U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 76-94-406

WESTINGHOUSE ELECTRIC CORPORATION
LARGE POWER TRANSFORMER DIVISION
MUNCIE, INDIANA 47302

July 1977

I. TOXICITY DETERMINATION

The following determinations have been made based upon environmental air samples collected on January 19-20, 1977, medical evaluations including confidential employee interviews, and available toxicity information:

A. Employees' exposure to airborne total nuisance particulates, oil mists, and organic vapors (ethyl alcohol, benzene, xylene, aliphatic solvent "140 flash", tert-butyl alcohol, methyl isobutyl ketone, and toluene) did not pose a health hazard at the concentrations measured at the time of this evaluation.

B. The majority of employees gave a history of apparent skin dermatitis with the route of exposure being direct contact with the oil which is adherent to surfaces of the transformer as it is assembled. Two major sources of direct contact with the oil occur when employees enter the transformer and large vats for various operations. The description by the employees was of typical lesions consistent with mineral oil dermatitis (oil acne and folliculitis). While there was some exposure to organic solvents, few workers complained of symptoms of irritation around these operations.

C. Workers who are exposed by direct contact with transformer mineral oil may develop a certain degree of oil acne. This problem may be a result of contact with the oil itself, and not any suspected toxic impurities or additives. Communication with the manufacturer and analyses of two bulk samples by NIOSH showed that the oil in question was almost pure mineral oil with few additives. Some employers had felt that the oil in question may have had some additives which could have been responsible for the apparent toxic manisfestations of the oil. This concern was not borne out by this investigation.

Detailed information concerning the results of the medical-environmental evaluation is contained in the body of this report. Recommendations are also included in this report which are designed to alleviate dermatitis problems caused by direct contact with the oil.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services; Information and Dissemination Section; 4676 Columbia Parkway; Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS); Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

a) Westinghouse Electric Corporation; Muncie, Indiana
b) Authorized Representative of Employees
c) U.S. Department of Labor - Region V
d) NIOSH - Region V

For the purpose of informing the approximately 400 "affected employees", the employer shall promptly "post" for a period of 30 calendar days the Determination Report in a prominent place(s) near where exposed employees work.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 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 (NIOSH) received such a request from an authorized representative of Local 917 of the International Union of Electrical Workers regarding the employees' alleged complaints of "skin irritation, infectious running sores, injuries slow to heal". Subsequent discussions with employees indicated that the request was submitted because some workers suspected they were being poisoned by some additive to the transformer oil.

IV. HEALTH HAZARD EVALUATION

A. Conditions of Use

The Large Power Transformer Division of Westinghouse Electric Corporation has approximately 1600 employees involved in the manufacture of very large power transformers and to a lesser degree the overhaul of old transformers. The plant is operated on a three shift, five day week basis. The facility is approximately 700,000 square feet with the middle bay about three stories high to accommodate movement of the transformer via crane. The following is a brief resume of some specific operations covered by this request:

1. Department M-60; Vapor therm operations involve two large 100,000 gallon tanks in which the phase (middle portion of transformer) is placed in the tanks. The purpose of this operation is to get rid of any water and to impregnate all parts with oil.

2. Department A-60; Bridge support operations involve phase assembly where oil-impregnated parts (from Department B-70) are used to complete the phase assembly.

3. Department A-10; Iron core building operations involve placing sheet iron parts around the phase. This is primarily a stacking operation.

4. Department A-20; Fit for some test operations involve fitting appropriate connections together, putting outside steel shield over transformer, installing bushings, installing radiator, and assuring all connections are correct. This involves entering the inside of the transformer.

5. Department A-50; Detail assembly plus hot oil test operations involve final checkout (prior to tests) and filling and testing the transformer and radiator with hot oil.

6. Department K-10; Transformer testing operations involve specific tests on transformer to assure it meets operational specifications. The transformer is tested with man-made lightening.

7. Department A-30; Leak test of transformer and disassembly and package for shipment operations involve disconnecting all major parts (e.g., bushings, radiators, etc.) inside and outside of the transformer and packaging for shipment.

8. Department B-70; Various phase parts and materials are impregnated with hot oil under pressure in two large tanks which are about one half the size of the vats used in Department M-60.

