower and lower from the various agencies over a period of 50 years. Is that correct?

A I think they had settled, by 1970, on a 10 parts per million.

Q Ten parts per million?

A And then -- 50 years was a little too long. I think it was more like 25 years.

Q What is the acceptable regulatory exposure level right now?

A One tenth of a part per million.

Q All right. What was it five years ago?

A Which agency?

Q ACGIH.

A Ten parts per million, I believe. And OSHA, too. But OSHA had recommended one part per million back in 1978, and the Supreme Court threw it out. So they went back to the 10 parts per million.

Q And you were of the belief that no parts per million is the acceptable level. Is that correct?

A Because there are certain -- yes, because there are certain sensitive people that even Dr. Hunter, in 1939, and his diagnostic finding was that he reached that conclusion and published it in the medical literature from Boston General Hospital. Fortunately, I was working there in 1941, '42, and got to know Dr. Hunter, and he convinced me from his -- his finding with patients that only zero, and he recommended it in his article of 1939 that for some people only zero concentration was safe.

Q But you can't reach zero concentration levels, can you?

A Well, you can substitute -- in addition to getting them as low as practical, you can then substitute your medical surveillance and pick up those hypersensitive people before they go beyond a certain point in their blood changes and rescue them, so to speak.

Q What's the concentration of benzene in the air outside, in your opinion?

A Here in Houston, Harris County?

Q Yes.

A Not greater than one -- average of one part per billion.

Q Billion or million?

A Billion.

Q Are there areas in South Texas that are one parts per million in air concentration?

A I don't know of any that I have seen the results. I have seen some alleged concentrations, but the EPA and the Texas Board of Air Pollution Control would have all that information available by district, county, cities and counties, but I don't have it.

Q And I believe you mentioned in your earlier testimony that there are extremely high concentrations of benzene in cigarette smoke. Is that correct?

MR. BAGGETT: I'm going to object to your references to, quote, extremely high, unless you --

MR. MYERS: I'll rephrase the question.

Q That per puff, for cigarette per puff the concentration is in the area of 100 parts per million?

A That is the value that was available to me in 1941 while I was associated with Harvard School of Public Health. And Dr. Drinker's students made those tests. I did not make them, so it's hearsay to me. But I have no reason not to think that Dr. Drinker and his group, being the authorities that they were on method, were able to detect that much. And that was reported to me as a student.

Q And you believe that report that you read as to the 100 parts per million per puff?

A I did at that time. Now, of course, I recognize that the tobacco companies may have changed the composition of the tobacco, and that may not be the same value that was found in 1930s.

Q And then, of course, with the concentration of benzene in cigarette smoke, you would, I take it, reasonably conclude that secondhand smoke, that is, people that are exposed to smoke that are in a general, an area of the smoker would be exposed to high concentrations of benzene, wouldn't you?

A I do not have that information. I have curiosity to know just what it might be, but I don't know how to go about getting it.

Q Exxon did not provide its subcontractor employee or subcontractor employees with respiratory equipment when moving crude oil, did they?

A It depended entirely on whether they had their own or what they were doing. And our safety department served as safety officers, and if they were doing anything different than what we would have been doing under the circumstances, handling the materials they were handling, they would have had to have had respiratory protection. Even we would furnish it to them, if they needed it.

Q Of course, you implemented a program when you were at Exxon to make sure that these subcontractors employees that were hauling crude oil for Exxon would be provided with respiratory equipment, didn't you?

A Only when we figured -- only when we analyzed the exposure and thought that they would be -- our employees would be wearing respiratory protection, we also insisted on them doing that.

Q And do you have any documents or any memorandums that you wrote to set up this particular program that you just mentioned to give respiratory equipment to subcontractor employees?

A No. I didn't remember putting it in a formal report, no, I don't recall I did.

Q Did you provide respiratory equipment to

Exxon employees that worked at service stations in the Forties and Fifties and Sixties that were direct employees of Exxon to protect them while they were pumping gasoline and petroleum products into customers' tanks?

A No, I don't remember we ever found that necessary.

Q Would you admit with me, sir, here today in this deposition under oath that those employees would be exposed to benzene vapor?

A No, I couldn't have any -- I don't have any information that would help you on that.

Q You don't know one way the other, then?

A I do not have any information.

Q Do you have any opinion, sir, as to what the concentration of benzene is in crude oil, any crude oil you can dream up?

A No. I understand others have looked into this but I never did do any personal investigation and I don't have any ways to limit it, what range it was.

Q I take it, then, when you were at Exxon, your concern over the benzene exposure with various employees was due to the concentration of the substance benzene itself, once it was taken and extracted from other products and put into one final product? Is that what your major concern was, the exposure to the benzene product itself after it was purified for sale?

A No. The light streams that we had in the refinery, many of those employees that had to do sampling and other things had to be included in our medical surveillance program. And they didn't have benzene in any particular concentration that I recall, but they were just included because they worked around the unit that potentially might have products that would be in the boiling range of the characteristics of benzene. And so we put them in the program, too.

Q Would you expect that an employee working on the inland waters or on the high seas transporting crude oil on tankers or barges would be required to walk around with a respirator on?

A I do not know about the conditions well enough to know. You're speaking of conditions that would be equally important, how well the barge seals were to prevent leaks and any escaping materials and so forth. All of those other factors of great concentration -- I mean great importance as well as the equal concentration of the benzene that they would be handling.

Q Are you a direct employee of Exxon at this point? Are you a salaried employee?

A No. I've been retired since '78.

Q You receive a retirement --

A 65, when I retired.

Q You receive retirement benefits from Exxon?

A I'm annuitant. I accumulated pension. I was there 31 years.

Q Are you familiar with Koch Industries, Koch Oil Company?

A Koch Oil?

Q Oil Company, Koch Industries? Have you ever heard of it?

A Huh-uh, I don't guess I have. I know coke was the primary source of benzene in our country for many years in the steel manufacturing, where they're coking the coal and they capture the vapors and fumes and recover it, distill it to get benzene, toluene, xylene.

Q Out of coal?

A Out of coal, soft coal.

Q That's not the company, though, that's the product?

A That was the nature of the product that they had to have for steel manufacturing, coke.

MR. MYERS: That's all I have. Thank you.

FURTHER EXAMINATION BY MR. BAGGETT

Q Professor, reference has been made to Exhibit No. -- Plaintiff's Exhibit No. 22, which has been referred to as the benzene exposure control program that was in place by '55. I direct your attention to part No. 2, page 2, dealing with truck transportation, railcars and barges. Now, I ask you if this part of your report relates to engineering controls and means by which loading of barges can be -- the benzene exposure can be limited?

A Yes. You see, we didn't make any exception of truck or barge or railcars and so forth. Down here now, when you get down to the potential exposure, number K, you make sure that you follow those. One place in here where it mentioned that sampling, gauging the barges and others to be accomplished with respiratory protection and neoprene gloves.

Q Yes, sir. When you were asked about this report, there was no reference to the barge controls. This sets out, does it not, how product is to be drained, how waste is recovered, how you have dripless valves and how you have automatic cutoff valves to prevent overflow, you have mechanical seals on pumps, you have calibrated probe with nitrogen for gauging during the filling. All of these were recognized back in the early Fifties as means where barge employees could be protected, were they not?

A We did.

Q Also, you were not asked about this, but look over on paragraph 5 on page 3. Were not product shipping employees, such as gaugers, truck, railcar, barge and tanker loaders, were they not involved in your medical and industrial hygiene urinary phenol program?

A They were, and they received periodic examination to determine if there were blood changes and so forth.

Q Sir, did you make it clear, when you were asked that -- was your -- when you were questioned about the refinery streams and the investigating and determining exposure potential for streams with 2.5 to 5 percent benzene, did I understand you to say that after that was done you moved on to the other process streams in the refinery to determine benzene content?

A Yes, yes, we did.

Q You didn't just stop because of 2.5 percent?

A Not at all.

Q Sir, going back when we began this deposition, you were questioned on state-of-the-art things that were known and knowable, and you referred to exhibits that are numbered in your deposition that show going back to the Thirties.

A Yes.

Q Was it not recognized back as late as the Thirties that if you had exposure, potential exposure to benzene and if -- you determined that, in the first instance, by monitoring. Is that correct?

A Yes.

Q And if you've got potential exposure to benzene, then it has been long recommended that you should be a part of a medical surveillance program?

A It has in these articles that were published back in the Thirties and even in the 1920's by the American Safety Council.

Q All right, sir. And looking as early as

1948 at the API bulletin, doesn't it tell you that chemically benzene is the simplest of the aromatic hydrocarbons?

A Yes.

Q Chemically, that's what it is. What is petroleum? What is crude? Isn't it hydrocarbons?

A It's hydrocarbons, but different configuration as far as the molecules and so forth are concerned.

Q But the aromatic hydrocarbons has been known, has it not, to be a part of a crude product?

A It has been known, yes.

Q And in 1948, did they not point out that benzene was used extensively in the petroleum industry? Is that correct, sir?

A It was. It had certain characteristics that were good for solvents. And, for example, you would take a potential lube oil and you would extract all the wax out of that lube oil with using a mixture of methyl ethyl ketone and benzene. And they were doing that in a plant that had been designed for our refinery in Baytown when I came. But we were able to substitute toluene rather than benzene, and we never bought any more benzene --

Q Professor Hammond --

A -- for that purpose.

Q -- to illustrate what was available in the petroleum industry in the Forties in the way of an industrial hygiene survey, you have testified about Exhibit P23, did you not?

A I did.

Q Sir, you have testified as to what was known and knowable, and that was the primary purpose for your testimony by the plaintiffs. You also have testified as to what the program was in place at Exxon during your stay as an industrial hygienist?

A I did.

Q Efforts were made, obviously, to question the validity of the Exxon program by Defendants' Exhibits 1 and 2. Can you tell me what these exhibits reveal so far as your program, industrial hygiene program at Exxon?

A The first one in 1958, and it's Dr. Howell who did all the examination for us of these employees with potential exposure. So we worked with him on the chemical plant, on the benzene plant as well as others, and he is well familiar with it. So when we went into the refinery and we had any type of information that would be new or original to add to his knowledge, we would inform him. If he saw some question in an employee that was questionable in his mind and he came from a certain unit, well, then he would let us know so that we could go back and make a survey of that unit to see how he could have been exposed to benzene.

Q Are these two documents just part of documents that show an ongoing industrial hygiene program that you put into place, and that is once you determined something was happening to result in a potent -- or to create a potential exposure, that steps were taken immediately to eliminate that?

A That was our program, yes.

Q And D No. 2 is actually one of the industrial hygiene surveys that were made back in 1975?

A It was.

Q Sir, the reference to a TLV or a maximum concentrate by reference to the industrial hygiene standards or by reference to the TLVs adopted by OSHA, those are for regulatory purposes, are they not, to set legal limits?

A They are what we know, and I used to work with the Department of Labor and others, that they were enforceable limits. In other words, if the employer did not correct the problem, they could be taken to court and fined for violation.

Q All right, sir. And when you look -- when you look back as early as 1948 at the API, when you look at Exhibit No. 9 on page 004 of the exhibit, it refers, does it not, to maximum permissible benzene concentration standards, whether they be the state standards or TLVs in effect back in the Forties. Is that correct?

A Yes, they did.

Q But still it concludes, does it not, and recognize early on that inasmuch as the body develops no tolerance to benzene and there is a wide variation in individual susceptibility, it is generally considered that the only absolutely safe concentration for benzene is zero?

A That is true.

Q And that is the standard that you tried to adopt and recognized as being applicable to protect the employees of Exxon?

A We followed that.

Q And if legally you could not accomplish that, how did you make sure that they were safe?

A Well, we did it by double-checking on them and biological testing in which we used the employee to make sure that his exposure had been zero or undetectable. And we could run that on the phenol urine sulfate test. And so we did all of that plus the medical surveillance that they did with blood to determine if we saw any bad effects.

Q So in your testimony in Skeen and here today, are you recognizing a difference between, quote, what is safe because of individual susceptibility, and what is, quote, legally enforceable under a TLV or a maximum --

A Allowable.

Q -- maximum permissible benzene concentration?

A That's right.

Q There is a difference, is there not?

A There is.

Q And there is no inconsistency in what you have testified to when you refer to one as being a legal limit and the other one being what you as an industrial hygienist have recognized as being a safe exposure or limit?

MR. SPEARS: Object to the form of the question.

A Yes. We might use the word legal limit or biological unit. And mine was a biological unit for all people. And the control program included, when safety manual and quoting from the API toxicological review of 1948 would not put in the safety manual a warning about the chronic benzene poisoning that can result from repeated or continuous exposure to relatively low concentrations of benzene vapor? Do you know of any reason why?

A I would not know.

Q And if that section dealing with benzene and reporting to an employee that the only safe level is zero because of individual susceptibility, can you think of any reason why that would be omitted from subsequent safety manuals of Conoco?

MR. SPEARS: Object to the form of the question.

A No, I couldn't contribute anything to that.

MR. BAGGETT: Or Continental Oil Company.

Can we go off the record, and let me run out to the car and see if I can get that '53 letter, and that will be it.

MR. SPEARS: It's in there, Bill. Didn't you say it was in there?

MR. BAGGETT: No. He refers to it in the report.

VIDEOGRAPHER: Off the record, 1:38.

[Recess]

VIDEOGRAPHER: On the record, 1:45.

MR. BAGGETT:

Q Professor Hammond, reference has been made in your report, which is Exhibit P3, to a letter of February 25th, '53 by you that you discovered in the safety department of Exxon. Can you tell me what that letter -- I thought I had it with me today; I don't. It's attached to the deposition in the Norman Ellis case and in the Steve Leblanc case and both of which involve Mr. Spears. I will produce a copy to all counsel. But could you tell me what that letter described?

A Yes. It described a visit I made to a pipeline station located up in Wyoming which I discovered that they were using benzene as a solvent to extract the BS&W from oil bottoms that came out of their pipeline storage tanks and that this was being done in an unventilated area that was only a one person and open shop, so to speak. But I said that we could substitute a nonhazardous material relatively for the benzene and get rid of it. And then, if not, we would have to put in the medical surveillance program for all the employees that worked in that area and used the benzene.

Q And, sir, that was consistent with what you have testified here today, and that is, so far as safety is concerned, you tried to accomplish zero exposure to benzene?

A Otherwise, that we would put in the medical surveillance for all those employees that worked in that area, and the only way we would make sure that they were not being exposed to danger or risk that we wouldn't want them to be with benzene.

MR. BAGGETT: I ask that this safety manual of Continental Oil Company marked dated July 1, 1953 be attached to the deposition as Plaintiff's Exhibit No. 25.

MR. MYERS: I'm going to object to the attachment of it. I have not seen it yet.

MR. FREEMAN: How about a couple of questions, Professor Hammond, while Mr. Spears is looking through that document.

First off, let me reserve cross-examination, Mr. Baggett, for this witness after today concerning his 1953 letter that was attached to Exhibit 2. Higman has not been a party to those prior testimonies. Higman has not been provided with a copy of that letter.

COURT REPORTER: Can I mark that real quick, before it gets away?

MR. FREEMAN: Yes.

MR. BAGGETT: Or I take it that I'm not -- that the testimony about that exhibit would be excluded, if you're not satisfied with it.

FURTHER EXAMINATION BY MR. FREEMAN

Q Mr. Hammond, Exhibit 22, there has been a great deal of discussion about your benzene control exposure document, three pages. To put this document into context, isn't it true that the company, Exxon, which you chaired the IH department, was greatly concerned about the possibility of benzene exposure to their employees in the mid Fifties because this benzene plant unit was preparing to go on-line at the Baytown facility?

A I can understand your question, and I will say that that did accelerate our concern. But this letter that was written in 1953 that explained what our agreements were with the operating people in 1948 would clarify that, that we already had the program that zero levels was the only acceptable levels, wherever we could reach that, and otherwise that we needed the education and medical benzene, is there?

A Yes.

Q Within this document itself?

A Yes. We already had put into the surveillance and dealing with the barge operators and any of the dock workers and others that were handling the hydrocarbons.

MR. FREEMAN: Object to the responsiveness of the answer.

MR. BAGGETT: Oh, I think it was responsive, very much.

MR. FREEMAN:

Q Professor Hammond, can you show me within Exhibit 22 where it specifically makes this procedure benzene exposure control applicable to crude oils less than 2.5 percent benzene?

MR. BAGGETT: First of all, that was not the question that you had asked awhile ago and the answer that you got.

A I don't see it here what I'm looking for. We covered that by saying and listed all of the potential exposures and others, because there were so many we didn't --

MR. FREEMAN:

Q Are you referring to someplace in Exhibit

22 where it says "and others"?

A I thought it was in 22.

MR. BAGGETT: It has been referred to, Counsel.

A Yeah, refinery streams. Look under III A, IV, that covers it, on page 2.

MR. FREEMAN:

Q That's the only place within this document?

A Well, it covered all those others.

Q Mr. Baggett asked you some questions concerning the distinctions in your opinions, Mr. Hammond, concerning legal limits and safe limits. Now, the ultimate purpose of the legal limit is not to satisfy the arbitrary whims of a state or federal bureaucrat, is it, Professor Hammond? One of the ultimate purposes of those legal limits, is it not, to not necessarily to guarantee but designed to protect the vast majority, the health and the welfare of people who are exposed to this particular harmful substance?

MR. BAGGETT: Excuse me. I object to that question. The effect of the legal limits is a question of law in which the jury or the court will determine, like the Walsh-Healey Act is a question of law and like TLVs will be -- legal effect of them will be a question of law.

MR. FREEMAN:

Q Professor Hammond, were not the legal limits, whatever those legal limits would have been at the time and however you define those legal limits at whatever level, were they not designed to protect the majority of the health and welfare of the workers?

A Yes. They spell that out in the TLV booklet that you can apply these limits and it will protect most of the people but not all of them, and that the few, whether it was 10 percent or 12 percent, I was just equally concerned about their welfare as I was about the 80 and 90 percent that this would protect.

MR. FREEMAN: Thank you.

FURTHER EXAMINATION BY MR. BAGGETT

Q Professor Hammond, within the four corners of the document P23, where they had sampling and gauging of barges and tanks to be accomplished with respiratory protection and neoprene gloves and these other engineering controls, was there anything, was that applicable to barges that came in with hydrocarbons?

A It was.

Q When you had monitoring under the medical, industrial hygiene program where you had urinary phenols administered to product shipping employees such as gaugers, truck, railcar, barge and tanker loaders, was that applicable to people, barge and tanker loaders involving hydrocarbons?

A It was.

Q And that includes crudes?

A All products.

MR. BAGGETT: Fine.

VIDEOGRAPHER: Off the record, 1:57.

SIGNATURE OF WITNESS

I, PROFESSOR JAMES HAMMOND, solemnly swear or affirm, under the pains and penalties of perjury, that the foregoing contains a true and correct transcript of the testimony given by me at the time and place stated, with changes, if any, and the reasons therefor noted on a separate sheet of paper and attached hereto, and that I am signing this before a Notary Public.

____

PROFESSOR JAMES HAMMOND

THE STATE OF TEXAS]

Subscribed and sworn or affirmed to before me, the undersigned authority, by PROFESSOR JAMES HAMMOND on this the _____ day of _____________, _____.

____

Notary Public in and for the State of Texas

STATE OF TEXAS]

COURT REPORTER'S CERTIFICATE

I, Wanda G. Kelley, a Certified Shorthand Reporter within and for the State of Texas, hereby certify that the foregoing proceedings occurred before me.

I further certify that the foregoing is a true and correct copy of the transcript of the proceedings to the best of my ability.

I further certify that I am neither attorney for, related to nor employed by any of the parties or any attorney of record in this cause, nor do I have a financial interest in the matter.

Witness my hand November 23, 1993.

Wanda G. Kelley

Wanda G. Kelley, Texas CSR 2007*
Nell McCallum & Associates Inc.
2900 Smith, Suite 104
Houston, Texas 77006
(713) 523-3767

*My Certificate Expires December 31, 1994

NO. 92-6203

JOSEPH L. HEBERT AND MARIE HEBERT	14TH JUDICIAL DISTRICT COURT
VS.	PARISH OF CALCASIEU
HIGMAN BARGE LINES, ET AL	STATE OF LOUISIANA

On November 24, 1993, PROFESSOR JAMES HAMMOND was notified by and through CERTIFIED MAIL SERVICE, by Mr. William B. Baggett, that the deposition taken in connection with the above cause was ready for inspection and signature as evidenced by the copy of said correspondence attached hereto and made a part hereof.

As of this the 10th day of January, 1994, PROFESSOR JAMES HAMMOND has failed to appear for the purpose of reading and signing said deposition; therefore, in accordance with the Texas Rules of Civil Procedure, said deposition is being tendered to Mr. William B. Baggett.

Witness my hand on this the 10th day of January, 1994.

Eileen Walton Csl

Eileen Walton

NELL McCALLUM & ASSOC.

HOUSTON, INC.

2615 Calder, Suite 111
Beaumont, Texas 77702
(409) 838-0333
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Nell McCallum & Associates, Inc.

November 24, 1993

WILLIAM B. BAGGETT, ESQ.
Baggett, McCall 7 Burgess
P.O. Drawer 7820
Lake Charles, LA 70606-7820

CM/RRR # P 921 297 171

RE: NO. 92-6203
HEBERT V. HIGMAN BARGE LINES

Dear Mr. Baggett:

Enclosed please find the original signature page from the deposition of PROFESSOR JAMES HAMMOND VOLUME 2 taken on November 18, 1993, in the above-referenced cause.

Please have the witness read your copy of the deposition, mark any corrections on the sheet provided and sign the original signature page before a notary public. If the signature certificate page is not returned to the above Houston office within twenty (20) days, the transcript will be handled as though signed.

Thank you for your assistance in this matter.

Very truly yours,
NELL McCALLUM & ASSOC., INC.

Lisa Dettling

Enclosures

cc: Robert Myers, Esq. — CM/RRR # P 921 297 173
Mark Freeman, Esq. — CM/RRR # P 921 297 172
Kenneth R. Spears, Esq. — CM/RRR # P 921 297 174

COPY
HUMBLE OIL & REFINING COMPANY
Houston, Texas
February 13, 1958

EXHIBIT
D-1

D-1

Dr. T. S. Howell
Baytown

This confirms our conference between you, Albert Moskowitz, S. D. Bozich and myself on the benzene plant and potential exposure to benzene. Afterward, Albert, Sam and I visited the plant. We found that the concentration range at the eye wash fountain near the oil separator at breathing level was 20-30 ppm. These low results compared to previous values were due to the unusually high wind from the north which was about 40° F. that morning. At two or three other spots downwind from leaks, such as a dripping sampling cock, the average atmospheric concentration of benzene was 10 ppm. We recognized that this was a good day for low concentration because of the unusually low temperature and high wind.

Sam and Albert proposed several corrective changes. The oil separator will be covered with a solid cover and vented through a stack above the second floor platform. A steam exhaust jet to accelerate the draft in this vent stack will be installed if there is no unforeseen problem to this addition. Sampling cocks will be re-piped so as to give a discharge point for flushing of the lines and potential leakage directly into a drain. A skimming line is to be re-routed from a drain on the ground platform to the oil separator.

