tions of the extent of exposures, (4) an inadequate follow-up of annuitants and (5) incomplete occupational histories on individuals diagnosed as having leukemia.

Infante et al. recently reported the results of an ongoing epidemiologic study among workers exposed to benzene during the manufacture of Pliofilm, a process unconfounded with mixed solvent exposures. (51) Although follow-up is less than 75% completed, the results already demonstrate a statistically significant excess of leukemia in benzene exposed workers as compared with the expectations based on the U.S. white male population or on a second population employed at an industry in the same state over the same period of time. Among benzene exposed workers, a five-fold excess of total leukemia and a 10-fold excess of myelomonocytic leukemias were demonstrated even under conditions leading to an underestimate of the true leukemia risk. Those conditions were the treatment and the analyses of individuals whose vital status was unknown—they were assumed to be alive until the last day of the study period. Note was made of the consistency of the types of leukemia in this study population (myelogenous and monocytic) with earlier case reports by Vigliani of workers who had died from benzene related leukemia in Italy.

The wide variety of clinical manifestations and hematological disorders observed in humans exposed to benzene, which range from simple anemia and leukopenia to aplastic anemia have been experimentally induced in animals. However, attempts to demonstrate the development of leukemia in animals exposed to benzene has met with less success. To date, a study by Lignac in 1932 is the only animal study known to OSHA in which leukemia has been observed in animals exposed to benzene. (38) Fifty-four mice (28 females, 26 males) were given subcutaneous injections of benzene (0.001 ml in 0.1 ml of olive oil) for 17 to 21 weeks. Nine mice were initially excluded following bacteriological examination and an additional 12 were lost through atrophy of various organs, especially the spleen. Lignac attributed these deaths to the size of the dose of benzene based upon the findings of a preceding experiment. Eight of the remaining 44 mice developed leukemia or Kundrat's lymphosarcoma and died 4 to 11 months after receiving the first injection. The absence of concurrent controls makes interpretation of the results difficult, and uncertainties as to the strain of the mice studied has frustrated efforts to independently confirm the findings.

More recent studies have failed to produce Lignac's results. Amiel in 1960 utilized four inbred strains of mice and subjected them to the same experimental program outlined in Lignac's study. (39) No leukemic or aplastic hemopathies were observed. More recently, Ward et al. administered benzene subcutaneously to a species and strain of mice which is responsive to leukemogenic agents. (40) Although they observed a slight increase in the percentage of granulocytic leukemias in the benzene-treated mice as compared with the controls, the authors viewed the increase as not statistically significant.

SUMMARY AND EXPLANATION OF THE STANDARD

The requirements of the emergency temporary standard are those which OSHA considers essential and feasible to protect employees from the grave danger resulting from benzene exposure until a permanent standard can be promulgated in accordance with sections 6 (b) and (c) of the Act. The following section discusses the significant provisions of the emergency temporary standard for benzene and the necessity for including these provisions in the ETS.

A. *Scope and application.* The emergency temporary standard applies to all employers and all establishments in which benzene is present, except for two general groups. The ETS does not apply to retail automotive service stations. It's estimated that there are presently more than 200,000 such service stations in the country. Further, the limited evidence presently available suggests that employee exposures during gas dispensing operations are generally below 1 ppm. In light of these facts, and the relatively short duration of the ETS, it has been determined that exclusion of such service stations from the ETS would be appropriate.

Similarly, the ETS does not cover exposure to liquids containing benzene in amounts of 1 percent or less by volume, or benzene vapor released by these liquids. Benzene is a contaminant as well as an additive in a multitude of industrial substances. OSHA estimates that some 60,000 facilities with over 400,000 employees are engaged in industrial operations utilizing liquid mixtures containing 1 percent or less benzene by volume.

Also based on the presently available evidence in the Arthur D. Little study the exposure of employee working with these mixture is generally less than 1 ppm on an 8 hour average. In view of the foregoing, the ETS excludes users of these mixtures from its coverage.

However, during the proceedings on the proposed permanent standard, it is OSHA's intention to consider the appropriate scope and application of its permanent standards to protect workers from the leukemia hazard of benzene exposure.

Meanwhile, the existing standard in § 1910.1000 which governs benzene exposure will continue to apply to retail automotive service stations and to operations which use liquids containing one percent or less benzene.

Thus, these employers must continue to limit their employees' exposures to benzene to the 10 ppm permissible exposure limit, 25 ppm limit ceiling and 50 ppm excursion limit of that section.

The emergency temporary standard is applicable to "general industry," construction and maritime.

B. *Permissible exposure limit.* The standard has separate permissible limits for airborne exposure and for eye and dermal exposures.

(1) *Airborne exposure limits.* Considerable scientific opinion supports the regulatory policy for carcinogens that no safe level exists for any exposed population. For example, the National Cancer Institute's Ad Hoc Committee on the Evaluation of Low Levels of Environmental Chemical Carcinogens (1970) stated:

> No level of exposure to a chemical carcinogen should be considered toxicologically insignificant for man. For carcinogenic agents, a "safe level for man" cannot be established by application of our present knowledge. (NCI, 1970, p. 1).

Furthermore, NIOSH has stated that, "it is not possible at the present time to establish an exposure level at which benzene may be regarded to be without danger," a position which it has consistently taken with regard to other carcinogens.

This regulatory policy is consistent with previous OSHA actions to control employee exposure to carcinogens; see, e.g. the preambles to the carcinogen standards, 29 CFR 1910.1003 et seq. (39 FR 3758); the vinyl chloride standard, 29 CFR 1910.1017 (39 FR 35892) and the coke oven emissions standard, 29 CFR 1910.1029 (41 FR 46742). Thus, the level of 1 ppm has been chosen, not as a "safe" or "no effect" level, but on the basis of OSHA's belief, for the reasons set forth in the technical feasibility and economic impact study prepared for OSHA by Arthur D. Little Co., that 1 ppm is the lowest level that generally can be achieved at this time.

(2) *Ceiling limit.* In addition to limiting 8-hour time weighted average exposures to 1 ppm, the emergency standard requires that no employee be exposed to benzene in excess of 5 ppm averaged over any 15-minute period. An employee may be exposed to varying concentrations of benzene during the course of the workday with some periods of exposure above 1 ppm and corresponding periods below 1 ppm. OSHA has determined that the peak excursions permitted under the present standard are not appropriate in regulating exposure to benzene—a human leukemia hazard for which no safe level can be determined. For this reason, the 15-minute ceiling limit of 5 ppm is established to limit the magnitude of brief excursions which might otherwise occur even where the 8-hour time weighted average was not exceeded.

(3) *Dermal and eye exposure limits.* The standard prohibits eye and repeated or prolonged skin exposure to liquid benzene. While studies indicate benzene is not readily absorbed through intact skin, direct contact with liquid benzene can cause blistering and breakage of the skin surface. (46), (47) Under these circumstances, or where the skin is otherwise broken, prolonged or repeated skin contact may result in significant absorption of benzene. In addition, benzene absorp-