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The North American Building
121 South Broad Street, Suite 1600
Philadelphia, PA 19107

RE: Eugene Salmieri, et ux. v. Sunoco, Inc., et al.
EPI Project No. 28165
Summary Report

Mr. Biedrzycki:

This summary report has been prepared at your request as a synopsis of my opinions regarding Mr. Salmieri's alleged exposure to benzene contained in Sunoco, ExxonMobil and Texaco's gasoline products while working at various service stations in the Philadelphia, Pennsylvania area from 1971 until 1988. Mr. Salmieri allegedly sold and pumped petroleum products manufactured by your clients, Sunoco, Texaco, ExxonMobil , and others during this time period.[5] According to the Plaintiffs' Amended Third Complaint and Jury Demand, Mr. Salmieri's exposures to gasoline and other benzene-containing products were a cause of his Chronic Lymphocytic Leukemia (CLL) that he was diagnosed with on 13 May 2004. [1]

I have been an industrial hygienist for more than 31 years. Currently, I am President of Environmental Profiles, Inc. in Baltimore, Maryland. Formerly, I was with the National Institute for Occupational Safety and Health and led a group of industrial hygienists conducting research for the National Occupational Exposure Survey. As an industrial hygienist for the United States Coast Guard, I conducted thousands of exposure assessments of a wide range of products, including numerous benzene-containing materials. My responsibilities also included the management of the occupational medical monitoring program for the 5th Coast Guard District. I was President of the Chesapeake Section of the American Industrial Hygiene Association (AIHA) and was a member of the national AIHA Product Health and Safety Committee and the Emergency Response Planning Committee. I have also authored the *Health and Safety Audits Manual*, published by Government Institutes, and the *AIHA Hazard Communication Guide*, published by the AIHA. The American Board of Industrial Hygiene certifies me as an industrial hygienist and the Board of Certified Safety Professionals certifies me as a safety professional.

As a certified industrial hygienist, I rely upon the following basic tools in order to conduct an exposure assessment of personal occupational exposures such as Mr. Salmieri's:

1. a characterization of the workplace environment;
2. a characterization of the job and tasks (including frequency and duration of exposures);
3. a characterization of the products (e.g. volatility, relative toxicity, etc.);

4. a characterization of the relevant safety and health regulations and the associated exposure limits;
5. an appropriate association of tasks, environment, job descriptions and chemical agents with the individual exposures being evaluated; and
6. use of the accepted air sampling and analytical techniques for occupational exposure to benzene.

Plaintiff's Work History

Mr. Salmieri graduated from high school in 1974. Based on Mr. Salmieri's Social Security records, his work history/exposure sheet, and deposition testimony,[1-5] Mr. Salmieri started his employment within the service station industry in 1971, while still in high school. Table 1 summarizes Mr. Salmieri's employment history.

Table 1: Mr. Salmieri's Work History

Dates	Employer	Title/Description	Products Allegedly Associated With His Exposure to Benzene
1971-1972	Sy's Sunoco	Pumped gas; 2-10p 2 days/week	Sunoco, Inc gasoline & diesel fuel, Brakleen, Permatex glues, sealer and gasket sealers, including Permatex adhesives, Form-A-Gasket and High Tack, Safety-Kleen recycled parts washing solvent, 105 Solvent Recycled.
1971-1972	Sy's Exxon	Pumped gas; 2-10p 2 days/week	Exxon/Mobil gasoline & diesel fuel – regular and premium, Brakleen, Permatex glues, sealer and gasket sealers, including Permatex adhesives, Form-A-Gasket and High Tack, Safety-Kleen recycled parts washing solvent, 105 Solvent Recycled.
1971-1974	Lee's Sunoco	Pumped gas; worked 2-10p M-F and 7a-3p on weekends	Sunoco, Inc gasoline & diesel fuel grades 190-260, Brakleen, Permatex glues, sealer and gasket sealers, including Permatex adhesives, Form-A-Gasket and High Tack, Safety-Kleen recycled parts washing solvent, 105 Solvent Recycled.
1974-1975	Nate's Citgo	Mechanic	Citgo Petroleum Corp gasoline & diesel fuel, Brakleen, Permatex glues, sealer and gasket sealers, including Permatex adhesives, Form-A-Gasket and High Tack, Safety-Kleen recycled parts washing solvent, 105 Solvent Recycled.
1977-1982	Frank & Mike's Mobil	Mechanic	Exxon/Mobil gasoline & diesel fuel, Brakleen, Permatex glues, sealer and gasket sealers, including Permatex adhesives, Form-A-Gasket and High Tack, Safety-Kleen recycled parts washing solvent, 105 Solvent Recycled.

Dates	Employer	Title/Description	Products Allegedly Associated With His Exposure to Benzene
1983-1988	Geno's Getty	Owner / Operator; pumped gas, shared mechanical work	Getty/Texaco gasoline, Brakleen until 1985; Non-Chlorinated Brakleen, Permatex glues, sealer and gasket sealers, including Permatex adhesives, Form-A-Gasket and High Tack, Safety-Kleen recycled parts washing solvent, 105 Solvent Recycled.
1988-1993	BP Electric	Electrician	No benzene exposure claimed.
1993-2000	Rihm's Auto and Transmission Repair	Owner; ran the business "paperwork, selling, answering the phone;" transmission cleaner for his mechanic.	Safety-Kleen transmission parts washing solvent, Non-Chlorinated Brakleen, Permatex glues, sealer and gasket sealers, including Permatex adhesives, Form-A-Gasket and High Tack, Safety-Kleen recycled parts washing solvent, 105 Solvent Recycled.
2001-present	Bucks County Water and Sewer Authority	Building Maintenance	No benzene exposure claimed.