The product tanks have two potential problems which are being studied. One of these problems will be solved easily by the insertion of an oil seal in the automatic gauge line. The seal will prevent benzene vapors escaping through the automatic gauge. The other problem involves sampling through the manhole on top of the tank. In the warm summer months it is probable that large amounts of benzene vapor would be present in the breathing zone of the gauger under the present arrangement. This is a point where acute exposure is potentially dangerous under all weather conditions and adequate venting or a recovery system should be installed for three product tanks and one high benzene rundown tank.

The laboratory ventilation was adequate.

The men complained of the handicap of the use of gas masks with the full face piece. They reported that this equipment obstructed their vision, added to the amount of benzene lost at the time of sampling and increased their danger of falls. In view of the short period required to sample the products, it is suggested that chemical cartridge organic vapor respirators would serve as needed in this operation. The gas mask should be held in readiness for emergency use as required for units handling highly volatile materials.

Urine specimens were to be collected at 2 P.M. February 11. Mr. George Taylor reported he was in position to analyze samples for two of the three shifts beginning with those of the 11th. He will test the other samples after he has done a little exploratory investigation of the best method of preserving those which the employees leave at 2 P.M.

The unit is producing at about 90% design capacity with quality of the product completely satisfactory.

MEDICAL DIVISION
Original signed:
J. W. Hammond
Industrial Hygienist

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt Fee will provide you the signature of the person delivered to and the date of delivery.

I also wish to receive the following services (for an extra fee):
1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

WILLIAM B. BAGGETT
Baggett, McCall & Burgess
P.O. Drawer 7820
Lake Charles, LA 70606-7820

4a. Article Number
P 921 297 171

4b. Service Type
☒ CERTIFIED

7. Date of Delivery 11/23/93

5. Signature – (Addressee)
Jody Blair

6. Signature – (Agent)

8. Addressee's Address
(ONLY if requested and fee paid.)

PS Form 3811, November 1990

DOMESTIC RETURN RECEIPT

P 921 297 171

RETURN RECEIPT SERVICE		
	POSTAGE	
	SHOW TO WHOM, DATE AND ADDRESS OF DELIVERY / RESTRICTED DELIVERY	/
	CERTIFIED FEE – RETURN RECEIPT	
	TOTAL POSTAGE AND FEES	

POSTMARK OR DATE

SENT TO: NO INSURANCE COVERAGE PROVIDED – NOT FOR INTERNATIONAL MAIL

WILLIAM B. BAGGETT
Baggett, McCall & Burgess
P.O. Drawer 7820
Lake Charles, LA 70606-7820

1993

PS FORM 3800

UNITED STATES POSTAL SERVICE

RECEIPT FOR CERTIFIED MAIL

IMPORTANT! PLACE STICKER AT TOP OF ENVELOPE TO THE RIGHT OF RETURN ADDRESS.

INDUSTRIAL HYGIENE

HEALTH SERVICES

benzene

D-2

EXHIBIT D-2

EXXON CHEMICAL COMPANY U.S.A.

INDUSTRIAL HYGIENE STUDY OF AROMATICS EXTRACTION UNIT BAYTOWN CHEMICAL PLANT

Study By:

Mr. J. A. Allen

Mr. E. F. LeBrocq

Mr. B. G. Simpson

Report By:

Mr. B. G. Simpson

Date of Study:

October 1975

Table of Contents

I. Summary

Environmental health conditions were evaluated at the AXU/HXU during October and November 1975.

Results of this study show:

Process technicians are not excessively exposed to high noise levels.

Significant exposure to benzene and toluene is possible when employees are collecting quality control samples and changing rich solvent filters. Installation of a closed sampling loop should eliminate excessive exposure during sample collection. Employees should wear supplied air respirators or organic vapor chemical cartridges when changing the rich solvent filters.

High concentrations of benzene and toluene were found coming from open sewer grates. Employee exposure to these vapors would exceed allowable limits. Introduction of aromatics to the sewer should be eliminated.

Housekeeping on the unit was good.

Safety showers, eyewashers, and safety equipment are well located.

II. Introduction

This report is part of the ongoing environmental health program for Exxon Chemical Company U.S.A., Baytown Chemical Plant.

Industrial hygiene studies measure the working environment to determine the presence of toxic chemicals and physical agents, and evaluate employee exposure. Samples were collected that represent both actual and potential exposure.

Exposure date is evaluated by comparison with recognized standards that consider such factors as frequency of contact, duration and nature of exposure.

Industrial hygiene studies evaluate current environmental health conditions and provide a baseline to compare future operations.

III. Process Description

A. Aromatics Extraction Unit

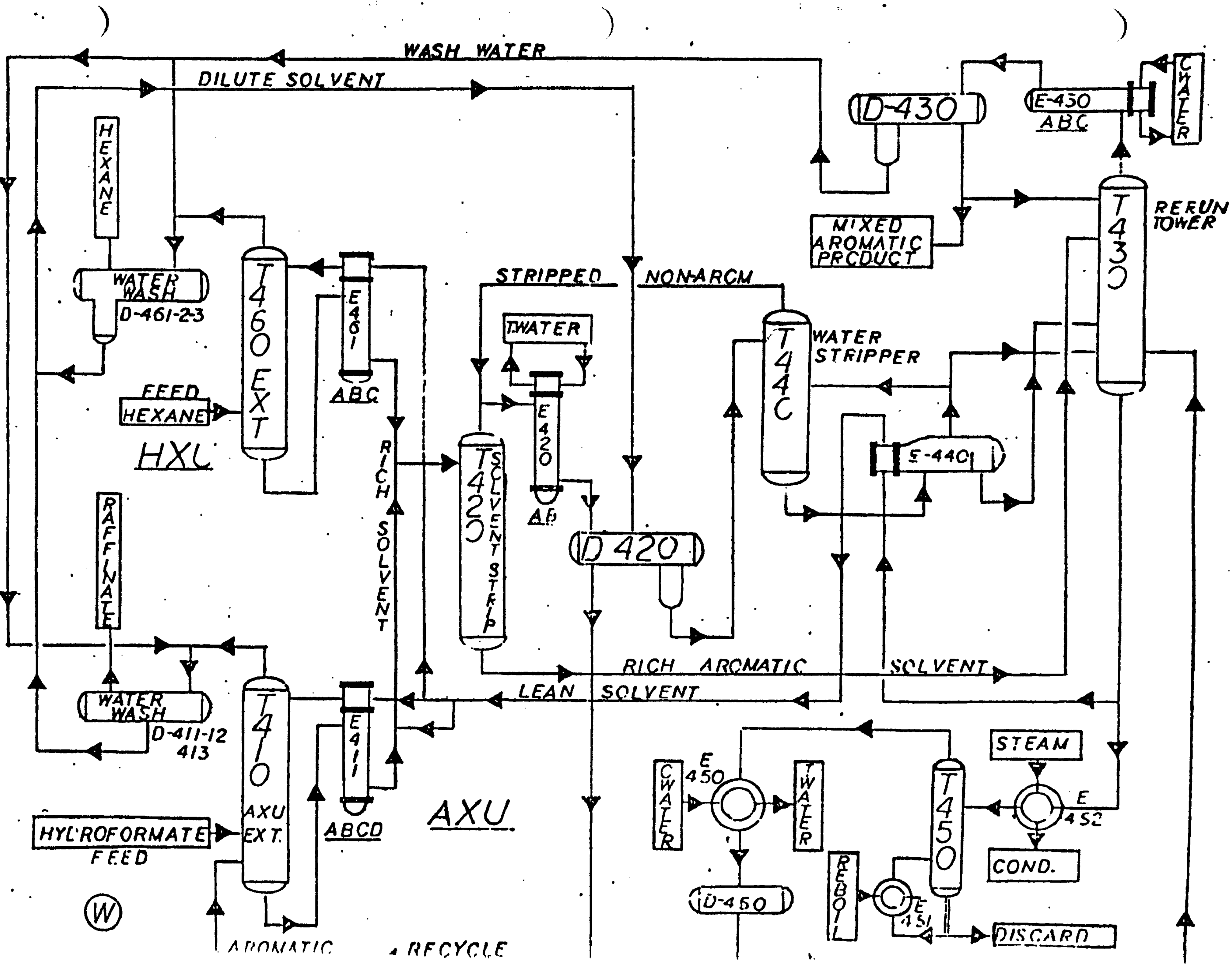
The Aromatics Extraction Unit (AXU) is a Universal Oil Products Company (UOP) process designed to extract high-purity aromatic fractions at high recoveries from a hydroformer feed containing mixed aromatics and paraffins.

Sulfolane, a solvent, is used to extract the aromatics (benzene, toluene, xylene) from the hydroformer feedstock. Raffinate from the extraction tower is returned to tankage after solvent separation. The aromatic rich solvent, containing dissolved nonaromatic hydrocarbons, proceeds to a solvent stripper tower for removal of nonaromatics.

From the bottom of the solvent stripper tower the aromatic rich solvent is pumped to the recovery tower for separation of the aromatics. The aromatics are sent to tankage prior to final finishing and the dilute solvent streams return to the water stripper and solvent regenerator.

B. Hexane Extraction Unit

The Hexane Extraction Unit (HXU) is co-located with the AXU. Feedstock for this unit is a powerformer stream from the LEFU, which has been fractionated to produce a hexane-octane rich cut. The HXU uses a sulfolane process to extract the benzene from the feed. The extraction tower rides "piggyback" on the AXU lean and rich solvent streams. The wash water system is common to both units. Extracted benzene proceeds from the HXU to the solvent stripper tower in the AXU.


WASH WATER
DILUTE SOLVENT
HEXANE
WATER WASH
D-461-2-3
T460 EXT
E461
ABC
FEED HEXANE
HXL
D-430
E-450 ABC
C WATER
MIXED AROMATIC PRODUCT
T430
RERUN TOWER
STRIPPED
NON-AROM
T WATER
E420
AB
T420
SOLVENT STRIP
RICH SOLVENT
D420
T440
WATER STRIPPER
E-440
RAFFINATE
WATER WASH
D-411-12
413
T410
AXU EXT.
E411
ABCD
AXU
HYDROFORMATE FEED
RICH AROMATIC SOLVENT
LEAN SOLVENT
E 450
C WATER
T WATER
D-460
STEAM
E 452
COND.
T450
REBOIL
E 451
DISCARD
AROMATIC RECYCLE
W

IV. Unit Evaluations

A. Materials

Feedstock, products, and materials necessary to operate the AXU/HXU are listed below. Toxicity data sheets for the materials are found in Appendix A.

	Percent
1. Feedstock	
Nonaromatic	21.4
Benzene	13.7
Toluene	25.5
C_8 Aromatics	30.7
C_9 Aromatics	8.7
2. Raffinate	
Nonaromatics	93.4
Benzene	0.0
Toluene	0.1
C_8 Aromatics	1.9
C_9 Aromatics	4.4
3. Extract	
Nonaromatics	2
Benzene	15.4
Toluene	29.9
C_8 Aromatics	42.8
C_9 Aromatics	9.9

4. <u>Additives</u>

Breaxit 8014 (Exxon Chemical) - D~~i~~emulsifier

Sulfolane (Shell Chemical) - Solvent

MAZU DF 100S (Mazu Chemicals Inc.) - Antifoam Agent

Diethanolamine (Union Carbide Corp.) - pH Control

Monoethanolamine (McKesson Chemical Co.) - pH Control

B. <u>Air Contaminants</u>

Employee exposure to toxic substances in air was determined by unit area samples, personal monitoring samples and short-term grab samples.

1. <u>Area Samples</u>

These samples show the exposure employees would receive if they were working at the monitored location. This type sample is also used to evaluate unit "tightness" and provide a baseline for future reference. A unit plot plan showing sample locations is in Appendix B.

<u>AXU Area Samples</u>

Date	Sample Location	Location	Air Contaminant Level, Parts/Million (ppm)	Threshold Limit Value (ppm)
10/7/75	1	5' N. E410B	Benzene - 1	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100
10/7/75	2	15' S. P451A	Benzene - 1	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100

* Trace - Less than 0.1 ppm.

Date	Sample Location	Location	Air Contaminant Level (ppm)	Threshold Limit Value, (ppm)
10/13/75	3	2' S. P434A	Benzene - 1	10
			Toluene - 1	100
			Xylene - 1	100
			Hexane - N. D.	100
10/13/75	4	1' S. P420A	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100
10/13/75	5	1' S. P432B	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - Trace*	100
10/13/75	6	1' S. P422B	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - Trace*	100
10/14/75	7	W. E461A	Benzene - 1	10
			Toluene - Trace*	100
			Xylene - 1	100
			Hexane - N. D.	100
10/14/75	8	W. E461A	Benzene - 1	10
			Toluene - Trace*	100
			Xylene - 1	100
			Hexane - N. D.	100

* Trace - Less than 0.1 ppm.

Date	Sample Location	Location	Air Contaminant Level (ppm)	Threshold Limit Value (ppm)
10/14/75	9	W. E461A	Benzene - 1	10
			Toluene - Trace*	100
			Xylene - 1	100
			Hexane - N. D.	100
10/14/75	10	S. P433A	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100
10/15/75	11	W. D450 2nd Floor	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100
10/15/75	12	S.E.E420B	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100
10/15/75	13	S. T420 2nd Floor	Benzene - 1	10
			Toluene - Trace*	100
			Xylene - 1	100
			Hexane - N. D.	100
10/15/75	14	S. T420	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100

*Trace - Less than 0.1 ppm.

Date	Sample Location	Location	Air Contaminant Level (ppm)	Threshold Limit Value (ppm)
10/22/75	15	S. P464A	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100
10/22/75	16	W. P413	Benzene - Trace*	80
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100
10/22/75	17	W. P413	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100
10/22/75	18	W. P461	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100
10/22/75	19	W. D461	Benzene - Trace*	10
			Toluene - Trace*	100
			Xylene - Trace*	100
			Hexane - N. D.	100

* Trace - Less than 0.1 ppm.

Results of area sampling show employee's exposure during a full eight-hour shift should be less than 10 percent of the allowable standard.

2. Personal Samples

Personal samples were collected on process technicians. These samples measure actual employee exposure during an eight hour shift.

AXU PERSONAL SAMPLING DATA

Date	Employee Shift	Air Contaminant Level (ppm)	Threshold Limit Value (ppm)	Comments
10/7/75	Batiste 7-3	Benzene-Trace*	10	-
		Toluene-Trace*	100	
		Xylene-Trace*	100	
		Hexane-N. D.	100	
10/13/75	Frazier 7-3	Benzene-Trace*	10	-
		Toluene-Trace*	100	
		Xylene-Trace*	100	
		Hexane-N. D.	100	
10/15/75	Frazier 7-3	Benzene-Trace*	10	-
		Toluene-Trace*	100	
		Xylene-Trace*	100	
		Hexane-N. D.	100	
10/28/75	Frazier 3-11	Benzene-Trace*	10	-
		Toluene-Trace*	100	
		Xylene-Trace*	100	
		Hexane-N. D.	100	
10/29/75	Batiste 7-3	Benzene - 4.38	10	
		Toluene - 15.84	100	Collected simulated quality control samples (feed, raffinate, extract).
		Xylene-Trace*	100	
		Hexane-N. D.	100	

*Trace - Less than 0.1 ppm.

Date	Employee Shift	Air Contaminant Level (ppm)	Threshold Limit Value (ppm)	Comments
10/29/75	Allen 3-11	Benzene- 2.27	10	-
		Toluene- 1.12	100	
		Xylene- 4.00	100	
		Hexane- N. D.	100	
10/30/75	Burns 11-7	Benzene- 4.23	10	Collected quality control samples (feed, raffinate, and extract).
		Toluene - 7.61	100	
		Xylene- 1.93	100	
		Hexane- N. D.	100	
10/30/75	Batiste 7-3	Benzene- 1.71	10	-
		Toluene- 1.93	100	
		Xylene- Trace*	100	
		Hexane- N. D.	100	
10/30/75	Batiste 7-3	Benzene- 20.33**	10	Simulated quality control samples (feed, raffinate, and extract).
		Toluene- 4.67	100	
		Xylene- 2.93	100	
		Hexane- N. D.	100	
11/4/75	Batiste	Benzene- 6.30	10	Peak sample- simulated quality control sample collection (feed, raffinate, and extract).
		Toluene- 5.65	100	
		Xylene- 6.51	100	
		Hexane- N. D.	100	

* Trace - Less than 0.1 ppm.
** Employee also changed rich solvent filter. See additional data under Short Term Samples.

3. Laboratory Quality Control Sampling

Personal air samples were collected while employees were sampling the feedstock, raffinate and extract. Quality control sampling takes place on the graveyard shift and requires a total of five minutes to complete. Sample lines are flushed to the pad allowing significant potential for high employee exposure.

The allowable standard for short term exposure to benzene is 25 ppm. Maximum short term exposure to toluene is 125 ppm.

SAMPLE RESULTS

Date	Name	Benzene (ppm)	Toluene (ppm)	Peak Exposure Standard Benzene/Toluene (ppm)
10/30/75	Batiste	1.71	1.29	25/125
11/4/75	Batiste	6.3	3.78	25/125

Although the peak exposure values do not exceed allowable limits, unnecessary exposure is caused by flushing sample lines to the pad. Flushing of aromatic hydrocarbons to the pad is not a desirable work practice.

4. Short Term Samples (Grab)

Grab samples are used to determine employee peak exposure to transient vapors and during interminent operations. Samples were measured by use of Drager Detector Tubes, charcoal tubes and a portable hydrocarbon analyzer.

Date	Location	Benzene	Toluene	Peak Exposure Standard Benzene/Toluene
10/20/75	Sewer East T-440	60 ppm	400 ppm	25/125 ppm
10/20/75	10 Ft. Downwind of Sewer T-440	10 ppm	-	25/125 ppm
10/20/75	East E461	25 ppm	25 ppm	25/125 ppm
10/20/75	Downwind E461	10 ppm	10 ppm	25/125 ppm
10/20/75	Roadway Between Pumps and Furnace	N. D.	N. D.	25/125 ppm
10/20/75	P420 B	N. D.	N. D.	25/125 ppm
11/4/75	Sample Point (Feed, Raffinate, Extract)	3 ppm	2 ppm	25/125 ppm
11/4/75	Column C-4 Sewer	210 ppm	200 ppm	25/125 ppm
11/4/75	Column C-5 Sewer	150 ppm	150 ppm	25/125 ppm
11/13/75	Changing Rich Solvent Filter Cartridges (20 MPH Wind)	30 ppm	-	25/125 ppm
11/13/75	Still Air in Trash Barrel for Used Fitters	210 ppm	400 ppm	25/125 ppm

5. Conclusions

Employee exposure to air contaminants based on eight hour time weighted average was found to be within standards for all samples collected except one. The sample in question was collected October 30, and was twice the allowable standard of 10 ppm benzene. Investigation showed the employee had changed the filter elements on the rich solvent filter. Air samples of this operation were collected on November 13 and showed high levels of benzene during filter replacement.

Employee exposure (eight hour time weighted average) was higher when quality control samples were collected.

Exposure to aromatic vapors from the sewer system is another point of contact likely to have caused higher exposure than would be expected from the data on unit area samples.

6. Recommendations

a. Eliminate introduction of aromatics to sewer.

b. Install a closed loop sampling line at each quality control sample point.

c. Ensure filter is well flushed prior to opening the rich solvent line.

d. Use Drager tubes to check for benzene when changing filters or breaking open lines.

e. Employees should wear supplied air respirators or organic vapor chemical cartridges when benzene concentrations exceed 10 ppm.

C. Biological Samples

Potential employee exposure to benzene can be determined by the use of area and personal air sampling, however, the final measure is the degree of actual employee exposure.

The human body metabolizes benzene to phenol which is excreted in the urine. There is a direct correlation between benzene exposure and urinary phenol levels. The normal range of phenol in urine for unexposed people is 5-20 mg/liter.

Excessive benzene exposure is represented by urinary phenol concentrations of 80 mg/liter or greater. Samples on the following page are identified as A, beginning of shift, and B, end of shift. Results of samples show no significant employee exposure to benzene.

D. Hearing Conservation

1. Noise Survey

Sound level measurements were made at specific locations on the AXU (see Noise Plot Plan in Appendix C). Potential hearing loss is based on the intensity and duration of noise exposure. The table below lists noise levels measured at specific locations and allowable unprotected exposure time.

OSHA Permissible Noise Exposures
(Table G - 16 29CFR 1910. 95 [a])

Duration Per Day, Hours	Sound Level dBA Slow Response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or Less	115

AXU Noise Survey

Location No.	Location	Noise Level (dBA)	Allowable Exposure Time (Hours)
1	S. W. Corner of Unit	79	8
2	P462	90	8
3	P440	90	8
4	P460A	93	5 1/2

COST $________
PAID BY PLF. DEF.
TBA No.________

EXHIBIT
D-3

D-3

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF TEXAS
GALVESTON DIVISION

SAMMIE JOE SKEEN, INDIVIDUALLY AND AS NEXT FRIEND OF ROCKY NEAL SKEEN AND ASHBY HOPE SKEEN, MINORS, As Administratrix of the Estate of WILBUR JACK SKEEN, Deceased, and JOE LYNN TAYLOR, JILL MARY CROOK, JOHN MATHEW SKEEN, and JACK CHRIS SKEEN, HAZEL SKEEN	§	C. A. NO. G-82-468
VS.	§	
MONSANTO COMPANY, ITS SUBSIDIARIES OR AFFILIATES	§	

PROCEEDINGS

BEFORE THE HONORABLE HUGH GIBSON

ON-LINE TRANSLATION

SEPTEMBER 30, 1986

COPY

WORLDWIDE COURT REPORTERS, INC.

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D-3

not be cured if you're not detected early.

Q. What disease was that?

A. Basically by the attack on the bone marrow which destroyed -- which produced the -- and destroyed that, which was the organ that produced the blood supply.

Q. Was there a name for the disease?

A. There was a name of the disease, depending upon the particular stage in which you caught it or found it.

Q. Can you give us some examples?

A. Simple anemia was evidence of it.

Q. Now, you've testified now that in small amounts, low concentrations, for prolonged periods of time, 40 or 50 years ago, benzene was known to cause anemia at least; is that correct?

A. Capable of being able to cause anemia.

Q. Didn't cause it in everybody?

A. Did not cause it, because of the known difference in susceptibility of individuals.

Q. What is a small amount, 40 or 50 years ago, what was a small amount of the low concentration of benzene?

A. Forty or fifty years ago, the criteria was that we would get it down to below a hundred parts per million.

Q. Forty or fifty years ago, a hundred parts per million was considered to be a low concentration; isn't that right?

A. Depending somewhat upon the technique you went about evaluating it or monitoring it. Many researchers and people who studied carefully found that they could measure it much below that and still were getting problems.

Q. We'll get to the measurement, but my question is: As far as health hazards, what was a low concentration 40 or 50 years ago? It was a hundred parts per million, wasn't it?