9. Department J-10; Condensors are impregnated with oil under pressure in a 5,000-10,000 gallon horizontal cylinder.

Most personnel are exposed to the mineral oil from touching the oil-coated and impregnated parts and surfaces. The maximum exposures to oil or possibly oil mists appear to be in Departments A-30 and A-20 during entry into the transformers, Departments M-60 and B-70 during entry into the large vats, and Department J-10 while opening the cylinder used for impregnating the bushings with oil. Operations in Department A-50 involving detail assembly and hot oil test operations were not conducted at the time of the survey.

B. Evaluation Progress and Methods

1. Progress

An initial walk-through survey was conducted on January 18, 1977. From discussions with employees and personal observations, it appeared that the major problem would be potential exposure to oil by direct contact, oil mists, and vapors from organic solvents (e.g., denatured alcohol, aliphatic solvent "140 flash", etc.) used for various tests such as leak tests. The medical-environmental survey was subsequently performed on January 18-19, 1977.

2. Environmental Methods

Personal air samples were used to evaluate employee exposures. The personal samples were obtained by attaching the pump to the worker's belt with the sampling media (e.g., filter cassette, charcoal tube, etc.) in a holder attached to the lapel of the worker to obtain a representative sample of air in the breathing zone of the worker. Samples were obtained for a sufficient period of time so that for all practical purposes they may be considered as eight-hour time-weighted averages.

Samples for determination of airborne concentrations of organic vapors were collected by absorbing vapors onto charcoal contained in glass sampling tubes at a sampling rate of 0.2 liters per minute (lpm). The sampling tubes were transmitted to the laboratory for analysis by gas chromatography.[1] Samples for determination of total nuisance particulates were collected by capturing the particulates or mists on tarred vinyl metracell filters at a sampling rate of 1.7 lpm. These samples were analyzed gravimetrically.[1] Samples for determination of oil mists were obtained with mixed esters of cellulose membrane filters (0.8 micron average pore size) at a sampling rate of 1.7 lpm. These samples were analyzed spectrofluorometrically for oil mists.[1] Bulk samples of the various mixtures were also obtained for analysis and use in analysis of the environmental samples.

All charcoal tubes were analyzed for ethyl alcohol, benzene, xylene, mineral spirits or aliphatic solvent "140 flash", tertiary butyl alcohol, methyl isobutyl ketone, and toluene. Results for tertiary butyl alcohol, methyl isobutyl ketone, and toluene on all samples were reported as not detected or less than 0.01 milligrams. Therefore, employee exposure to tertiary butyl alcohol, methyl isobutyl ketone and toluene are not a hazard and are not considered further in this report.

3. Medical Methods

Twenty employees were questioned and examined. A brief questionnaire was then completed containing identification data. A detailed occupational history and a medical history of complaints related to work were obtained.

Skin irritation and other symptoms were elicited which may be work related. In this regard it should be noted that the union was on strike for several months and operations had not yet completely returned to normal. Therefore, the skin lesions described in the health hazard evaluation request had not had sufficient exposure time to reoccur. Although the information gathered is of a historical nature, the information was consistent and considered valid.

C. Evaluation Criteria

1. Environmental Criteria

The three primary sources of environmental evaluation criteria considered in this report are: (a) NIOSH Criteria Documents with recommended standards for occupational exposure; (b) American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's) with supporting documentation; and (c) Federal Occupational Health Standards as promulgated by the Occupational Safety and Health Administration, U.S. Department of Labor (29 CFR 1910.1000). For the substances evaluated during this study, the primary environmental criteria used were:

Substance	Standard or Guide mg/M^3*
Total nuisance particulates	10.0 (b)**
Oil mists, particulate (mineral)	5.0 (b,c)
Benzene	3.2 (a,c)***
Petroleum distillates as aliphatic solvent "140 flash"	150.0 (b)****
Xylene	435.0 (a,b,c)
Ethyl alcohol	1900.0 (a,b,c)

*Approximate milligrams of substance per cubic meter of air sampled.

**Reference letters in parentheses refer to the source(s) from the above discussion from which the standard or guide was obtained.