While working at Sy's Sunoco, Sy's Exxon and Lee's Sunoco, Mr. Salmieri's duties included "sticking the tanks," which he described stating, "You would take the lids off that were on the ground, unlock the caps, pull the caps off. You had a 12-foot stick. And you would stick it in the tank, pull it up, find the measurement, wipe it off with a rag and move on to the next one." He would stick the tanks twice a day, every day and there was a separate tank for each grade of gasoline. He allegedly did not wear gloves when performing this task and he testified that his face would be just a couple feet from the opening. He reported that in the summer, the vapors were very strong. He stated that he used cream on his hands as his fingers cracked around his nails and noted that "At times of sticking the tanks, burning of the eyes, you could get discolorations in your hands. They would—from the gasoline. They would turn gray." Mr. Salmieri pumped various grades of gasoline at the service stations from 190 to 260 in the forms of regular, leaded, and premium. He also testified that he did not wear gloves while he pumped the gas.

According to Mr. Salmieri, he worked most frequently at Lee's Sunoco in 1971 and most at Sy's Sunoco in 1972. Mr. Salmieri stated that Sunoco and Exxon were the companies that delivered gasoline to these locations. He testified that there was a solvent tank at Lee's that he used solvent from for his personal vehicle. He could not identify the solvent, but stated that it was petroleum-based.

At Sy's Exxon station, he testified that he cleaned the floors with gasoline that was hauled from the pumps in a five-gallon bucket, dumped on the floor and brushed. It was then hosed off with water. This took about 45 minutes to an hour. There were three bays, but only one bucket of gasoline was used and he kept the bay doors open.

While at Nate's Citgo from 1974 to 1975, Mr. Salmieri primarily worked as a mechanic. He worked eight hours a day, six days a week and pumped "very little" gasoline. He stated that Citgo was the company that delivered gasoline to Nate's. Mr. Salmieri performed brake work, rebuilt alternators and starters, and performed general repair duties. He stated that they had a solvent tank and assorted Permatex products. The solvent tank used for parts cleaning, contained Safety-Kleen solvent. The parts Mr. Salmieri testified to cleaning included starter motors, brake parts, valve covers and assorted motor parts. Mr. Salmieri placed the parts in the tank, and then stated "You would turn it on. It had a light. And it had a hose with a brush. And then you scrubbed the parts with it." As to how often this was done, he testified "All day." Mr. Salmieri used solvent out of the machine for cleaning brake backing. When performing that task, he removed some solvent from the machine, put it into a can, and applied the material to the brake backings with a rag. He stated that four hours of his day were spent working on brakes. Mr. Salmieri used High Tack aerosol to stick gaskets. This was used mainly on water and fuel pumps. He would be "maybe a foot" away when he applied the product.

From 1974 to 1983, Mr. Salmieri was a mechanic at Frank & Mike's Mobil. He worked six days a week and pumped gasoline periodically. If it got busy, he stated he would pump gasoline into approximately ten cars per day. Regular, extra and premium were the grades of gasoline that he pumped at this station and he testified that Mobil delivered the gasoline they sold. Mr. Salmieri stated that approximately one or two years before he left Frank & Mike's, they became a self service gasoline station and he no longer pumped gasoline. As a mechanic, he did general repairs including brakes, exhausts and shocks, and performed state inspections. He used High Tack spray on brakes shoes so they would stick to the calipers. He also stated that he used Brakleen and was six to eight inches away from the brakes when he sprayed them with Brakleen. During the application of Brakleen, Mr. Salmieri stated that it burned if it got into his eyes. He used Safety Kleen solvent as part of his job and described it as a 30-gallon drum with a sink on top and a hose. It had a brush, a lid and said "Safety-Kleen" on the machine. He stated that most of the time the parts were put in the machine to be cleaned and he only drew solvent from the machine when needed. He placed small parts in the machine to be cleaned and cleaned the brakes by hand with a brush. He did not wear gloves, goggles or an apron when working with the Safety-Kleen solvent.

In July of 1983, Mr. Salmieri purchased Geno's Getty and was the owner/operator until 1988. He worked from 6am until 5pm or 6pm and he pumped gas as well as helped with the mechanical work. He sold regular and premium gas at this station and would sometimes pump gas for two to three cars at one time. Mr. Salmieri was also responsible for sticking the tanks at Geno's and stated that he experienced "Dry hands. You still had fumes, burning eyes." He did not seek medical attention for either and just used lotion on his hands. Getty Oil, then Texaco delivered gas to this station. With the repair work, Mr. Salmieri stated that they used Brakleen to clean parts. He used solvent for any parts that needed to be cleaned and all brake work. There was a 35-gallon tank of Safety Kleen for cleaning and a 100-gallon tank for transmission

washing. He did not use gloves when working with the Safety Kleen solvent. He stated that he performed brake work at Geno's in the same way as at Frank &Mike's.

From 1988 until 1993, Mr. Salmieri worked as an electrician for BP Electric. He did not claim benzene exposure from this position.

In1993, Mr. Salmieri purchased Rihm's Automotive and Transmission and was the owner/operator until 2000. His duties included "paperwork, selling, answering the phone" and he was the transmission cleaner for his mechanic. He testified that he performed the transmission cleaning "Every day. Seven hours a day." For cleaning he used "S-K. Hot water. Some Two-Plus-Two carburetor cleaner." According to Mr. Salmieri the Two-Plus-Two would sting if it got in his eyes and he did not wear gloves for cleaning. Brakleen was used as well to clean brakes. The transmission cleaner was like a large dishwasher that would run for 30-35 minutes at a time. He opened the door to add or remove parts or to move them. When he did this, a 200°F water and solvent mixture sprayed out. To clean small parts with the Safety Kleen and Two-Plus-Two, he filled a two-pound coffee can with the solvent and used a hard bristle brush to clean parts by hand. Mr. Salmieri testified that he cleaned four to six transmissions and their related parts per day. There was no ventilation near the machine except for the 15 foot by 15 foot door that was opened during good weather. He stated that he had a vacuum machine that helped to remove exhaust fumes from the building. Mr. Salmieri also testified that he used High Tack Spray-A-Gasket during his time at Rihm's more than any other position.

