U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION REPORT NO. 77-45-619

ETHYL CORPORATION, HOUSTON PLANT
PASADENA, TEXAS

SEPTEMBER 1979

I. SUMMARY

The Ethyl Corporation, Houston plant in Pasadena, Texas, has been producing tetraethyl lead since 1952, and is now also manufacturing various organic compounds primarily for soap production. More recently, aluminum alkane compounds as chemical intermediaries have also been in production. Vinyl chloride monomers were produced from 1960-1975. The current health hazard evaluation was requested because of concern over 3 cases of multiple myeloma which have occurred among plant workers over the past 7 years. Also, there were complaints from the personnel working in the laboratory of one case diagnosed as multiple sclerosis, cardiac problems, and other illness.

In March of 1977, Dr. Burdick, who was the plant physician at the time, did a mortality study of the Houston plant workers[1] and concluded that there was no significant increase in cancer among the employees. However, the study only included workers employed from 1960 through 1977 and only considered exposure since October 1, 1960, although the plant began operation in 1952. It is difficult to assess the significance of the company study in relation to multiple myeloma because the detailed presentation involved "non-minority" males and the one death from multiple myeloma was a black male.

NIOSH personnel visited the plant June 29, 1978, and August 1-3, 1978. A review of employee records showed that there is a fairly stable work force, although the workers do move around from position to position within the plant. Records were available from the beginning of plant activity in 1952, but the records for periods prior to 1965 for inactive employees were deficient in respect to specific work assignments during the period of employment. Dr. Burdick reportedly obtained about 98% of the death certificates on deceased employees for the period from 1965-1976. The completeness prior to 1965 is not certain.

On an acute basis, it appears that current complaints are confined to the laboratory. This is primarily a quality control laboratory with production workers able to bid in for jobs. No definite association could be established between work place exposure and current acute illness. Some previously known lead overexposure and occupational injuries were found. Recognizing the hazards of working with tetraethyl lead, this plant has had a lead monitoring and control program from the beginning.

A morbidity-mortality study may be able to characterize more definitively any relationship which may exist between multiple myeloma, or other illness, and workplace exposure at this plant. It is hoped that the study that will be conducted by the Biometry Section, Industry-Wide Studies Branch, Division of Surveillance, Hazard Evaluations, and Field Studies, NIOSH will answer the questions regarding these aspects of the request.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio, 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

a) Ethyl Corporation, Houston Plant, Pasadena, Texas 77501
b) Authorized Representative of Employees - Local 4-1600 OCAW, Pasadena, Texas
c) Oil, Chemical and Atomic Workers International Union, Denver, Colorado 80201
d) U. S. Department of Labor, Region VI
e) NIOSH, Region VI

For the purpose of informing the approximately 850 "affected employees" the employer shall promptly "post" for a period of 30 calendar days the Determination Report in a prominent place(s) near where exposed employees work.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees of the Oil, Chemical and Atomic Workers Union regarding possible long-term effects from exposures at the plant. Of particular concern were three cases of multiple myeloma diagnosed over the past five years and additionally, some serious nerve disorders among laboratory workers and a concern for suspected rising numbers of cancer cases and heart attacks.

The union first approached NIOSH for some information to help them proceed with a program to establish medical criteria to ensure that employees working for the Ethyl Corporation, Houston plant should not suffer diminished health, functional capacity, nor life expectancy because of their work environment. Further, correspondence at that time showed that over the past 20 years, primarily in the last 10 years, there had been 19 cancers including liver, breast, brain, esophageal, gastric, vocal cords, seminoma, pancreatic, colon, lung; 23 cases of cardiovascular disease deaths and 20 other deaths, among a workforce averaging approximately 1000.

Following this correspondence, the plant physician did a mortality study at the plant. This will be discussed further in this report.

NIOSH was contacted again in January 1977 because of concern over 3 cases of multiple myeloma which had occurred in the plant between November 1971 and November 1976. The earliest case had died - the other 2 were still living under treatment. Reference was also made to serious nerve disorders in 4 to 6 employees working in the laboratory, 1 being a case of multiple sclerosis.