***The current ACGIH-TLV for benzene is 30 mg/M^3 with a reference that benzene is a chemical substance associated with industrial processes which are suspect of inducing cancer in man. However, recent studies from clinical as well as from epidemiological data are conclusive at this time that benzene is leukemogenic because it produces progressive, malignant disease of the blood-forming organs. Based on this more recent data NIOSH recommended to OSHA that an emergency standard for benzene be 3.2 mg/M^3. OSHA has recently published an emergency standard for benzene of 3.2 mg/M^3.

****In case of a mixture of air contaminants particularly with organic solvents, the overall effects are considered as additive. An employer shall compute the equivalent exposure as follows:

$$*Em = \frac{C_1}{L_1} + \frac{C_2}{L_2} \ldots \frac{C_n}{L_n}$$

Where:

Em is the equivalent exposure for the mixture.
C is the concentration of a particular contaminant.
L is the exposure limit for that contaminant, from Table Z-1, Z-2, or Z-3.

*The value of EM shall not exceed unity or 1.

Occupational health exposure limits for individual substances are generally established at levels designed to protect workers occupationally exposed on an eight hour per day, 40 hour per week basis over a normal working lifetime.

2. Medical Criteria

a. Toxic Substances Data[2,3,4]

(1) Nuisance Dusts

Nuisance dusts have few adverse effects on the lungs and do not produce significant disease or toxicity when exposures are kept under reasonable control. These dusts are biologically inert so that when inhaled the architecture of the alveoli remains intact, little or no scar tissue is formed, and any reaction provoked is potentially reversible. Excessive concentrations in workroom air may reduce visibility, cause unpleasant accumulations in the eyes, ears, and nose, and secondarily cause injury to the skin due to vigorous cleansing procedures necessary for their removal.

(2) Oil Mists

The primary effects of mineral oil are upon the skin. Dermatitis remains a common problem among workers coming in contact with such oil. Oil acne and folliculitis result 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 inflammation. In occasional cases, secondary infection in the primary lesions of oil folliculitis have been observed and in such cases the individual's skin or nose is the source of the offending agent.

The health standard for oil mist (mineral) of 5 mg/M^3 refers to airborne mist of petroleum-base cutting oils or white mineral petroleum oil. Experimental findings indicate that heat-decomposed oil fumes are irritant

but do not result in changes in the lungs at 5 mg/M^3. It has been alleged but not proven that the inhalation of extremely high levels of oil mists could result in lipid pneumonitis.

(3) Benzene

Dermal contact with liquid benzene may cause erythema and blistering of the skin. A dry, scaly dermatitis may develop during prolonged or repeated exposure. Acute exposure produces an initial state of euphoria followed by giddiness, headache, nausea, a staggering gait, and, if not immediately removed from exposure, a state of unconsciousness. In chronic benzene poisoning at lower levels of exposure, symptoms of headaches and fatigue were prominent. Other common troubles include nervousness, vertigo, sleeplessness, and shortness of breath. The unique aspect of chronic benzene poisoning is its effect on the blood-forming system. Recent studies have reported cases of benzene-related blood dyscrasias and chromosomal aberrations. Although some investigators have observed acute forms of leukemia associated with benzene exposure, a recent connection with chronic leukemia has been shown. NIOSH recommends that the level of benzene in air be kept as low as possible (3.2 mg/M^3).

(4) Petroleum Distillates as Aliphatic Solvent "140 Flash"

The term petroleum distillates is a general term applicable to various mixtures of hydrocarbons, such as solvent naphtha, mineral spirits and aliphatic solvent "140 flash" which are used to describe various fractions and grades. These solvents have a definite narcotic action at higher concentrations. Effects of single acute exposure have been reported ranging from headache to nausea and inebriation. Prolonged or repeated exposure has been associated with irritation of the skin and mucous membranes of the respiratory tract and eyes. The TLV is partially arrived at based upon the amount of impurities such as benzene, xylene, and toluene found in a sample.

(5) Xylene

Xylene is a primary irritant affecting eyes, mucous membranes and skin. High levels affect the hematopoietic system in animals. Excessive exposure to high levels can cause pulmonary edema and severe liver dysfunction. Xylene may also cause dizziness, drowsiness, and incoordination at high levels. Xylene may also contain benzene.