Table 2 outlines Mr. Salmieri's alleged exposure to Exxon, Sunoco and Texaco gasoline.

Table 2 Exposure to Exxon, Sunoco and Texaco Gasoline

Dates	Gasoline Brand	Location	Tasks	Frequency & Duration
1971-1972	Exxon – regular and premium	Sy's Exxon	He pumped gas and stuck the gasoline storage tanks, but did not specify the number of tanks. He cleaned the floors of the garage each night with a five-gallon bucket of gasoline. He put the gasoline on the floor, brushed it around and then hosed it down with water.	Worked two days per week for eight hours per day (2-10pm). The tanks were stuck twice per day, but the duration of the task was not identified. He did this each night he worked for approximately 40-60 minutes.
1977-1982	Mobil	Frank & Mike's Mobil	He primarily worked as a mechanic performing general repairs including brakes, exhausts and shocks, and performed state inspections. He pumped gas when the station was busy. He filled approximately 10 cars per day.	Worked six days per week for eight hours per day (2-10pm).
1971-1972	Sunoco – grade range from 190 to 260	Sy's Sunoco	He pumped gas and stuck the gasoline storage tanks, but did not specify the number of tanks.	Worked two days per week for eight hours per day (2-10pm). The tanks were stuck twice per day, but the duration of the task was not identified.
1971-1974	Sunoco	Lee's Sunoco	He pumped gas and stuck the gasoline storage tanks, but did not specify the number of tanks.	Worked three days per week for eight hours per day (2-10pm during week, 7am-3pm on weekends). The tanks were stuck twice per day, but the duration of the task was not identified.

Dates	Gasoline Brand	Location	Tasks	Frequency & Duration
1983-1988	Texaco – regular and premium gasoline	Geno's Getty	Owner/operator of Geno's Getty. He pumped gas and helped his mechanic.	Worked six days per week for 11 hours per day. He would pump gas into two or three cars at one time throughout the day.

Assessment of Benzene Exposure during the use of Exxon, Sunoco and Texaco Gasoline

Air monitoring for determination of employee exposure is presently the only method accepted by OSHA for evaluating compliance with occupational health standards. However, there was not any personal sampling performed on Mr. Salmieri. Therefore, in order to assess Mr. Salmieri's benzene exposure, I have had to rely upon data available in the published literature.

In 1977, Exxon reported a study of benzene exposure to "driveway salesmen" using their Exxon Parking Garage Station in Houston and the Exxon Car Care Center, Buffalo Speedway in Houston. Charcoal tubes and DuPont constant flow pumps were worn by the station attendants for seven to eight hours per day for three days. Results were reported to be "0.522% benzene in gasoline" and those monitored to be "exposed to only 1/10 of the proposed benzene TWA of 1.0ppm."[9]

Several papers have been published that have examined benzene exposure to gasoline station attendants. Table 3 summarizes these studies for gasoline attendant exposure assessments.

Table 3 Gasoline Station Attendant Exposure Assessment Studies

Study	Benzene Data			Gasoline Data			Comments
	Number	Overall Range (ppm)	Location Mean (ppm)	Number	Overall Range (ppm)	Location Mean (ppm)	
McDermott and Vos (1979)[38] 8-Hour TWA Data	84	<0.01-2.08	0.02-0.24	84	0.42-114.29	3.63-22.30	In the case of the 2.08 ppm TWA concentration, the authors hypothesized that because of the sample constituent make-up, the benzene exposure was unrelated to dispensing gasoline.

Study	Benzene Data			Gasoline Data			Comments
	Number	Overall Range (ppm)	Location Mean (ppm)	Number	Overall Range (ppm)	Location Mean (ppm)	
							The benzene content of Exxon unleaded, regular and premium gasoline ranged from 0.4 to 3.1%. The benzene content of Texaco unleaded, regular and premium gasoline ranged from 0.2 to 3.5%.
McDermott and Vos (1979)[38] STEL (15 minute) Data	8	<0.01-1.21	Not Reported	8	1.81-99.2	Not Reported	The sampling pumps were only operated during gas pumping activities. The benzene content of Exxon unleaded and premium gasoline ranged from 0.4 to 3.1%. The benzene content of Texaco unleaded, regular and premium gasoline ranged from 0.2 to 3.5%.
Halder, et al. (1986)[32]	21	0.0-4.2	0.3[A]	21	0.3-32.5	4.5[A]	Gasoline exposure represented by C6+ hydrocarbons.
Hartle (1993)[33]	97	0.01-0.52	0.03-0.06	Not Assessed	Not Assessed	Not Assessed	Benzene exposures at service stations equipped with vapor recovery systems were equivalent to exposures measured at other stations without vapor recovery systems. Benzene concentrations in gasoline ranged from 0.39% in super unleaded in Cincinnati to 2% in super in Los Angeles.
Nordlinder and Ramnas (1987)[43] 8-Hour TWA Data	>100	Not Reported	0.12-2.10	Not Assessed	Not Assessed	Not Assessed	Gasoline in Sweden contained 4 to 5% benzene, which is much higher than that found in the United States. Comparing the maximum benzene concentrations found by