A. That was about the level at which they could adequately or quantitatively measure or monitor the product.

Q. So in the literature 40 or 50 years ago, if they discussed low concentrations or small amounts, you could safely assume that they are talking about something in the range of a hundred parts per million; isn't that right?

A. Yes. And if you examine the literature very carefully, you realize that they really didn't have very good information about what the concentrations were.

Q. Do you know what the mechanism for causing leukemia is?

A. Not entirely. It's a medical question that I would like to pass over. I'm not a qualified physician.

Q. Do you pass that on to somebody that is, like a hematologist?

A. I would pass that on to a specialist other than in the field of industrial medicine.

Q. Would a hematologist qualify?

A. I not qualified to answer that, because I'm not could occur to someone being exposed over some lengthy period of time to 10 parts per million?

A. The first symptoms that we could expect to look for, if there were symptoms of some damage, would be in the blood system or in the blood counts that we measure.

Q. Is it your testimony that an individual exposed to 10 parts per million of benzene over some prolonged period of time would have some reflection of that in his blood picture?

A. Not unless he's gotten some damage. It would be reflected and you could measure it easily by measuring the phenol content of urine or the urinary sulfate ratio, which would be my approach to the problem rather than the medical approach, which is blood.

Q. Is benzene a human leukemic, that is, does it cause leukemia in humans at the level of 10 parts per million?

A. I'm not aware of any experiences or cases where it was proven that 10 parts per million caused that.

Q. In fact, when I asked you in March if you had an opinion about the levels at which benzene is a human leukemogen as known today, that's March 1986, do you recall your answer is, the best information that we've been able to establish would be 35 to 40 parts per million and above?

A. That's the human cases that have come to my attention.

Q. Yes, sir. And you certainly wouldn't be prepared to

Q. Does the ACGIH also discuss substances that are known or suspected to be carcinogens?

A. They do.

Q. And leukemia is a cancer and, therefore, leukemogens are carcinogens; is that correct?

A. Yes. That's another definition the same way.

Q. Do you know what the ACGIH classifies benzene as today? Is it a known or a suspected human carcinogen, according to the ACGIH?

A. It probably defines it as suspected human carcinogen.

Q. And it's never classified it as a known human carcinogen, has it?

A. That is true, I believe.

Q. And you've been on that committee since '77 or '78?

A. '77, '78, yes.

Q. You've not made that change in the recommended or in the TLV booklets, have you?

A. I have not. However, I -- even though I might have voted against not including it as a human carcinogen, I was outvoted, because in our company's operations we always practiced using it as a human carcinogen and my operations and my recommendations to the company and the protection of my people was always assume it was.

Q. These other experts in the ACGIH committee on which you sit overruled you; is that what you're saying?

value.

Q. In any event, what was the date on the one you signed, the Exxon sheet?

A. That one was the 10th month, '77, October 1977.

Q. What did Exxon's Material Safety Data Sheet on benzene look like in 1969 and 1970?

A. I don't remember, but we had them. But I don't recall.

Q. Do you remember that you had this third page?

A. We had that information available in some form or another. Whether it was the third page or actually typed in on the form, I don't recall.

Q. Your sworn testimony is that in 1969 you were advising folks that you gave these material safety data sheets all of the same information that you were in '77?

A. Or the equivalence, yes, sir.

Q. Is it the same or the equivalent?

A. Yes. It may not have been the same wording, but it was to tell them that prolonged exposure would cause bone marrow injury leading to severe or fatal blood disorders, yes.

Q. You also told us today that in your position on the Committee on Airborne Contaminants with the ACGIH, that your position was that benzene should be listed as a known carcinogen; is that correct?

A. I voted for that.

Q. Yes, sir. In the 1977 Materials Safety Data Sheet which you signed --

A. Yes.

Q. -- how do you list benzene, under "Chronic," the last page?

A. Benzene is increasingly suspected as a carcinogenic chemical in man by reason of an association with leukemia in some instances of excessive occupation exposure.

Q. So the Materials Safety Data Sheet which you signed in 1977 listed benzene as a suspected carcinogen?

A. Yes.

Q. And is there an explanation for that since you told us it was your view?

A. This is for the public or the customer, which is the general public, that bought the product. And with that information on there, I dare say that anyone that was going to be using the product certainly would come back for more definite information about the product. It was to stimulate and raise a red flag for them that they had a very hazardous, dangerous material.

Q. But even though you thought it was a known carcinogen, you said it was a suspected carcinogen because they'd come back to you, that would raise a red flag?

A. I would certainly have expected them to ask me for the evidence and the data.

Q. And what exposure would it take to lower, see any effect in the urine, assuming there were no dietary interferences at all, no other interferences, how much benzene would you have to have to show any difference at all?

A. Mr. Scott, we presented that yesterday on a table of the significance of what the exposure would be when the ratio of the sulfate fell below 80, and I'll refer you back to that information that's been already entered.

Q. That's something you would have to look at the books to tell you?

A. That's true.

Q. It's not the kind of thing that any of us would remember?

A. Let me mention and emphasize again, that I individually looked at anything suspiciously if it was less than 80 percent, and found out how and why there was a change in this ratio.

Q. Isn't it true that you had to have exposures greatly in excess of 10 parts per million to affect the urine sulfate ratio at all?

A. You're very near the break point at 10 parts per million.

Q. It has to be at least 10 parts per million?

A. Yes. You're very near, as I say, a little above may levels these folks had during those years, can you?

A. I would like for the jury to know that if we kept the TWA down below 10 parts per million throughout their workday, throughout their week and throughout their career, they are not going to have any significant problems in any of their life. And if we have hypersensitive people that that would be affected, they'd be detected the very first week or two that they working there, and they'd be moved to some safe operation. And they were, I'm sure, but I don't know of anyone that we -- we didn't have enough people to run into that one in a thousand or one in a hundred thousand that you might have.

Q. My point is that you can't tell this jury that the Exxon folks were exposed only to one part per million or two parts per million. All you can say is, it was less than 10, correct?

A. We were only working to that goal of 10 parts per million.

Q. All right.

A. I'm still convinced there's no problem under 10 parts per million.

Q. All right. I want to ask you about that, because yesterday Mr. O'Quinn showed you an article by Lamson Blaney, which you've described as one of the medical directors of Monsanto in Massachusetts. One of the first statements that he read to you -- one of the first statements he read to you was right here at the top of the page of Exhibit No. 1680, Plaintiffs, "The statement has been made informally that the maximum allowable concentration for benzene vapors should be zero." Do you remember that?

A. I heard that.

Q. You don't agree with that?

A. I don't think that's practical that you can live that way.

Q. And you weren't trying to tell this jury that Monsanto should have known that zero was the exposure level in 1950 or even today?

A. No. I don't recommend zero as a limit.

Q. All right.

A. And I think 10 parts per million and less is sufficient.

Q. Now, on the hypersusceptibility question, what test can you do on a pre-employment physical to determine whether an individual is going to be hypersensitive or hypersusceptible to benzene?

A. Only by the history, his history, in regard to whether or not he's been exposed to benzene or some concentration of benzene in the past and had any particular reaction. That's brought out by careful medical history of him.

CONFIDEN

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

4400 FIFTH AVENUE

PITTSBURGH, PA.

INDUSTRIAL HYGIENE SURVEY

of the

Baton Rouge Refinery

LOUISIANA DIVISION

ESSO STANDARD OIL COMPANY

Baton Rouge, La.

February - April, 1949

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INDUSTRIAL HYGIENE SURVEY

MADE FOR

ESSO STANDARD OIL COMPANY

BATON ROUGE, LOUISIANA

FEBRUARY 23 - APRIL 20, 1949

Arrangements for this survey were made in 1948 through the office of Dr. R. C. Page, General Medical Director, Standard Oil Company (N.J.). It is a part of a larger study which will include four plants of the Esso Standard Oil Company, Sarnia Refinery of Imperial Oil Limited, and the Aruba Refinery of Lago Oil and Transport Company. Field work at all the plants will have been completed before the submission of this report. The field work at Baton Rouge embraced the period February 23 to April 20, 1949. Mr. J. F. Morgan was present at the refinery for the entire period of the work, Mr. W. C. L. Hemeon spent two weeks at the refinery, and Mr. George F. Haines, Jr., of the Foundation staff, assisted during a period of two weeks.

Persons in Standard Oil Company (N.J.) directly concerned with the work are Dr. Joseph P. Holt and Mr. N. V. Hendricks; in the Esso Standard Oil Company headquarters, Dr. John S. Denholm and Dr. Clyde M. Berry. At Baton Rouge, the official contact was Dr. Howard Hansen.

During the course of the survey, close association was established with Mr. E. Stauverman, Jr., Mr. Roy E. Brady, and Mr. Stanley Day, of the Safety Department.

The important conclusions of the survey are highlighted in the "Summary" section of the ensuing pages.

S U M M A R Y

There are four principal classes of materials of significance in the present considerations.

(1) Materials which are known from experience to cause slowly develop ing toxic effects when workers are chronically exposed to atmospheric concentrations above certain levels, as lead dust, silica dust, benzol vapor, and the lik

The severity of exposure to this class in conventional manufacturing processes in factory buildings can usually be appraised quantitatively by analys of the workroom air. Situations in the oil refinery where this could be done were few.

(2) Materials whose primary action is acute poisoning from short-time exposures. The acute poisoning may be effected by a single exposure incident. They usually have no chronic effects at lower concentrations. Carbon monoxide is an example. Asphyxiant or narcotic concentrations of carbon dioxide and aliphatic hydrocarbon vapors are in this category.

(3) Materials, as acid gases, which are irritating to breathe, repulsive, and hence, obvious in their presence; therefore, these warning properties tend to discourage exposures to injurious concentrations, except as they occur in accidents.

(4) Materials as PBN, C_9, and related aromatics which, because of their physical or chemical relationship to classes of known physiologically active materials, may be suspected of having deleterious health effects but about which there is no evidence from human exposures to permit of their accurate classification.

In the following tables, exposures of refinery employees to materials which are classified above are separated according to the evaluation arrived

at in the course of the survey. Table I summarizes the exposures where it was possible to conclude that a definite health hazard existed.

Table II summarizes potential exposures to substances definitely known to be harmful, but where our observations indicated the intensity of exposure to be within safe limits.

Table III describes the largest and most important class of exposures where there is no experience to guide one to any definite conclusion, but wherein by inference (necessarily somewhat tenuous), we are led to suspect the possibility of hazardous conditions. In these cases, medical supervision of workers is indicated, so that by means of periodic examination of special design, any incipient health effects will be detected before widespread development occurs.

We have included in Table III the already recognized potential carcinogen hazards in exposures to the high boiling cut from catalytic cracking, wax pressing, OLA tars, and unknown substances from alcohol manufacture. Not heretofore recognized is the possibility of oil mist inhalation in various localities. Some measurements of oil droplet concentrations in atmospheric suspension have been made in various locations.

Table IV summarizes exposures to materials which are conservatively estimated to be innocuous or of negligible toxicity at the levels of concentration encountered in practice.

Table V summarizes recommendations for mechanical improvement of conditions in several locations.

In general, and to the credit of the executive attitude at this refinery toward safety and health, many of the hazards discussed in this report had already been recognized. Corrective measures have been instituted widely.

Table I

HAZARDOUS EXPOSURES TO MATERIALS OF KNOWN TOXICITY

Operation or Location	Substances or Conditions	Employee Group Affected
Paracril Plant	Acrylonitrile--by inhalation in vicinity of latex and coagulation pots.	One or two process men.
Catalyst Plant	Chromic oxide, various other raw materials and products--by inhalation and skin contact.	The 13 catalyst plant workers.
Sandblast Sheds	Silica dust--by inhalation.	Sandblaster helpers
Pipe Shop in Chemical Products Division	Metal fumes have produced symptoms of metal fume fever.	Boilermakers, welders, and burners.
Brick grinding Shed.	Silica dust enters shed from sandblast.	One man of Mason Department.

Table II

EXPOSURES TO HAZARDOUS MATERIALS JUDGED TO BE WITHIN SAFE LIMITS

Operation or Location	Substances or Conditions	Employee Group Affected
Butyl Rubber	Methyl chloride in vicinity of reactors and in finishing building. Safe usage by reason of process control, ventilation, and daily air analysis.	Process and mechanical workers in these areas.
Butyl Rubber Finishing Building	Talc dust at packaging.	Packers
Butyl Rubber Reactors	Aluminum chloride exposure is controlled by wearing respirators.	Process workers in the reactor area.
Alcohol Plant	Inhalation of acetaldehyde is at present prevented by use of respirators.	A few process workers in alcohol denaturing.
Anti-freeze production in Alcohol Area.	Methyl alcohol exposures are controlled by informed personnel and natural ventilation.	Process workers and pipe-fitters assigned to the area.
Paracril Plant	Acrylonitrile--in control rooms and in finishing building beyond coagulation pots.	Machinists, process workers, except attendants at latex and coagulation pots.
Light Oil Treating Plant	Lead--mist at ground level from aeration in doctor regeneration.	Process workers at ground level.
Shell Still Batteries No. 16 and No. 17.	Hydrogen sulfide exposures slight in receiving houses.	Still operators and helpers at the units.
No. 2 D. & S., Hydrogen Sulfide Recovery Unit	Leakage of hydrogen sulfide is effectively prevented in the process equipment.	
Tetra Ethyl Lead Blending Plant	Tetra ethyl lead--satisfactory control measures are practiced.	Blending plant employees, machinists pipefitters, and laborers.
	Gasoline anti-oxidants--skin contact is unlikely in present mode of handling.	

Table II
(Continued)

Operation or Location	Substances or Conditions	Employee Group Affected
Wax Presses--Plate Repair Shop	Method of removing suspected carcinogenic material from plates before repair acts to prevent skin contact.	Plate shop personnel
Wax Presses--Refrigeration Unit	Paraffin Distillate, Foots Oil--no important exposures occur.	Process workers
Grease Manufacturing Plant	Dust of dry grease ingredients. Not significant by reason of low toxicity or infrequent occurence of exposures.	
Light Ends Plant and Gas Compressor Houses	Hydrogen sulfide is generally not a chronic toxic hazard at those places where it occurs in the process streams because of the degree of confinement and the ventilation of such places.	
Machine Shop	Metal spray and nitrogen oxides, safe by reason of infrequent use of toxic metals and outdoor location.	Machinists
Lead Melting Pot (portable)	Insignificant exposure by reason of low frequency.	1 Boilermaker helper.
General, at Process Units	Mercury, with reference to skin contact with liquid.	M. & I. workers
Underground Lead-sheathed conduits	Lead fumes. Infrequent occasion for fume evolution.	Electricians
General, in furnaces of process units and boiler houses.	Silica dust in furnace breakdown and repair.	Masons, Laborers
Underground Pipes where digging is required to locate leaks.	Heavy aromatics boiling above 700°F, skin contact.	Laborers--exposures are fairly well eliminated by present control practices.
Barges, repair of	Lead fumes from welding.	Welders
Tanks in Tetra Ethyl Lead Service	Tetra Ethyl Lead and residues.	Laborers
Refinery Lab.	Aniline. Mercury vapor.	Lab. personnel
Printing Standards	Volatile solvents and process liquids.	Machine operators

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Table V
(Continued)

Operation or Location	Substances or Conditions	Remarks	Type of Mechanical Remedy Applicable
Sandblast Sheds	Silica dust.	For protection of sandblast helpers and others in vicinity.	Confinement of silica dust.
Paint Shop	Paint removers likely to contain benzol.		Exhaust booth.
Pipe Shop, Chemical Products Area	Metal fumes.	Welding non-ferrous alloy pipes.	Local exhaust system.
Catalytic Cracking Units	Catalyst	With reference to welders' work at turnaround.	Respirator should be worn beneath welder's hood.
Lead Burners Shops; at No. 3 Acid Plant and in Chemical Products Area	Lead fumes	General room ventilation does not effect dilution of fumes between torch and burner's nose.	Local exhaust system.
Refinery Laboratory: Gas Analysis Room	Mercury vapor		Improve floor surface to facilitate cleaning.
Old Boiler Shop	Fumes from preheating Hastelloy D tubes.	Question of nickel carbonyl formation.	Extension of hood over furnace.

P R O C E S S   W O R K E R S

CHEMICAL PRODUCTS DIVISION

CRACKING DEPARTMENT

Paracril Plant.

The principal process involved here is the polymerization of butadiene and acrylonitrile. Other substances besides the reactants are:

Daxad 11
PX 441 (di-tertiary-butyl-para-cresol)
Caustic soda
Acetic acid
Lorol mercaptan
Hydroxylamine hydrochloride
Candellila wax
Superloid

Number of Employees and Their Principal Stations. In the finishing building, three or four men per shift spend most of their time at the station alongside the drying oven. One or two men are active at the conveyor line where rubber enters the drying oven. Three or four men are engaged fairly steadily at the packaging end of the conveyor. One man intermittently tends the control panel behind the coagulation pot. It is estimated that he is in this locality approximately half of the time.

Reactor Control Room. One man per shift works here fairly steadily.

Control Room Over Strippers. One man works here full-time per shift. In addition to the above locations, there is intermittent attendance by the personnel already mentioned to the reactors, pumps, refrigeration unit, feed drums, storage shed, etc.

Exposures Incident to Normal Operation. Attention was directed principally to the possibility of inhalation of vapors of acrylonitrile. This was done for two reasons: First, the probable toxicity of acrylonitrile to man, as indicated by animal experiments, is greater than with other materials present in this plant; secondly, the properties and the quantities of acrylonitrile, and the conditions of its use in the process, indicate a greater chance for absorption of this substance by the men than for the other substances used.

Appreciable concentrations of acrylonitrile are most likely in the vicinity of the coagulation pot in the finishing building, because at this point the product and reactants first reach an unenclosed vessel. An exhaust hood stands several feet over the top of the pot.

Measurements of acrylonitrile vapor on the platform near the control panel showed 90-180 parts per million in samples collected over a period of several hours on two different days.

Samples collected in the following locations showed negligible or trace amounts of acrylonitrile vapor in air:

(1) control room at reactors

(2) control room over strippers

(3) entrance end of drying oven in finishing building

(4) operator's desk in finishing building

Concentrations at other outdoor locations, such as the vicinity of recycle pumps, charge pumps, knock-out drums for compressors, and charge drums would also be expected to be negligibly low. The question of the possibility of fairly high exposures at repeated intervals in the act of sampling the reaction mixture for completeness remains open. Sampling commences at the reactors about four to five hours after the start of reaction and continues thereafter for the duration of the reaction. Samples are taken with increasing frequency until the rate of once every 20 minutes is reached. We obtained an estimate of an average frequency of approximately once an hour. There is undoubtedly some vapor exposure at sampling, as evidenced by the strong odor in the vicinity of the sampling lines.

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Information is lacking on the effects of prolonged or repeated inhalation of acrylonitrile in known concentration ranges by man. The published maximum allowable concentration for this substance is 20 parts per million. This figure was arrived at after animal experimentation by the U. S. Public Health Service. Guinea pigs and other species showed kidney damage. An observation was made that the action of acrylonitrile resembled that of inorganic cyanides for which 20 p.p.m. had previously been accepted as the limit.

We conclude from our observations at this plant that there is some possibility of chronic intoxication from prolonged work in the vicinity of the latex and coagulation pots. Extension of the exhaust hood face to the level of the top of the pot would effectively reduce acrylonitrile concentrations on the working platform. Close medical supervision of men working in this area is advisable.

Steam Cracking Plants, No. 1 and No. 2.

Materials and Processes. Gas oil is cracked in the presence of steam to produce ethylene, propylene, butadiene, an aromatic distillate containing isoprene, aromatic tar, heavy fuel oil, gas oil, and some residual gas. A clay treating plant at OLA-2 removes a gummy polymer from the aromatic distillate.

Exposures. In the routine operation of these units, exposures to inhalation of vapor are infrequent. The men spend most of their time in and around the control houses which are isolated from process materials. The necessity for collecting samples, making valve adjustments, inspecting equipment, and making changes in operation takes the men to areas where vapors may occur. This process equipment is out-of-doors. Time spent in such areas is of short duration. Vapor exposures are of short duration and infrequent.

Skin contact with the process material does not occur in normal

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operation. Unusual events may cause spills and leaks necessitating contact, principally with the hands and feet.

Significance of Exposures. The aromatic distillate is important toxicologically because it contains benzene, toluene, and xylene to the extent of approximately 29 volume per cent. Another 12 per cent of the fraction consists of aromatics boiling between 302°F. and approximately 450°F. It is impossible to obtain a knowledge of concentrations of these substances in air which may be encountered in those infrequent occasions when exposures occur because of their transitory nature. Since benzene is the most toxic and most volatile compound in this group, evaluation of exposures to it is of paramount importance. Evaluation under the supervision of the medical department, on the basis of urine sulfate ratio determinations for the group of process people most likely to be exposed is recommended. A discussion of this evaluating technique occurs in the appendix.

The aromatic tars produced at these units are included in the program for control of suspected carcinogenic materials. Pumps, vessels, and lines containing the tars have been labeled and precautions have been put in force. Contact with these tars by process people is infrequent, according to our observatic of normal processing activity.

Butadiene Extraction Plants.

Materials and Processes. A product stream from steam cracking containing C_4 mono and diolefins goes to butadiene extraction units 1 and 2 for removal of butadiene. The process includes the preparation of cuprous ammonium acetate, its reaction with the hydrocarbons, and the subsequent separation of butadiene. One ammonia refrigeration unit serves the two extraction plants.

Tertiary butyl catechol is added to butadiene as it goes to storage in the following manner: The inhibitor is removed from the can or fiber drum in which it is received; it is melted in a pressure drum, dissolved in butadiene to make a concentrated solution, and is then metered into the butadiene on its way to storage. A control house for the extraction plant is isolated, materials of great toxicity are not present, and exposures of men by skin contact or inhalation are not frequent in normal operation.

Isobutylene Extraction Units Nos. 1, 2, and 3.

Materials and Process. Butylene streams from the petroleum products division and from the butadiene extraction units undergo sulfuric acid extraction. Isobutylene and butylene are the products.

Exposures. Prolonged vapor exposures do not occur in the normal operation of this plant.

Significance of Exposures. The feed stock and products are simple asphyxiants and anesthetics. Very high concentrations for a prolonged period would be necessary for the anesthetic effect to be noticed. Health hazards at these plants consist only of the accident hazard connected with the handling of sulfuric acid. Extensive precautions are taken.

Diolefin Extraction Unit.

Aromatic distillate discussed under the heading "cracking plant" is treated at this unit for the removal of isoprene. It will be recalled that in this stream, benzene, toluene, and xylene make up a fraction amounting to 29 volume per cent of the total. Opportunities for exposure are approximately the same as at the cracking plant. Similar medical control is recommended for the men who work here. Vapor concentrations in the air at breathing level of worker at the unit are too transitory to permit appraisal of the hazard on the basis of air samples or monitoring.

BUTYL RUBBER UNITS

There are three similar polymerization units, two of which are operating. One finishing building is in operation.

