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September 28. 1993

Ms. Laura Shely
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Houston, TX 77002

Certified Mail - RRR
#P-678 730 295

Re: Cause No. A-127,321
Rosie Lee Richard, et al -vs-
The Ethyl Corporation, et al

Dear Laura:

Enclosed for your review please find a report from Hari H. Dayal, Ph.D., F.A.C.E. If you have any questions, please feel free to call me.

Sincerely,

B. Adam Terrell

BAT:twb
Enclosure

cc: Mr. John G. Bissell
STRONG, PIPKIN, NELSON & BISSELL
San Jacinto Building -- 14th Fl.
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Beaumont, TX 77701

VC4471

An Epidemiologic Report for Richard Vs. Ethyl Corp. et al
No. A-127, 321 in the
58th Judicial District
Court of Jefferson County, Texas

Prepared for: Reich & Binstock
Attorneys at Law

By: Hari H. Dayal, Ph.D., F.A.C.E.
Professor

My name is Hari H. Dayal. I am a Professor of Epidemiology and Biostatistics in the Department of Preventive Medicine and Community Health at the University of Texas Medical Branch at Galveston, Texas.

My major research interest is in the area of Environmental Epidemiology. I am a Fellow of the American College of Epidemiology. The opinions expressed here represent my best professional judgment based on available facts. However, these opinions do not reflect the opinions of my employer, the University of Texas Medical Branch at Galveston.

I have reviewed the documents provided to me by the law firm of Reich and Binstock including medical records and personnel files of Mr. Richard, defendant's answers to several plaintiff's interrogatories and request for production of documents, report by Dr. Marcus, a toxicologist, and the report by Mr. Parker, an industrial hygienist. In addition, I have relied extensively on the published papers and reports in the epidemiological, medical, and toxicological literature. I have also relied on the literature on epidemiologic methods, particularly as they apply to exposure assessment in occupational and environmental epidemiology. The final opinion represents a synthesis of all this information.

The facts in this case pertain to Mr. Richard, who in April, 1986, at the age of 58 presented with symptoms of severe abdominal pain, was diagnosed as having adenocarcinoma of the pancreas with liver metastasis, and who died in July, 1986, from the disease. The brief interval between diagnosis and death is consistent with the generally poor prognosis associated with pancreatic cancer. Mr. Richard's relevant social history included smoking one to two packs per day for a total of fifty to sixty pack years and heavy drinking which he quit at some point in time prior to the diagnosis. Previous and concurrent medical conditions included depression, anxiety, hemorrhoids, measles, mumps, rheumatic fever, and pain/tenderness of testicles. Mr. Richard's medical history did not include diabetes mellitus. His father died of brain tumor. His mother had a history of diabetes mellitus.

Mr. Richard's work history shows that he started working at Ethyl Corp. as maintenance laborer in January, 1969. He worked at Ethyl until May, 1986, when, following his diagnosis of pancreatic cancer, he was placed on extended disability. During his seventeen years of work at Ethyl, Mr. Richard worked for most of the time as a machinist. Before joining Ethyl, Mr. Richard worked for sixteen years as a construction laborer.

According to the report of the industrial hygienist, Mr. Parker, the employment records of Mr. Richard do not provide a complete picture of all the places he worked during his employment at Ethyl, nor do they provide a clear picture of all the tasks he performed during his employment. There are also no clear records of all the chemicals to which Mr. Richard was exposed while working at Ethyl. Ethyl's industrial hygiene practices were inadequate in that there was no attempt to quantify Mr.

Richard's exposure level to the many hazardous chemicals present in his work environment. However, based on where Mr. Richard worked and his coworker's deposition, it would appear that he worked in close proximity to a number of hazardous chemicals, including ethylene dichloride, tetraethyl lead (TEL), Ortho-toluidine, and vinyl chloride. Moreover, per Mr. Parker's report, based on established odor thresholds for the chemicals present in Mr. Richard's work environment, it is quite apparent that he was most likely unknowingly exposed to these chemicals at a level well above the OSHA standards.

To sum up, the job title of machinist combined with the evidence of presence of hazardous chemicals in the work environment provide sufficient grounds to impute long term on-the-job chemical exposure to Mr. Richard during his seventeen years of employment at Ethyl. This is not the most direct and quantifiable measure of exposure. However, the information on which to base purely quantitative measure is rarely available in environmental and occupational epidemiologic investigations. In fact, that is why the method of job-occupation matrix is a fairly well-accepted way of determining long-term environmental/occupational exposure to chemicals (for a full discussion, see the recent book, *Principles of Exposure Measurement in Epidemiology*, Armstrong et al, Oxford Medical Publications). Hence, according to acceptable state-of-the-art methodology, Mr. Richard had long-term exposure to hazardous chemicals while working as a machinist for seventeen years at Ethyl.

A review of the literature on pancreatic cancer provides these findings. The epidemiologic literature establishes cigarette smoking and diabetes mellitus as risk factors. Associations with alcohol intake are inconsistent across the literature; a few studies show a positive effect (drinkers having a higher risk), the majority of studies show no effect (drinkers and non-drinkers having the same risk), and, a few studies published in leading journals even show drinkers to have a protective effect (drinkers having a lower risk than non-drinkers). Similarly, the association of pancreatic cancer risk with coffee consumption is inconclusive. Many epidemiologic studies have examined the role of diet in pancreatic cancer, and some have found high consumption of meat to be a risk factor, whereas frequent ingestion of fruits and vegetables appear to afford protection.

The literature on pancreatic cancer also extends to the examination of familial risk factors and exposure to chemicals in occupational settings. On the familial factor, a leading study concluded that pancreatic cancer shows no evidence of clustering with other cancers in the family. The evidence in the literature on chemical exposures and pancreatic cancer risk is derived from both the animal studies and epidemiologic studies. A large number of chemicals have been shown to induce pancreatic tumors in animal models. Several epidemiologic studies, using different study designs, have demonstrated an elevated risk among individuals in certain job/industry categories with potential exposure to hazardous chemicals. One study showed that, after adjustment for smoking and dietary patterns, those with long-term employment in machine repairs or as mechanics had an odds ratio of 2.5 for pancreatic cancer.

Now, let us examine the specifics of Mr. Richard's case in view of the scientific and medical data on pancreatic cancer. His past alcohol intake would not have put him at high risk of developing the disease. He did not have diabetes himself; his mother's diabetes does not appear to be of any relevance. Although his father died of brain cancer, this should not influence Mr. Richard's chances of developing pancreatic cancer as pancreatic cancer shows no evidence of clustering with other cancers in the family.

Mr. Richard's smoking history would put him at risk of developing pancreatic cancer. Mr. Richard's occupational exposure to hazardous chemicals while working as a machinist at Ethyl also put him at high risk for the disease. Whenever multiple risk factors are involved in the causation, the issue of risk enhancement or synergism becomes critically important. The occupational exposure to chemicals at Ethyl not only by itself increased the risk of pancreatic cancer, but also enhanced the risk associated with smoking.

Based on reasonable scientific probability, therefore, it is my opinion that while Mr. Richard's smoking may have contributed to the risk, his prolonged on-the-job exposure to a variety of hazardous chemicals at Ethyl Corp.., as a single risk factor, as well as, a risk enhancer, was a significant factor in the development of his pancreatic cancer.

Respectfully submitted,

Hari H. Dayal, Ph.D., F.A.C.E.
Professor