Study	Benzene Data			Gasoline Data			Comments
	Number	Overall Range (ppm)	Location Mean (ppm)	Number	Overall Range (ppm)	Location Mean (ppm)	
							Hartle (1993) and McDermott and Vos (1979) in bulk gasoline samples (2%) with the maximum Swedish value (5%), the Swedish benzene content in gasoline is a factor of 2.5 greater than the United States. If the benzene content in Swedish gasoline were reduced by a factor of 2.5, the resulting air concentration would also be reduced accordingly. Therefore, extrapolating the Swedish air sampling data to a mechanic population using gasoline with benzene concentrations found in the United States would result in a benzene exposure of approximately 0.8 ppm.
Nordlinder and Ramnas (1987)[43] Task Data (5 to 50 minute samples)	6	0.37-4.32	Not Reported	Not Assessed	Not Assessed	Not Assessed	Task-based samples of tasks consistent with Mr. Salmieri's testimony were below the OSHA 5 ppm STEL. Considering the differences in the benzene content between Sweden and the United States as noted above, air concentrations would be reduced by a factor of 2.5.

Established Occupational Health Guidelines and Regulations for Benzene and Gasoline

Prior to the formation of OSHA[22] and promulgation of its initial regulations in 1971, the American Conference of Governmental Industrial Hygienists (ACGIH) had established a Threshold Limit Value (TLV) for benzene. The TLV "...refers to airborne concentration of chemical substances and represents conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects."[23] Between 1963 and 1976 the benzene TLV was changed from a 25 ppm 8-hour TWA TLV to a 25 ppm ceiling TLV. Since 1976 the TLV has been reduced to 10 ppm as an 8-hour

TWA (1977-1996) and to 0.5 ppm (1997 to the present). The current benzene TLV is recommended to minimize the potential for leukemogenesis.[23]

When OSHA was formed in 1971, it adopted the American National Standards Institute (ANSI) benzene standard of 10 ppm as an 8-hour TWA with a ceiling of 25 ppm. This original standard had an acceptable 50 ppm 10-minute peak concentration. In 1987, OSHA reduced the 8-hour PEL TWA from 10 ppm to 1 ppm and added a STEL of 5 ppm (Federal Register 1987). This standard became effective on 10 December 1987.

There is no OSHA PEL for gasoline; however the ACGIH has developed a gasoline TLV. The first gasoline TLV that was developed during Mr. Salmieri's tenure as a gasoline station attendant and mechanic was in 1982. Since that time the gasoline TLV was 300 ppm as an 8-hour TWA with a STEL of 500 ppm. The current benzene TLV is recommended to minimize the potential for ocular and upper respiratory tract irritation. Table 4 contains a summary of the OSHA PEL and ACGIH TLV for benzene and the ACGIH TLV for gasoline during Mr. Salmieri's tenure as a service station attendant.[22-23]

Table 4: Benzene and Gasoline Occupational Health Standards and Guidelines

Year	OSHA PEL		ACGIH Benzene TLV		ACGIH Gasoline TLV	
	8-Hour TWA	STEL/Ceiling	8-Hour TWA	STEL/Ceiling	8-Hour TWA	STEL/Ceiling
1963	None	None	None	25 ppm ceiling	None	None
1971	10 ppm	25 ppm ceiling	None	25 ppm ceiling	None	None
1976	10 ppm	25 ppm ceiling	10 ppm	None	None	None
1980	10 ppm	25 ppm ceiling	10 ppm	25 ppm STEL	None	None
1982	10 ppm	25 ppm ceiling	10 ppm	25 ppm STEL	300 ppm	500 ppm
1987	1 ppm	5 ppm STEL	10 ppm	None	300 ppm	500 ppm
1997-Present	1 ppm	5 ppm STEL	0.5 ppm	2.5 ppm STEL	300 ppm	500 ppm

Mr. Salmieri was a gasoline station attendant and mechanic from 1971 until 1988. During this time period there were changes made to OSHA's PELs and ACGIH's TLVs for benzene. Based on the air monitoring studies of gasoline station attendants and other information and data referred to above, Mr. Salmieri's long term TWA benzene exposures and short term excursion exposures while working as a gasoline station attendant and mechanic during the time period of 1971 to 1988 would have been significantly lower than the then applicable and contemporary OSHA PELs and ACGIH TLVs.

Product Information and Material Safety Data Sheets

The product at issue in this matter is gasoline. Gasoline is a complex mixture of paraffinic, olefinic, and aromatic hydrocarbons ranging from C_3 to C_{11} compounds and may contain as many as 250 separate hydrocarbons. Overall, the mean benzene content of gasoline is 1% or

less.[23, 46] According to IARC (1989)[35] regarding unleaded gasoline exposures, there is inadequate evidence of the carcinogenicity in humans and limited evidence for the carcinogenicity in experimental animals. Relevant industrial hygiene references cited no association between gasoline exposures and CLL.

The purpose of the OSHA Hazard Communication Standard is to establish uniform requirements for hazard communication in the manufacturing sector for worker health and safety. Under the provisions of the final standard, each employee in the manufacturing industries who is exposed to hazardous chemicals shall receive information about such chemicals through a comprehensive hazard communication program. The standard was designed to ensure that all employers receive the information they need to inform their employees properly of recognized health and safety hazards, and to design and implement employee protection programs. In addition, it provides necessary information to employees, so that they can meaningfully participate in, and support, the protective measures instituted in the workplace.

Since November 1985, chemical manufacturers and importers were required to evaluate the hazards of the chemicals they produce or import, and transmit this information to downstream employers by means of labels on containers and MSDS. In addition, since May 1986, all covered employers were required to provide the information to their employees by means of labels on containers, MSDS, and training.

