U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 74 - 106 - 223

McGraw Edison Company
Canonsburg, Pa.

SEPTEMBER 1975

I TOXICITY DETERMINATION

It has been determined that employee exposure to oil mist and additives in the test area of the transformer assembly buildings were not toxic under conditions noted during the evaluation of the work place on November 19 and 20, 1974. This determination was based on analysis of air samples, results of non-directed worker interviews, observation of work practices and personal communications with the transformer oil refining company.(1) Detailed information concerning environmental results are contained in the body of the report.

II DISTRIBUTION OF AVAILABILITY

Copies of this hazard evaluation determination are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

a) McGraw Edison Company
b) Authorized Representative of Employees
c) U. S. Dept. of Labor - Region III
d) NIOSH - Region III

For the purpose of informing approximately 96 employees, this report shall be posted in a prominent place readily accessible to workers for a period of at least 30 days.

III INTRODUCTION

Section 20(a) (6) of the Occupational Safety and Health Act of 1970, 29 U.S. Code 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 received such a request from an authorized representative of employees to evaluate the hazard associated with mineral oil and oil additives as used in high voltage transformers.

IV HEALTH HAZARD EVALUATION

A. Plant Process

McGraw Edison, Power Systems Division, fabricates, assembles, tests and repairs electrical transformers and switchgears. The request submitted by test operators concerned exposure to "oil mist" during duplication of various field operation conditions. Three operations were of primary concern. The first involved the changing of solid copper bar connectors ("straps") which by placement determine the mode of operation (output) of the transformer. The second concerned the entry of testers into transformers to connect high and low voltage bushings, while the third involved the operation of vacuum pumps and the discharge of oil mist from the same.

The mineral oil used in these operations is supplied to McGraw Edison by Texaco and is a Gulf Coast B-1 grade. The oil has a neutral ph and contains between ten and sixteen percent aromatic hydrocarbons. At times limited amounts of 2,6 ditertiary butyl-4-methyl phenol(DBPC) is used as an anti-oxidant to prevent deterioration of the oil.

B. Evaluation Design

The initial survey at McGraw Edison, Power Systems Division was conducted by Wesley Straub, industrial hygienist, and Robert Rostand, M.D. of the National Institute for Occupational Safety and Health on November 19 and 20, 1974. The areas designated in the request were observed with employer and employee representatives. Due to the diverse nature of the operations at this plant, it was decided to interview those workers involved in the transformer testing operations as a representative group of workers. Employee interviews were conducted in a non-directed manner. Limited cutaneous examinations as well as an examination of mucous membranes of the eyes, nose, and throat were conducted. Employees considered to be at greatest risk were monitored for oil mist particulates using personal and area sampling methods. Air samples were collected on cellulose membranes and were analyzed photofluoroscopically for oil mist particulate.(2) No samples were collected for oil vapor at the time of the visit. To obtain a simulated work exposure to oil vapor during entry into a confined space, bulk samples of oil, obtained from the plant, were heated in the laboratory to 90° to 100° F, and air samples of the vapor phase collected on activated charcoal. The air samples were subsequently analyzed for "oil vapor," toluene, and xylene by gas chromatography.(3) The limit of sensitivity for photofluorometric technique used is 0.003 milligrams (mg) while

the sensitivity of the chromatographic technique is 0.2 milligrams for oil vapor and 0.01 milligrams for toluene and xylene.

Air samples for DBPC were not collected due to the infrequent use and limited exposure.

C. Evaluation Criteria

1. Environmental Standards

a) Oil Mist Vapor

The occupational health standards, established by the American Conference of Governmental Industrial Hygienists (ACGIH), of 5 mg/m^3 was recommended as an index of good industrial practice rather than prevention of injury.(4) The Occupational Safety and Health Administration(OSHA) by publication is the Federal Register (Vol. 36, No. 150, May 29, 1974) incorporated this index as the official federal standard for oil mist in industrial air.