Materials and Process. Isobutylene and isoprene are polymerized to form butyl rubber. Aluminum chloride is used as a catalyst. Spent catalyst is hydrolized, neutralized, and discarded (2,000 pounds of aluminum chloride are received and used every 10 days).

Methyl chloride: This solvent finds large scale use as a carrier for the reactants and as a solvent for the catalyst. Methyl chloride is stripped from the polymer slurry, purified, and reused. (Loss of methyl chloride is in the range of 12,000 to 15,000 pounds per day. Of this amount, 4,000 pounds represents the unaccounted-for loss.)

Caustic solution: Caustic is used in neutralization of hydrochloric acid.

Zinc stearate: Zinc stearate is formed at the plant from stearic acid, zinc sulfate, and caustic. Its production is on a small scale, amounting to six batches in a 24-hour period. Zinc stearate for both polymerization units is formed in one location.

Phenyl-beta-naphthylamine is added as an inhibitor. It is received as a dry powder and about six times a day, a solution containing six shovelfuls of powder is prepared. Its use amounts to about 180 pounds a day.

Xylyl mercaptan is used as a plasticizer. It is made up in kerosene solution and is added to the rubber at the extruders in the finishing building.

Talc is dusted onto the finished product prior to packaging.

Exposures.

1. Control houses for the two polymerization units are isolated from the process units. The 12 men per shift who control the polymer units spend the greater part of the time in and around the control houses. They are, therefore, isolated from exposures to vapors escaping from the units. Instruments in the control house are of the receiver type except for the spectrophotometer room in each house, which has stream lines bringing small amounts of the volatile reaction mixture into the instruments. These rooms are well-ventilated by both exhaust and supplied air systems.

2. Manufacture of zinc stearate. This batch-wise process is performed twice a day by one man. Technical stearic acid and zinc sulfate are added by shovel to a reactor. Stearic acid is non-toxic and non-dusty. The technical grade contains other fatty acids as impurities. They are likewise non-toxic. Zinc sulfate is a material of low toxicity. The actual time spent in moving it to a reactor is so short that,even if dust arose, exposure time would be practically negligible.

3. Preparation of PBN solution. Twice per shift one man moves six shovelfuls of the powder into a solution drum. It might be expected that in so doing there would be some contact between the material and the skin, and that he might inhale some dust. PBN itself has not caused any acute toxic effects at this installation. The possibility that one or more of its cancer-forming homologues might be present as an impurity is sufficient to make advisable the use of a respirator during the time the material is being transferred.

4. Preparation of aluminum chloride solution. This irritating and dusty operation, for which a respirator is worn, is performed by one man in about 10 minutes every third day. Handling this material is a nuisance, but not a health hazard.

Table III
(Continued)

Operation or Location	Substances or Conditions	Employee Group Affected	Nature of Possible Effects
Wax Presses	Wax, Paraffine Distillate, Foots Oil, Pressed Oil--as liquid or in the form of mists.	Lube and Paraffine employees, machinists, and pipefitters assigned to this area.	Cancer (?)
Wax Presses--Refrigeration Unit	Paraffine Distillate, a suspected carcinogen.	Machinists and pipefitters in repairing coolers.	Cancer(?)
Crude Scale Wax Sweaters	Crude scale wax and oil, possibly carcinogenic, depending on prior treatment of the stock.	Pipefitters.	Cancer(?)
Solvent de-waxing (MEK) Plant	Vapor of benzol, ? occurs in low concentrations in working areas.	Process workers, machinists and pipefitters assigned to the unit.	Upset of urine sulfate ratio in simple exposure cases; blood changes in cases of intoxication.
Grease Manufacturing Plant	Inhalation of mists and skin contact with grease ingredients and products.	Grease Plant employees.	Unknown
Lube Oil Treating	Sulfur dioxide or sulfuric acid mist.	The problem of irritation may be critical in employees in agitator area having unusual pre-disposition.	Abnormal tooth decay; upper respiratory irritation.
Phenol Treating Plants	Phenol vapor	Workers at Phenol Plant, especially sample takers and pipefitters.	Unknown Skin - Acute
Thermal Cracking Units	Oil mist and vapor, including clarified oil from catalytic cracking.	Sample takers and other process people, pipefitters assigned to the units.	Cancer (?) HCCGO.

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Table III
(Continued)

Operation or Location	Substances or Conditions	Employee Group Affected	Nature of Possible Effects
Steam Cracking Units in Petroleum Products	Aromatic distillate because of benzol content.	Sample takers and other process people, pipefitters assigned to the units.	The same signs of exposure and intoxication outlined for benzol previously.
	Aromatic tars and clarified oil from catalytic cracking.		Cancer (?)
Catalytic Cracking Units	Clarified Oil and slurry oil when encountered either as liquid or as mist at hot oil pumps.	Process people and mechanical crafts assigned to these units, especially pipefitters.	Cancer (?)
	Silica-alumina catalyst--dust inhalation, also entry into eyes.	Significant for pipefitters, welders, masons, and laborers.	Eye irritation; lung abnormalities (?)
Power and Boiler Houses	Noise	Full-time employees of these places.	Impairment of hearing
Barisol Plant	Carbon tetrachloride, ethylene dichloride.	Former process workers and pipefitters and machinists formerly assigned here.	Liver abnormalities
Machine Shop. Disassembly to re-assembly Shop	Aromatic tars and oils boiling above 700°F, spilled from undrained equipment and accumulating on the ground.	Machinists.	Cancer (?)
Pipe Shop in Petroleum Products Division	Lead fumes may be encountered in future work on bonded lead pipe.	Boilermakers, welders, and burners.	Increased lead in urine and blood as evidence of exposure.

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Table III
(Continued)

Operation or Location	Substances or Conditions	Employee Group Affected	Nature of Possible Effects
Lead Burners Shops at No. 3 Acid Plant and in Chemical Products Area	Lead fumes, especially from bonding.	Lead burners and helpers.	Increased lead in urine and blood as evidence of exposure.
Main Electric Shop	Varsol and Xylenes	Shop electricians	Irritation of eyes and nose, nervous and digestive disorders.
General, throughout refinery	Solvent vapors from cements for insulating materials.	Insulators.	
Disposal Dump	Oil smoke, fumes, and mist. (Heavy aromatic wastes)	Laborers	Cancer (?)
Bubble Towers throughout refinery	Hydrocarbons from gas oil to heavy tar. Skin contact.	Laborers	Skin effects. Cancer (?)
Tube Cleaning, general	Coke dust	Laborers	Respiratory disorders
Vertical Soaking Drums at Thermal Cracking Units	Skin contact with tar and coke from thermal cracking.	Laborers	Skin effects. Cancer (?)
Condenser Boxes at Thermal Cracking Units	Skin contact with tar.	Laborers	Skin effects. Cancer (?)
Paint Shop	Inhalation of benzol in use of paint remover. Frequency is unknown.	Painters	Upset urine sulfate ratio in simple exposure cases.
General	Benzol occurring in other paint products.	Painters	Upset urine sulfate ratio in simple exposure cases.
Asphalt Processing	Mists and vapors	Asphalt workers	Cancer (?)

Table IV

EXPOSURES OF LOW INTENSITY TO MATERIALS OF A LOW ORDER OF TOXICITY

Operation or Location	Substances or Conditions	Employee Group Affected
Paracril Plant	Butadiene vapor	Process and mechanical.
Butadiene Extraction Unit	Mono- and di-olefins	Process and mechanical.
Isoprene Extraction Unit	Butylenes	
Diolefin Extraction Unit	Acetone	
Butyl Rubber Plants	Zinc sulfate, stearic acid, and zinc stearate.	Process workers in reactor group.
Alcohol Plants	Hydrocarbon feed stocks and low-molecular weight products and by-products.	Process and mechanical.
Light Oil Treating Plant	Petro Green D Dye.	Treating Plant porters.
Tetra Ethyl Lead Blending Plant	Petroleum dyes	Blending Plant workers.
Propane de-waxing, de-oiling, de-asphalting.	Propane	
Wax Filter Plant	Bauxite	
Lube Filter Building	Dust of Attapulgus clay.	
Specialty Stills (1929 Plant)	Petroleum vapors	
Generally, throughout refinery.	Welding fumes	Welders and burners
Generally, throughout refinery.	Fumes from burning coke deposits. Good ventilation is provided.	Welders

TABLE IV
(Continued)

Operation or Location	Substances or Conditions	Employee Group Affected
Catalytic Cracking Unit	Asbestos	Placed in this table with reference to exposures at turnaround for welders, masons, laborers.
M. & I. Shops	Varsol vapor	
UOP Poly Plant	Hi Sil Dust	Laborers
Railroad Car Unloading	Brick Dust	Laborers
Bricklaying sites	Brick Dust	Masons

Table V

RECOMMENDATIONS FOR MECHANICAL IMPROVEMENT OF CONDITIONS

Operation or Location	Substances or Conditions	Remarks	Type of Mechanical Remedy Applicable
Paracril Plant	Acrylonitrile vapor		Improved hood over coagulation pot.
Butyl Rubber Plant	PBN	Inhalation of dust during preparation of solution.	Dust respirator on exposed worker.
Butyl Rubber Finishing Building	Talc dust.	At packaging of finished product.	Improved hoods to capture dust at scales.
Catalyst Plant	Dust of chromic oxide and a variety of other materials.	Multiple dust sources throughout the building.	An extensive exhaust ventilation system for the plant.
Tetra Ethyl Lead Blending Plant.	Gasoline dyes.	Dusty for short periods during preparation of solution.	Use of respirator by the one person who shovels dry dye.
Grease Manufacturing Plant	Mist of grease ingredients and products.		Improved hoods over heating, saponification, and mixing kettles.
Lube Oil Blending	PX 441	Disagreeable odors and mist at solution preparation.	Exhaust hood.
Machinists' OLD PUMP Disassembly and SH Reassembly Shop	Liquid material spilled from pumps, etc., some of which may be carcinogenic		Installation of floor drain beneath disassembly location.
M. & I. Shops	Spilled mercury	Exposure not hazardous at present. Chance for future accumulation.	Improved floor surfaces to facilitate cleaning.
Main Electric Shop & 9	Varsol and Xylol vapors Steam Oakite.		Exhaust hood for spraying.

5. Supervision of reactor performance requires periodic visits several times per shift on the part of the process men to the pump and reactor areas. The pump areas have roofs, but no side walls. The reactors were formerly enclosed in a building. These buildings have had a section of the side walls removed for increased ventilation. At the time when we were searching for areas of possible high methyl chloride concentrations, there was great air movement through these reactor buildings, which precluded the possibility of accumulation of high concentrations.

6. Finishing building.

(a) Attendants at Oliver filters and vibrating screens: This is the location where one would expect most intimate association of men with the vapor of methyl chloride. Vapor concentrations are controlled by proper vacuum on strippers preceding this step in the process, and by exhaust ventilation over each filter and screen. Two men per shift spend part of their time at a distance of about 30 feet from the line of filters and screens. Occasionally each day, men mount the platform at each of the units. Routine spot checks by the chemical products laboratory and our own analysis of the samples collected over one and one-half hour periods showed less than 10 p.p.m. in the immediate area of screens and filters.

We are satisfied that the efforts which were made to control methyl chloride vapors, after the poisoning cases of 1943-44, are effectively operating today.

(b) Tunnel dryers. These are exhausted and vapors discharged outside the building. In our experience, men are seldom close to the dryers.

(c) Extruders and milling machines. There is full-time attendance by several men at these machines. Visible atmospheric contamination probably consists of water vapor, oil mist, PBN fumes, and possibly kerosene and xylyl mercaptan.

A deposit of scum was observed on the overhead roof structures in this vicinity, representing the accummlation since the plant was put in operation. Examination of the scum by the chemical products laboratory showed it to consist essentially of phenyl beta-naphthylamine. To obtain an estimate of the amount that might be put into the air by sublimation from the extruders in the course of a day, we learned that 180 pounds per day are used. Of this amount, the major portion leaves the product in water drainage to the sewer from water-rubber slurry and by separation of fine particles for subsequent burning. The loss by sublimation is considered by the process heads to be minor, probably less than 1 per cent of the amount added, or 1.8 pounds per day--equivalent to 500-700 milligrams per minute. Considering the vastness of the room, the exhaust ventilation at some points of escape, and the convection currents from the hot machinery and materials that would tend to remove sublimed material from the breathing zone of workers, it is difficult to believe that vapor exposures are significant. Yet the demonstrated carcinogenicity of several aromatic amines closely related in structure and physical properties to phenyl-beta-naphthylamine, specifically B-naphthylamine, and the possibility that some of these may occur as impurities in the commercial product, make it advisable that this situation be carefully evaluated. In medical examination of workers from this section, particular attention should be directed to detection of cancerous or pre-cancerous manifestations of bladder abnormalities, until it is finally clear that no such hazard exists.

(d) Talc dusting and rubber packaging. About five men work full time on the packaging line. There is a dust exposure on the part of the men who remove slabs of rubber from the conveyer to the paper cartons. Concentrations were found to be in the range of 9 to 16 million particles per cubic foot. Hoods provided for this job are ineffective because of their size and contour; for example, each man must weigh each package as it is filled. The scale is not enclosed in the hood. He must frequently add a piece of rubber to the package on the scale. Talc dust is dispelled into the air by this operation and is not captured in the exhaust line. The results of dust counts from samples collected at the breathing level of each of the packagers are tabulated in the Table.

Table 1

DUST CONCENTRATION--TALC DUST IN BUTYL RUBBER FINISHING BUILDING

Sample Designation	Elapsed Time	Sampling Location	Concentration Million particles per cubic foot
63	8 min.	At breathing zone of 3rd packer in line of 3, packing at normal rate.	16
64	5 min.	At breathing zone of 2nd packer in line of 3, packing at normal rate.	12
65	6 min.	At breathing zone of 1st packer in line of 3, packing at normal rate.	8.6
66	4 min.	At breathing zone of man dusting cut slabs of rubber for re-run through extruder, dusting by means of broom dipped in dust. There are 4 men working together, dusting and sawing slabs of rubber. This is about 60 feet from the talc dusting machine.	8.5
67	5 min.	General air sample throughout the area described in 66.	2.6

It is probable that concentrations of talc dust which were found in this locality constitute only a nuisance. It is true that there have been reports of pneumoconiosis from inhalation of dust in talc mining and milling, but concentrations responsible for these occurrences were in a much higher range than those we found. Some state codes require that concentrations of talc dust be kept below 15 m.p.c.f. Elimination of the nuisance by improvement in ventilation [illegible]

(e) Utility men. Several men work at such jobs as preparing stock for re-run. They are frequently in the immediate vicinity of the talc dusting and milling machines.

(f) Miscellaneous groups of supervisors, physical and chemical testing men, etc., work at various places around the west end of the finishing building. Their exposures to dust, mist, and vapors would be infrequent and of short duration because most of their time is spent in areas remote from the processes.

ALCOHOL PLANTS

Complete protection of the health of workers in the production of ethyl and propyl alcohol requires that three separate and distinct problems be recognized, evaluated, and controlled.

Accident Hazard. The first of these is an obvious accident hazard connected with the use and handling of large quantities of sulfuric acid. This problem is well understood at the plant. Effective controls are practiced. They consist of provision of protective clothing, safety showers, and certain mechanical features of process units.

Blending Agents. The second problem is connected with the use of certain toxic materials as blending agents and denaturants. Acetaldehyde is the principal denaturant for ethyl alcohol produced at this plant.

It is irritating to the mucous membranes when inhaled as a vapor and, for this reason, will not be tolerated by men for periods long enough to give any evidence of systemic damage.

Denaturing with acetaldehyde takes place in a building under government supervision. We did not see the denaturing process during the course of our survey.

for use in the building, which has only natural ventilation. We believe that use of respirators is sufficient precaution against inhalation of acetaldehyde vapor.

Methyl alcohol is used occasionally as the denaturant for ethyl alcohol and is used quite frequently as a blending agent with iso-propyl alcohol in manufacture of antifreeze.

Continued exposure to vapors of methyl alcohol may lead to chronic poisoning which is characterized by irritation of the mucous membranes, possibly leading to bronchitis and pulmonary affections which may be associated with headache, tinnitus, tremors, local and multiple neuritides, and more or less severe visual disturbances (Flury and Zernik, 1931).

The toxicity of methyl alcohol is well-respected in this plant. We saw the precautions which are provided at the blending site and at the loading racks. Most of the work connected with blending and loading of methyl alcohol takes place out-of-doors. The possibility of prolonged inhalation of significant concentrations of methyl alcohol is remote.

The hydrocarbon feed stock for both alcohol plants and the principal products of these plants are toxicologically in the class of narcotics. Inhalation of concentrations necessary for narcotic action does not occur. There is no evidence of systemic poisoning from ethylene and propylene or from the alcohols and ethers which are derived from them.

Carcinogenic Problem. The third problem at these plants is one which has risen in the Bayway alcohol plant and in the plant of one other company manufacturing iso-propyl alcohol from propylene. Statistical studies have revealed an abnormally high incidence of cancer among men who have worked in these plants for more than ten years. Cancers of larynx, pharynx, and nasal sinuses have occurred. The locations of these lesions suggest that there might be some way in this company and in one other company to determine, if possible, what substances in the occupational environment may be the carcinogenic agents responsible for these lesions. Without going into details of these research programs, it will suffice to mention that the possibility of air-borne nickel carbonyl having its origin in some of the nickel alloys in the process equipment is being investigated. Another path of the investigation leads to an attempt to identify certain poly-cyclic hydrocarbons which are known as carcinogenic agents in the by-products of the action of sulfuric acid on propylene. The current problem at the Baton Rouge alcohol plant is to determine, if possible, whether the same conditions which give rise to atmospheric contaminants in the working environment at the Bayway alcohol plant exist at Baton Rouge. Several notable differences are readily apparent. For example, the propylene stream coming to the Baton Rouge alcohol plant is much purer than the stream processed at Bayway, at present and in the past. Secondly, a lower concentration of sulfuric acid is used at Baton Rouge. This results in a lesser amount of high molecular weight side products. Thirdly, the physical arrangements of the plant at Baton Rouge, which is a new modern plant incorporating all improvements in design up to seven years ago, are completely different from Bayway's plant. The matter of the enclosure of process equipment is the most striking difference. Whereas at Baton Rouge we find a minimum of enclosure, Bayway has all processing equipment following the hydrolysis step indoors. At Bayway, the control rooms and stations for performing tests on product and reactants are in much closer proximity to stripping stills than at Baton Rouge. Maintenance at Baton Rouge is more successful in keeping the process materials in closed systems because of the newness and improved quality of the equipment.

These remarks serve only to illustrate the kind of differences that might be significant in the final determination of whether two plants have a

If, indeed, the cancer problem at Bayway has an occupational origin, the conditions which permitted its occurrence may have existed in the earlier years of alcohol operations at Bayway, and changes in equipment and process material over the years may have eliminated the causative factors. Occupational cancer more frequently than not requires a long period of time to reach the stage where it is recognized clinically. Even if there are conditions at Baton Rouge favorable to the development of cancer, it cannot be expected to be recognized clinically at this time. Investigation now for possible causative factors is aimed at the prevention of illness in future years. Success, even if completely attained, will not be known.

On the basis of our observations at both Bayway and Baton Rouge, we can suggest that certain steps be taken:

First, that investigation of alloys in use at the plant, their products of corrosion, and the possibility of air-borne nickel carbonyl be carried on simultaneously at Baton Rouge.

Second, we recommend that close attention be paid to the manner of drawing samples at the various sampling locations at the alcohol plants. Because of the frequency of drawing samples and the obvious splashing that occurs, we consider the sampling act to be one of the most important sources of contact between operating personnel and the materials that are being processed. High temperatures and obvious splashing suggest the existence of mist and vapors at the sampling locations.

Third, frequent physical examinations of all the employees at the alcohol plants and selective placement of men are essential. What is apparently a localized site of attack suggests that persons with upper respiratory affections and chronic sinusitis are unacceptable for work at the alcohol plants.

The fourth suggestion is that the medical department establish close cancer problem would have been greatly facilitated had the medical department, upon becoming cognizant of the problem, had recourse to a log of process and equipment changes over the course of the years. At Baton Rouge, it is still early enough to establish a system whereby all important changes which might have a bearing on future health problems can be made available for joint study by the medical department and the process heads.

CATALYST PLANT

This plant is engaged in the batchwise production of a variety of solid, granulated, powdered, and pellet products for catalysis of reactions carried out in several refineries. The type of product depends upon current demand. Production of a specific catalyst may last for several days, several weeks, or several months. About a dozen men are employed in the plant.

A list of chemicals and other raw materials used at the catalyst plant during the last five years appears as Table 2, below. A brief discussion of the toxicity of several of these compounds follows.

Toxicity of Some Chemicals Used in the Catalyst Plant.

Molybdenum Trioxide, powder: Ingestion, injection, and inhalation experiments have indicated that acute toxicity of molybdenum compounds, including molybdic oxide, is appreciable, but fairly low. Its toxicology in industrial use has not been sufficiently well studied to warrant an assumption that it is non-hazardous. Uncontrolled dustiness of this compound should not be permitted.

Tungstic Acid: Ingestion and injection experiments with animals have led to the conclusion that this metal is more toxic than molybdenum. Toxicological data from industrial dust exposures to tungsten compounds is lacking. Uncontrolled dust exposures should be avoided on the basis of uncertainty of effects.

Table 2

CHEMICALS AND OTHER RAW MATERIALS USED AT CATALYST PLANT DURING LAST FIVE YEARS

Material	Approximate Weight of Materials Used
Activated Alumina, 2-4 Mesh	1,500,000 Lbs.
Iron Oxide, Powder	400,000 Lbs.
Chromic Acid, Flakes	30,000 Lbs.
Chromium Nitrate, 50 Percent Concentration	50,000 Lbs.
Activated Carbon, Pellets	100,000 Lbs.
Molybdenum Trioxide, Powder	200,000 Lbs.
Superfiltrol Clay	100,000 Lbs.
Ball Clay	60,000 Lbs.
Nickel Nitrate, Crystals	80,000 Lbs.
Nickel Carbonate, Powder	20,000 Lbs.
Tungstic Acid	100,000 Lbs.
Hydrofluoric Acid, 60 Percent	15,000 Lbs.
Magnesium Oxide	15,000 Lbs.
Phosphoric Acid, 85 Percent	15,000 Lbs.
Cobalt Sulphate, Crystals	80,000 Lbs.
Naphthenic Acids	130,000 Lbs.
Nickel Sulphate, Crystals	150,000 Lbs.
Anhydrous Ammonia	50,000 Lbs.
Sulphuric Acid, 98 Percent	75,000 Lbs.
Sodium Hydrosulphide, 45 Percent Solution	450,000 Lbs.
Potassium Fluoride, Crystals	500 Lbs.
Caustic Soda, 100 Percent NaOH	25,000 Lbs.
Copper Nitrate, Crystals	7,500 Lbs.