In March of 1977, the physician at the Ethyl Corporation Houston plant completed his mortality study,[1] a copy of which was supplied to NIOSH in September of '77. After review of the report, the Biometry Section of the Industry-wide Studies Branch in a memo dated October 28, 1977, recommended that further investigation should be conducted. Due to personnel shortages, it was not possible to schedule a NIOSH visit to the plant until June 1978, at which time the current investigation was undertaken. An Interim report (SHEFS I) was sent to the plant in September of 1978 followed by a more extensive evaluation from the Biometry Section in December of 1978.

IV. HEALTH HAZARD EVALUATION

A. Process Description - Conditions of Use

The Ethyl Corporation Houston plant covers many acres of land along the Houston ship channel. With the exception of the tetraethyl lead production area, the majority of the production facilities are out in the open with only a minimal amount of roofing and walls. There are buildings for administrative offices, Medical Department and cafeteria; the locker rooms, maintenance shops, quality control laboratory, tetraethyl lead production, the initial portions of the aluminum alkane process, and several small control rooms are situated at various points throughout the plant.

The plant has been producing tetraethyl lead since 1952. The process involves reacting a sodium lead alloy with ethyl chloride. The lead is supplied as large blocks of the metal or comes from a secondary smelter which recovers unreacted lead from the process. The sodium is obtained by electrolysis of brine with the chlorine being reacted with hydrogen to form hydrogen chloride which is then reacted with ethylene to form the ethyl chloride needed for ethylating the lead. Ethylene dichloride is also produced utilizing the chlorine. Ethylene dibromide has been shipped in since 1952. Tetramethyl lead is also shipped in. When antiknock blends are desired, the blending is done at this plant. Finished products are shipped by rail or ocean tankers.

Between 1960 and 1975 ethylene dichloride was used as a source of hydrogen chloride for the tetraethyl lead production with vinyl chloride being sold as a by-product.

In 1965 the company began producing synthetic coconut oil alcohol. This portion of the plant produces aliphatic olefins and various alcohols with ethyl alcohol and butyl alcohol as by-products for which there is no particular market. These are discharged into a sewage lagoon. There is also a small portion of the plant which produces diethyl and dimethyl aniline, and a section that produces aluminum alkane which are sold as intermediates for the production of soap and other products.

Because of the explosive hazards, except in the administration building and a few designated areas, no smoking is allowed. There are protective walls built at particularly critical places, although there are occasional reactor accidents causing injury or, rarely, death. As blowouts of TEL reactors occur about 16 times per year, workers in the TEL area are required to have respirators available. Besides the work on the plant itself, the workers at this facility are responsible for maintaining chemical handling equipment on Ethyl Corporation ships and are responsible for cleaning their tanks while they are docked. This last job is now often done with contract workers.

B. Company Medical Program

The plant has a staffed Medical Department with a full-time physician. Workers receive a pre-employment physical exam, and, on a voluntary basis, a complete physical examination every few years after age 40, the usual being 3 to 4 years with about 90% participation. Specific job areas have specific biological monitoring performed. For tetraethyl lead, workers and maintenance workers are questioned monthly about symptoms likely to be due to organic lead exposure and have blood pressure and pulse taken. Every 2 months they have a urine lead level performed with more frequent testing if air monitoring suggests there may be a problem, or the individual's past history or activities suggest that exposure may have been greater than normal or that the individual reacts to exposure to a greater degree than most. A urine lead of over 250 ug/L calls for immediate removal. Levels between 150 and 180 persisting for three readings will cause a restriction from further exposure. Levels of 70 to 120 ug/L call for continued observation. When a person is removed from further exposure, the restriction remains in effect until he has had 2 urine leads below 100 ug/L or blood leads below 60 ug/dl. Blood leads are now routinely run on the furnace workers, although it has been the Medical Department's experience that even in the furnace workers elevated urine leads are found long before elevated blood leads. The company laboratory uses the diazanone method of lead determination and participates in the CDC proficiency testing program. Men are required to shower before the specimen is obtained.

Workers in the diethyl aniline area receive annual examinations and have complete blood counts (CBC) with examination of platelets on a quarterly basis because of possible minimal benzene exposure. Carpenters are examined annually because of possible asbestos exposure.