The 1974 Threshold Limit Values List published by the ACGIH also includes an entry for "oil mist vapor." In general, the aromatic hydrocarbons content will determine what limit applies and is derived according to the following equation:

$$\frac{1}{\frac{f_a}{TLV_a} + \frac{f_b \ldots f_n}{TLV_b \; TLV_n}}$$

Where "f" is the composition of solvent (percentage weight) and "TLV" is the corresponding threshold limit value.

b) 2,6 ditertiary butyl-4-methyl phenol DBPC)

No threshold limit value has been established for DBPC. The ACGIH has, however, listed in the 1975 Notice of Intended Changes,(5) a proposed limit of 10 mg/m^3 (listed under the synonym of 2,6 ditert-butyl cresol) which is also the limit for a nuisance particulate.

2. Biological Effects

a) Oil Mist Vapor

The primary effects of mineral and hydraulic oil are upon the skin and dermatitis remains a common problem among workers coming in contact with such oil. Oil acne and folliculitis results from mechanical blockage of the follicular openings in skin contact areas. This results in comedones(blackheads) and papular lesions (pimples or white heads) associated with varying degrees of inflamation. In occasional cases, secondary infection in the primary

lesions of oil folliculitis have been observed and in such cases the patient's own skin or nose is the source of the offending agent.

Reports of experimental findings do not indicate even minor changes in the lung when animals are exposed to air concentrations of 5 mg/m^3.(6) The role of additives and oil from partial heat-decomposition have yet to be completely evaluated experimentally. The few experimental findings that do exist indicate that heat-decomposition oil fumes are irritant instead of protective.(7) The inhalation of extremely high levels of oil mist can result in lipid pnemonia,(8) but this remains an uncommon problem.

b) 2,6 ditertiary butyl-4-methyl phenol (DBPC)

From the results of chronic toxicity studies using animals, it was concluded that DBPC is a relatively innocuous compound.(9) There are no reports of occupational dermatitis related to the use of this compound.

D. Results and Discussion

1. Medical

A total of fifty-eight (58) workers representing 60% of the electrical testers were interviewed and examined. Of these, nine had exzematous hand dermatitis which in the majority of cases were mild. Two individuals had non-occupational dermatitis and were under a physician's care or using medication to control the problem. A large number of individuals reported skin problems in the past. The fact that no cases of oil acne were discovered and that the most common skin problem was of an exzematous nature suggests the men may be cleaning their hands and arms with an oil solvent and/or the soap may be inappropriate. Complaints about emissions from the vacuum pump operation, from the curing ovens and the freshly cured transformer were frequent. Twenty-six men noted transient symptoms in the past which they related to these emissions. On the day of the NIOSH visit which was a "usual" work day, only two men who worked inside a transformer noted any symptoms of irritation. The frequent complaints about emissions might possibly be evidence of mild irritation.

2. Environmental

Samples collected during removal of transformers from curing ovens showed no detectable levels of oil mist. Although ovens appeared to be leaking around the door seals, smoke tube measurements indicated that internal ventilation systems were operating satisfactorly and maintaining the ovens under a negative pressure. All other employee exposures evaluated during environmental sampling for oil mist were minimal ranging from 0.4 mg/m^3 during strap changing operations on top of the transformer to 1.4 mg/m^3 while attending

a vacuum pump. Samples collected under conditions simulating those present during entry into large transformers resulted in values ranging from 62 milligrams (mg) to 436 mg per sample. Weights were converted to parts-per-million using an average molecular weight of two-hundred-eighty-five (285)[1] and concentrations ranged from 5 to 38 parts-per-million(ppm) of total oil vapor. Detailed information regarding composition of the transformer oil was not available. Personal communication with the producer of the transformer oil indicated that neither benzene nor chlorinated compounds were present in the oil. Subsequently, the samples were analyzed for xylene and toluene, to obtain an indication of aromatic content, and concentrations were less than one ppm.

E. Recommendations.

From this information it is felt that exposure to oil mist, particulates and vapor during vacuum pump operation, strap changing, and entry into transformers to perform bushing connection should not under normal conditions represent a health hazard. This does not rule out transient peaks in concentration of oil mist and vapors under present operating conditions which could result in the development of mild irritations especially during entry into transformers. In an effort to reduce irritation during entry into transformers, it is recommended that a confined space entry procedure be established. While maintaining exposures at a minimum under normal working conditions, this program will also provide added protection to workers against accidental excessive exposures. A typical program should contain as a minimum:[10]

1) Stand-by worker stationed outside the confined space to summon help and provide assistance during an emergency.