<u>Nickel Salts</u>: Animal experiments have shown definite toxicity of nickel salts. They cause inhibition of growth of young animals, changes in the pancreas, effects on the respiratory and cardiac nerve centers, and liver and kidney damage. On the basis of minimum lethal doses in injection experiments, nickel is about 50 per cent more toxic than cobalt.

<u>Cobalt sulphate</u>: Cobalt salts are recognized as skin irritants. Toxic manifestations following ingestion include abnormalities in the blood-forming organs. Effects of prolonged exposure to cobalt dusts free from other toxic metals have not been sufficiently well studied to be understood. No per-

Chromic Acid: Dermatitis, chrome ulcers, and perforation of the nasal septum have long been recognized as being incident to exposures to hexavalent chromium compounds. Recently, a high incidence of lung cancer was discovered among workers in a plant manufacturing these compounds. Exposures for prolonged periods to low concentrations of dust and short-time exposures to high concentrations are to be scrupulously avoided. The maximum allowable concentration on the basis of injury to the nasal tissues has been established at 0.1 milligram per cubic meter of air.

There is good evidence in the recent occurrence of nosebleed among several employees that the catalyst plant is in need of effective dust control equipment. At the time of the nosebleeds, the plant was engaged in the production of a converter catalyst from chromic acid flakes and iron oxide powder. The principal dust sources are the dry grinding and mixing vessel on the third floor, the ball mill in which imperfect pellets are ground for re-extrusion, and the various operations of drying and screening the pellets. In the case of the chromic acid, the irritant effects became apparent in a matter of a few weeks after the production of this catalyst was begun.

Effects of inhalation of dust of other chemicals over a period of a few weeks or a few months may not always be so apparent as in the case of the chromic acid. More subtle effects could go undetected until serious illness and disability resulted.

Additional evidence of the need for a permanent exhaust ventilation system for dust control is the amount of settled dust on overhead structures throughout the building. The present use of propeller fans in wall installations is ineffective. The use of respirators is impractical because of the discomfort associated with continued wearing through the often prolonged cycle of a dust-producing operation.

Skin Contact. Irritation of the skin of workers by chemicals used in this plant has occurred in the past. Effective dust control will greatly reduce the amount of skin contact with these materials. At the present time, skin contact occurs even in the locker room used by these workers because of the invasion of dust into all quarters of the building. The use of protective gloves and jackets is effective in preventing skin contact while actually transporting materials.

PETROLEUM PRODUCTS DIVISION

REFINING AND OIL MOVEMENT

Distillation.

This department operates pipe stills and two shell still batteries; 96 men are employed in crude distillation and some 68 on re-run. There is no indication of any potential health hazard in the routine operation of refinery pipe stills.

Attention was drawn to the possibility of petroleum vapor or hydrogen sulfide exposure on the part of the operators of Still Batteries No. 16 and No. 17. Three or four men per shift operate each of these batteries. At these locations, product streams flow through the still house which is the principal station of the operating personnel. Look boxes are provided for each stream. There is a possibility of leakage of vapors from the look boxes or their lines. On two occasions, we were unable to detect the presence of petroleum vapor with a sensitive combustible gas indicator. Details of these tests are given in the following Table.

Table 3

PETROLEUM VAPOR MEASUREMENTS IN NO. 16 AND NO. 17
BATTERY STILL HOUSES

Date	Location and Operations	Concentration (p.p.m.)
4/6/49	No. 17 Battery Still House. No. 1 system charging after turnaround; No. 2 system running crude; No. 3 system running mixed gas oil. Several measurements made.	Less than 10
4/6/49	No. 16 Battery Still House. No. 1 system running mixed gas oil from separators. No. 2 and No. 4 systems handling low octane distillate feed; No. 3 system running heating oil. Tests made at 6 locations among the look boxes.	0 - 10

Plans are underway and work has already started on providing an enclosure for operating personnel separate from the location of the look boxes. Side walls will be removed from the present enclosures. This is in keeping with the general tendency to open up buildings where there are sources of leaks from process equipment. Other examples are various pump rooms that have been opened up and some gas compressor houses from which the side walls have been removed. In the case of No. 16 and No. 17 Battery Still Houses, execution of these plans should result in complete elimination of any potential health or safety hazards from vapor or hydrogen sulfide.

<u>No. 2 D. & S. and Hydrogen Sulfide Recovery Unit</u>.

These two units are under the direction of the same operators. Hydrogen sulfide comes to the recovery unit from various sources. From this unit, tri-potassium phosphate solution is pumped to No. 3 D. & S., operated by the Light Ends Department, for use there in scrubbing gas.

The hydrogen sulfide-laden solution is sent back to the recovery plant for regeneration. There is no pump handling the spent solution, therefore, leakage at pumps does not put hydrogen sulfide into the air. This scrubbing unit is exceptionally tight. No odor of hydrogen sulfide was detected.

At the base of the flare stack, there is a water seal drum to prevent flash back. Under the operating conditions that we saw, there is some spillage and leakage from this water-seal drum, permitting an appreciable escape of hydrogen sulfide at ground level. This was formerly in an isolated area, but now the new Light Ends Plant stands in close proximity to the source of leakage. A high local concentration of hydrogen sulfide seems possible under weather conditions producing little air movement. We consider this the most important potential site in the refinery for acute accidental or chronic exposure to hydrogen sulfide gas. Accidental exposure to high concentrations persons entering the immediate vicinity of the flare stack base to perform mechanical work. Sub-acute effects, such as conjunctivitis or upper respiratory irritation might be suffered by process people constantly in the nearby Light Ends Plant.

Oil Movement.

Oil Movement has control of pumps, gauges, pipe lines, storage tanks, barge loading, car loading, lead tetra-ethyl blending, use of inhibitors, and dyes.

Tetra-ethyl lead blending. This operation is performed under safe practice rules, prescribed by the suppliers of tetra-ethyl lead. Medical control by the refinery Medical Department is rigid. Protective equipment and clothing, as well as facilities for personal sanitation, are provided the employees. Two men are employed per shift. Aside from the normal routine of blending lead tetra-ethyl into gasoline, there are periodic calls for cleaning of tanks, pumps, and pipe lines. These jobs are done under the supervision of the suppliers' safety people. Equipment is routinely flushed with lead-free gasoline before it is turned over to the mechanical department. We know of no additional precautions or changes in procedure that are necessary in the handling of tetra-ethyl lead.

Addition of Dye to Finished Gasoline. Two men work on each shift. A dye solution is prepared from the dry dye about three times in 24 hours. The dye is removed from the drum in which it is received by means of a scoop. It is weighed and scooped into the solution drum. It is a dusty job, as shown by the deposit of dye on all structures in the room. Infrequency and short duration of the dust-producing job suggests the use of dust respirators for the prevention of dust inhalation. Prevention of inhalation is desirable, since the exact effects of such inhalation, where a variety of dye materials are used, are difficult to

Addition of Inhibitor to Finished Gasoline. The inhibitors that are currently in use are UOP-5 and DuPont-5. Inhibitor is drawn by vacuum from the drum in which it is received into mixing and metering drums and from there is bled into the streams. This procedure offers only the remotest chance for a man to come in direct contact with the inhibitor.

Light Oil Treating. This includes acid and alkali treating, calcium hypochlorite treating, and doctor sweetening. Of these processes, only the doctor sweetening involves the use of materials or processes that are of interest from the standpoint of employee-health.

Litharge Handling. Fresh litharge is added to regenerated doctor solution by dumping directly from drums into the open regenerator tanks. The size of the tank and the location of the platform and crane prevent free movement to the windward side while dumping. Respirators are worn by men doing the dumping for the prevention of inhalation of fine lead dust. All litharge dumping is done by two porters on "A" shift, with a frequency somewhat less than once a day. These men are on the Medical Department's schedule for twice-yearly examination.

Doctor solution regenerator tanks are in a crowded area in this refinery, differing in this respect from the situation at Aruba. With the thought that employees in the treating plant, other than those who actually dump litharge may be exposed to toxic amounts of lead as dust or as a mist from tanks being aerated for doctor regeneration, we sought to learn the concentration of lead in the mist escaping at the top of the tank. The opportunity to make such measurements presented itself at Sarnia. The results showed that two samples of air, collected in the heaviest concentration of mist at the tank top on the downwind side during aeration following litharge addition, contained 0.17 and 0.27 milligrams of lead per cubic meter, respectively. If we consider lead in a range of 0.1 to 0.5 milligrams per cubic meter to be present at the tank top, we may safely assume that, with dilution occurring before it reaches ground level, and with variation in wind direction, that no men are constantly exposed to concentrations of lead likely to produce symptoms of lead poisoning.

The validity of this assumption might be tested by performing urinary lead determinations for the group of exposed persons. Such measurements will serve to indicate, far better than atmospheric sampling and analysis at this outdoor location, whether lead absorption is occurring in these individuals.

Addition of Dye to Tractor Fuel. The treating of tractor fuel includes the addition of a dye known as Petro Green D Dye, which is a product of Patent Chemicals Company, Patterson, New Jersey. The same two porters who handle litharge and doctor sweetening occasionally make up two-pound packages from the bulk dye in drums. A lack of dye deposit on the floor and structural members of the room in which this packaging is performed indicates a low order of dustiness in the performance of the job.

LUBRICATING AND PARAFFINE DEPARTMENT

Wax Presses.

The fact that there is a statistically significant high incidence of cancer among wax press cleaners was demonstrated in another refinery. Cases of scrotal cancer have been discovered among the press cleaners at Baton Rouge. Investigations are now underway by the company to identify a specific carcinogenic agent or agents in the material which enters the presses. Immediate steps were taken to prevent any further contact with the material that may be responsible for the pathologic changes in the men.

The first step was logically to prevent the obvious contact between the skin of the pressmen and machinery or implements on which there was a deposit of paraffine distillate, paraffine wax, or foots oil. One particular zone of contact to which attention was directed is the anterior surface of the thighs and the pubic region. This was based on the observations that pressmen sometimes lean forward against a waist-high, horizontal bar that runs the length of each press on both sides, and that some of the cancers occurred on the scrotum.

To prevent such contact, all press cleaners are now provided with clean work clothes and aprons for each shift and are required to take a shower daily before leaving the plant. These precautions are effective in preventing this particular type of contact. A shower room for press men is conveniently located and maintained in a sanitary condition.

Other skin contacts with wax and pressed oil must have taken place in past years, in the cellars where press cleaners go daily to clean the floors, remove sawdust, etc. preparatory to the entry of pipefitters and machinists.

In spite of the precautions taken to date, there remains full-time opportunity for absorption of materials through the skin of the press cleaners' hands. Such absorption cannot be ruled out as a mode of entry of the suspected carcinogen. Its prevention has not been effected because of an inability to find a satisfactory glove material that will exclude the contaminant from the hands and, at the same time, permit efficient manipulation of the flat steel blade with which wax is removed from the presses. Frequent washing and wiping with clean cotton waste are temporary, but not wholly satisfactory, precautions.

Another mode of entry of carcinogenic material into the body of man is by absorption through the lungs following inhalation. Following inhalation of chromic acid, cancers were formed in the lung itself. Inhalation of beta-naphthalamine results in the formation of bladder tumors. Skin cancers have occurred in workers with arsenic, where at least a part of the exposure has been to inhalation of arsenic compounds as dust. With this thought in mind, an effort was made to learn whether oil mist might be present in the air in wax press rooms in sufficiently fine particle size to permit of passage to the deeper portions of the lung. Samples of the air were collected by means of the midget impinger with water as the collecting medium. Microscopic examination of the water suspension definitely showed the presence of oil droplets of less than 5 microns diameter.

Table 4, which follows, shows the locations where samples were collected and a rough approximation of quantities present,on the basis of counts that were made in a manner analogous to that used in making dust counts. As shown in the Table, mist was discernible in rooms with both doors closed and filtration in progress, and also in rooms with doors open and actual press cleaning taking place.

A demonstration of the presence of oil droplets in the air in wax press rooms is significant of the fact that inhalation of a potentially carcinogenic material occurs. The importance of this occurrence in relation to the present cases of illness and to the prevention of future cases is a matter that can be evaluated only by a broad investigation into the reasons for mist formation, the

Table 4

OIL DROPLET COUNTS -- PARAFFIN PRESS BUILDING

Sample Number	Sampling Time	Location	Evaluation (Particles per cubic centimeter of air)
77	10 min.	In "hot" press rooms Nos. 5, 4, and 3, in which the pressure is on. No men working in these rooms during the sampling time. Sample taken while walking around the filter presses.	11.3
78	10 min.	In "hot" press rooms Nos. 13 and 14, pressure on. No men working.	21.2
79	8 min.	In "cold" wax press rooms Nos. 30 and 31, pressure on. No men working. At conclusion of sample period, two pressmen entered for the purpose of cleaning the presses.	0.0
80	11 min.	"Cold" press rooms Nos. 30 and 31, during beginning stage of press cleaning, starting when pressure is withdrawn and ending with four minutes of actual press cleaning.	6.4
81	7 min.	Outdoor sample in vicinity of lube agitators directly north of tank 331, wind of moderate velocity from the south-east.	7.8
68	10 min.	In "hot" press room No. 11. Pressure on.	7.1
69	10 min.	In "hot" press room No. 9. Pressure on. Many visible oil-wax leaks.	2.8
70	10 min.	In "hot" press room No. 6, shortly after presses have been cleaned. Both doors open.	0.0
71	10 min.	In "cold" press room No. 18. Pressure on.	1.4
72	10 min.	In "cold" press room No. 24. Pressure on.	7.1
73	10 min.	In "hot" press room No. 9 during cleaning of the filter presses. Both doors open.	2.8
74	10 min.	Outdoor sample in vicinity of lube oil agitator tanks.	0.0

nature of the material in droplet form, its carcinogenic activity under experimental conditions, and methods of eliminating exposures to inhalation of the mist.

Some observations were made at the wax presses in the Bayonne Refinery for the purpose of comparing conditions there with those at Baton Rouge. It was noted that maintenance efforts at Baton Rouge are more successful in preventing leakage of material from the presses. Gross leakage, in the form of voluminous sprays against the press room walls and ceiling were seen at Bayonne, but not at Baton Rouge. The nature of the wax-containing stock and the percentage recovery of wax that is desired have, of course, been the factors that govern the extent of the maintenance effort and may account in whole for this observed difference in performance. Handling of San Joaquin distillate, responsible at Bayonne for most of the press room contamination, has not been undertaken at Baton Rouge.

Another notable difference in the operations at the two plants is the fact that Baton Rouge has but one press per room, while Bayonne has some multiple installations. This may mean that Bayonne press cleaners experience a contact with material as a mist, spray, or leak from presses adjoining the one on which they are working which is lacking in the Baton Rouge operation.

These differences, both of which would seem to indicate less intimate contact of men with material at Baton Rouge, may or may not be significant when applied to forecasting cancer incidence. They may assume some meaning when the identity of the carcinogenic material and its mode of entry are better understood.

Plate Shop.

Across the road from the wax press rooms is a shop consisting of one room in which plates and filters are cleaned by means of steam, and two other rooms in which repairs are made to the canvas filters. About 8 men work in this shop on day shift. Filters are brought by the press cleaners to the cleaning room. They are placed on a rack, the room is closed, and live steam is turned onto the filters on the racks and left on overnight. As each filter is put on the rack for cleaning, the others which have been exposed to steam are pushed down toward the far end. In this manner of rotation, by the time a filter reaches the end of the rack it has been cleaned and is ready for repair. The time actually spent in the cleaning room is only the time required to remove a clean filter from a rack and the time required to turn on or shut off the steam line. Exposure of men to the vapor and mist arising from the steam cleaning is, therefore, infrequent. The actual work of repairing filters occasions no contact with contaminating wax or oil.

Refrigeration Unit.

At this unit, actual contact with the materials being handled is limited to the machinists and pipe fitters. No hazardous exposures on the part of the process operators can be foreseen.

Crude Scale Wax Sweaters.

Feed for the crude scale wax sweaters consists of wax and oil after pressing has removed some oil, flash-topping at No. 1 vacuum pipe still has removed still more oil, and acid treating and caustic neutralization has improved it. Men are not exposed to the mixture in the sweating room during actual operation. Maintenance men do come in contact with the material when effecting repairs. These will be discussed elsewhere.

Refined Wax Sweating.

This process is similar to that described above but handles wax with much lower oil content.

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Propane De-waxing, Propane De-oiling, and Propane De-asphalting.

These three processes of the lube and paraffine department appear to have no health significance. There is intermittent exposure to propane in unknown concentrations. Non-volatile materials at these units consist of lube stocks for further treatment and the residues which are wax, oil for cracking feed, and asphalt for fuel. Occasions for skin contact with these materials are infrequent in normal operation. There is no evidence of danger from skin contact, however frequent.

MEK Plant.

Processing materials. The solvent employed in this process consists of methyl ethyl ketone 50%, benzene 30%, and toluene 20%. The solvent is stripped from the oil and returned for reuse. The separation of precipitated wax from the oil solution is accomplished in six large rotary filters. Since this is a low temperature process, the filters are enclosed as completely as possible and surrounded by insulating material. The refrigerant is propane.

Personnel. This unit is operated by five men per shift. One of these men spends his full time in a small room in the filter building. The remainder divide their time between the isolated control house and various parts of the plant.

Control of Exposures. The extremely toxic character of benzene and its volatility make its complete control a prime concern in the operation of this plant. Protection against accumulation of solvent vapor was built into this plant by design engineers. Storage tanks and pumps stand in the open air, leaving the filter room as the only enclosure for benzene vapors. A phase of operating procedure which is of great significance in the control of solvent exposures, although it probably had origin [illegible] the draining of units prior to repair or replacement and their flushing with inert gas prior to disconnecting.

The ventilation system in the filter building has recently been made the subject of a thorough investigation by the Petroleum Technical Service. The survey indicated that solvent vapor concentrations (as measured with the MSA Benzol Vapor Indicator) in excess of 100 parts per million could not be detected and that the most commonly encountered value was 20 parts per million. In view of these results, and our own which are similar and appear in Table 5 (following), we conclude that in the present mode of operation of this plant, loss of solvent to the atmosphere in the places where men work does not result in excessively high concentrations in the breathing level.

Table 5

MEASUREMENT OF SOLVENT VAPOR IN MEK PLANT

Date	Location	Result *
4/5/49	Lower level of filter building, 10 feet inside the S.W. door.	20
4/5/49	On steps of West ladder to upper level.	0
4/5/49	Beneath Filter No. 1.	Less than 20
4/5/49	On steps of East ladder to upper level.	Less than 20
4/5/49	In filter room control room where the filter operator spends most of his time.	15 - 20
4/5/49	Lower level; over drain to sump.	30
4/6/49	Beneath Filter No. 2, near sump	Less than 10
4/6/49	At pump handling wax-solvent from No. 2.	20
4/6/49	Beneath Filter No. 2. At southernmost sump.	0
4/6/49	At sump beneath No. 5 filter.	0
4/6/49	On upper level. West side.	10
4/6/49	Inside operators shack.	0
4/7/49	At 10 locations on lower level beneath filters.	0 - 20
4/7/49	At base of pipe discharging waste to sump, not at man's breathing level.	100 - 200

* Total vapor, in ppm.

Urine samples from a group of five process men were examined during our survey and showed normal values for the sulfate ratio. The results are given in Table 6, which follows:

Table 6

RESULTS OF URINE SULFATE RATIO MEASUREMENT
FOR MEK PLANT WORKERS

Sample Number	Ratio of Inorganic Sulfate to Total Sulfates	Organic SO_3 gm/liter
12007	0.85	0.259
1541	0.84	0.269
5940	0.90	0.110
11374	0.84	0.400
12279	0.90	0.273

The high degree of toxicity of benzene and the fact that leakage of solvent does occur, requires that continuing checks be made on the concentrations in the air. The PTS proposal that routine measurements with the Benzol Vapor Indicator be made is a sound one. The frequency of the measurements should be fixed through correlation with the production schedule and results obtained. The instrument itself is satisfactory, provided that it is checked about once a month against known concentrations of the solvent mixture in a test chamber.

It is desirable also to periodically examine the urine of the 21 process people at the unit and mechanical people regularly assigned to the unit to detect any variation of the ratio of inorganic to total sulfate from the normal range. Such a variation will be detectable in advance of symptoms of poisoning, should excessive exposures occur; and will supplement the atmospheric tests as a method of measuring exposures. A discussion of urine sulfate ratio determinations as a means of evaluating benzene exposures is included in the Appendix.

Wax Filtering.

In this process of filtering wax through bauxite and bauxite roasting, a dust source is the base of the regenerator tubes, where the heated bauxite falls to a conveyor belt and is carried to the hopper. The only excursions into this dusty area are for the purpose of replacing wooden pegs on the shake-out apparatus and for loading fresh bauxite from sacks to hopper. The former requires about five minutes several times per shift, possibly hourly. The latter is done infrequently and requires relatively few minutes. Occasional inspection of the operation and replacement of belts accounts for other trips into the dusty places.

The regenerator runs 24 hours to fill one charge. Two 24-hour regenerator periods may follow one another closely and then not again for the remainder of the week.

About seven or eight men are present at this unit during a 24-hour period. They spend most of their time in the room on the northwest corner of this building, ground floor. This room is closed off from the dusty area of the building, but some dust enters to settle on desk, ledges, instruments, etc.

Typical dust counts are:

1. At base of bauxite chutes during regeneration: 23 m.p.c.f.
2. In control room, immediately after blowing out the chutes with compressed air: 4 m.p.c.f.
3. In room containing hopper to receive new bauxite, during regeneration: 1 m.p.c.f.

This dust contains no crystalline free silica, therefore, no silicosis hazard exists. Dust concentrations where the men spend the major part of their

Lube Filter Plant.

Filtration of lube stocks through fixed beds of Attapulgus clay and the regeneration of the clay by the downward passage through a kiln is a process which has no industrial health significance. Clay dust occurs in some parts of the buildings which house the two filter plants and the clay regenerator. This dust contains no crystalline free silica. There is no silicosis hazard. Our observations and dust counts made in the plant show a low degree of dustiness most of the time. Concentrations are not sufficient to constitute a nuisance. Results of the dust counts are given in the Table that follows.

Table 7

DUST COUNTS AT LUBE FILTER PLANT

Sample Number	Sampling Time	Location	Dust Counts (m.p.c.f.)*
79	5 min.	Sample taken at level of elevator motor in regenerator building. No men working in this area at this time, except two carpenters at a lower level.	1.0
80	10 min.	On floor level beneath regenerative furnaces, around the base of No. 2 furnace.	0.0
82	8 min.	General air sample on level around top of filters. No visible dust sources.	0.1
83	6 min.	General air sample on level around base of lube oil filters. No visible dust sources.	0.0

Phenol Plant.