As discussed in the preamble to the hazard communication standard, "a material safety data sheet is essentially a technical bulletin … which contains information about a hazardous chemical, such as chemical composition, chemical and physical characteristics, health and safety hazards, and precautions for safe handling and use." Although the MSDS serves as the primary means by which detailed hazard information is transmitted to downstream employers and employees, it is only one element of the means by which such hazard information is communicated.

Under the hazard communication standard, gasoline is considered to be a mixture because it is a combination of two or more chemicals that is not the result of a chemical reaction. Furthermore, because gasoline has been tested as a mixture, the hazard communication standard requires manufacturers or importers to use that test data to determine its hazards. Therefore, it is not necessary to include a separate warning for benzene.

Mr. Salmieri testified that none of his employers provided him with information about the potential hazards of gasoline. No one told him what it was composed of nor did he ask. Mr. Salmieri also denied that he was ever provided copies of fuel product MSDSs. He did not try to avoid getting gasoline or solvent on his person and stated that if he had read something that had stated "vapor harmful," he would have changed the way he used it.

Contrary to his testimony, there are several memos from ExxonMobil that state their policies for MSDS dissemination during the period Mr. Salmieri worked with or around their products. In

one such letter dated 29 July 1992, addressed to Mr. James S. Dick, Mr. Michael P. Murray and Mr. Lowell T. Norris, all of the Marketing Technical Services, from Mr. William B. Rawl states "From 1971 to the present, EUSA's product literature has been routinely given to its customers by its sales representatives and/or via mail. This literature has included Handling Petroleum Solvents brochure, Petroleum Solvents brochure, Product Data Sheets, Technigrams, Application Data Sheets and Material Safety Data Sheets."[7-10]

I have reviewed the Exxon MSDSs[10] for regular gasoline (February 1974, June 1976, July 1983), regular unleaded gasoline (February 1974, August 1979, April 1986, March 1987) and Exxon Extra gasoline (August 1979). I have also reviewed Mobil Material Safety Data Bulletins for regular gasoline (1982) as well as "Toxigrams." It should be noted specifically that toxicity of gasoline has been tested as a mixture. The Exxon MSDS incorporated the appropriate information as required by the Hazard Communication standard.

Texaco also sent communications to those affiliated with their products in September 1983 including a letter explaining an animal study, an updated MSDS and a leaflet on gasoline safety and health precautions. They distributed a Hazard Communication Program pamphlet entitled "Gasoline Health and Safety Facts" as well as other pamphlets entitled "Important Information from Texaco about Gasoline" and "Gasoline How to Handle and Utilize Safely." In 13 May 1988 and 6 June 1988 mailed letters from Texaco to its customers; they acknowledge sending an MSDS as well as the fact that they send them to their customers every 24 months. The letters also state that the aforementioned brochures and pamphlets are available upon request and encourage their customers to share the MSDSs and any other information with their employees. From 1983 to 1988, Mr. Salmieri owned and operated Geno's Getty and was supplied gasoline by Texaco. As the owner/operator, he would have received communications from Texaco regarding product warnings and updates.[11-15]

I have reviewed the Texaco MSDSs for regular leaded gasoline (September 1983, March 1984, May 1986, April 1987, April 1988), super leaded gasoline (April 1988), regular unleaded gasoline (September 1983, March 1984, May 1986, November 1987, February 1988, April 1988), super unleaded gasoline (September 1983, March 1984, April 1987, June 1987, April1988), unleaded plus gasoline (April 1987, June 1987, April 1988), unleaded intermediate gasoline (May 1987, June 1987), and premium unleaded gasoline (September 1983, March 1984, April 1987, April 1988). It should be noted specifically that toxicity of gasoline has been tested as a mixture. Therefore, it is not necessary to include a separate warning for benzene. The Texaco MSDS incorporated the appropriate information as required by the Hazard Communication standard.[15]

Employer Responsibility

No information was supplied regarding training that Mr. Salmieri may have received from the various service stations where he was employed. Additionally, no information has been

provided regarding any of the service stations' safety and health programs, policies, or procedures. The only documents that were provided were those that the parent gasoline-supply companies provided to their stations. Since the inception of the Occupational Safety and Health Act (OSHA) in 1970, the duty of an employer under the OSHA regulations is to provide safe and healthful workplaces for their employees. Specifically, these regulations define the employer's responsibility to evaluate and convey the potential hazards associated with a product used by their employees and the measures necessary to protect the employees' safety and health.

During the time that Mr. Salmieri was employed at the various service stations there was readily available knowledge of the gasoline and benzene hazards and there were regulatory programs, policies, and procedures in place at that time. Exxon and Texaco gasoline MSDSs, which specified safe work practices for the product, were available to Mr. Salmieri's employers. Therefore, Mr. Salmieri's employers had the responsibility to convey information provided in the MSDS, provide education regarding the safe work practices with the product, evaluate the potential exposures encountered by their employees, and ultimately were responsible for protecting Mr. Salmieri's health.

At the same time, Mr. Salmieri testified that while he was an employer, he did not provide his employees at Geno's or Rihm's with any formal safety training, did not have MSDSs available or a Right-to-Know station. Mr. Salmieri also had a responsibility to educate his employees regarding the safe work practices with the products they used and to evaluate their potential exposures.

Both OSHA and the National Fire Protection Association (NFPA)[50] have regulations or guidelines regarding the handling of flammable liquids. Based upon its flash point, gasoline is considered a Class I flammable liquid. Specific to service stations, OSHA regulations prohibit the storage of Class I flammable liquids except in closed containers, and also prohibits the dispensing of Class I flammable liquids into a portable container unless the container is constructed of metal, has a tight closure with screwed or spring cover, and is fitted with a spout or so designed so that the contents can be poured without spilling (29 CFR 1910.106(g)). Based on Mr. Salmieri's testimony regarding his use of gasoline as a cleaning solvent in open containers, his employers chose to ignore these regulations. Had the employers required that the employees follow these regulations, it would have further limited their employees' potential benzene exposures.

