NIOSH Comments

COMMENTS OF THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH ON THE COAST GUARD NOTICE OF PROPOSED RULEMAKING ON BENZENE

46 CFR Parts 30, 151, 153, and 197
Docket No. CGD 88-040

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health

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INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) appreciates the opportunity to comment on the Coast Guard's proposed rule on Benzene [46 CFR Parts 30, 151, 153, and 157] as published in the Federal Register on Monday, January 29, 1990 [55 FR 2978]. NIOSH supports the Coast Guard in developing a proposed rule to revise the special carriage requirements for benzene and benzene mixtures and in adding new regulations concerning occupational exposure to benzene on Coast Guard inspected vessels.

EXPOSURE LEVEL

The Coast Guard is amending its regulations to incorporate the lower benzene exposure limits adopted by the Occupational Safety and Health Administration (OSHA) to provide workers in the marine industry with the same protection as their land-based counterparts. The Coast Guard is proposing to adopt the OSHA permissible exposure limit (PEL) of 1 part of benzene per million (ppm) parts of air for an eight-hour time-weighted average (TWA), and a short-term exposure limit (STEL) of 5 ppm averaged over a 15-minute period. The OSHA standard and the Coast Guard proposed rule also include an action level of 0.5 ppm.

NIOSH previously submitted comments [NIOSH 1986a] to OSHA in March 1986 and testified on March 20, 1986 on the OSHA rule [NIOSH 1986b]. NIOSH continues to advocate the positions presented in the comments and testimony at that time. NIOSH stated in the testimony:

> "The data on benzene leave no doubt regarding the human carcinogenic potential of this chemical. NIOSH recommends that occupational exposure to benzene be controlled so that no worker is exposed to more than 0.1 ppm as an 8-hour time-weighted average (TWA) and that short-term exposure be controlled so as not to exceed 1 ppm as determined in any 15-minute sampling period".

The NIOSH testimony presented data on pharmacokinetics, evidence of cytotoxicity, results from long-term exposures, results from short-term exposures and the role of skin absorption to the overall exposure to benzene.

NIOSH concluded that:

> "...pharmacokinetic data, the evidence of cytotoxicity, and the results of recent epidemiologic studies of workers exposed to benzene by inhalation provide a consistent basis upon which to predicate a recommendation for a new PEL for benzene.

While the OSHA (proposed) standard of 1 ppm does in fact 'substantially reduce the risk of leukemia,' NIOSH believes that the 5-16 deaths per 1,000 workers that would be expected based on the OSHA estimate is far greater than warranted. Therefore, NIOSH recommends that the PEL for benzene be reduced to 0.1 ppm as an 8-hour TWA and that there be a limit on short-term exposures of 1.0 ppm as determined in any 15-minute sampling period."

NIOSH is submitting the following data that were used as a basis for the NIOSH recommended 0.1 ppm TWA:

1. The single exposure described in the Chemical Industry Institute of Toxicology [Erexson et al. 1986] study accurately defines the shape of the dose response curves for these cytogenetic endpoints and indicates that a 6-hour exposure to concentrations of approximately 1 ppm breathing zone benzene and above can induce measurable cytogenetic effects in rodents.

2. The results of the modeling conducted by Rinsky et al. [1987] "indicate that an exponential decrease in risk of death from leukemia would be achieved by lowering of occupational exposure to benzene. Thus, according to the model derived in the present study, a worker exposed to benzene at an average exposure of 10 ppm daily at work for 40 years would have an increased risk of dying from leukemia, an odds ratio (OR) of 221.4 with a confidence interval (CI) equal to 4.8 to 9897. If the average daily exposure were lowered to 1 ppm, the risk would decrease to (OR = 1.7, C.I. = 1.2 to 2.5). At 0.1 ppm, the risk would nearly be indistinguishable from background (OR = 1.06, C.I. = 1.02 to 1.10)."

3. Using the Crump and Allen [1984] risk assessment which examined not only the Rinsky cohort but also the cohort of Askoy and Dow, OSHA has determined that at 1 ppm as an 8-hour TWA there will be 5-16 excess deaths from leukemia due to exposure per 1,000 exposed workers. Therefore, to arrive at 1 excess per 1,000 workers exposed to benzene, an exposure of 0.2 ppm as an 8-hour TWA would be required.