At the Phenol Plant, adequate precautions for the prevention of skin contact with phenol are in effect. They consist of provision of all the necessary protective clothing and emergency showers. The personnel at the plant are aware of the accident hazards. Our attention was drawn to the existence of phenol vapor in certain areas of the plant, as evidenced by the odor. Chronic phenol poisoning from prolonged inhalation of low concentrations of vapor has been demonstrated in animal experiments. It results in respiratory difficulty, digestive disturbances, and central nervous system disorders. Damage to liver and kidney also occurs. Toxicological data for man from industrial exposures are lacking. It is difficult to say, on the basis of available information, what concentrations of phenol in the air of work places can cause chronic illness.

The principal sources of phenol vapor are leakage at pumps handling fresh phenol feed, de-phenolizer feed, etc., and a tank which collects drainage from all sources of liquid leakage. The need for heating the leakage as it is collected and drained from the units, in order to keep it liquid, causes greater vaporization than would be expected from cold phenol. These sources of phenol leakage are outdoors. Two rows of pumps which serve these plants are in open areas adjacent to the control room. Eight men per shift operate the two phenol plants. They spend approximately equal time in areas where phenol vapor is noticeable. In all cases, the time amounts to approximately no more than one hour per shift. Most of their time is spent in the control rooms which have fresh air supplies and in outdoor locations around the plant, remote from the sources of phenol vapor.

The following table shows the results of measurements of phenol vapor in the air in various locations.

Table 8

PHENOL MEASUREMENTS

Sample Number	Location	Date	Phenol Concentration (parts per million in air)
66-64	South pump group No. 2 plant.	4/4/49	
71-67	At drain to sump. No. 1 plant.	4/4/49	< 4
73-72	Control room. No. 1 plant.	4/4/49	
1	South pump area. No. 1 plant.	4/8/49	11
2	Same as 1.	4/8/49	6

In air samples collected at a point between two pumps which were visibly leaking hot phenol mixtures, concentrations were found to be in the range of 6 to 11 parts per million. These concentrations exist in the area where the greatest amount of phenol would be expected. On the basis of these results, one can reason that in the control house, where the men are present for most of the working day, the concentration of phenol vapor will not exceed 1 or 2 parts per million. The occurrence of detrimental effects from continued inhalation of this range of concentration would not seem possible when one considers the ability of the normal human body to detoxify phenol by means of sulfates and glycuronic acid. However, it is advisable that close medical supervision of these men be exercised. Any nervous disorder or history of chronic digestive or respiratory difficulties among the phenol plant workers should be sufficient to raise the question of occupational origin.

Lube Oil Treating.

The plant area containing acid agitators, sludge kettles, caustic wash, and water wash vessels is noted for the presence of sulfur dioxide and sulfuric acid mist. It is evident that the treaters' exposure is the greatest of all personnel, for they must supervise the treating and sludge hydrolysis. They are required by these duties to mount several times a day to the top of the agitator vessels. In so doing, they cannot always remain to the windward side. Their reaction is typical of personnel at operations of this kind. They become inured to irritant concentrations that would offend persons not constantly exposed. As a group, if there are effects on their health, these might be expected to manifest themselves as increased incidence of tooth decay and upper respiratory affections of an acute nature superimposed on predisposing conditions, such as asthma, catarrh, etc. Permanent systemic damage from such exposures are not known.

The other category of exposed persons, those who work in the neighborhood and are intermittently exposed to somewhat lesser concentrations, are more apt to be irritated by occasional high-exposure incidents. These exposures are nuisances rather than health hazards, except in cases of individuals made highly susceptible by predisposing illness affecting the respiratory or heart functions. Such individuals are known in other refineries. They can suffer respiratory difficulties and distress bordering on prostration. Their transfer to plant areas uncontaminated by acid gases is the simplest solution to their difficulties.

Lube Oil Blending.

The manner of transfer of lube oil additives from tank car, to storage, to blending tanks by pumps does not furnish occasions for intimate contact of these substances with the men. An exception is the weighing and addition of PX-441 to small batches of heated oil to make a concentrated solution. The high temperature causes fume evolution which is disagreeable. Installation of a canopy exhaust hood over the mixing tank would eliminate the obvious cause for complaint in this operation, which is performed frequently.

Grease Manufacture.

Exposures on the part of the five to eight men per shift who operate the grease manufacturing plant consist of: (1) inhalation of mists rising from heating tanks, and with steam from saponification kettles, and mixing kettles; (2) inhalation of dust during the receipt, storage, and addition of dry ingredients; (3) skin contact with grease ingredients and products. The evaluation of these exposures must take into consideration the fact that many products are produced only occasionally and with great variation in amounts.

Inhalation of Mists.

Much of the mist arising from heating of the starting materials in grease manufacture is traceable to tanks containing purified vegetable oils and animal fats. For such exposures, there is no indication of hazard. The saponification reactants likewise are regarded as insignificant. At the mixing tanks, there is occasion for entry into the air of some of the large variety of chemicals and additives. In many cases, these are harmless. An exception if that of the suspected carcinogenic agent whose presence is known to the medical department. These exposures are so unpredictable in duration that medical experience with the men involved will have to be the basis for their evaluation.

It is a fact, as illustrated in other grease plants within the company, that mist escaping from saponification and mixing kettles can be effectively captured by properly designed and well-maintained exhaust ventilation systems. Where such systems exist, inhalation of mist becomes negligible in the plant.

Inhalation of Dust.

Dust exposures in grease manufacture are of minor importance because the dusty material which is handled most constantly and in greatest amount (lime) is non-toxic in quantities absorbed as dust and other materials of higher potential toxicity (lead, asbestos, mica) are handled either in small amounts with negligible frequency or in a manner that does not cause the dispersion of great quantities in the atmosphere. Asbestos, for example, after receipt and storage, is added to grease batches with a frequency that was estimated at 6 to 8 times per month. Its handling does not require violent tearing apart in the dry state with consequent dispersion of dust. Occasional exposure to the moderate dustiness of normal handling is not the type of exposure that is known to have caused asbestosis in workers of other industries.

Red lead comes in small cans and is added infrequently to grease batches. The act of dumping from the can into the mixing vessel is the only dust dispersing operation in its handling. It is difficult to conceive of toxic amounts being absorbed by any workman in this manner.

Skin Contact.

Contact of the ingredients and products with the skin of the hands, arms, and faces of the workers in the plant occurs frequently. Its occurrence is due chiefly to deposits of these materials on equipment from misting. Deleterious effects from such skin contact cannot be predicted merely from a knowledge of the effects of the individual compounds on the skin of man for, in the case of a grease mixture, the inclusion of the additives and chemicals in a matrix of soaps and oils makes the chance of their unobstructed contact with the skin questionable. Evaluation of the dermatitis hazard rests, therefore, in the department. In the absence of any evidence from this source, it is safe to assume that no problem exists and that the company meets its responsibility to its workers by providing them with adequate cleansers and washing facilities.

CRACKING DEPARTMENT

Thermal Cracking

1,000 pound Coils: No. 21 and No. 22 Units.

Materials and Process. Feed stock is gas oil from various sources, clarified oil from PCLA, and pitch bottoms (from pipe stills). Products are gas (C-1 to C-4), naphtha, cycle gas oil, and tar.

Exposures. Exposures to inhalation of vapor and mist from the materials that are being processed can be expected to occur in the act of sampling process material, in the neighborhood of pumps where leakage occurs, and in the neighborhood of pumps which give rise to oil mist. Such exposures are significant health-wise when the material consists of clarified oil or the tar produced from cracking clarified oil. These are suspected carcinogenic agents. The control of oil mist inhalation in a program for complete prevention of occupational tumor formation is discussed in the section dealing with Wax Press Rooms.

Collection of oil mist in an impinger and evaluation of the results by a procedure analogous to that used in dust counting gave the following results:

Table 9

CONCENTRATION OF OIL MIST IN VICINITY OF PUMPS AT THERMAL CRACKING UNIT

Sample Number	Sampling Time	Location	Droplets per Cubic Centimeter of Air
64	8 min.	No. 21 - 1,000-pound cracking coils, in doorway to control house near hot pitch feed pump.	1.59
65	4 Min.	Adjacent to hot pitch feed pump, two feet from shaft which appears to be chief source of oil mist.	0.0

These evaluations serve only to demonstrate the presence of oil mist in the location cited.

Number of Men. Operating personnel consists of six men per shift.

Location and Features of Control House. The control house in which the men spend most of their time consists of two rooms adjacent to one another and close to pumps. Mist from hot oil pumps can enter through open door on west side of control room. Pump site is covered by a roof and enclosed on two sides. Reflux pumps handling light fractions (naphtha) have fair amount of leakage, but are located good distance from control house and are not enclosed. Materials for measurement are brought into the control house (no transmitter-receiver type instruments here). Activation of recorders is by means of natural gas. Brown and Foxboro instruments in shop bleed tests showed escape of 0.02 and 0.32 cubic feet per minute respectively. There is an estimated total of 15 such instruments for the No. 21 and No. 22 units. Tests with benzol vapor indicator gave no deflection around the instrument panel. Full scale reading was obtained when the intake was placed at the meter face.

The location of hot oil pumps just outside the door of this enclosed control house affords the opportunity for the entrance of fairly high concentrations of oil mist and vapor of varying composition and of unknown significance health-wise. Escape of vapor and gas from instrument lines inside the house is thought to be of insignificant importance because of the small amount of leakage that can be tolerated from the standpoint of process control.

Sampling. Helper at the unit takes a sample from the "hot bottoms" line about four times per shift. The line must be bled for several minutes before drawing the sample. The person drawing the sample cannot always stand to windward side because of the location of the draw-off pipe over the drain to the sewer.

The three-sided shed where the gravity test is made, effectively encloses vapors from the hot oil being tested, causing increased concentrations in the operator's breathing level.

The location of the end of the draw-off line, with respect to the opening to the sewer line and to the position that must be taken by the man prior to and during sampling, affords too great an opportunity for splashing and volatilization of the material that is being drawn. Less confinement at the site of gravity testing is desirable.

Since sampling and testing are the acts providing the most intimate contact of process men with the material, an effort towards improvement of these arrangements is suggested.

750-pound Coils: No. 19 and No. 20 Units.

Process. Feed stock and products are similar to those of No. 21 and No. 22 units. (Note: When clarified oil from PCLA is used as feed, it is supplied under sufficient pressure by pumps at PCLA. We have inferred from this that there is no pump here handling unaltered clarified oil--hence, no mist of this substance as received.)

Number of Men. About nine men per shift operate 17, 18, 19, and 20 cracking coils.

Location and Features of Control House. The control area is not as completely enclosed as that at No. 21 and No. 22. Instrumentation is the same. Proximity of pumps and invasion of mist from hot oil pumps through open doorway is about equal. Results of oil mist counts are as follows:

Table 10

CONCENTRATION OF OIL MIST IN VICINITY OF PUMPS AT THERMAL CRACKING UNIT

Sample Number	Sampling Time	Location	Droplets per Cubic Centimeter of Air
66	10 min.	No. 20, 750-pound cracking coil, near hot oil pumps handling gas oil from various sources.	7.44
67	8 min.	No. 20, 750-pound cracking coil, adjacent to pump handling cold gas oil and another running pitch bottoms. Wind is from north-east and some mist from hot oil pumps may reach this position through the open doorway.	1.23
68	7 min.	No. 20 unit, in doorway between hot oil pump room and control room, directly downwind from hot oil pumps.	7.44

Conclusions Regarding Exposures of Men.

Exposures by skin contact and inhalation of mist or vapor is possible at sampling locations. The sites were not inspected, nor was the frequency noted; this is, therefore, an inference from observations at other units.

Mist from the hot oil pumps to the north was found to invade the space (semi-enclosed) where process men spend most of their time reading instruments and filling out charts and data sheets. This is not a continual exposure, depending on wind from the northern quarter or lack of wind.

Unusual situations, one of which we witnessed, such as a broken valve, occasionally will cause spillage or leaks that result in skin contact before repairs can be effected by the pipe fitters.

Steam Cracking

Process.

Feed stock for this process is virgin heavy naphtha. The products con sist of a dilute butadiene stream, an aromatic distillate, residue gas, aromatic tar, fuel oil, and a C_5 cut which goes to isoprene extraction. Clarified oil from PCLA is used as a quenching agent.

Number of Men. Three men per shift spend most of their time in the control house which is closely associated with the feed and water pumps.

Association with Toxic Substances. The substances at this unit which deserve closest scrutiny are the tar bottoms, clarified oil, and the aromatic distillate.

The tar fraction and the clarified oil are included in the suspected carcinogenic materials for which special precautions against skin contact have been planned. They are discussed separately.

The aromatic distillate is described as containing 56 per cent aromat- ics. Initial boiling point of the fraction is 300°F. and final boiling point, 475°F. Leaving the cracking coils, this distillate is handled by a pump near th control house. It undergoes fractionation at No. 4 D & S; after separation here it is put through a clay treating process similar to that at OLA 2, in the chemi cal products area. It finally goes to Tank 961 on the western side of the run- down tank area. The boiling range of this fraction includes the boiling points of C_9 and higher mono-nuclear aromatics. Any problem of toxicity of this fracti would be of the order of toxicity of cumenes, etc. and not of the type of benzen toluene, and xylenes. Observations at this unit and at Tank 961 failed to dis- close any occasion for prolonged breathing of this fraction.

There are several reasons why the operations at these units are of interest to those concerned with the maintenance of employee health:. (1) Chron: toxic effects of C_9 and related aromatic hydrocarbons are not sufficiently well-understood; (2) the exact extent of occasionally repeated vapor exposures of me: at these units could not, of course, be determined in the course of this survey; (3) the process is similar to that at OLA-1 and OLA-2. There is no assurance th: changes in feed stock or processing conditions will not result in the production of the more volatile aromatics of the type of benzene.

Catalytic Cracking

Three catalytic cracking units are operated. No. 1 is the first fluid catalytic cracking unit to be put in operation anywhere and differs radically in design and operation from No. 2 and No. 3, which are identical.

Materials and Process.

Feed stocks for the catalytic cracking units include reduced crude fro: end-fired stills, virgin gas oil from crude distillate, various residual stocks from the production of lubricating oil, and cycle gas oil from thermal cracking. Products are gas (to C_4), light naphtha, heavy naphtha, and heavy cycle gas oil. A finely-powdered silica-alumina catalyst is handled as a fluid.

Number of Men. 90 persons are employed on three shifts in the operati of the three catalytic crackers.

Significant Exposures.

(1) Catalyst dust: Unloading of fresh catalyst from the cars in whic it is received is a relatively dust-free job. Twenty-seven to thirty carloads c catalyst per month are received. Removal from storage and return of regenerated

units themselves when the high velocity of the catalyst stream causes corrosion in pipe lines. This occurrence is not infrequent, especially on the No. 1 PCLA. When leakage occurs, exposure to the dust is suffered mainly by maintenance men who are called upon to repair the lines.

The toxicological information now available indicates that this material is unlikely to cause silicosis. This may be due to its being so lean in very fine dust fractions compared with naturally produced dust; or to its relatively high rate of solubility. In any case, we conclude that any exposures we learned about are of no significance health-wise.

(2) Heavy catalytic cycle gas oil: This fraction occurs in two forms at the unit. The first is known as slurry oil and contains catalyst in suspension. The second is clarified oil which is the same oil stock after removal of catalyst. These substances are the principal materials involved in the program for control of skin contact with carcinogenic oils. This phase of their activity is discussed in a separate section.

Two other factors concerning the handling of these oils are worthy of consideration. The first is the existence of fine mist in the vicinity of hot oil pumps carrying either slurry or clarified oil. We demonstrated the existence of such a mist and observed that there is occasion for men to spend at least short intervals of time in areas where mist is present.

An air sample collected by means of an impinger at PCLA No. 1, three feet from the shaft of a pump handling hot clarified oil was evaluated in a manner analogous to dust counting and showed 21.3 droplets per cubic centimeter. At the time of sampling, there was a visible mist arising from the shaft of the pump with each stroke. Mist also arose from the cylinder block upon which oil had been spilled from a sampling line.

Inhalation of oil mist affords equally good opportunity for contact as carcinogenic agent that may be present into the body of a man. A careful review of all the localities where such misting occurs and the correlation of this occurrence with the presence of men seems to be warranted.

The remaining consideration is the immediate formation of blisters upon skin of men where spillage of slurry oil has occurred. It is true that in many cases, these blisters would appear to be thermal blisters from hot oil. There is good evidence, however, that some of the properties of the oil may be responsible. In those cases where heat can be ruled out as a cause of blister formation, question arises as to whether this is a unique effect of slurry oil or whether it is a manifestation common to several other petroleum fractions, notably kerosene. An associated question is whether this occurrence of blisters may be related to the irritant effects on eyes and respiratory system following exposure to catalyst dust, a possible relationship lying in the adsorbed oil on spent catalyst.

UTILITIES AND LIGHT ENDS

Light Ends

Petroleum Vapor.

The principal effect of the inhalation of vapors of saturated and unsaturated light hydrocarbons is narcosis from prolonged breathing of concentrations in the range of a few thousand parts per million. We know from refinery surveys that such concentrations do not prevail for prolonged periods in areas where men work. However, industrial hygiene codes of some states and the National Conference of Governmental Industrial Hygienists include tolerable limits of 500 or 1,000 parts per million as definitive of good working conditions. It is a matter of interest, therefore, to obtain some estimation of concentrations that are encountered in the light ends plant of this refinery. For this purpose, the 1929 Gas Absorption Plant, whose units are now used as specialty stills, was chosen. The control house of this plant was described to us by personnel of the light ends division as the most "gassy" in the refinery, the reason being its location in the midst of the process units.

The fractionation towers at the 1929 Gas Absorption Plant handle principally virgin heavy naphtha, separating C_3 and C_4 from C_5 and heavier; they also were handling propylene polymer, separating a small amount of C_4 from the remaining heavier polymer. Readings in the range of 25 to 50 parts per million were obtained downwind from a sewer opening beside water cooling coils with a sensitive combustible gas indicator. Elsewhere about the plant, in the control house, at the base of No. 4 Specialty Still, at No. 3 Rectifier, and downwind from a leaking valve 50 yards from the control house, readings were essentially zero. These readings show the effect of the mild breeze, which was blowing on the day the measurements were made (April 12, 1949), in diluting the vapor soon after it

The examples typify our findings of petroleum vapors around outdoor process equipment.

Hydrogen Sulfide.

In the compression and distribution of gases containing hydrogen sulfide and their subsequent recovery for use, the hazard has been recognized and effective precautions to prevent its escape in places where men work are generally quite good. A fairly recent development has been the removal of sections of side walls at No. 1 and No. 2 Gas Compressor houses. Ventilation thus provided is in addition to the local exhaust ducts at the compressors.

At the various units of the light ends plant, when men encounter hydrogen sulfide it is most often as a barely perceptible amount in outdoor pump locations where natural ventilation and lack of confinement prevent its accumulation. If we disassociate from our consideration the necessary precautions against accidental inhalation of amounts sufficient to cause immediate symptoms of acute poisoning, such as would occur in equipment failure, it would seem that there is no problem of hydrogen sulfide poisoning. No areas where men work for prolonged periods in amounts sufficient to cause chronic poisoning could be noted in this survey, except as noted in the discussion of the flare stack adjacent to the new light ends plant.

Acid Recovery Plants.

The processes of hydrolyzing acid sludge, recovering weak acid, and concentrating this acid to 85-90 per cent by vacuum distillation is associated with the obvious possibility of accidental acid burns for which the proper precautions have long been practiced. There is nothing else significant to employee health about this type of work.

Boiler Houses and Power Houses.

The best approach to the question of possible damage to hearing in places where high noise levels exist, such as the power houses, is to make a hearing inventory among the men who are exposed, in order to detect any changes with the passage of time. Measurements of noise levels in the work places do not give a satisfactory basis for predicting damage to hearing. Satisfactory standards do not exist, chiefly because of great variation in response between individuals at given noise levels. The matter can be resolved by determining the state of a person's hearing in a pre-placement examination and determining in subsequent yearly examinations any changes that occur.

M A I N T E N A N C E   A N D   C O N S T R U C T I O N

PIPE DIVISION

The Pipe Division of M. & C. Department was subjected to careful study in the course of the survey because personnel of the division forms a numerically large segment of the plant population and because the performance of the functions of the division places its men in intimate contact with process material. Pipefitters comprise 23 per cent of M. & C. employment and about 9 per cent of the total refinery personnel. After the General Labor Division, it is the next largest M. & C. division.

The Pipefitters enter into nearly every phase of processing from the initial installation of a unit through its normal operation, routine maintenance and general inspection, turnaround, dismantling, or change of design. In their work of blanking off lines for removal or repair of pieces of equipment, they can suffer an exposure to whatever material is in the unit. The magnitude of the exposure is dependent chiefly on the effectiveness of draining or flushing by the process people before the unit is released to the pipefitters. Typical exposures of this nature range from the short-time breathing of gasoline vapors in an instance where a pump or valve on a gasoline line is removed from service to an occasion where pipefitters render prolonged assistance in removing a large number of heating tubes from a crude reboiler in acid service at the alcohol plant. The former is typical of an exposure where the hazard to health is of a low order of magnitude, the latter, one of doubtful or uncertain magnitude.

Of the 765 men employed in Pipe Division, close to 200 are regularly assigned to process units. These men have fairly steady assignments and are subject to fairly steady environmental conditions. Turnaround work and shifting demands of building and reconstruction gives to most of the men in the Division a those two who were formerly assigned (those with the longest tenure can be identified by the machinist foreman) should be given the routine physical examination required of the press cleaners. Equal facilities for the practice of personal hygiene are necessary for the maintenance machinists.

Butyl Rubber Reactors and Finishing Building.

There is a low incidence of exposures to methyl chloride by the machinists. In the reactor building, natural ventilation through the open side walls is usually good. In the finishing building, routine greasing of the screen shakers and the filter mechanisms requires exposures of short duration. Repair work on these units is performed while the flow of materials is shut down and while the ventilation system is still operating.

Paracril Plant.

Exposure of machinists to acrylonitrile and other volatile substances in the paracril plant do not exceed those of the operating personnel, which were shown by air analysis to be within acceptable limits, except in the vicinity of the latex pot and the coagulating pot.

Gas Compressors.

Since maintenance of gas compressors in various parts of the Petroleum Products Division and the Chemical Products Division accounts for a large part of the total time spent by maintenance machinists, there is a certain degree of importance attached to the possibility of gas inhalation at these units. In our examination of the compressor buildings, we failed to see any localities where accumulation of amounts of gas sufficient to produce chronic intoxication was a likely occurrence. There undoubtedly have been some exposures in the past and may be occasionally at the present time. Most of the obviously dangerous exposures have been eliminated, either by providing exhaust systems over the escape points or by opening up the building to permit natural ventilation. Methyl chloride and hydrogen sulfide concentrations have been reduced by these two methods, respectively. A review of all such installations from the standpoint of chronic exposures to low concentrations of gas is recommended.

Contact with Heavy Catalytic Cycle Gas Oil and OLA Tars.

The machinists are among the crafts which have had and will continue to have opportunity in the daily performance of their duties at the process units which handle these materials and at field tank pumps for contact with these substances. Future contact is regulated as a part of the general program. No unusual or unforeseen incidents relating to contact were observed in this study.

Machine Shop

Main Shop.