For the last two years complete examinations on all workers receiving examinations in addition to history and physical have included an SMA-12 (now Chem-26) on blood; CBC with differetcial count; pulmonary function testing on a Jones Pulminar* and a 14 x 17 chest X-ray; hearing screening, and vision screening; and, if over 40, an ECG. No MD certificates are required for workers returning from sickness but they are required to be cleared by the Medical Department before return to duty. The plant health center does provide treatment for minor health complaints.

According to the Medical Department in the past few years there have been only 3 or 4 cases of lead intoxication, the presenting symptoms being nightmares and/or anxiety. Additionally there are one or two workers "sensitive" to organic lead who require restriction from any exposure from time to time. Blood leads are predominantly within the normal range. Even in the furnace area (TEL area) most blood leads are below 40 ug/dl.

* Mention of commercial name does not constitute NIOSH endorsement.

There is a regular program for monitoring air lead levels in the tetraethyl lead building with a 2 ug per cubic foot action level requiring respirator use. Three ug per cubic foot is the maximum allowed.* Results of air monitoring are sent to the Medical Department. Workers in the tetraethyl lead building are required to have respirators available to be used if there is an accident or blowout. Workers shower at the end of work. The company supplies work clothes from the skin out and separate baskets for storing work clothes and street clothes. Workers can get clean work clothes daily but are not required to change that frequently.

C. NIOSH Study Design

After a review of the company's mortality study by the Biometry Section of Industry-wide Studies Branch, an on-site visit was arranged to include epidemiologists to investigate the possibility of further study of the plant's mortality, and medical personnel to evaluate the need for a current cross-sectional morbidity study. The initial visit was performed on June 29, 1978, with a walk-through tour of the plant complex, conferences with management and labor, following which the epidemiologists evaluated the availability of data and the medical team consulted with the plant Medical Department. There was a repeat medical visit August 1-3 to interview workers in the quality control laboratory. The standard non-directed questionnaire was utilized, which collects data on name, age, current job, previous jobs, and queries as to any health problems the worker has. If he identifies health problems, these are further characterized as to the circumstances under which they occur, their course, and factors which influence this. Plant medical records were also reviewed on workers who had indicated problems for which they had been seen at the plant clinic.

D. Toxic Substance Data

1. Tetraethyl Lead[2,3,4]

Tetraethyl lead is readily absorbed by inhalation or through the intact skin. Once absorbed the tetraethyl lead is metabolized primarily to triethyl lead, but a considerably smaller portion is metabolized to inorganic lead. Both the triethyl lead and the inorganic lead can be deposited in tissues. The inorganic lead can be incorporated into the bone, and both the organic lead and inorganic lead may be excreted in the urine. Toxic effects of tetraethyl lead are primarily upon the functioning of the central nervous system and are unrelated to blood lead levels. Symptoms of tetraethyl lead poisoning frequently suggest a psychiatric problem and may include hallucinations, tremors, delirium, insomnia, delusions, headaches, and violent mood swings. In the most severe cases, there may be convulsions, coma and death. Recovery may be slow, but is usually fairly complete among survivors although intellectual impairment and decreased working ability has been reported. The usual method of monitoring for organic lead exposures is by urinary lead analysis.

*Expressed in mg/m^3 this is 0.1 mg/m^3, the 1978 TLV recommended by the American Conference of Governmental Industrial Hygienists.