(6) Ethyl Alcohol

Ethyl alcohol vapor, even in low concentrations, is irritating to the eyes and upper respiratory tract. This feature of ethyl alcohol is more

important in setting the limits for exposure than the secondary toxic effects from the absorbed alcohol.

D. Results and Discussion

1. Environmental Results and Discussion

The personal sample results for oil mists and total nuisance particulates are presented in Tables I and II, respectively. Twenty-three (23) samples were obtained for oil mists and twenty-one (21) samples were less than ten percent of the health standard or guide of 5 mg/M^3 for oil mists. The two maximum results of 0.6 mg/M^3 and 1.4 mg/M^3 were all less than thirty percent of the health standard or guide of 5 mg/M^3 for oil mists. The two high results were obtained during entry into a transformer by two employees in Department A-30. There were fourteen samples obtained for total nuisance particulates and all results were ten percent or less of the health standards or guides for total particulates of 10 mg/M^3 or for oil mists of 5 mg/M^3.

Table III presents the analytical results of 19 samples for various organic compounds which were used on a limited basis. The results are not felt to be indicative of a forty-hour week but rather for those operations conducted during the survey. All of the results for ethyl alcohol and xylene were less than one percent of the health standards or guides for ethyl alcohol of 1,900 mg/M^3 and for xylene of 435 mg/M^3. Eighteen of the 19 samples were less than three percent of the health standard or guide for aliphatic solvent "140 flash" of 150 mg/M^3. The maximum result was 26.0 mg/M^3 which is less than eighteen percent of the health standard or guide for aliphatic solvent "140 flash". No benzene was detected in 16 out of 19 personal air samples obtained during the survey. The maximum result for benzene was 1.8 mg/M^3 which is sixty percent of the health standard or guide for benzene of 3.2 mg/M^3. Even when considering the combined effects ($Em = \frac{C_1}{L_1} + \frac{C_2}{L_2} \cdots \frac{C_n}{L_n} = 1$) of all the organic compounds covered by this evaluation, employee exposure would be a maximum Em of less than 0.65 or sixty-five percent of the health standard or guide of Em = 1.

The environmental results for oil mists and total nuisance particulates show that the levels for these contaminants are not toxic. In addition, the environmental results confirm, in the opinion of the NIOSH investigators, that employee exposures to the organic compounds covered by this evaluation are not considered as toxic at levels found during the survey. In fact, all of the levels, with only a few exceptions, were at the lower levels of detection for these compounds. Also operations vary from day to day. For instance, the vapor therm operator did not enter the tank or vat on January 20, 1977. Therefore, the results may be lower when considering a 40 hour work week.

2. Medical Results and Discussion

Approximately 20 employees who are considered the most exposed were interviewed. Workers had been on a strike for about four months and had been back to work for only a few weeks. Therefore, the lesions described by the request did not have sufficient exposure time to reoccur. No direct confirmation of the alleged skin problems were observed at the time of the survey. The exposure is to mineral oil used as a dielectric insulating fluid in large transformers. The route of exposure is by direct contact to oil that is adherent to surfaces of the transformer as it is assembled. The heaviest exposure appeared to be in Department A-30. Workers in this department would prepare for shipment finished transformers which had been tested and from which mineral oil had been drained prior to shipment. The exposure to the oil most frequently came when workers would have to enter the transformer to tighten connections in preparation for its shipment. Brushing up against oily surfaces would transfer the oil to the clothing and skin of the workers. There were few complaints about exposure to oil fumes. Other long-term exposures (up to 5 hours) involved entry into transformers occurring in Department A-20, and short-term exposures of approximately 30 minutes involved entry into the large vats or tanks used for oil impregnation in Departments M-60 and B-70. These operations involve possible contamination of clothing and/or skin to almost every portion of the body by direct contact. A similar situation may occur when initially opening the door to the large horizontal cylinder (Department B-70) while removing a bushing, particularly if sufficient time is not allowed for the bushing to cool to ambient temperature prior to opening. Most of the employees are exposed to direct contact with oil either on clothing or skin, primarily to the arms and forearms, by touching the oily surfaces during normal working conditions.