The main shop was found to be without any apparent industrial health problems. Lighting and sanitation facilities are excellent. Use of solvents is limited to Varsol, which is handled in such a way that, even though its toxicity and volatility were great, exposures would not be significant.

Disassembly and Reassembly Shop.

Pieces of equipment come to this location directly from the process units or from an Oakite cleaning in the tanks of the heat exchanger cleaning shop. Those pieces of equipment which have been in service at units handling the heavy catalytic cycle gas oil, OLA tars, or re-run tars bear a special identification tag. When they are disassembled, some of this suspected carcinogenic material may be released. We saw slurry oil spill out of a slurry pump which had been through the Oakite cleaning. There is a problem of its disposal. The nearest drain to the sewer is about 60 feet from the place where heavy equipment is disassembled.

Metal Spraying.

About 15 different types of metal are sprayed in a shed with open sides near the machine shop. Stainless and mild steel wires are most frequently used. The amount of lead spraying seems to be too small to be of any importance toxicologically. It was described to us as consisting of about one small job a month for a part of acid service at the Chemical Products Area. Bronze is no longer used.

Incidents of poisoning by nitrogen oxides generated by the heat of the spraying torch, that are described in the literature, have occurred in enclosed spaces where it has been possible for concentrations of these gases to accumulate over a prolonged period. It is safe to assume that such accumulations could not occur in this open shed.

BOILERMAKER DIVISION

Riggers.

The work of the riggers, who numbered 67 in the entire plant, did not come in for close scrutiny in this survey. It was adjudged that in the performance of their mission of moving and erecting heavy equipment, their exposures to toxic and hazardous material are slight. Riggers are not active on a job until after process men have taken a given piece of equipment off stream and pipefitters have blanked it off from the flow; actual close work with the equipment is of short duration.

Opportunity for skin contact with acids or high-boiling aromatic hydrocarbon exists. For protection, riggers are furnished protective clothing, which they carry with them to a job. Contaminated riggers' clothing is laundered by the refinery in accordance with the general program for prevention of prolonged contact with substances implicated as possible cancer-formers.

Welders and Burners.

106 welders include 98 electric welders and 8 gas welders. All of these men are first class mechanics and their work is limited to welding. Fitting of parts to be welded is done by other crafts.

The burners number 66, consisting entirely of first class mechanics. Work inside drums, towers, etc. amounts to a considerable percentage of the total work of welders and burners. An important aspect of this inside work is that pieces of equipment in which inside work must be done are routinely cleaned by sandblasting before the welders and burners enter. This practice effectively limits their inhalation of atmospheric contaminants to those products of the welding or burning process, i.e., fumes or gases from the base metal, welding

Welding on ordinary structural grades of steel with coated electrodes results in the escape to the atmosphere of fumes containing iron oxide and oxides of several metals found in the electrode coating. Manganese, titanium, and silicon are common. The gaseous products consist of carbon dioxide, carbon monoxide, water, and nitrogen oxides. These fumes and gases originate in the extreme heat of the arc and are thus given an initial velocity upwards that tends to disperse them to less than harmful concentrations in any but the most confined spaces. Given a fair sized enclosure and some natural movement of uncontaminated air from outside the contaminants will disperse in a satisfactory manner. In cases where the welding is performed in a confined space with no ventilation the symptoms are primarily those of nose and throat irritation, and cough.

In welding on galvanized steel, the proportion of zinc oxide in the total fume is greater than that of iron oxide. Metal fume fever may result unless total fume concentrations are kept at a much lower level than is necessary in the case of welding on uncoated steel. Good ventilation of the space is effective in preventing the occurrence of metal fume fever.

Welding on lead or cadmium-coated base metal may constitute major health hazards. Cadmium fumes are not believed to constitute a chronic poisoning hazard, but do represent a very serious accident hazard where concentrations are high due to poor ventilation. Exposures of only a few hours duration are sufficient to cause serious lung involvement and even death. Protection may be provided either in the form of local exhaust ventilation or the wearing of a fume respirator beneath the welder's face shield. No instances of these types of welding were noted in the refinery.

Welding on stainless steel involves exposures to fluorides from the rod coating. Excessive exposure to these fumes causes irritation of the nasal passages, and not infrequently nosebleed. This is generally believed to be caused by the formation of hydrofluoric acid. In our opinion, there is no likelihood of fluorosis from such exposures. Fluorosis is a development of bone abnormalities resulting from many years exposure to large concentrations of fluorides.

We were unable to obtain a first-hand impression of fume conditions in any of this welding work. However, the exposure being basically of nuisance type, scientific evaluation is not required and ordinary inquiry will suit all purposes.

Ventilation for inside welding work is provided by Lamb "air siphons" furnished by the boilermakers and installed by pipefitters. An estimated 30 or 40 "siphons" are available in the entire refinery.

Surfaces painted with red lead are encountered in minor repair work on barges, an infrequent job, and on new structural steel, also infrequent. An electric blower is provided to furnish local exhaust on the barge work. Red lead is removed from new structural steel by burning and brushing prior to welding. The short duration of these jobs and their lack of frequency make it unlikely that there is any hazard to burners or welders from inhalation of lead fume from work on steel that has been painted with red lead.

Protective clothing is provided for work in acid areas. It is stored in division tool rooms or kept personally by individual welders.

Coke deposits are sometimes cut from inside equipment by burners' torch. Ventilation equipment is called for and used because of the smoke and heat in confined quarters.

Cutting and melting of lead scrap is done by one man with a portable lead pot, working occasionally at various locations. Several efforts to witness this job failed because of its discontinuous operation. This man should be included in physical examination schedule for lead burners.

The Pipe Shop (Petroleum Products Division) is operated jointly by pipefitters and welders. Pipe welding is done in a structure having open sides. An estimated 95 per cent of the work is on new pipe, limiting fume exposures to the innocuous type of black iron welding. Lead-lined pipe is not seen at this shop. Fume exposures are not serious at this shop at this time, although certain positions may put a welder's head for a time in the region of heavy fume from the arc. This might assume a more serious nature if in the future the new pipe containing a bonded lead lining, which was described to us at the acid plant, should be brought to this shop for cutting or welding of flanges. Provision of local exhaust equipment for removal of the fumes from their point of origin to a distance from the welder's breathing zone would then become necessary.

Boilermaker Shop, 572 Area, in Chemical Products Division north of No. 4 Finishing Building, employs one welder and one burner. There was nothing in the layout of the shop nor in the description we obtained of its work to suggest the existence of occupational disease hazards.

Pipe Shop, Chemical Products Division.

At the welding shop, Chemical Products Division, west of No. 1 Alcohol plant, five welders and three burners, all on "A" shift, are employed at fabricating and repairing pipe sections. Fume exposures are limited mainly to fumes from the metal being welded and the rod and coating. No estimate could be obtained of the relative proportions of work on new and used pipe. It was ascertained that residual material in used pipe was removed by burning at a point remote from the shop and in a manner that results in no fume or vapor exposure to the man doing the burning. In this shop, welders complained of illness from welding on certain types of alloys described as "Red Copper," "Red Brass," and "Everdur." In welding such material, heat is applied by means of a carbon electrode in the usual welder's electrode holder. Pipe sections undergoing this process are of such sizes and shapes that it is impossible for a welder to always stay out of the zone of most dense fume from the arc.

The illness they described is suggestive of metal fume fever, being an acute illness having its onset several hours after work has ceased, and being characterized by chills, fever, vomiting, and headache.

The Everdur alloys contain copper, 95 to 98 per cent; silicon, 1.5 to 4 per cent; and about 1 per cent manganese.

Red Brass usually contains 85 per cent copper and 15 per cent zinc.

There are no chronic effects from metal fume fever. The acute illness can be prevented by installation of a local exhaust system in this shop to carry away the fumes from their points of origin.

Boilermaker Shop. "Old Boiler Shop."

Activities in this shop consist of:

Electric welding--one or two arc welders perform various repair jobs.

Burning--three machine burners work in this shop full time. A variable number of hand torch burners are present.

Gas welding--the gas welding shop in this building is the site of employment of the eight gas welders included in the employment list for the Boilermakers Division. The work consists of oxy-acetylene welding of non-ferrous alloy parts, using principally un-coated rods of composition similar to the base metal. A considerable proportion of the work load consists of effecting repairs to Hastelloy D heating tubes used in acid service at the alcohol plants, IIA units, and acid concentrating plants.

The shop is provided with a local exhaust system for removal of fumes from the actual welding. Hastelloy D tubes which contain 85 per cent nickel must be pre-heated to about 600°F. in a furnace at the shop before welding. Some 20 heating tubes per month are handled here, and three is the maximum number in any one day. When these tubes come to the shop with a coating of some residue of carbonaceous material from the unit from which it was removed, there is an evolution of fumes, at least in the first stages of heating to the correct temperature for welding.

The possibility of the formation, under these conditions of combustion, of nickel carbonyl has been raised. Nickel carbonyl, a volatile material posessing a high degree of acute toxicity, has been responsible for the development of lung cancer in the nickel refining industry. We are not in a position to comment on the possibility of its presence in the fumes from heating these tubes. Inhalation of these fumes can be greatly diminished by the installation of a hood over the furnace port.

Welders at Catalytic Cracking Unit Turnaround.

At turnaround of catalytic cracking units, the services of welders and burners are required for about 3/5 of the turnaround period. Welders work three shifts a day, six days a week, and burners on two shifts, 6 days a week. An estimated sixty per cent of the work is inside work and, of this, forty per cent is considered dusty work. A high proportion of the work inside is on stainless and chrome steel. Dust sources are residual catalyst, especially in the precipitators where it is easily disturbed from its resting places on the shakers, refractory and insulation dust in the regenerators, and settled dust remaining after sandblasters have left the tower. Dust elimination efforts have gone a long way toward cleaning up the vessels for the turnaround mechanics. Additional protection from inhalation of these dusts can be offered these welders and burners by providing them with a filter-type respirator designed for dust and fume. Types that will fit beneath the welder's hood are available.

The danger of contracting illness from inhalation of these dusts in the concentrations prevailing during the turnaround is thought to be rather small for the following reasons:

(1) Exposure time for an individual welder or burner over the course

of a year will amount to probably no more than one month. (There are about four turnaround periods of about 15 days normal duration on the three units.) All boilermaker crafts are rotated on catalytic cracker turnaround;

(2) Catalyst dust and most of the refractory dust that is encountered is relatively non-hazardous by reason of its composition and particle size.

Lead Burners

Lead Burner Shop at No. 3 Acid Plant.

About four men work part-time in a shop which is open on three sides. This affords good natural ventilation and prevents accumulation of lead fumes in the lead shop. It does not prevent the inhalation of fumes rising directly from the burning or bonding torch. Measurements of atmospheric lead during burning and bonding at Aruba showed that concentrations in air at the nose of the man can exceed the recommended limit even in outdoor locations, because of the proximity of the man's nose to the source of fume. With this experience and with the results of the urine lead determinations that were made at Aruba, we recommend that some exhaust ventilation be provided for lead burning in this shop.

Lead Burning Shop in Crafts Building in Chemical Products Area.

Three men work about half-time in this shop. This room has fairly good natural ventilation. The same remarks regarding inhalation of fumes coming directly from the torch apply here.

Outside Lead Burning and Bonding.

About half of the time of the seven lead burners and seven helpers is spent performing jobs at the process units. Many of these jobs require work in spaces somewhat more confined than the shops themselves. Examples are re-boilers at the alcohol plants.

Medical Control Measures.

Lead burners and their helpers are examined twice yearly by the Medical Department for symptoms of lead poisoning. We suggest that the examinations be supplemented with urinary lead determinations, so that evidence of absorption may be detected before symptoms of poisoning occur. As a part of this survey, we obtained urine specimens from 12 lead burners and helpers. As a group, these men showed normal excretory values. The results are shown in the following Table.

Table 11

RESULTS OF LEAD DETERMINATIONS IN URINE OF LEAD BURNERS AND HELPERS

Name	Sample Number	Amount (Cubic Cent.)	Specific Gravity	Concentration (Milligrams of Lead per liter)
Chapman	3016	230	1.020	.170
Christof	3249	110	1.028	.097
Elkins	1830	155	1.025	.120
Fisher	3093	115	1.027	.132
Kelley, B. A.	328	380	1.010	.055
Kelley, B. F.	1030	295	1.012	.058
Kelley, O. D.	251	295	1.023	.098
Martin	844	175	1.030	.153
Nettles	1372	180	1.020	.115
Thomas	3012	93	1.026	.192
Whittey	3464	95	1.026	.102
Williams	134	475	1.004	.095

Periodic urinary lead determinations will reveal any changes in the exposures, which at the present time are not excessive.

Utility of Lead Urinalysis.

The measurement of the amount of lead excreted in the urine is a useful means of evaluating exposure to lead and, therefore, a valuable adjunct to medical techniques in supervising the health of lead workers. It utilizes the respiratory systems of the members of the group of exposed persons as collecting devices for the lead in the atmosphere. By its mechanism of collection it eliminates any forms of lead in air that do not contribute to actual lead absorption, such as coarse dust particles. Furthermore, it averages out exposure with time, eliminating the intermittent high or low concentrations that might be found in sporadic air sampling and analysis. The amount excreted in the urine is proportional to the amount absorbed within certain limits of individual variation.

The influence of individual variation makes it necessary to use urinary lead concentrations as measures of group exposures rather than as measures of individual exposures. The knowledge of exposure obtained from urinary lead determinations can be utilized to point out the need for environmental control of the contaminant, and for indicating the frequency of, or even need for, medical examinations in the detection of early signs of lead poisoning.

Normal urine, from persons with no industrial exposure to lead, contains 0.02 to 0.10 milligrams of lead per liter, dependent largely on the dietary intake. Amounts of lead in the range 0.15 to 0.20 milligrams per liter are considered indicative of exposure at a borderline level of actual toxicity, with a probable degree of safety.

Extensive experience indicates that the collection and analysis of "spot" samples of urine, containing about 100 ml., is a satisfactory procedure for determination of exposure. It has an advantage over the collection of 24-hour specimen in that its collection can generally be closely supervised and the danger of contamination of the sample lessened.

Precautions against contamination are the use of chemically clean vessels and stoppers and scrupulous cleanliness during voiding of the sample. In a 100 ml. sample, containing 0.15 mg. of lead per liter, the analyst will have to work with only 15 micrograms of lead. The possible influence of dust or other foreign matter in the sample is obvious.

We were told at the acid plant of the contemplated use of steel pipe with bonded lead lining. The use of this pipe may introduce increased exposure to lead fumes because it will not be possible to remove the lead lining at will, prior to making changes in the shape or length of pipe sections, as can be done with the lead inserts now used. The urinary lead determinations will be valuable in determining whether this expected increase of exposure actually occurs.

METER AND INSTRUMENT DIVISION

Shops.

The shop men routinely overhaul, clean, and repair meters and instruments. There is a main shop in the Petroleum Products Area and a shop in the Crafts Building of the Chemical Products Area. Smaller shops are located in the East and West Esso Laboratories Areas, and in the RLA Mechanical Shops.

In the shop work, mercury is the principal hazardous material encountered. Measurements were made of the concentration of mercury vapor in the air of each of these shops, except the RLA Mechanical Shop. In none could we find concentrations as great as 0.1 mg. per cubic meter of air, a concentration considered a safe upper limit for 8-hour daily exposure. Results of all measurements are shown in Table 12 (page 71).

The main Meter and Instrument Shop, which handles the greatest volume of mercury, has a system for collection and recovery of spilled mercury, the effectiveness of which is shown by the absence of visible deposits on the benches or floor and by the extremely low atmospheric concentrations found.

The trial of this system in the main shop is expected to lead to similar installations in the other shops. There is need of such a system in the Chemical Products Area Crafts Building and in the East and West Esso Laboratories shops. Although low atmospheric concentrations were found in these places, the difficulty of removing spilled mercury from this type of floor makes it appear that sufficient accumulations may occur to give rise to higher concentrations with the passage of time.

It is well to remember that the occurrence of mercury vapor in hazardous concentrations in laboratories and shops is more likely to result from evaporation of spilled mercury having extremely large surface area, than from the actual manipulations with liquid mercury in the shop or laboratory work.

Table 12

MERCURY VAPOR MEASUREMENTS--
METER AND INSTRUMENT SHOPS

Sample Number	Location	Air Volume (Cu.Ft.)	Mercury Concentration (Mg./cu.m.)
1	Main Meter and Instrument Shop. In vicinity of meter racks. Sample intake near floor.	20	0.08
2	Main Meter and Instrument Shop. In room used as office and storeroom. Visible deposits of spilled mercury on floor. Sample inlet at clerk's desk.	26	0.08
3	Shop in East Pilot Plant Area. New location for this shop. No visible deposits on this rough concrete floor. Sample intake on top of work bench at workers' breathing level.	15	trace
4	Shop in West Esso Laboratories Area. Shop located here for 3 months. Signs of spillage around mercury reservoir under bench. Rough concrete floor. No floor drain. Sample intake moved during sampling to three locations at breathing level.	10	trace
6	Shop in Crafts Building in Chemical Products Area. Visible deposits of spilled mercury on rough concrete floor. Floor drain has no trap for recovery of mercury.	20	0.08

The use of Varsol for cleaning purposes in these shops is not considered hazardous in view of the ammounts used and low volatility of this product.

Outside Men.

The principal duties of the outside men are inspection of thermocouple wells and orifice plates, trouble shooting at instrument locations, including repair at the site, and inspection and repair at time of turnaround.

These routine duties take the meter and instrument men into areas of exposure to process material of highly diversified character. Quantitatively, their exposures are considered somewhat less than that of process operators at the respective units. They are furnished protective clothing to prevent skin contact with heavy aromatic distillate, acids, and alkali. That they are sometimes exposed accidentally to high vapor concentrations is evident from the account of a "fainting" incident that occurred in the MEK plant and the fact that cases of poisoning with methyl chloride occurred among meter and instrument men when its use was new.

Exposure to mercury vapor in confined spaces by outside M & I men is not steady enough to cause any concern.

Skin contact with liquid mercury occurs on meter and instrument repair jobs. The frequency of its occurrence was not ascertained. It is not a serious potential source of industrial disease, because (1) the supervisors and the men know that it should be avoided and do so as much as is possible; (2) washing facilities are available and are used after encountering liquid mercury on the job.

Shift Men.

Shift men of the Meter and Instrument Division work out of the main shop and the Chemical Products Area Craft Building Shop and on the current turnaround jobs. Their work does not differ from that of the straight day men in the same area.

ELECTRICAL DIVISION

The greater part of the time of these men is spent away from the proximity of process material. Repair of refrigeration units, as in drinking fountains and air conditioning equipment, wiring and lamp replacements in the offices, maintenance of power lines overhead and beneath the ground are jobs that require no consideration in a review of health factors.

In work at the units, such as installation of lamps, maintenance and replacement of motors, temporary power and light wiring at turnaround, etc. the electricians' contact with process material is generally neither intense nor prolonged.

They work out of the main shop and way stations. Two or three men at a unit turnaround is the usual number.

Line Gang.

The line gang is composed of 13 rated men and one laborer. The work is mostly outdoors on overhead lines. Occasionally they are employed at pulling cable in underground conduits and, in bad weather, they may be employed at lamping in and around process units. Their employment is non-hazardous from the industrial health standpoint.

Electricians Assigned to Process Units, Laboratories, and Offices.

Five men are regularly assigned to process units, two at the catalytic cracking units and three at butyl rubber polymerization.

Twelve electricians are assigned to laboratories and offices. They may be excluded from consideration of health hazards.

Main Electrical Shop.

Four men are present full time at the main electrical shop. Their work is primarily that of motor cleaning and repairing. Approximately 100 motors per month are handled in this shop. Varsol is the regularly used cleaning agent. Its use in this shop is probably the greatest opportunity that exists in the refinery for toxic manifestations from repeated daily inhalation and skin contact, should there be any such manifestations from this substance.

According to a description furnished by the Refinery Laboratory, Varsol consists of a narrow cut fraction boiling between 300 and 400 degrees Fahrenheit. Its aromatic content was given as follows:

Varsol B (105)	15.5%
Varsol C (106)	15.5%
Hi Flash Varsol (107)	13.0%

This boiling range would indicate that benzene, the most toxic of the aromatic hydrocarbons, is absent and that toluene and Xylenes are also absent. Aromatic substance in the analysis would presumably consist of ethyl benzene, propyl benzene, isopropyl benzene (cumene), ethyl toluene, etc.

These compounds are in a class about which little is known toxicologically, except for the acute effects of single large doses. It would seem that the low aromatic content, low volatility, and natural ventilation at the shop would result in a toxic vapor exposure of a low order of magnitude. Determination of just what the exposure amounts to and what its effects may be on the men as determined by close medical observation would be desirable undertakings.

Pedigree Products No. 150 Thinner is used in the shop to the extent of about five gallons per week as a thinner for insulating paints and varnishes which are sprayed, for cleaning spray equipment, and for cleaning the hands. This product is described by its manufacturer as consisting of commercial xylenes. Its use constitutes an exposure of undetermined toxicological significance. Although the toxicity and volatility of xylenes are low, spraying of paints containing them as a thinner and intimate skin contact in washing the hands may produce undesirable effects in the men. Respiratory protection for the operators of spray equipment and substitution of a less irritant skin cleansing agent are logical starting points for elimination of any hazard that exists. In periodic medical examinations of these workers, attention should be directed at discovering any eye irritation, dermatitis, or central nervous system changes.

Skin Contact with Suspected Carcinogens.

Skin contact with heavy aromatic oils and other petroleum products from handling contaminated extension cords and floodlights that have seen service at process units is avoided by routine cleaning with steam by one man on "B" shift at the electric shop.

The regular duties of electrical maintenance men do not subject them to contact with acids or heavy aromatic oils and tar. Any contact is accidental, involuntary, and infrequent.

Underground Lead Work.

Lead sheathing in underground electrical conduits is relatively scarce in this refinery, being used for one voltage. Maintenance work on lead sheathing in underground conduits is done by one man. It was estimated that he is engaged for no more than one week per year at this type of work.

Because of its infrequent occurrence and the nature of the work, no lead poisoning hazard can be forseen in this work.

Occurrence of Nitrogen Oxides.

Vacuum tube rectification at the catalytic cracking units eliminates the possibility of exposure tc nitrogen oxides, which is said to occur in other plants.

MASON DIVISION

This division includes 63 brick masons, 56 concrete and sandblast workers, and 72 insulators.

Masons.

The tearing down and removal of furnace brick at the No. 22 thermal cracking unit was observed in order to determine the degree of intensity of dust exposure in this type of work. Four dust counts made in the breathing zone of man performing this work showed concentrations ranging from 0.4 to 2.5 million particles per cubic foot, which are beneath hazardous levels. In work of this kind, there is usually some degree of natural ventilation. The work is intermittent. Some unit turnarounds require a minor amount of brick replacement. Dust encountered in this work would be expected to contain free silica to the extent of 25 to 30 per cent, as found in the Aruba survey. The job, therefore, is not considered to constitute a positive silicosis hazard.