2. Multiple Myeloma[5,6]

Multiple myeloma is a malignant disease of the plasma cells often associated with the production of a very specific plasma protein associated with the immune globulins. Characteristically, the abnormal plasma cells develop in the bone marrow where plasma cells are normally produced. They lead to a weakening of the bone and dissolution of the minerals in the bone leading to punched-out lesions showing up on X-ray. Pathological fractures from very minor trauma are not uncommon in this disease and are the cause of some of the bone pain. The patient is also likely to have increased difficulty controlling infections. Other than acute symptoms from the problems of bone destruction, the disease is most likely to be discovered because of abnormal protein in blood or urine, or abnormal cells on white blood cell count. Anemia is a common finding. In some patients an abnormal proteinaceous material called amyloid is laid down in various tissues, particularly the kidney, which may eventually lead to kidney failure. Over the past few decades there has been an increase in the incidence of multiple myeloma in a number of Western countries. It is possible that this trend may represent an increased utilization of medical facilities and improved diagnosis rather than an actual increase in incidence. Also as our understanding of the immune mechanisms of the body has improved, more diagnoses are being made at an earlier stage in the disease utilizing blood and urine analysis. Earlier diagnosis coupled with better treatment, has lead to a considerably longer survival of persons with multiple myeloma than occurred at an earlier date. The cause of this disease is not known at this time, although there has been some indication that repeated stimulation of the immune system may play a contributing part.

3. Multiple Sclerosis[7,8]

Multiple sclerosis is a demyelinating disease of the white matter of the central nervous system of unknown cause. It is most commonly a disease of early adulthood and is characterized by periods of exacerbation and remission. Geographically, it is more common in the northern temperate climates than in the more tropical climates. Symptoms may include muscle weakness, incoordination, paresthesias and visual complaints (which include blurring of vision with a central blind spot and decreased visual acuity or double vision). Some of these, particularly the visual complaints, may remit spontaneously to leave almost no traces. Over the years, the neurological deficits gradually increase eventually causing sufficient disability that the individual cannot be profitably employed. Although multiple sclerosis is not a diagnosis that is readily made on a single diagnostic visit, the course of the disease is fairly characteristic when followed over time. Life expectancy following diagnosis of multiple sclerosis varies considerably, the average being between 13 to more than 25 years. The cause of death is often intercurrent infection.

From time to time the suggestion of a causal relationship between lead and multiple sclerosis has been advanced. This has been based on goegraphic distributions of environmental lead and of multiple sclerosis, the fact that lead has caused demyelination in some experimental animals, and the fact that multiple sclerosis is a demyelinating disease.[9] However, a couple of recent studies[10,11] exploring this have failed to show abnormalities in lead levels in multiple sclerosis cases, even though blood, urine and mobilizable lead were studied and several stages of the disease were involved. More recent studies raise the possibility of an immune mechanism as the cause of the disease, possibly related to the measles virus.[7]

E. NIOSH Study and Review Findings

1. Epidemiologic

a. Review of the 1977 Company Mortality Study

The company mortality study[1] discussed the mortality experience of workers at the Houston Plant of the Ethyl Corporation. Only permanent non-minority male employees exposed from October of 1960 to August 1, 1976 were included in the cohort presented in detail. The control group was the general Texas population of 1970. Age-specific mortality rates for the plant population were calculated using employee "manyears" and mortality rates for the 1970 Texas population. Follow-up for the study group was nearly 100%.

The conclusions made by Dr. Burdick were:

1) The mortality rate for plant employees was lower than expected for natural and unnatural causes based on the U.S. Bureau of Census Health Statistics for the Texas population.

[This result is consistent with the "healthy worker" theory, whereby worker populations generally experience a lower mortality rate than the general population. Worker groups are composed of only those people healthy enough to maintain a job whereas the general population includes the ill who are unable to be employed.]

2) Two plant populations studied were found to experience a larger number of observed cancer deaths than expected. These groups, consisting of the male non-minority population with a minimum of one year plant exposure and the male non-minority population with a minimum of five years plant exposure, each experienced 20 observed cancer deaths during the 16 year study period. The expected deaths for the two groups were 17.2 and 16.2 respectively. The differences between expected number of deaths and the observed number of deaths for the groups was considered to be statistically non-significant using the X^2 test.

The two worker groups studied include only male employees (minority and minority) to TEL for 1) a minimum of one year and 2) a minimum of five years. The results are as follows:

TEL Exposure (1960-1975)

	Minimum Exposure 1 Year	Minimum Exposure 1 Year
Total # observed		
Deaths ("all Cancers")	20	17.2
Expected #	20	16.2
Deaths "All Cancers"		

The differences between the observed and expected deaths were not significantly different using the Chi Square ($\alpha = 0.05$). Additionally, the data include neither job-specific classifications, other than the major breakdowns of TEL and non-TEL exposures, nor a tissue specific categorization of the cancers.