2) Stand-by emergency equipment such as self-contained breathing apparatus or an air line respirator (equipped with protected air line and emergency escape air supply).

3) Use of a safety line and harness.

4) Utilization of either mechanically induced dilution ventilation along with an air sampling program or:

5) Personal respiratory protective equipment such as an air line respirator or self-contained breathing apparatus.

In an effort to reduce dermatological problems it is recommended that:

1) Soft impermeable rubber gloves which are thin enough to preserve manual dexterity be provided to men who come in close contact with oil of any type. The use of barrier creams is not

a substitute for the use of gloves.

2) An emollient-type skin cleaner such as PLY® or SBS-300® may also help in controlling occupational dermatitis. (The use of trade names does not constitute an endorsement of such products by the U.S. Public Health Service.)

V REFERENCES

1) Personal Correspondence, R. Savoit, Texaco Corp., NY, NY

2) NIOSH, Manual of Analytical Methods, HEW Publications No. (NIOSH) 75-121 P&CAM #159

3) Ibid, P&CAM # 127

4) Documentation of Threshold Limit Values, third ed., 1971, American Conference of Governmental Industrial Hygienists, pp. 191-2

5) Notice of Intended Changes, American Conference of Governmental Industrial Hygienists, Vol. 19, No. 3, Jan-Feb, 1975

6) Wagner, W.D., Wright, P.G. and Stokinger, H.E.,: Inhalation Toxicology of Oil Mist, Chronic Effects of White Mineral Oil, Am. Ind. Hyg. Assoc. Journal 1 25:158 (1964)

7) Wagner, W.D., Dobrogorski, O.J., Stokinger, H.E.: Arch, Env. Health 2 523 (1961)

8) Weissman, H., Lipid Pneumonia: Report of Two Cases, Am. Rev. Tuberculosis, 64:572 (1951)

9) Deichman, W.B., et al, AMA Arch Ind. Health, 11:93 (1955) quoted in Patty, Industrial Hygiene and Toxicology, Vol. II, P. 1408

10) Commonwealth of Pennsylvania, Title 25, Rules and Regulations, Part 1, Subpart D, Article IV, Chap. 201.31, Sept. 28, 1971

VI AUTHORSHIP

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TABLE 1
AIR CONCENTRATIONS
MCGRAW EDISON, POWER SYSTEMS DIVISION
CANONSBURG, PENNSYLVANIA
REPORT 74 - 106
November 20, 1974

Location	Operation	Sample Time (hours)	Oil Mist[1] (mg/m^3)[5]	Oil Mist Vapor, Total[2] (ppm)[6]	Xylene[3]	Toluene[4]	Remarks	Exposure (hours)
Bldg 25 S	Strap Transfer (extern.)	1.3	0.4				Operator's exposure	1.3
Bldg 47	Bushing Connection	1.25	0.5				Operator's exposure	1.25
Bldg 47	Tending Ovens	0.5	N.D.[7]				Operator's breathing zone removing transformer from oven	1.0
Bldg 47	Tending Vacuum Pump	0.75	1.4				Operator's exposure	1.5
		0.75	N.D.				General air west of vacuum pump	1.5
							General air work table north of vacuum	
							General air, by exhaust of vacuum pump	
	Entry into transformer	0.1		5	N.D	N.D.	Simulated operator's exposure	
		0.1		25	N.D	N.D.		
		0.25		23	N.D.	N.D.		1.25
		.5		38	N.D.	N.D.		

Threshold Limit Value Based On A Time Weighted Average For An 8-hour Day

(1) Oil mist, particulate $5mg/m^3$

(2) Oil mist, Vapor Calculated from the formula $\frac{C_1}{T_1} + \frac{C_2}{T_2} .. \frac{C_n}{T_n}$

(3) Xylene 100 ppm

(4) Toluene 100 ppm

(5) mg/m^3 milligrams of particulate per cubic meter of air

(6) ppm parts of vapor or gas per million parts of air

(7) N.D. denotes none detected