The pharmacokinetic data [Parke and Williams 1953], the data reported by CIIT and data reported by Wong [1986] provide a basis for the recommendation for a limit of 1.0 ppm on short-term exposures. The pharmacokinetic data demonstrate the persistence of benzene in the body following its inhalation. The CIIT animal data demonstrated the ability of single benzene exposures of 3 ppm to induce cytotoxicity and the study by Wong [1986] demonstrated the ability of intermittent exposures to peak benzene concentrations of 25 ppm and less to cause leukemia.

CHEMICAL PROTECTIVE CLOTHING [Section 197.555]

The recommended exposure limits presented by NIOSH at the hearing and the OSHA standard are designed to protect against the effects of inhaled benzene; they do not account for the possibility of skin absorption. The data of Susten et al. [1985] clearly demonstrated that significant benzene absorption can take place in workers handling petroleum distillate that contains 0.5% benzene. Airborne exposure limits such as the NIOSH REL or OSHA PEL are not protective against potential skin absorption. Therefore, when there is potential for skin absorption, personal protective equipment and clothing that is chemically resistant to benzene must be provided to ensure the adequacy of the standard.

The proposed rule [197.555] indicates that "employees must be provided with coveralls or a large apron, boots, gloves, and, if necessary, tight-fitting eye goggles to limit dermal exposure to, and prevent eye contact with, liquid benzene." NIOSH recommends that for coveralls, gloves, aprons, etc. requirements be set forth to ensure that the proper type of chemical protective clothing (CPC) is specified. Provision should be made to specify CPC that will be appropriate for handling benzene in terms of permeation, penetration or degradation of the material used in coveralls, aprons or gloves. CPC made from polyvinyl alcohol, Teflon®, Viton®, and polyethylene/ethylene vinyl alcohol have been shown to provide good chemical resistance (breakthrough times greater than 4 hours) to benzene permeation [Forsberg et al. 1989].

RESPIRATORY PROTECTION [Section 197.550]

The Coast Guard proposes to base their selection of respirators solely upon their assigned protection factors (APF) [NIOSH 1987a]. Included in the proposed selections are certain air-purifying respirators (APR) with APFs ranging from 10 or 50. NIOSH recommends that APRs should not be used for protection against known carcinogens. NIOSH policy states:

> "Regardless of the selected exposure limit for a carcinogen, the best engineering controls and work practices should be instituted. Respirators should not be used as a substitute for proper control measures. When respiratory protection is required to achieve the lowest exposure concentration, then only the most effective respirators should be used. Two types of respirators are recommended: a full-facepiece SCBA operated in a pressure-demand or other positive pressure mode or a full- facepiece supplied-air respirator (SAR) operated in a pressure-demand or other positive pressure mode in combination with a SCBA operated in a pressure demand or other positive pressure mode. The practicality of each situation must be assessed to determine the most technically feasible protection for the worker." [NIOSH 1987a]

Even if benzene were not an acknowledged carcinogen, benzene does not possess adequate warning properties to allow the use of APR [NIOSH 1987b] as proposed by the Coast Guard [55 FR 2895]. Two cases of inadequate respiratory protection against benzene are cited by Vollbrecht [1972]. In each case, the cartridges were completely saturated with benzene. One of the exposed workers died. The author concluded that olfactory detection of benzene penetration is unreliable.

The Coast Guard is directed to the NIOSH Respirator Decision Logic [NIOSH 1987b] and the NIOSH Guide to Industrial Respiratory Protection [NIOSH 1987a] for guidance in designing and implementing a respirator selection and use program. NIOSH also suggests that the Coast Guard consider adopting OSHA's respirator use regulations [29 CFR 1910.134].

ENVIRONMENTAL MONITORING [Section 197.540]

Environmental Surveillance

Initial exposure monitoring is to be conducted within 60 days of the effective date of the final rule, or when benzene is first loaded as cargo, unless comparable monitoring has been conducted within a year [55 FR 2985]. Periodic monitoring intervals would be set by the Coast Guard at one year [55 FR 2985]. Additional monitoring is required for changes in procedures, equipment or work practices that may change personal exposure.