3) The mortality of the plant population under study was also broken down by age and the following causes: Heart Disease, Cancer, Stroke, Motor Vehicle Accident, Other Accidents, Pneumonia, Homicide, Suicide, Cirrhosis, Emphysema, and other. These were then consolidated into death due to natural causes, deaths due to unnatural causes (accidents) and total deaths and compaired to 5 lengths of plant exposure for non-minority males and to two lengths of TEL exposure for combined minority and non-minority males.

The NIOSH reviewer felt this study left some unanswered questions; some due to limitations of the available data, some due to the manner of presentation.

1) The presentation of the data is somewhat misleading. The reader is led to believe that a large proportion of the cancer deaths occurred in the group with a minimum of one and five years exposure. This is true when all the employees having up to 20 years exposure are included in the total. But if the cases were divided into five-year exposure groups, the employees with one to four years of exposure, experienced no cancer mortalities, while those exposed for longer than five years experienced all the deaths.

Likewise, the deaths caused by heart disease occur most often in those employees having five or more manyears in the plant.

Table I illustrates the number of deaths by five year age groups and length of exposure. Note that for every age category having a minimum of one manyear of plant exposure (1-4 manyears) there were no deaths from either cancer or heart disease.

2) In this study, only those males employed at the Houston plant since October 1960 were included in the study population. Those employees working only from 1952 through 1959, were excluded, although these men were exposed to the plant for a maximum of nine years. The data show that deaths from cancer and heart disease increase after five manyears of exposure. Therefore, these men should have been included in the mortality study.

3) It should have been noted that due to the "healthy worker effect", the number of observed deaths within the plant population should be lower than the expected number deaths as calculated using the 1970 rates from the general Texas population. Therefore, if the observed number of deaths are higher than or even close to the expected frequencies, further investigation should be made into the exposed population.

4) Several questions which might still be answered are:

   a) If the cancer deaths were grouped by site, would there be a significant increase in one cancer type over another? Also, if cancer deaths were grouped according to area(s) of the Houston plant, would there be any increase in the incidence of cancer in isolated areas of the plant?

   b) Are the deaths observed causally related to exposures in the work environment? To determine if fatal diseases were causally related to exposure in the work environment, numerical documentation of worker exposure should be evaluated. In this paper, the employees were divided into those exposed to TEL or other plant employees. (Supposedly, those categorized as "plant employees", were not exposed to TEL at any time for the duration of their employment at the Houston plant.) No documents were presented showing ambient plant levels of TEL nor any other raw materials used in the production of TEL. It is possible that TEL is not the causative agent of any fatal illness(es), but an elemental component of TEL.

It was noted that work histories were not kept before 1965, however, it would be well worth the effort to find out to which substances those people who died of cancer were exposed, and the actual length of exposure, in years, prior to the diagnosis.

c) Is the percentage of non-minorities with Spanish surnames included in the study, equal to the percentage of Spanish surnamed males in the Texas population?

b. NIOSH Review of Data Availability

An examination of the personnel record retention system was conducted with the assistance of the Personnel Supervisor, the Supervisor in charge of Employee Benefits and the Manpower Move in the plant.

Currently, the plant employees 1100 workers, of whom 14% are black, 4% female, and 5% of Hispanic origin. No women with child bearing potential are permitted to work in the plant, due to the possible harmful effects of inorganic lead on the fetus.

The employee population is fairly stable with an average yearly turnover rate of 5%. To illustrate this stability in 1977, approximately 400 employees celebrated their 25th anniversary with the company.

1) Personnel Records:

The personnel record keeping system was assessed to determine the feasibility of conducting an in-depth epidemiologic study.

The company retains some information on all of their employees both past and present. A complete file is kept on all current employees containing: the application for employment, job change notices, absentee slips, and other material not pertinent to job status, i.e., letters of recommendation and scholastic records. Records of current medically-exempt and non-exempt employees are retained in the active file.