The workers complained primarily of skin rashes. There appeared to be two types of rashes which would occur on skin surfaces with direct contact with mineral oil. First: Primarily on the lower extremities, where oil had come in contact with clothing and soaked through the clothing, raised red bump-like lesions which like oil acne occasionally was accompanied by blackheads. Second: Primarily on the upper extremities,

described as a fine maculopapular red rash, frequently scaly, itchy, and appearing to be on the surfaces of the body which were frequently washed in an effort to remove oil to which they had been exposed. As expected there was considerable variation in individual response to oil contact, ranging from no problem following prolonged exposure to significant skin problems following brief exposure to the oil. Most of the individuals acknowledged that while on strike with cessation of exposure, their skin problems had substantially subsided. One individual who indicated that his skin problem had persisted during the strike acknowledged that this may have been attributable to exposure to other chemicals on another job on which he moonlighted. Interestingly, another individual noted that approximately two years ago the company had instituted a policy of job rotation in this department (A-30). Prior to that time he had worked in the transformers with significant exposure and had a low grade persistent problem with skin lesions. Since the institution of the system of rotation, he found that his exposure to oil was never sufficiently prolonged at any one time to result in the development of skin lesions. The rotation of employees in high risk areas for direct contact with the oil is a good work practice.

Discussions with workers who may be exposed to hot oil mists (e.g., tanks in Department M-60, etc.) indicated some problems with oil acne. However, they did not appear to have any other significant medical problems (e.g., irritation of eyes and respiratory tract, headaches, etc.) which might be attributable to their exposure. There appeared to be some minimal exposure to organic solvents for some operations, although there was an apparent lack of any consistent or significant symptomatology or complaints (e.g., headaches, dizziness, irritation of eyes or respiratory tract, etc.) which might be attributed to the organic solvents in use during the survey. Some complaints concerned the paint spray operations involving the metal shell of the transformer but this operation was not considered as part of the request. Further, it is our understanding that OSHA has evaluated the paint spray operations and this matter may still be under consideration by OSHA and/or others.

3. Conclusions

Although it is the judgement of the NIOSH investigators that employees are not exposed to excessive airborne concentrations of the compounds involved in this evaluation, it was also observed that employees are exposed to direct contact with transformer oil, and this exposure resulted in dermatitis problems with certain employees. For instance, both employees entering the transformer in Department A-30 had portions of their clothing saturated with oil. One of these employees had a reddish-pimplish rash on the forearm which may have been a result of the entry and direct contact with the oil and/or the previous use of harsh detergents.

Based on the information previously presented, it is determined that employees were not exposed to airborne concentrations of oil mists, total nuisance particulates, and organic solvents which could be considered as toxic during this survey or from information elicited from past symptomatology of the employees. This statement is more relevant when one considers a 40 hour work week as opposed to an 8-hour time-weighted average.

It is concluded from the information previously presented that employees are exposed to direct contact with the transformer oil during operations which have resulted in various degrees of oil acne problems in some of the workers. With the exception of safety glasses, gloves, and rubber boots (to prevent sliding and slipping), there was no protective clothing for the employees except that provided by the employee. Some of the employees expressed a fear that they were being poisoned by some additive to the transformer oil. Contact with the manufacturer of the transformer oil and subsequent analysis of the oil by NIOSH confirmed that there are no additives to the oil such as polychlorinated biphenyls (PCB's) which could be considered as an additional hazard to the employees. The mineral oil is primarily a 100 percent mineral oil with no additives according to the manufacturer and confirmed by NIOSH analytical results. Therefore, there is no foundation to the employees concern that they are being poisoned by an additive to the transformer oil.

Interviews and observations by NIOSH investigators showed that the trenches (north and south of Department A-20) contained oil puddles, oily rags and other oily debris. These trenches also contain pipes and pumps which contain heated oil during various hot tests on transformers and apparently result in oil mists due to contact with the oily debris.

The exhaust from most vacuum pumps was vented to the outside atmosphere, although at least one vacuum pump (e.g., Department A-30) was vented to the working atmosphere. These pumps provide a source of irritating fumes as well as carbon monoxide.