Plaintiff's Industrial Hygiene Expert: Robert Laumbach MD, MPH, CIH[6]

I have reviewed Dr. Laumbach's 26 May 2008 report. In his report he concluded that "Mr. Salmieri has chronic lymphocytic leukemia caused by his exposure to benzene while working as a gasoline station attendant and as automotive mechanic. His exposure to benzene from gasoline, Safety Kleen parts washing solvent, and Brakleen products were all substantial contributing factors in causing his chronic lymphocytic leukemia." He stated that over his

service station and mechanic work history that Mr. Salmieri's cumulative benzene exposure was 141 ppm-year with 139.4 ppm-years from his use of gasoline. These numbers were obtained by adding the dermal dose and inhalation dose calculations together. Dr. Laumbach calculated Mr. Salmieri's inhalation exposures to benzene as 4.9 ppm-years as a gas station attendant, 1.7 ppm-years from work with Safety Kleen, 0.00017 ppm-years from High Tack Aerosol and 0.0021 ppm-years from Brakleen products. In support of his statements for dermal exposure he relied in part on studies reviewed by Kalna and Teitlbaum (2000)[36] for steady-state flux parameters, Hanke et al. (1961) for an *in vivo* study to get steady-state flux and Susten el al (1985)[48] for hand and skin exposures to benzene during relatively brief periods of dermal contact.

Dr. Laumbach has calculated a cumulative benzene exposure from gasoline and benzene that was estimated using both alleged dermal and inhalation exposures, whereas the OSHA PEL is determined based solely on inhalation exposures to workers in large, statistically powerful human epidemiology studies. Dermal exposures were not ignored in the development of the OSHA benzene standard. Instead, the dermal contributions to exposure were deliberately assessed by those developing the occupational health standard. The worker populations evaluated were known to have had both dermal and inhalation exposures. The level of exposure via inhalation was measured for the worker populations included in the epidemiology studies used in the development of the OSHA benzene standard[29], while the dermal dose estimates required modeling estimates. The dermal component was not added to the inhalation exposure for total exposure because the application of dermal values would have required extrapolation from animal models and the uncertainties that go along with translating data between species.

Dermal modeling of exposure dose is not a standardized or accepted industrial hygiene method for evaluating an individual's exposures to gasoline or benzene for comparison with established occupational health standards such as gasoline or benzene. The degree of uncertainty associated with these models varies widely depending on the values estimated for flux, the use of a dynamic flux value for the specific material being evaluated and other exposure factor estimates as Dr. Laumbach identified in his report. Dr. Laumbach chose to use a steady-state flux parameter of 0.37 mg/cm^2-hour obtained from the Hanke study conducted in 1961 and multiplied it by five to account for Mr. Salmieri's damaged skin. In that study, Hanke et.al. discussed two approaches for determining the absorption of benzene through the skin. One method is the excreted phenol in urine which resulted in an average value of 0.24 mg/cm^2-hour. A second method was to apply pure benzene under a watch crystal and measure directly the amount that was absorbed and what was left in the watch crystal. This approach yielded a flux value of 0.4 mg/cm^2-hour. Both of these approaches applied benzene to the skin with a cover over the top of the application to prevent evaporation. Benzene evaporates readily and under normal dermal contact, the majority of benzene that comes into contact with the skin will evaporate. Additionally, when benzene is in a mixture of other hydrocarbons, such as with gasoline, the other hydrocarbons compete against the benzene for absorption through the skin. Dr. Laumbach did not take that into consideration when looking at absorption of benzene through the skin from gasoline. Therefore

Dr. Laumbach's estimate of dermal exposure to Mr. Salmieri from benzene is of unknown reliability.

Measuring airborne levels of gasoline or benzene in the workplace is the only accepted industrial hygiene method for assessing regulatory compliance or for comparing an individual's cumulative exposures to cumulative inhalation exposures upon which regulatory levels were established. "Although information obtained during a qualitative evaluation or walk-through inspection of a facility is important and always useful, only by measurement can the occupational hygienist document actual levels of chemical or physical agents."[40]

"The acceptability of a workplace is judged by comparing monitoring results with Occupational Exposure Limits (OEL's)."[34] The health guidelines for gasoline and benzene are based on the amounts of the chemical in a volume of air, thus assessment of airborne exposures is the only standard and accepted practice.[29] Sampling and analytical error for air monitoring methods have been determined for each standard air sampling and analytical method. Standard methods for air sampling and analysis are published, readily available, and widely used. There is no standard or accepted method for determination of benzene skin absorption that has an associated error rate.

Using Dr. Laumbach's air sampling data[6], I estimate Mr. Salmieri's cumulative benzene inhalation exposure to be 4.1 ppm-years. This was calculated as 24,050 hours worked as a gas station attendant, assuming that the working year is 1,920 hours and using Dr. Laumbach's grand mean of 0.326 ppm benzene.

Conclusions

Based on the documents and literature I have reviewed I express the following opinions to a reasonable degree of scientific certainty.

- This matter involves the alleged inhalation of gasoline, not benzene. While benzene is a minor component of gasoline, toxicity testing has been conducted on gasoline and diesel fuel. Based on standard industrial hygiene references, occupational exposures to gasoline and diesel fuel are not associated with CLL.

