U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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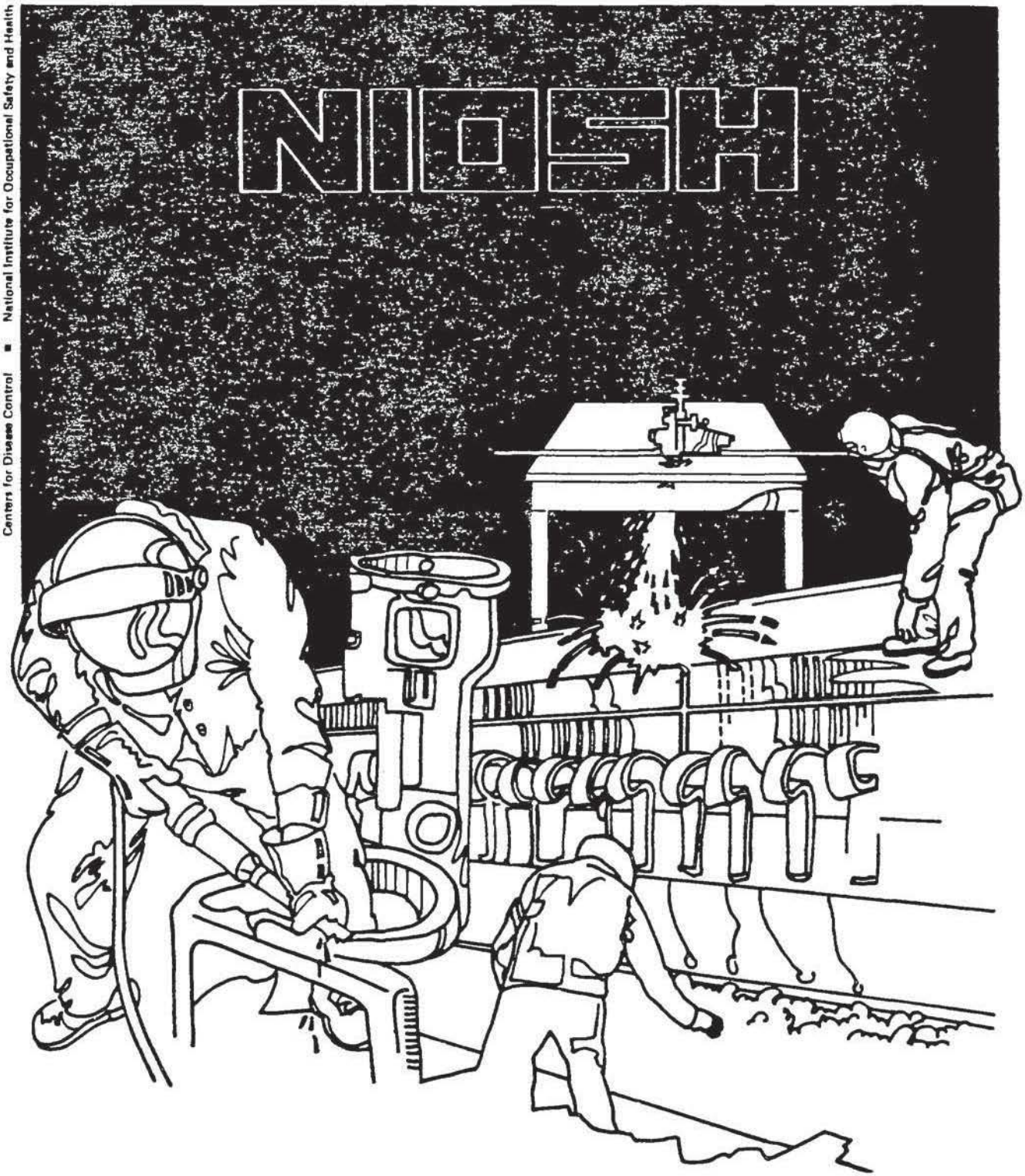

Health Hazard Evaluation Report

HETA 85-375-1861
INTERNATIONAL ASSOCIATION
OF FIRE FIGHTERS (IAFF)
LOS ANGELES, CALIFORNIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any 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 Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 85-375-1861
JANUARY 1988
INTERNATIONAL ASSOCIATION
OF FIRE FIGHTERS (IAFF)
LOS ANGELES, CALIFORNIA

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I. SUMMARY

On May 23, 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate respiratory complaints, neurologic symptoms, and dermatological problems among fire fighters, police officers, and paramedics following a major chemical warehouse fire that occurred on April 13, 1985, at the Research Organic, Inorganic Chemical Corporation (ROC/RIC) in Sun Valley, California.