V. RECOMMENDATIONS

The following recommendations are submitted to management to obviate observed and potential hazards and to provide a more desirable working environment for all personnel:

A. A program of periodic inspection and cleaning of oily debris from the trenches containing the pipes and pump houses to avoid the generation of undue oil mists should be implemented.

B. All exhaust systems from the vacuum pumps should be vented to the outside atmosphere.

C. Workers should be informed of the various contributing factors which may have led to an increased incidence of dermatitis with this plant and the measures necessary to reduce this incidence of dermatitis.

D. The following hygienic measures should be implemented as appropriate for those operations involving direct contact with transformer oil:

1. Gloves should be used whenever possible to reduce exposure to oils and cleaning materials within the plant. It is particularly necessary that gloves be used when oils or strong cleansing agents are being used as exposures to these may be particularly damaging to the skin. In some operations gloves may not be able to be used during normal operations because they impede manual dexterity. Gloves should be as thin as possible in order to allow sufficient dexterity and must be impervious to the oil or solvent being used. The use of heavily contaminated or saturated cloth gloves should be prohibited. Where possible, gloves should have either a cotton inner lining or the employee should use a cotton inner glove under the impervious outer glove. Gloves which have become broken and damaged should be discarded.

2. Impervious clothing (e.g., coveralls, coats, etc.) should be provided for certain operations such as entering transformers. The use of rubber gauntlets (not gloves) which protect the arms and forearms may be of some value.

3. It is realized by the NIOSH investigators that gloves and ancillary impervious clothing or rubber garments may be an impractical solution (reduce manual dexterity) or present other potential problems such as heat stress during summer months. Therefore, it may be difficult to avoid some degree of skin problems.

4. Frequent changes of work clothing should be provided. In particular, clothing contaminated with oils and solvents should be changed frequently and should be cleansed before reuse. A system could be developed where employees leave their soiled coveralls at a designated area at the end of each shift and pick up a clean pair. The soiled coveralls could be cleaned by either an industrial laundry or the company could have a industrial washer and dryer installed.

5. A mild soap should be provided at all cleaning facilities. Mild soap and water would be an effective cleansing agent in the majority of operations in the plant. The use of strong cleansers, such as Boraxo, should be reserved for those instances where soap and water cleansing is not sufficient. Such strong cleansers should not be used routinely. Soft paper should be used for drying after washing.

6. It should be emphasized to each employee that personal cleanliness is the most effective method for avoiding dermatitis problems. Personal cleanliness is a must. Waterless hand cleaners are especially valuable in removing oil from the skin. Showers are highly desirable since many employees commute wearing oil-saturated clothing. Employees should shower or otherwise wash carefully each day after the shift. This should be followed by a complete change to clean clothing.

7. Barrier creams may afford some protection to the hands from the action of solvents, cleansers, or oils and are worth a trial. The following barrier creams may prove helpful: Kerodex No. 51 manufactured by Ayerst Laboratories, N.Y., N.Y.; PLY No. 9, The Milburn Company, Detroit, Michigan; and West Chemical Cream No. 411 manufactured by West Chemical Products, Inc., Long Island, N.Y. Mention of these products and names of the manufacturer is not considered as an endorsement by NIOSH. It is recognized that there may be equally effective products on the market and equally effective creams could also be tried.

E. The following medical management program should be implemented:

1. Preemployment examination should be performed on new employees. Persons with a history of atopic dermatitis, recurrent eczema or who currently have active dermatitis should not work in areas where they are heavily exposed to transformer oils or solvents.

2. Any employee who develops dermatitis should have a prompt examination and suitable treatment. If the dermatitis appears to be work related, the work exposures should be evaluated carefully to determine the nature of the contact which may have been responsible and what additional hygienic measures, if any, are necessary.

F. A representative of the company should contact the producer of commercial soap to explain the exposure and obtain the manufacturer's recommendation of the best mild soap, to their knowledge, for removing oil in this kind of exposure. While abrasive soaps are not necessarily contraindicated for use of the upper extremities, they should not be used to bathe the rest of the body.