Records of terminated and deceased employees are kept in the inactive file. In 1965, records of all inactive employees were edited and microfilmed. There are five alphabetized rolls of microfilm of those employees terminated or deceased prior to 1965. Information on the microfilm consists of: application for employment, attendance record, termination record, employee safety record and employee history card. The employee history card does not specify the area in which an individual worked, but only the type of job classification, e.g., operations, maintenance. In the case of a deceased employee, the death certificate is included.

Death certificates were collected by Dr. Burdick for approximately 100% of the deceased employees who worked at the Houston plant from 1965 until the present. Prior to 1965, death certificates were not obtained with any consistency.

The records of employees terminated or deceased after 1965 have not been microfilmed. There are approximately 900 records of inactive employees which are not microfilmed, and 1100 of active employees.

If an individual is transferred from one company to another within Ethyl, both personnel and medical records are moved to the new place of employment. Movement from this plant is infrequent; however, movement from job to job within the plant is substantial, allowing for a great variability in exposures.

2) Medical Records:

The medical records for all employees, ever working at the plant, are retained intact. Any injuries, complaints and examinations handled by the plant clinic are noted in the record. Information acquired by personal physicians is not obtained for the file. The plant physician (1978) indicated that he has minimal contact with personal physicians.

Commencing in 1952, persons who have had any exposure to TEL, including operators and maintenance personnel, have been periodically screened for lead through a urine lead test. The results are recorded on a standard form, the area in which the individual was working at the time of the urine test is also noted on the form. This information may be useful in determining who might have been exposed to TEL but could not be used to assess total exposure or dose.

A preliminary review of the records of the three multiple myeloma cases, revealed that all three of the individuals began working at Ethyl Corporation in 1952 and had exposure to TEL. Two men worked exclusively in the TEL area, one for 8-10 years and the other for 20 years (since 1952). The third case was a maintenance person who could have been exposed to many of the chemicals used throughout the plant. The maintenance person died in November 1971, the other two are still living. All of the men were over 45 years of age when their illness was diagnosed.

Several factors must be considered in the review of these cases.[12,13,14,15,16,17] Both the literature and vital statistics data indicate an increasing mortality rate for whites and blacks of both sexes. (See Table II.) The adjusted death-rates increased considerably from 1950 to 1967. (See Table III.) Multiple myeloma occurs infrequently before the age of 30, increasing with age and peaking about 65-70 years of age. Table IV shows the 1969 mortality rates for Texas and for Harris County for comparison.

In addition, technological advancements during the last 20 years have improved the accuracy of the diagnosis of multiple myeloma, possibly increasing the incidence during the past few years.

In this plant, approximately one-third to one-half of the employees are over 40 years of age with about one-third of the present work force (400) having 25 years of experience with the company. This population is reaching the age at which multiple myeloma becomes increasingly prevalent.

Those with fifteen or more years at the plant are entering a period when latency and long term exposure become significant variables in the occurrence of occupationally acquired illnesses. If there is an occupationally related multiple myeloma etiology, the combination of both latency and long term exposure in this population may be a factor in the occurrence of illness among the workers.

2. Medical

During the week of August 1, 1979, thirty-seven (37) laboratory workers were individually interviewed. The roster listed a total of 46. Table V characterizes the age, length of service, and smoking habits of those interviewed. Plant medical records were reviewed on 13 workers who had been evaluated at the plant clinic. Of the 37 only 8 (22%) had no medical problems. Of the 29 with medical problems, 18 (62%) felt they had problems which might be related to their jobs, and 27 (93%) felt they had problems not related to their jobs. Table VI lists some of the more common complaints. One should remember that except for injuries, acute effects and a few specific exposures (as lead), it is extremely difficult to individually relate health problems to the job. The four most common complaints were elevated leads, clearly job related, but only about a third of the men mentioned it as such; sinusitis, which all believed related to living in the area; and back injuries, half being allegedly related to work. Findings did not pinpoint a particular problem area. Several of the men felt that shift work and/or the pressures for rapid analysis caused them to be nervous. This was not helped by a noisy exhaust fan in the wet lab. It was also felt that when a large number (up to 8) of the 14 gas chromatographs were running in the vapor phase chromatography (VPC) lab it gave workers headaches. The ventilation exhaust is through a grill at bench level at the end of the room opposite the door. Although the major combustion product from gas chromatographs is water, with heavy usage the ventilation in the laboratory may well be inadequate for comfort.