During July 14-18, 1986, NIOSH conducted a medical survey among fire fighters, police officers, and paramedics involved with the fire. Self-administered medical questionnaires and baseline pulmonary function test (PFT) data were obtained from 98 individuals.

Questionnaire results indicated that dermatological problems and neuro toxic symptoms were reported by several fire fighters and police officers. Eighteen fire fighters (26.5%) and nine police officers (29%) reported a rash lasting for more than one day after the fire. Neurotoxic symptoms (fatigue, forgetfulness, irritability, headaches, and difficulty sleeping) reported as occurring both in the month after the fire and persisting over a year later, were also prominent among survey participants. For several of these symptoms a statistically significant association with reported high exposure at the time of the fire was found. Increased shortness of breath, chronic cough, and chest pain or tightness were also reported by a substantial number of participants. These findings were also significantly associated with reported high exposure at the fire, but not with cigarette smoking. Pulmonary function test results revealed a number of police officers and fire fighters with a mild obstructive pulmonary function pattern. Due to the lack of baseline PFT data for these individuals, any association with exposure at the fire was difficult to evaluate.

On the basis of the data obtained during this investigation, the NIOSH investigators concluded that the symptoms experienced by fire fighters, police officers, and paramedics were associated with exposures during the fire. Possible exposure to organic chemicals in runoff water, and exposure to heavy smoke most likely contributed to the occurrence symptoms. Recommendations for protecting hazardous materials response personnel, (fire fighters and police) as well as recommendations for medical surveillance of all emergency personnel are presented in Section VIII of this report.

KEYWORDS: SIC 9224, Fire Fighters, Chemical Fires, Smoke Inhalation

II. INTRODUCTION

On May 23, 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Association of Fire Fighters (IAFF), the United Fire Fighters of Los Angeles City (Local 112, IAFF) and the Los Angeles Police Protective League, to evaluate health effects among fire fighters, police officers, and paramedics who were involved with a chemical warehouse fire. The request concerned chemical exposures and reported adverse health effects experienced by these emergency personnel subsequent to a fire that occurred on April 13, 1985 at Research Organic/Inorganic Chemical Corporation (ROC/RIC) in Sun Valley, California.

On September 24, 1985, NIOSH investigators met with representatives from the IAFF, Los Angeles Police Protective League, IAFF local 112, Los Angeles Police Department Medical Liaison and Los Angeles Fire Department Medical Liaison, to discuss the investigation and obtain pertinent background information.

On September 25, 1985, NIOSH investigators met with some of the fire fighters and police officers who were at the scene of the fire. On February 25, 1986, NIOSH investigators met again with representatives from IAFF Local 112, the Police Protective League, LAFD Medical Liaison, The Los Angeles City Medical Services Division and the Los Angeles City Occupational Safety Office, to obtain additional background information.

During July 14-18, 1986, NIOSH conducted the health survey, offering medical questionnaires and pulmonary function testing (PFT) to fire fighters, police officers, and paramedics who were involved with the fire. The questionnaires solicited information to characterize exposures and subsequent symptoms experienced by individuals who were at the fire, along with other epidemiologic data.

III. BACKGROUND

A. The Warehouse

The warehouse, a chemical repackaging and distribution business, occupied a single story, brick structure of approximately 12,000 sq. ft. with a flat wooden roof. Other buildings are located on both sides. The rear of the premises has a fenced-in parking and storage lot of approximately 1/4 acre. During 1984, when the business was operating as Biochem Inc., the owner was cited by the California Occupational Safety and Health Administration (CAL/OSHA) as well as the fire department, for numerous health, safety, and fire code violations. Approximately six weeks before the fire, a

police officer, responded to a burglary call at the site; shortly after leaving the premises, he developed a nose bleed that persisted through the following day and was accompanied by dizziness, cramps, nausea and diarrhea. The incident was reported to the Los Angeles County Health Department, who inspected the premises and found numerous safety and health code violations. Although the business owner was ordered to cleanup the premises, no corrective actions were taken.