Unless additional monitoring is required, the proposed rule would require only annual monitoring of worker exposure to benzene. NIOSH questions the ability of annual monitoring to adequately assess the exposure of high-risk workers. For more than 40 years, it has been recognized that removal from further exposure may prevent toxic sequela [Savilahti 1956; Hamilton 1985]. With the advent of passive monitoring devices for benzene, a relatively inexpensive method for personal monitoring is available that does not necessarily require the presence of a technically trained person during sampling [Twisk and Urbanus 1987]. These devices are sufficiently accurate and precise to fully meet the $\pm$25% criteria specified by the Coast Guard in 55 FR 2985 [Fung and Wright 1986]. Other devices, such as a thermally desorbable miniature passive dosimeter [Gonzalez and Levine 1986] or possibly a direct-reading passive detector tube, may be available shortly. Therefore, there is no technical reason to limit environmental monitoring to a single full period sample on an annual basis.

In Section (a)(5), the term "normally high" in the following statement must be defined: "If the benzene level is normally high for the operation, monitoring must be conducted under those adverse weather conditions typically encountered for the operation, such as low wind, stable air, or high temperature." Monitoring should be accomplished under worse case scenarios. Paragraph (c) requires that the exposure

monitoring be repeated in July or August; thus, the Coast Guard did attempt to sample under one of the three adverse environmental conditions indicated above.

MEDICAL SURVEILLANCE [Section 197.560]

NIOSH does not consider leukemia to be a screenable health effect. However, other benzene effects on bone marrow (e.g., hypoproliferative anemia, leukocytosis, leukopenia, and aplastic anemia) can be detected early by available medical tests.

While reversible bone marrow toxicity would not be expected to occur at or near the proposed action level, the screening tests proposed by the Coast Guard are appropriate to screen for these effects.

PROGRAMS TO REDUCE PERSONAL EXPOSURE [Section 197.545]

Section (b)(1) suggests that an engineering control, such as a vapor recovery system, is only necessary when personal exposures exceed the PEL. Some facilities and vessels are currently equipped with vapor recovery systems. This system eliminates the potential for personal exposure from a venting tank during loading operation. One should note that the cargo tank vents on barges without a vapor recovery system are normally located within 10 feet of the tank gauging tubes. The chemical vapor plume emanating from the cargo tank vent, during the loading process, may envelope the worker gauging the cargo level [Trainor et al., 1986]. To prevent such an exposure, a vapor recovery system should be used whenever loading a tank with benzene.

GAUGING SYSTEMS [Section 151.05-1]

This section recommends a "closed" gauging device as defined by § 151.15-10(C). Though potential for vapor exposure using "restricted" gauging appears to be limited, workers generally use stainless sounding tape to manually measure the cargo level. In most cases, inhalation and dermal exposure can be expected using this method of gauging. Closed gauging, as the name implies, maintains complete integrity of cargo containment. Southwest Research Institute completed a study for the Coast Guard in 1985 titled "A Crew Exposure Study - Phase II Volume III - At Sea, Part A" [NTIS #AD A155 233]. Sampling results during the tank topoff procedure using restricted gauging indicated that two of nine workers were exposed to levels between the action level and the PEL, one of nine between the PEL and the STEL, and one of the nine greater than the STEL. Because 4 of 9 exposures were above the NIOSH REL of 0.1 ppm,

engineering controls such as closed gauging should be employed. Implementation of closed gauging will eliminate any exposure due to inhalation or skin absorption directly associated with the cargo gauging system.

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15. Supplementary Notes

16. Abstract (Limit: 200 words) This testimony concerns the support of NIOSH for the proposed rule to revise the special carriage requirements for benzene (71432) and benzene mixtures and in adding new regulations concerning occupational exposure to benzene on Coast Guard inspected vessels. The recommended exposure limits presented by NIOSH at the hearing and the OSHA standard are designed to protect against the effects of inhaled benzene and do not account for the possibility of skin absorption. The proposed rule delineates the use of chemical protective clothing including coveralls or a large apron, boots, gloves and tight fitting eye goggles to limit dermal exposure to and prevent eye contact with liquid benzene. NIOSH suggests that the Coast Guard refer to the NIOSH guide for selection of appropriate respirators and consider adopting OSHA's respirator use regulations. The requirements for environmental monitoring, environmental surveillance, and medical surveillance are described. Programs to reduce personal exposure and the recommended gauging systems are discussed.

17. Document Analysis a. Descriptors

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