- Mr. Salmieri worked as a gasoline station attendant and mechanic from 1971 until 1988. During this time period there were changes made to OSHA's PELs and ACGIH's TLVs for benzene. Based on the air monitoring studies of gasoline station attendant and other information and data, Mr. Salmieri's long term TWA benzene exposures and short term excursion exposures while working with or around gasoline during the time period of 1971 to 1988 would have been significantly lower than the then applicable and contemporary OSHA PELs and ACGIH TLVs.

- Because gasoline has been tested as a mixture, the hazard communication standard allows manufacturers or importers to use that test data to convey its hazards. Therefore, it is not necessary to include a separate warning for benzene. The Exxon and Texaco MSDSs incorporated the appropriate information as required by the Hazard Communication standard. It was the duty of his employers to provide their employees with this information and the means for understanding the information contained in these documents. As an employer at Geno's Getty, it was Mr. Salmieri's duty to provide his employees with this information as well.

- The modeling of the cumulative dermal dose equivalent in ppm-years by Dr. Laumbach and adding that to the airborne cumulative dose is not a standardized industrial hygiene practice for comparison to occupational health standards such as gasoline or benzene. Dermal contributions to benzene exposure were considered in the development of the OSHA Benzene Standard and the resultant standard recognizes that measuring airborne levels or modeling airborne levels of gasoline or benzene in the air is the only accepted industrial hygiene method for assessing regulatory compliance or for comparing an individual's exposure to a hygienic standard.

In summary, dermal exposure models, as applied here, lack the reliability necessary to calculate historical exposures for a given individual. Dermal exposures are not separately calculated and then added to the inhalation exposure dose by the relevant regulatory authorities or as a matter of standard industrial hygiene practice when measuring and comparing occupational exposures to regulatory and guideline occupational exposure limits. Dermal dose model calculations have no known error rate. There is no standard or validated method for determining flux for solvents in occupational settings. Flux estimates have no known error rate, no known reliability, and no known reproducibility. Therefore, a solvent exposure model based on flux similarly would have an unknown error rate and unknown reliability. No attempt was made by Dr. Laumbach to address the inherent uncertainties in applying dermal exposure calculations.

My opinions are based on my more than 31 years of experience as an industrial hygienist and safety professional. My experience has included health hazard evaluations and audits of multiple operations. My experience has also included the development of exposure assessment strategies, training of employees who worked in numerous industrial operations, my prior work as a member of the AIHA's Product Safety and Health Committee, and my current membership in the Society for Chemical Hazard Communication. I also base my opinion upon portions of the scientific literature focused on hazard communication and occupational health hazard assessment.

For purposes of this report, I have reviewed numerous documents, articles, studies and publications, which include but are not limited to the following:

1. Plaintiffs' Third Amended Complaint and Jury Demand.
2. Deposition of Eugene Salmieri taken 5 January 2007.
3. Deposition of Eugene Salmieri taken 18 February 2008.
4. Eugene Salmieri Social Security records.
5. Product ID and Exposure Periods produced by plaintiff.
6. Expert Report of Robert Laumbach dated 26 May 2008.
7. Exxon Company USA Memo from W.H. Meyer to Mr. R.A. Pierpont, Jr. Headquarters Marketing dated 25 March 1977. Gasoline Vapor Exposure Driveway Salesmen. EMSAL0802.
8. Exxon Corporation. Letter to Dr. Elkins from R.E. Eckardt, M.D. dated 8 March 1976. Re: Benzene Content in Unleaded Gasoline. EMSAL001217.
9. Sherwood, R.J. 4 May 1970. *Exposure to Benzene Vapour During the Handling of Motor Gasoline*. EMSAL0502.
10. Various ExxonMobil Product Material Safety Data Sheets.
11. Texaco, Inc. Letter to Customer from R.T. Richards with updated MSDS and leaflet information dated September 1983. REX-0279.
12. Texaco, Inc. Letter to Customer from R.T. Richards with updated MSDS and leaflet information dated 13 May 1988. REX-0469.
13. Texaco, Inc. Memo on Gasoline Vapor Warning and Timeline dated 1 August 1983. TEX-0602.
14. Texaco, Inc. Memo on Gasoline – Hazard Communication Non-Texaco Employees dated 9 August 1983. TEX-0604.
15. Various Texaco Product Material Safety Data Sheets.
16. Material Safety Data Sheet for High Tack Spray-A-Gasket dated 9 January 2007.
17. Material Safety Data Sheet for Safety-Kleen 105 Solvent Recycled dated 21 October 2005.

18. Material Safety Data Sheet for Brakleen (aerosol) dated 8 January 2007.

19. Material Safety Data Sheet for CRC 5084 Brakleen – Non Chlorinated dated 8 January 2007.

20. Various state and federal occupational safety and health legislation and/or regulations.

21. Various occupational safety and health publications and articles developed by government agencies, professional and trade associations, voluntary consensus standards organizations, and researchers.

22. Williams-Steiger Occupational Safety and Health Act of 1970 (OSHAct), paragraph 4 (b)(1).

23. American Conference of Governmental Industrial Hygienists, Threshold Limit Values, 1946 to present.

24. American Petroleum Institute (API). 1948. *API Toxicological Review, Benzene.* September 1948, American Petroleum Institute.

25. Brief, Richard S., et al. 1980. "Benzene in the Workplace," *American Industrial Hygiene Association Journal.* 41:616-623.

26. Caldwell, D.J., Armstrong, T.W., Barone, N.J., Suder, J.A., Evans, M.J. 2000. "Hydrocarbon Solvent Exposure Data: Compilation and Analysis of the Literature." *American Industrial Hygiene Association Journal.* 61:881-894.

27. Chen, J.D., Wang, J.D., Jang, J.P., Chen, Y.Y. 1991. "Exposure to Mixtures of Solvents Among Paint Workers and Biochemical Alterations of Liver Function." *British Journal of Industrial Medicine.* 48:696-701.