Laying of new brick requires some cutting to shape at the site. For this purpose, the division has three clipper saws. They are equipped with dust exhaust but no collectors. The dust is discharged to the air at the rear of the apparatus. This effectively prevents the prolonged inhalation of dust by the operator. Persons in the area are, of course, exposed to the discharged dust. Their exposure is occasional since the saw is portable. The new type of saw with wet dust suppression, which is on order, will effectively prevent this nuisance practice of discharging dust to the air.

The replacement of brick in the catalyst regenerators in fluid catalytic cracking units is known as a dusty job. The greatest source of dust is the disturbance of residual catalyst in the chamber. Of secondary importance is asbestos dust, which is present to an unknown extent. It is probably minor because there is no process whereby the asbestos is broken down to fine particle size. The overhanging "Jointless" firebricks used in this installation can be excluded from consideration as an important source of dust for the method of installing them is not dust producing. The longevity of the brick in this service, and the normal frequency of four turnarounds per year serve to classify this dust exposure as occasional.

Replacement and laying of brick in acid areas constitutes a large part of the brick masons' employment. The brick has a low free silica content. Cutting and shaping is done mainly outdoors. The dust exposure is not considered hazardous. Use of Basalite adhesive can result in exposure to irritant fumes, unless precautions are taken. The irritant property of the fume is so intense that chronic exposures are necessarily avoided by the men themselves. Formaldehyde

Concrete and Sandblast.

There is an interchange of men between concrete and sandblasting jobs which makes it difficult to determine just how many persons in the course of a year spend sufficient time in the vicinity of sandblasting to require physical examination by the Medical Department. The tendency toward increasing requirements for sandblasting inside process equipment prior to mechanical work at unit turnarounds makes it necessary that a continuing check on exposed personnel be kept by or for the Medical Department.

At units where we observed sandblasting inside towers, drums, or other equipment, the dust was well enough confined so that only the man handling the blasting hose was in a high concentration. He is, of course, protected with an approved supplied-air mask and helmet. There may be, and probably are, occasions where escape of dust is in the direction of attendants at the sand blast machines.

This is a situation which can only be evaluated by repeated observation and measurements at the scene.

At the sandblast shed next to the salvage yard, blasting of small parts from the process units, such as bubble caps, is done almost daily. The open sheds provided for this work provide no confinement of the dust. The shed where men must stand to attend the machines is sufficiently close to the blasting to receive at most times a high dust concentration. The attendants use no respiratory protection. Dust counts in this area, as shown in Table 13, which follows, ranged from four to 14 million particles per cubic foot. These concentrations are excessively high for free silica dust. Attendants at these units should be required to wear dust respirators during the whole time that sandblasting is being done. A more satisfactory long-range solution to the problem will be to provide a modern enclosed sand-blast shed with dust recovery system at the proposed new location at the Mechanical Crafts new buildings.

Table 13

DUST CONCENTRATIONS IN VICINITY OF SANDBLAST SHED

Sample Number	Sampling Time	Location	Dust Count (Million particles per cu.ft.)
68	5 min.	Around perimeter of brick-crushing shed.	7.4
69	5 min.	At entrance to shed just east of sandblasting shed. This is the regular station of the man tending the machine for the sandblasters.	14
77	5 min.	Inside the shed mentioned in No. 69.	14
78	7 min.	Same location as No. 77.	7.3
82	5 min.	Along side the eastern-most sandblast shed. No blasting being done in this shed at this time. Dust comes from two sandblasters working in the other shed.	4.2

Brick and Asbestos Grinding.

In a shed adjacent to the sandblast shed, a crushing machine is used several days each month to provide ground brick to be used as aggregate. Its use for grinding asbestos was described to us as very infrequent. Although an exhaust fan and duct are connected to this machine, there is considerable escape of fine dust within the room during its operation. Another important source of dust at this location is the sandblast shed next door. We feel that even in times past, when brick grinding was a continuous daily job to keep the polymer plant catalyst tower supplied, the high silica dust from sandblasting could have been a more important health factor than the occasional asbestos dust and brick dust in this shed. Use of a dust respirator in the brick grinding shed should be required.

Insulators.

We saw no operations in the refinery where insulators would be exposed to high concentrations of dust, harmless or otherwise, from the material with which they work. They do use a large variety of cements, thinners, solvents, and adhesives of unknown composition. There are some occasions where high concentrations of volatile constituents of these products will be encountered. The Medical Department should have some means of acquiring knowledge of the particular products that are in use and what the principal constituents are, so that proper medical control can be exercised.

GENERAL LABOR

Refinery Disposal Dump.

Fourteen men are employed and the majority have worked here more than ten years. All types of liquid and solid wastes from refinery processes, to the extent of 100-150 truckloads daily are disposed of here by open pit burning of combustibles. Since combustion is only of bon-fire type, considerable smoke results, and there is undoubtedly opportunity for major vaporization of materials surrounding the area of the actual fire. Dumping of heavy aromatics is said to be one of waste materials, and this suggests the good possibility of exposure of men to smokes containing injurious materials in vapor or mist form. Obviously, the men will attempt to take advantage of wind direction to avoid smoke, but this redeeming feature was minimized by our informants. At the time of our inspection, the wind was favorable for avoidance of smoke. The variety of waste materials handled and atmospheric conditions makes it impossible to appraise these conditions on a scientific basis, beyond the suggestions outlined above. General Labor supervisors rate the occupation as one of the worst problems they have.

Ethyl Lead Tanks Cleaning.

This hazard is recognized and precautions taken to comply with requirements and recommendations of the Ethyl Corporation (as well as duPont), which includes gas testing before entry into tanks, use of special protective clothing, supplied-air respirators, and periodic medical examination.

Exposure to Powder Catalyst Dust. Cleaning Reactor Chamber (PCLA).

A number of men are exposed for an estimated average of three months per year. The dust is very irritating to the upper respiratory tract and to the eyes.

It was generally agreed that men wear the respirators provided, faithfully, and this is a good index of the irritating qualities of the dust--since voluntary wear of respirators is only done where discomfort it imposes is of lesser extent. Goggles provided are worn but not as faithfully as respirators and, frequently, minor eye injury cases are reported to the Medical Department.

Cleaning Bubble Towers.

Inspectors, as well as laborers, cannot totally avoid skin exposures to various deposits in bubble tower and plate cleaning and inspecting, even though they wear rubber suits. These men literally must lie in the material where space is often no more than 15 inches deep. Some examples of this type of exposures are in the bubble towers of Cracking units 17, 18, 19, 20, 21, and 22, Pipe stills 1-8, PCLA 1, 2, and 3, ALA 1, 2, and 3, etc.

The deposits encountered in such places consist of a wide variety of materials from gas oil and naphtha used for flushing prior to entry to heavy polymers and coke deposits of unknown composition.

Exposures of this type to skin contact with materials of unknown composition and toxicity constitute one of the category of exposures of questionable importance. Fuller understanding of the effects of such exposures can only come with continued medical observation. The desire for complete health protection of refinery personnel dictates the necessity for avoidance of such exposures as much as possible and limiting the occurrence of possible ill effects by restoring cleanliness of person and clothing immediately following each exposure incident.

Cleaning Reactors, Light Ends Plant.

Renewal of polymerization catalyst occurs at a rate of about once in three months and lasts for about two days. The job is performed by a group of ten men at an out-of-doors location. The material they encounter is coarse and granular, hence non-dusty. No significant exposures can be seen in the performance of these duties.

Tank Cleaning.

A certain amount of unavoidable skin contact occurs when laborers enter a tank to remove sediment remaining after pumping out the tank. These exposures are in the same category with those described in the section above, entitled Cleaning Bubble Towers. Respiratory protection is afforded by the use of hose masks. Spent clay from the lube filters is used to "dry up" the last of the sediment to facilitate its removal by wheelbarrow. This practice constitutes no dust hazard by reason of the granular form of the material used.

Tube and Soaker Cleaning.

An important segment of the duties of general labor consists of cleaning tubes at the furnaces of the various refining units. Some eighty men are employed on this job over three daily shifts.

There is no doubt that this is a dust-producing operation.

It is likewise evident that there is no accumulation of dust concentration at the breathing level of the cleaners, because their position is open to the outside air on three sides and above. There is usually a fair amount of air movement about their position. When dust production ceases, dust at the breathing level is quickly dissipated. The production of dust is fairly constant after the tubes have been opened and cleaning equipment has been put in place. Total exposure time, as for most M & C operations outside of shops, is variable and, hence, unknown. The effects on health from inhalation of these dusts, if and when it occurs, are likewise unknown.

Cleaning Soaking Drums at Thermal Cracking Units.

Cleaning out vertical soaking drum at cracking coil No. 22 was done by means of a mechanical auger inserted from the bottom. Water wash flows down through the drum. This cleaning rig is used on 19, 20, 21, and 22 coils. Four laborers comprise its crew.

There is no dust exposure because of the use of water. There is opportunity for skin contact with materials in the drum while fitting the bit and while cleaning the sludge and coke away from the rig. We were told that one man is sometimes put into the drum from the top for scaling with a hand tool.

These contacts would be an important exposure in cases where the unit has been feeding clarified oil from catalytic cracking. There is an opinion in some quarters that the aromatics boiling over 700°F. are not destroyed, but concentrated, in the heavy tar fraction when clarified oil is fed to thermal cracking coils. This opinion should be tested by means of some animal toxicological experiments.

Dismantling Condenser Boxes.

Four laborers were engaged in dismantling a condenser box on the No. 22 unit. There was a copious flow of heavy tar from the coils as end-connections were removed. Skin contact was plentiful. Some pipefitters were also involved in this occurrence, which was described as unusual by the pipe-fitter foreman, as gas oil is usually encountered in dismantling these coils. In this instance, the tar may or may not be considered potentially carcinogenic, depending upon its source and prior treatment. The occurrence serves to point up the necessity for establishing some procedure whereby every unexpected incident that results in prolonged contact of material over a large area of men's bodies shall be reported to the Safety Department or some other responsible agent for determination of whether the regulations concerning clothing, showers, and medical examination for potential carcinogens shall be applied.

Exposures to Heavy Aromatics.

General Labor foremen have given earnest consideration to the problem. A question was raised that, in digging ditches to uncover pipeline leaks, the men may encounter a deposit of aromatics seepage. Alertness to this occurrence, which obviously exists in the division, is essential to success of the program for prevention of contact. Actual supervision of the use of protective boots and gloves that are provided for such occurrences is the other essential for success.

Another question is that of replacement of work clothing which men will wear for long periods in normal practice. This is one of the many details that must be worked out in the plan for providing clean work clothes when there has been contact with suspected carcinogenic material.

Skin contacts with heavy aromatics, on the part of general yard labor, has been considerably lessened by the provisions for flushing out lines before work is done on the catalytic cracking units. Similar provisions are being arranged at thermal cracking units where clarified oil is cracked.

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CARPENTER AND PAINTER DIVISION

Paint Shop.

The use of paint remover for stripping office furniture and other items occurs with sufficient frequency to require precautions against injurious inhalation of vapor. It is urged that special ventilation be provided for this work. It can be arranged by installation of a large propeller exhaust fan, e.g., 24" to 30" diameter, and placing of all paint remover work immediately adjacent to this fan. The present system of placing furniture outdoors for removing paint is not an assurance of safety against inhalation of the vapors of benzol, toluol, or chlorinated hydrocarbons which may be present because it depends on the vagaries of the winds and is not at all practical during extended rainy periods.

Painters.

The relatively minor role of painting by refinery personnel is indicated by the fact that about 32 men actually do painting. Of this number, five or six men are part-time spray painters. (Major paint jobs on new construction, tanks, and process equipment is done by contractors.) Respirators are provided for all indoor spray work, which is very infrequent. No red lead is sprayed by refinery personnel.

An item of major interest to the Medical Department is the possibility of the occurrence of benzol in some of the formulations used. Since the sources of paint products, and even the composition of products from the same source, are subject to variation, a check on benzol exposures can best be obtained by random application of urine sulfate measurements to the members of the group.

M I S C E L L A N E O U S

LABORATORIES

Refinery Laboratory

Aniline.

Daily routine aniline point tests are made. We could see no practice in the conduct of these tests that would result in breathing appreciable amounts of aniline vapor or any skin contact with aniline, except, perhaps, accidentally. The amount of aniline required for a test (approximately 10 c.c.) is drawn from a reservoir in an exhaust hood. It is mixed with material being tested on a laboratory bench away from the hood. After the test, used aniline is discarded, there being no facilities for re-distillation. Our only suggestion regarding the protection of workers from aniline is that the physical examination of these people be increased in frequency from once to twice a year, to conform to practice in the other refineries that we have seen.

Mercury Vapor.

Those laboratories in which metallic mercury is used were visited in company with Mr. Day, of the Safety Department, for the purpose of observing the extent and manner of use and the disposition of spilled mercury. Hygienic practice in the use of mercury consists of controlling accumulations of vapor or dust in the working environment. This can be accomplished by providing a reasonable amount of room ventilation and in keeping the floors and work benches free of spilled mercury. Evaporation takes place from finely divided droplets dispersed on a floor surface at a much greater rate than it will from mercury reservoirs on laboratory apparatus, because of the greater surface exposed to the air. The American Standards Association has adopted the value of 0.1 milligram per cubic meter of air as the maximum permissible concentration. It constitutes a good bench mark for control of mercury vapor exposures. It expresses an easily attained level of control.

The results of measurements made in the various laboratories are known to the Safety Department. They are summarized in the Table below (page 88) for convenience.

Only the Gas Analysis Room of the Refinery Laboratory showed a concentration bordering on the level of what constitutes good practice. In this instance, replacement of the contaminated floor mats and cleaning and painting of the contaminated floor will effectively reduce the atmospheric concentration to the level prevailing in the other laboratories. The Gas Analysis Room of the Chemical Products Laboratory is in a much worse condition as regards spilled mercury on the floor and beneath the work benches, but accumulation of concentrations in the air is prevented by the excellent ventilation system.

Table 14

MERCURY VAPOR DETERMINATIONS--LABORATORIES

Sample Number	Location	Mercury Concentration (Mg. per cu.m.)
5	Refinery laboratory. Gas Analysis Room. Fairly smooth concrete floor. Rubber mats. Not much ventilation. Sample intake at breathing level in two locations.	0.18* Greater than 0.1
7	Plancor 572 Lab. Sample at breathing level near POD apparatus. No visible spilled mercury.	Less than 0.02* 0.0
8	Refinery Laboratory. Leonard's Lab. Small use of mercury. Good ventilation. No visible deposits.	0.0
9	Distillation Group Laboratory:	
	(a) Near vacuum still	0.0
	(b) Near glass still	0.0
10	Fuel Products Lab. Mercury is washed here for use in test at treating plant. Sample taken near washing apparatus in open cage locker.	0.0
11	Chemical Products Main Laboratory:	
	(a) Analytical Lab. In vicinity of Polarimeter at breathing level	0.0
	(b) Gas Analysis Lab. Visible deposits of spilled mercury on the floor, on rubber mats, underneath laboratory benches. Six exhaust ducts with intake one foot off floor, good air supply to room. Sample taken at breathing level.	0.0
	(c) Special Problems Lab. B. Small use of mercury; good air movement.	0.0
	(d) Special Problems Lab. A. Small use of mercury.	0.0

* Results obtained by a chemical method utilizing absorption in iodine and a colorimetric determination. Air volume 20 cubic feet. All other results were obtained by use of the General Electric Mercury Vapor Detector.

PRINTING STANDARDS

The shop, design section, and office of this division employ about 33 persons in a one-story frame building.

Materials Handled.

The use of AzO dyes in the Ozalid process and of photographic chemicals constitute possible sources of dermatitis in susceptible individuals with which the Medical Director is fully aware. There are several solvents and process liquids in use which are of interest because of the likelihood that these, and similar preparations that may come into use from time to time, contain substances of known toxic properties, such as methyl alcohol and carbon tetrachloride.

Those currently in use are:

Ditto Direct Process Liquid
Multilith Blankrola
Multilith Repelex
Multilith Repelex
Multilith Platex
Multilith Deoxit

Ventilation.

Besides the doors and windows which are usually open, ventilation of the working space is furnished by a 48-inch attic fan, a wall exhaust fan at the location of the photographic reproducer, and the exhaust fan connected with the hood over the Ozalid Process. It is estimated that the ventilation rate exceeds 12,000 to 15,000 cubic feet per minute. This ventilation rate will suffice to keep concentrations of vapor of liquids commonly used in formulations of this kind below 100 parts per million in the air, should the total evaporation rate amount to as much as 2.5 gallons per hour. According to our observations of the processes, the evaporation rate of liquids in this shop is much below this figure. Concentrations of vapor in the air are thus maintained at a level safely below that which would cause harm to the personnel.

If there were acute exposures to high local concentrations of harmful solvents at any of the machines, these would have manifested themselves by symptoms of nausea, dizziness, or irritability.

ASPHALT PLANT

blowing still

We did not make a study of the facilities at this refinery for oxidizing, blending, and packaging asphalt. In view of the experiences at other refineries within the company, it would be advisable to examine these facilities from the standpoint of production of vapors or mists in oxidizing, aromatic vapors in cutback blending, and asphalt mist at drum filling, wherever such atmospheric contaminants may prevail for extended periods in areas where men are at work.

A P P E N D I X

PREVENTION OF EXPOSURE TO HIGH BOILING AROMATICS

We have reviewed the basic information which indicated the necessity for a program of control of exposure to catalytic cracking or steam cracking fractions boiling above 700°F.; we are also acquainted with the exposition of this program to employees on February 23 and 24, 1949, and with the general rules for personal conduct and hygiene with respect to persons encountering these fractions in the course of their duties. We have reviewed the Safety Department's survey of exposures to high boiling aromatics in the refinery, which includes recommendations for further action and additional precautionary measures.

These studies indicate that the Refinery is in a favorable position with respect to prevention of skin contact with these oils by employees and early detection of any skin changes brought about by contact. The first and most important favorable point is that the employees are fully informed of the reasons for precautions. They have thus been put in a questioning frame of mind. Possibilities for exposure that were overlooked in the original directives and survey have been suggested and will continue to be brought out by the several hundred alert supervisors and workers that are affected. The list of proposed improvements in the Safety Department's survey contains several examples, notably the necessity for providing better means for flushing out slurry heat exchangers and steam generators at the catalytic cracking units, especially those that must be worked on while a unit is in operation. Some details of procedure still remain to be accomplished. Slurry pumps, in present practice, are not satisfactorily drained of the oil before removal to the machine shop for disassembly. There seems to be a chance for small parts from service in heavy aromatic oils to reach the sand blast shed for cleaning without warning labels.

With widespread knowledge of the problem, the prospects are excellent for the development in time of totally effective procedures.

The adequacy of facilities for taking showers and for provision of protective clothing assumes a great importance in this program for prevention of skin contact. We find that the refinery is well-equipped with shower rooms and that they are well-distributed for easy accessibility by those who may be in need of such facilities during a working day or at the end of the working day. Any tendency toward further centralization will have a detrimental effect on the ready accessibility of the rooms after the occurrence of a spill or a splash of the oil fractions that are to be avoided. Maintenance of these shower rooms in a clean and sanitary condition is generally quite good. There are a few exceptions:

(1) The colored room at the road oil stills. The location of this washroom under a water tank makes light and ventilation a difficult problem but maintenance on a par with facilities elsewhere could still make it a good place to take a bath.

(2) The colored room beneath tank No. 291 (next to No. 2 boiler house) is likewise ill-kept.

(3) The colored room at the Plate Shop suffers from overcrowding.

General Labor foremen say that 99 plus per cent of Negro laborers take showers on their own time at the end of the working day. This habit should be encouraged in every practical way. Good maintenance of the shower rooms is most important.

In the matter of dividing potentially exposed personnel into <u>frequent</u> and <u>infrequent</u> groups, we question the inclusion of nearly all process employees at PCLA units, QBLA, and OLA in the <u>frequent</u> category, while the number of Mechanical employees is minimized. In our experience, the process employees spend more time at places where these oils are handled but experience less skin contact than Mechanical employees who may less frequently be in areas of exposure but more often are exposed. A simple time study on these groups should clarify the respective exposures.

In addition to what has been done to lessen skin contact with these high boiling aromatic oils, we propose that a complete program for prevention of exposure should include the prevention of inhalation of vapor or mist of these fractions. We were able to demonstrate the presence of oil mist in the vicinity of hot clarified oil pumps at the catalytic cracking units. We feel that there should be a concerted effort to identify and evaluate every occurrence of oil mist in places where men work and where the stock consists of oils that are presently included in this program for prevention of skin contact. The toxicological potentialities of inhalation of a mist of a substance that is potentially carcinogenic cannot at present be adequately defined but seems to deserve a great degree of important consideration. Initial efforts should be directed to the areas of slurry and clarified oil pumps at catalytic cracking units; feed pumps at thermal cracking units receiving clarified oil; quench oil pumps at steam cracking units; the tar product pumps of steam cracking units; and the use of steam lines for flushing away surface deposits that have resulted from spills or leaks.

All sampling locations at units handling these oils should be examined for the purpose of ascertaining whether the person who draws the sample can accomplish his mission without suffering exposure to mist or splashes of the stock he is sampling.

BENZOL EXPOSURES

While potential exposures to benzol in various locations (summarized below) may have been over-emphasized, the uniquely toxic character of the vapor warrants special attention.

Various investigations in the consuming industries, especially in coated fabrics plants, where enclosure of equipment and ventilation were thought to be good, disclosed cases of benzol poisoning at concentrations of 75-100 p.p.m. The action is particularly insidious; many fatalities from chronic exposure to low concentrations are known.

Time for the survey did not permit detailed appraisal of this hazard in the several possible exposure locations. We did not feel that any were particularly significant, especially for average individuals in good health. The possibility of unfavorable developments, however, in an occasional susceptible individual could not be ruled out, and this is the reason for the general recommendation for medical supervision for workers potentially exposed.

Urine Sulfate Test.

This test provides a convenient method for measuring the degree of a worker's exposure to benzol vapors during a given day, and is particularly applicable to appraising the exposures of workers in the listed locations.

Summary of Potential Benzol Exposure Areas.

Solvent De-waxing (MEK) Plant
Steam Cracking Plants No. 1 and No. 2
Diolefin Extraction Unit
QHLA Steam Cracking Coils
Paint Shop

EXHIBIT #16

Transcript Quality Assurance Checklist

Deposition scheduled by: ______________________

Notice prepared by: ______________________

Subpoena prepared by: ______________________

Subpoena served by: ______________________

Setting confirmed by: ______________________

Deposition reported by: SK

Transcript edited by: ______________________

Transcript proofread by: ______________________

Deposition videotaped by: ______________________

Transcript copied by: M

Exhibits prepared by: M

Transcript bound by: JS

Transcript page-checked by: ______________________

Transcript billed by: ______________________

Transcript packaged by: ______________________

Transmitted for signature by: ______________________

Notice to opposing counsel by: ______________________

Transcript delivered by: ______________________