G. The data contained in this report, although indicative of some exposure to benzene (probably as a minor impurity in mineral spirits - "flash 140" solvent) at levels less than the health standard or guide, is not sufficient to provide assurance that employees' exposure to benzene is or is not toxic for operations not covered by the survey. Therefore, it is recommended that a more indepth environmental study be performed by Westinghouse concerning any operation, including paint spray operations, where benzene may be an impurity in the solvent. It is suggested that solvents with benzene be replaced with those found to be benzene free.

VI. REFERENCES

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4. Harrison's Principles of Internal Medicine, 6th Edition, McGraw-Hill Company, 1970.

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TABLE I

RESULTS ERSONAL AIR SAMPLES (AA FILTERS) FOR OIL MISTS . AINED DURING ENVIRONMENTAL SURVEY CONDUCTED ON JANUARY 19 (DENOTED BY SAMPLE C-No.) and 20 (DENOTED BY SAMPLE B-No.), 1977, AT WESTINGHOUSE ELECTRIC CORPORATION LARGE POWER TRANSFORMER DIVISION: MUNCIE, INDIANA: REPORT NO. 76-94. (RESULTS EXPRESSED AS mg/M^3 - MILLIGRAMS OF COMPOUND PER CUBIC METER OF AIR SAMPLED).

DEPARTMENT	OPERATION	SAMPLE NUMBER	SAMPLING PERIOD AM PM	OIL MISTS mg/M^3
M-60	Vapor Therm Operator 1	C-19	7:47--3:12	0.2
M-60	Vapor Therm Operator 2	C-1	8:18--3:25	0.2
A-10	Core Builder Operator 1	C-12	7:35--3:09	0.1
A-20	Fitter Operator 1	C-13	9:26--3:16	0.2
A-20	Electrical Test Operator 1	C-21	9:32--3:19	0.3
A-20	Electrical Test Operator 2	C-18	9:35--3:16	0.3
A-30	Fitter Operator 1	C-11	8:13--3:05	0.2
A-30	Fitter Operator 2	C-15	8:15--3:07	0.2
A-30	Fitter Operator 3	C-2	8:15--3:06	0.2
A-60	Phase Assembler 1	C-10	7:58--3:20	0.3
A-60	Phase Assembler 2	C-5	8:00--3:21	0.3
J-10	Bushing Operator 1	C-16	8:04--3:19	0.2
J-10	Bushing Operator 2	C-7	8:06--3:20	0.1
K-10	Electrical Test Operator 1	C-14	9:17--3:21	0.1
A-20	Fitter Operator A	B-6	8:00--2:09	0.3
M-60	Vapor Therm Operator A	B-23	7:35--2:29	0.2
A-30	Pressure Test Operator A	B-17-1	7:47--3:09	0.2
A-30	Fitter Operator A	B-102	10:30--3:07	1.4
A-30	Fitter Operator B	B-17-2	10:30--3:05	0.6
A-50	Treatment Operator A	B-9	8:30--1:58	0.3
A-60	Phase Assembler Operator A	B-101	7:50--2:58	0.2
B-70	Treatment Tank Unloader A	B-100	7:37-11:06	0.2
B-70	Treatment Tank Operator A	B-22	7:45-11:09	0.3

Environmental Criteria for oil mists is 5 mg/M^3.

TABLE I.

RESULTS OF PERSONAL AIR SAMPLES (VM-1 FILTERS) FOR TOTAL PARTICULATES OBTAINED DURING ENVIRONMENTAL SURVEY CONDUCTED ON JANUARY 19 (DENOTED BY SAMPLE C-No.) and 20 (DENOTED BY SAMPLE B-No.), 1977, AT WESTINGHOUSE ELECTRIC CORPORATION LARGE POWER TRANSFORMER DIVISION; MUNCIE, INDIANA; REPORT NO. 76-94. (RESULTS EXPRESSED AS mg/M^3 - MILLIGRAMS OF COMPOUND PER CUBIC METER OF AIR SAMPLED).