28. Code of Federal Regulations, 29 CFR Part 1910.

29. Federal Register. 34460-34578. Department of Labor, Occupational Safety and Health Administration. 29 CFR Part 1910. Occupational Exposure to Benzene; Final Rule. 11 September 1987.

30. Federal Register. 22516-22529. Department of Labor, Occupational Safety and Health Administration. Occupational Exposure to Benzene; Emergency Temporary Standards; Hearing. 3 May 1977.

31. Ford, D. P., Schwartz, B.S., Powell, S., Nelson T., Keller, L., Sides, S., Agnew, J., Bolla, K., Bleeker, M. 1991. "A Quantitative Approach to the Characterization of

Cumulative and Average Solvent Exposure in Paint Manufacturing Plants." *American Industrial Hygiene Association Journal.* 52: 226-234.

32. Halder, Clive A., et al. 1986. "Gasoline Vapor Exposures. Part I. Characterization of Workplace Exposures," *American Industrial Hygiene Association Journal.* 47:164-172.

33. Hartle, R. 1993. "Exposure to Methyl tert-Butyl Ether and Benzene Among Service Station Attendants and Operators." *Environmental Health Perspectives Supplements.* 101(Suppl. 6):23-

34. Hawkins, Neil C., et al., A Strategy for Occupational Exposure Assessment, American Industrial Hygiene Association, Fairfax, VA 1991.

35. International Agency for Research on Cancer (IARC). 1989. *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Occupational Exposures in Petroleum Refining; Crude Oil and Major Petroleum Fuels.* IARC, Lyone, France.

36. Kalnas, Jonas, and Teitelbaum, Daniel T. 2000. *Dermal Absorption of Benzene: Implications for Work Practices and Regulations.* International Journal of Occupational Health. 6: 114-121.

37. Manufacturing Chemists Association (MCA). 1960. *Chemical Safety data Sheet SD-2, Properties and Essential Information for Safe Handling and Use of Benzene.* MCA: Washington, DC.

38. McDermott, H.J. and Vos, G.A. 1979. "Service Station Attendants' Exposure to Benzene and Gasoline Vapors." *American Industrial Hygiene Association Journal.* 40:315-321.

39. Mulhausen, John R., and Joseph Damiano. 1998. *A Strategy for Assessing and Managing Occupational Exposures.* AIHA, Fairfax, VA, Second Ed.

40. National Institute for Occupational Safety and Health (NIOSH). 1974 and 1976. *Criteria for a Recommended Standard, Benzene.*

41. National Institute for Occupational Safety and Health (NIOSH). 1974 and 1976. *Criteria for a Recommended Standard, Benzene.*

42. NIOSH Manual of Analytic Methods is available at http://www.cdc.gov/niosh/nmam/ and includes validated sampling and analytical methods. OSHA validated sampling and analytical methods are available at http://www.osha.gov/dts/sltc/methods/index.html. Information regarding limit of detection, range, and precision; i.e. sampling and analytical error is provided for validated NIOSH and OSHA methods.

43. Nordlinder, R. and Ramnas, O. 1987. "Exposure to Benzene at Different Work Places in Sweden." *Journal of Occupational Hygiene*. 31:345-355.

44. OSHA Preamble to the Benzene Standard. Federal Register 52(176): September 11, 1987; pp. 34503-34505.

45. The Occupational Environment-Its Evaluation and Control, Edited by Salvatore DiNardi, American Industrial Hygiene Association, Fairfax, VA, 1997.

46. Rappaport, S.M., Selvin, S., Waters, M.A. 1987. "Exposures to Hydrocarbon Components of Gasoline in the Petroleum Industry." *Applied Industrial Hygiene*. 2:148-154.

47. Runion, H.E. 1975. "Benzene in Gasoline." *American Industrial Hygiene Journal*. 37:338-350.

48. Susten, A.S., Dames, B.L., Burg, J.R., Niemeier, R.W. 1985. "Percutaneous Penetration of Benzene in Hairless Mice: An Estimate of Dermal Absorption During Tire-Building Operations." *American Journal of Industrial Medicine*. 7:323-335.

49. Verma, D.K., Johnson, D.M., Shaw, M.L., de Tombe, K. 2001. "Benzene and Total Hydrocarbons Exposure in the Downstream Petroleum Industries," *American Industrial Hygiene Association Journal*. 62:176-194.

50. National Fire Protection Association (NFPA). 1961. *Flammable and Combustible Liquids Code*. NFPA 30.

This report is based on the information available to me at this time. Should additional information become available, I reserve the right to determine the impact, if any, of the new information on my opinions and conclusions, including the opinion and conclusions regarding Mr. Salmieri's benzene exposure, and to revise my opinions and conclusions if necessary.

Sincerely,



John W. Spencer, CIH, CSP
President

JWS/hlb

Attachment 1
Defendant Identification List
(Taken from Plaintiff's Third Amended Petition)

1. Sunoco, Inc. f/k/a Sun Company, Inc. and f/k/a Sun Oil Company, Inc.
2. CRC Industries, Inc.
3. ChevronTexaco Corporation Individually and as the Successor to and through liability for Piercing the Corporate Veil of Texaco, Inc.
4. Texaco, Inc.
5. ExxonMobil Corporation Individually and as the Successor to Exxon Corporation and Mobil Oil Corporation
6. Citgo Petroleum Corporation
7. Safety-Kleen Systems d/b/a Safety-Kleen
8. Safety-Kleen Corp. in its own right and d/b/a Safety-Kleen Systems Inc.
9. Safety-Kleen HoldCo.
10. Henkel Corporation Individually and as Successor to Henkel Loctite Corporation f/k/a Loctite Corporation d/b/a Permatex