F. Summary

In 1977 the Corporate Medical Director of Ethyl Corporation, conducted a mortality study on the TEL workers in the Houston plant. He found no significant increase in the incidence of cancer among these employees. However he did not use a complete cohort in this study including only workers employed from 1958 through August 1, 1976 and did not consider exposures prior to October 1, 1960, although the plant began operation in 1952.

Review of available records showed that complete files are kept on all current employees. Records for employees terminated or deceased prior to 1965 have been edited and microfilmed. An approximation of exposure to TEL would have to be deduced from medical records for these workers. Records in hard copy are available for workers inactivated since 1965. Medical records are complete from the start of the plant in 1952. The only exception is that both personnel and medical records are transferred to the new place of employment when the worker transfer from one Ethyl Corporation facility to another. This is infrequent, unlike within plant job movement.

To resolve any questions concerning the possibility of excess cancer among the workers it will be necessary to reanalyze the company study data and complete follow-up on those people working for at least one year from 1952 to 1958.

Review of the health status of the laboratory workers failed to indicate any specific health problems which could be related to job exposures other than a few injuries and a few chemical exposures, mostly to lead. Subtle relationships would depend on a morbidity-mortality study similar to the one needed to evaluate the multiple myeloma incidence.

IV. RECOMMENDATIONS AND ANTICIPATED FURTHER ACTION

1. To conduct a comprehensive and conclusive epidemiological study on this population, the data should be re-analyzed after a complete follow-up of those workers employed for at least one year, prior to 1958. This would be helpful in determining if there are any other multiple myeloma cases among those exposed to TEL, especially since TEL was the principal product before 1960. Exposure to TEL may be approximated by the notations in the medical records, which indicate job location of the employees at the time of the periodic urine lead test. Because the work histories before 1965 are universally incomplete, the medical records are the only means to document a TEL exposure. This study should also identify other serious health conditions if present.

Project plans for a morbidity/mortality study of the workers at the Ethyl plant during FY 80 by the Industry-Wide Studies Branch, DSHEFS, NIOSH have been approved.

2. The ventilation in the VPC lab should be checked for adequacy during heavy usage.

3. The problem with the fan in the wet lab should have been corrected by this time as it was indicated that parts were on order.

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TABLE I

ETHYL CORPORATION
Houston Plant, Pasadena, Texas
HE 77-45

MORTALITY DATA FROM THE 1977 COMPANY MORTALITY STUDY

Length of Exposure	Minimum of 1 manyear (1-4)		Minimum of 5 manyears (5-9)		Minimum of 10 manyears (10-14)		Minimum of 15 manyears (15-19)		Minimum of 20 manyears (20)		Total Number of Deaths For all Ages	
Disease	Heart Disease	All Cancers	HD	AC	HD	AC	HD	AC	HD	AC	HD	AC
AGE: 35-39	0	0	0	2	0	1	0	0	0	0	0	3
40-44	0	0	0	3	3	0	1	0	0	0	4	3
45-49	0	0	0	1	5	2	2	2	1	1	8	6
50-54	0	0	0	0	1	1	4	2	2	1	7	4
55-59	0	0	0	0	1	1	1	1	3	1	5	3
60-64	0	0	2	0	1	0	1	0	1	0	5	0
65-69	0	0	0	0	0	0	0	1	0	0	0	1
TOTAL	0	0	2	6	11	5	9	6	7	3	29	20

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TABLE II

MORTALITY RATES FOR MULTIPLE MYELOMA (ICD 203) BY RACE AND SEX
FOR THE UNITED STATES 1959-1970 BY 5-YEAR INTERVALS
(RATES/100,000)

	U.S. TOTAL	WHITE		NON-WHITE	
		MALE	FEMALE	MALE	FEMALE
1950	0.8	1.0	0.8	0.8	0.8
1955	1.3	1.4	1.1	1.5	1.0
1960	1.7	1.9	1.5	1.8	1.4
1965	1.7	1.8	1.5	2.1	1.8
1970	2.2	2.2	2.0	3.2	2.1