DEPARTMENT	OPERATION	SAMPLE NUMBER	SAMPLING PERIOD AM PM	TOTAL NUISANCE PARTICULATES mg/M^3
M-60	Vapor Therm Operator 1	C-2969	7:47--3:12	0.2
A-20	Fitter Operator 1	C-2966	9:26--3:16	0.5
A-20	Electrical Test Operator 1	C-3000	9:32--3:19	0.3
A-30	Fitter Operator 2	C-2971	8:15--3:07	0.2
J-10	Bushing Operator 1	C-2977	8:04--3:19	0.2
M-60	Vapor Therm Operator A	B-2970	7:35--2:29	0.4
A-20	Fitter Operator B	B-2959	8:00--2:07	0.3
A-20	Fitter Operator A	B-2967	8:00--2:09	0.3
A-30	Pressure Test Operator B	B-2978	7:49--3:09	0.3
A-30	Fitter Operator B	B-2956	10:30--3:05	0.3
A-30	Fitter Operator A	B-2979	10:30--3:07	0.3
A-50	Treatment Operator B	B-2910	8:30--1:58	0.3
B-70	Treatment Tank Unloader B	B-2968	7:40-11:07	0.3
B-70	Treatment Tank Operator A	B-2988	7:45-11:09	0.4

Environmental Criteria for total nuisance particulates is 10 mg/M^3.

TABLE III

RESULTS OF PERSONAL AIR SAMPLES (CHARCOAL TUBES) FOR ORGANIC SOLVENTS OBTAINED DURING ENVIRONMENTAL SURVEY CONDUCTED ON JANUARY 19 (DENOTED BY SAMPLE C-No.) AND 20 (DENOTED BY SAMPLE B-No.), 1977, AT WESTINGHOUSE ELECTRIC CORPORATION; LARGE POWER TRANSFORMER DIVISION; MUNCIE, INDIANA; REPORT NO. 76-94. (RESULTS EXPRESSED AS mg/M^3 - MILLIGRAMS OF COMPOUND PER CUBIC METER OF AIR SAMPLED.)

DEPARTMENT	OPERATION	SAMPLE NUMBER	SAMPLING PERIOD AM PM	ETHYL ALCOHOL mg/M^3	BENZENE mg/M^3	XYLENE mg/M^3	ALIPHATIC SOLVENT "140 Flash" mg/M^3
M-60	Vapor Therm Operator 1	C-5	7:47--3:12	0.5	ND	1.1	2.5
M-60	Vapor Therm Operator 2	C-11	8:19--3:25	3.4	0.3	2..	26.0
A-10	Core Builder Operator 1	C-8	7:35--3:09	0.2	ND	1.0	1.5
A-20	Fitter Operator 1	C-12	9:26--3:16	0.6	ND	1.2	1.8
A-20	Electrical Test Operator 2	C-10	9:35--3:16	0.6	ND	1.1	1.8
A-30	Fitter Operator 1	C-1	8:13--3:05	0.6	ND	0.8	1.2
A-30	Fitter Operator 3	C-7	8:15--3:06	0.7	ND	1.0	1.5
A-60	Phase Assembler 1	C-3	7:58--3:20	0.3	ND	1.4	1.4
A-60	Phase Assembler 2	C-2	8:00--3:21	0.3	ND	1.2	1.9
J-10	Bushing Operator 1	C-4	8:00--3:19	1.6	1.8	1.2	3.5
J-10	Bushing Operator 2	C-6	8:06--3:20	1.2	0.7	1.2	2.7
K-10	Electrical Test Operator 1	C-9	9:17--3:21	1.3	ND	1.7	2.6
M-60	Vapor Therm Operator A	B-21	7:35--2:29	ND	ND	1.1	1.5
A-20	Fitter Operator B	B-10	8:01--2:07	ND	ND	1.3	1.8
A-30	Fitter Operator B	B-20	10:30--3:05	ND	ND	1.3	1.9
A-50	Treatment Operator A	B-9	8:30--1:58	0.6	ND	2.0	3.9
B-70	Treatment Tank Unloader A	B-4	7:35-11:06	ND	ND	2.7	2.7
B-70	Treatment Tank Unloader B	B-5	7:41-11:07	ND	ND	2.5	2.5
B-70	Treatment Tank Operator A	B-2	7:45-11:09	ND	ND	1.7	1.7
Environmental Criteria are ----------				1,900	3.2	435	150

N.D. - denotes none detected.

NOTE: The above samples were also analyzed for tert-butyl alcohol, methyl isobutyl ketone, and toluene, and these compounds were not detected.