B. The Fire

The fire (of undetermined origin) began at approximately 2:45 p.m. on April 13, 1985. Drums of chemicals began exploding inside the building as the fire engulfed the warehouse and consumed the chemicals stored there. Numerous flammable, corrosive, and reactive compunds were also stored at the warehouse at the time of the fire, according to records obtained from the company by the Los Angeles County Health Department. (Table I) The Los Angeles Police Department (LAPD) reported that the cloud of smoke from the fire reached heights in excess of 1,500 feet and was driven by a five to ten-mile per hour wind, blowing toward the north. At ground level, the smoke dispersed in all directions due to wind shifts and was carried down-wind approximately one third to one half mile.

The area's businesses and residents were evacuated, and police established an initial perimeter of approximately 500 feet around the site to control the large crowd that had developed and to control access to the area. Excessive smoke and wind forced police (who had no respiratory protection or other protective gear) to extend the downwind perimeter to three quarters of a mile, and the upwind perimeter to a quarter-mile. At nearby Burbank Airport, air traffic control was notified of the cloud of toxic smoke and advised to divert aircraft away from the site, since it was located beneath the approach path for the airport's north-south runway. At approximately 3:45 p.m., the flames were extinguished and fire officials declared the fire under control.

The U.S. Environmental Protection Agency (EPA) along with the health department, monitored the site for the next several days for potential hazards due to chemical reactions. Clouds of chemical vapors caused by leaking drums and smoldering debris, left the site marginally stable. With the assistance of the U.S. Coast Guard's Pacific Strike Team, EPA was able to stabilize and secure the site. A radiation hazard, created by the presence of uranium and thorium salts stored inside the building, was also mitigated with the assistance of a radiological contractor and a health physicist from the radiation management section of the health department.

During the period of April 17-29, 1985, cleanup and removal activities took place at the site, where significant amounts of debris were removed and pools of chemicals were neutralized, solidified, and prepared for disposal at an approved site. The inside walls and floors of the building were steam cleaned numerous times to reduce residual radiation to background levels.

C. Exposures and Health Effects

Exposures to fire fighters and police officers occurred as a result of inhalation of smoke and fumes and direct skin exposure to chemicals present in runoff water from the site. Due to the undetermined nature of the chemicals, police personnel and fire fighters reported to the LAFD decontamination center after the fire, where they were rinsed down with a solution of trisodium phosphate and water as a precautionary decontamination measure. One group of police officers underwent this process at a car wash set up to serve as a secondary, makeshift decontamination center. Uniform clothing and personal effects were cleaned with laundry detergent and water, and twenty-two police vehicles were washed down, inside and out.

Paramedics monitored blood pressure and symptoms of personnel for approximately one hour. Ten police officers and 52 fire fighters were referred to hospitals for further medical follow up. Three police officers and six fire fighters were subsequently admitted for chemical exposures and smoke inhalation. Seven bystanders near the scene of the fire, were evaluated for chemical exposures; one was subsequently admitted for further treatment.

A variety of ill health effects, including headaches, nausea, memory loss, hypertension lethargy, nose bleeds, and irritability, were reported among police and fire personnel immediately after the fire. Some of these health problems were still being experienced by some individuals at the time of the survey.

IV. METHODS

A. Environmental

At the time of the fire, the Los Angeles County Health Department collected samples of runoff water used to suppress the fire, samples of chemical residues from the site, and air samples. Samples were tested qualitatively to determine chemical classifications and groupings.

Several months after the fire one NOMEX fire fighter turnout coat reportedly used at the fire, along with wipe samples from a boot, reportedly worn by a fire fighter at the scene of the fire, were submitted to NIOSH for analysis of identifiable organics, and soluble/insoluble metals.

B. Medical

Eighty-one fire fighters, 52 police personnel, and 14 paramedics, who were at the scene of the fire were eligible to participate in the NIOSH survey. Personnel were notified by letter of the survey, as well as by announcements issued by LAPD, LAFD, IAFF Local 112, and the PPL.