TABLE III

AGE-ADJUSTED MORTALITY RATES FOR MULTIPLE MYELOMA
FOR THE UNITED STATES
BY RACE AND SEX 1950 and 1967
(RATES /100,000)

	WHITE		NON-WHITE	
	MALE	FEMALE	MALE	FEMALE
1950	0.98	0.75	1.09	0.79
1967	2.17	1.53	3.38	2.39

TABLE IV

MORTALITY RATES FOR MULTIPLE MYELOMA (ICD 203) BY RACE AND SEX
FOR THE STATE OF TEXAS AND HARRIS COUNTY (1969)
(RATES/100,000)

	WHITE		NON-WHITE	
	MALE	FEMALE	MALE	FEMALE
TEXAS	1.65	1.14	2.9	1.77
HARRIS COUNTY	2.0	1.2	3.6	2.6

TABLE V

ETHYL CORPORATION
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DEMOGRAPHIC DATA ON QUALITY CONTROL LABORATORY WORKERS
August 1-3, 1978

	No Health Complaints	Any Health Complaints	Total
Number	8	29	37
Age Avg. (Std. Dev.)	46.1 (9.0)	49.1 (7.8)	48.4 (8.0)
Range	35-56	34-62	34-62
Median	50	49	49
Years with Ethyl Corp.			
Avg. (Std. Dev.)	20.6 (6.1)	20.8 (6.1)	20.7 (6.0)
Range	13-26	12-26	12-26
Median	22.5	26	26
Years in Laboratory			
Avg. (std. Dev.)	3.9 (6.0)	9.2 (7.9)	8.1 (7.7)
Range	2m-15y	2m-26y	2m-26y
0- 4 yrs. % (cum. %)	75 (75)	28 (28)	38 (38)
5- 9 yrs.	0 (75)	31 (59)	24 (62)
10-19 yrs.	25 (100)	28 (86)	27 (89)
20+ yrs.	0 (100)	14 (100)	11 (100)
% of total employment spent in Laboratory			
Avg. (Std. Dev.)	22.2 (35.4)	42.3 (34.9)	38.0 (35.5)
Range	1-80	1-100	1-100
0- 9 % (cum. %)	75 (75)	17 (17)	30 (30)
10-19	0 (75)	17 (34)	14 (43)
20-74	0 (75)	38 (72)	30 (73)
75+	25 (100)	28 (100)	27 (100)
Smoking History (%) Current	38%	38%	38%
ex-Smoker	50%	38%	41%
Never Smoked	12%	24%	22%

Note: Differences are not statistically significant at $\alpha = 0.05$

TABLE VI

ETHYL CORPORATION
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HEALTH COMPLAINTS OF 37 QUALITY CONTROL LABORATORY WORKERS
August 1-3, 1978

1.	No Complaints		8	
2.	Known Chemical Exposures:	Elevated Leads	10	(2)*
		Chemical Burns	1	
		Chlorine Exposure	1	
3.	Respiratory :	Sinusitis	8	(3)
		Other Upper Respiratory Complaints	5	(1)
		Breathing Difficulties	2	
4.	Injuries:	Back	6	
		Other	2	
5.	Cancers and Other Tumors:	Skin	2	
		Colon	1	
		Growth in Month		(1)
6.	Nervous System:	Nervousness	3	(1)
		Tiredness or Depression	3	(1)
		Headaches	2	(1)
		Multiple Sclerosis	1	
7.	Eyes :	Irritation	2	
		Visual Problems	2	
8.	Ears :	Hearing Loss	2	
		Infection (inner ear)		(1)
9.	Cardiovascular:	Heart Attacks	2	
		Hypertension	4	
		Chest Pains and Angina	1	(1)
10.	Gastrointestinal:	All	9	(1)
11.	Urinary Tract :	Kidney Stones	3	
		Other	3	
12.	Arthritis all types		5	
13.	Skin		3	

*Number in parentheses are problems found on record review but not mentioned by worker. These are in addition to number given before the parentheses.