Self administered medical questionnaires were completed by survey participants in efforts to determine individuals exposures during the fire, subsequent health effects (with a focus on neuro-toxic problems) and other pertinent epidemiological information. Baseline pulmonary function tests (PFT's) were administered by NIOSH technicians to screen individuals for respiratory abnormalities. Ohio Medical Products dry rolling seal spirometers, connected to Spirotech dedicated computers, were used to administer PFT's. The Pulmonary Function Tests measured; 1) Forced vital capacity (FVC) - the volume of air forced out of the lungs after breathing in as deeply as possible; 2) One second Forced Expiratory Volume ($FEV_{1.0}$) - the amount of air forcibly exhaled during the first second of expiration; 3) the ratio of $FEV_{1.0}$ to FVC; and 4) Forced expiratory flow (FEF) - the average flow of air measured during the middle portion of the FVC maneuver. The PFT computer component recorded the flow-volume curves and analyzed them according to calculated predicted values, based upon the individual's age, height, sex, and race. Results were calculated based upon the "best" test results from a minimum of three acceptable efforts, where the $FEV_{1.0}$ and the FVC from the two best curves differed by no more than 5%. $FEV_{1.0}$/FVC ratio was calculated based upon the best observed readings, regardless of which tracing they were selected from.

In interpreting the test results, pulmonary function is considered "normal" if the $FEV_{1.0}$ and the FVC are each 80% or more of the values predicted for an individual, and if the $FEV_{1.0}$/FVC ratio is 70% or more of the predicted value. The FEF result is less predictable than the other two tests and is typically used to measure and compare changes in lung function over time. Predicted normal lung function values used in NIOSH Health Hazard Evaluations are derived from Knudson et al, 1976[1].

V. RESULTS

A. Environmental

Samples of runoff water, and chemical residues collected by the Los Angeles County Health Department identified the presence of acids, selenides, cyanides and organic chemical bases. Specific quantitative and qualitative results were reportedly not available. Air samples detected mercury, pyridine and hydroflouric acid vapors.

Test results from samples of the turnout coat and wipe samples of the boot, submitted to NIOSH for analysis, were inconclusive. The length of time from the date of the fire to the date samples were submitted, the absence of "blank" materials for comparison testing, and an improperly sealed shipping container, were cited as reasons making it impossible to draw any conclusions regarding exposure to specific organic combustion compounds.

B. MEDICAL

Ninety eight people (67% of these eligible) participated in the NIOSH study. These included 64 fire fighters, 5 paramedics, and 29 police. Ninety two (93%) of the participants were male; seven (7%) were female. Table II provides a breakdown of the participants by sex, race, and other pertinent information. For the analysis of the medical survey data, the results on the participating paramedics will be grouped with those for the fire fighters.

Eighteen of the fire fighters (27%) and nine (29%) of the police reported a rash persisting for more than one day after the fire (Table III). The occurrence of this persistent rash was significantly associated for both groups with the participants reporting their skin being wet during the fire ($X^2 = 5.239$, $p<0.22$ for fire fighters; $X^2 = 4.096$, $p<0.043$ for police). There was also the expected relationship for a participant having a rash on a particular part of his/her body and reporting that the same part of their body had become wet during the fire.

Neurologic symptoms were also quite prominent among the participants (TABLE IV). These included such symptoms as fatigue, forgetfulness, irritability, headaches, and difficulty sleeping both in the month after the fire and persisting over a year later at the time of our survey. In reviewing these results, it is important to note that symptom prevalence is reported as an increase in the symptom as compared to before the fire. The current prevalence of many of these symptoms is actually much

higher. For several of these symptoms, a statistically significant association with reported exposure at the time of the fire was found. Reported exposure was based on a positive response to the question "While you were at the fire, were you exposed to levels of smoke and fumes that made breathing very difficult or at times left you gasping for air?" No significant association was found between these symptoms and reports of the participant's skin becoming wet during the fire.

Table V presents the prevalence of other symptoms ascertained in the survey. Again, these are presented as increased prevalence compared to before the fire.

Respiratory symptoms (compared to before the fire) and the results of the pulmonary function testing are presented in Table VI. Increased shortness of breath, chronic cough, and chest pain or tightness were reported by a substantial number of the participants and were significantly associated with reported exposure at the fire but not with cigarette smoking. The results of the pulmonary function testing indicated a number of police officers and fire fighters with obstructive changes on their pulmonary function tests (usually mild changes). Given the absence of pulmonary function tests obtained prior to the fire, no attempt could be made to relate these changes to exposure at the fire.

VI. DISCUSSION

Fire fighting has traditionally been considered by many health and safety professionals to be one of the most hazardous occupations.[2] In today's environment, the existence of thousands of toxic chemicals, has compounded this hazard dramatically. When one considers that chemicals are common, everyday ingredients in household and work-place items such as furniture, plastic plumbing fixtures, office accessories, carpeting fabrics etc., the term "hazardous" takes on a new meaning, since one does not readily associate hazards with these kinds of items. For the fire fighter, whether it be a fire in a residence or structure containing these items, or in a warehouse where the basic chemical ingredients are stored, the chemical fire may represent the most lethal occupational environment known.

For health investigators, the chemical fire is one of the most difficult incidents to evaluate. Difficulties in determining toxic constituents of smoke, unknown by-products of multiple chemicals mixing and reacting with one another, as well as with water, and the effects of combustion and thermal decomposition, make it virtually impossible to delineate exposures. Medical evaluation of these exposures is also very difficult, since health effects may not occur immediately.

While there have been significant advances in personal protective gear and clothing, fire fighters may encounter exposures so harsh that personal protective equipment and clothing may actually dissolve or their protective qualities be severely compromised.

The ROC/RIC fire is a typical illustration of the problems presented by chemical fires. Although there were over 100 chemicals stored on the premises, an inventory was not obtained until after the fact. Fire fighters and police officers had no idea of what they were dealing with. In addition, the potential for rescue personnel, as well as bystanders to be exposed to organic chemicals in the runoff water from the site posed a hazard that was not immediately recognized. Furthermore, the role of police personnel at these incidents must be examined. The specialized duties fulfilled by police officers during these incidents, to control crowds and maintain order during evacuations, protect property, and provide individuals with assistance and information, are critical needs. However, police personnel cannot, and should not, be expected to perform their duties during these incidents without personal protective equipment and clothing. Specialized training and the availability of protective equipment during this incident might have had a dramatic impact on preventing or at least minimizing exposure-related adverse health effects. When reviewing the medical results from this study the persistence of neurologic symptoms in several individuals over a year later, are troubling findings, and although these results suggest a direct association of these problems with exposures sustained at the fire, exactly what these individuals were exposed to that caused these problems remains unknown. Exposure to organic chemicals in runoff water from the site was associated with the dermatological complaints reported and may have possibly lead to some of the neurological symptoms as a result of skin absorption. In light of this, it is particularly troubling that police officers involved with this fire had to perform their duties with absolutely no respiratory protection, rubber boots, or other protective equipment or clothing. The number of fire fighters who developed adverse health effects suggests that their standard protective gear is also inadequate for these incidents.

The incidence of respiratory and other symptoms reported among study participants is consistent with results of other NIOSH studies of fire fighters, after large fires involving chemicals.[3,4] For most individuals, these symptoms developed after the fire, and there occurrence may be attributable to exposures during the fire. Varying degrees of exposure may have influenced the very occurrence of these symptoms as well as their severity.

Acute medical care for fire fighters and other rescue personnel subsequent to these incidents is another area that needs improvement.

As demonstrated during this incident, although all rescue personnel received medical evaluation, this was often focused on one complaint and ignored other possible problems. For example, a fire fighter with respiratory complaints would be delayed in getting a pulmonary evaluation due to focus on other health complaints. Improved coordination with providers of acute medical care, along with specific protocols to guide medical evaluation for instances such as this fire would be helpful.

Overall, the effects and relationship of individuals' exposures during this fire to longer term health problems cannot be predicted. However, a high incidence of adverse health effects that did occur, points out the urgent need for better protection for all emergency personnel responding to these incidents.

VII. RECOMMENDATIONS

1. Fire fighters, police and paramedics often face serious exposures when responding incidents such as the ROC/RIC fire, because they lack appropriate protective equipment. In order to prevent these emergency personnel from sustaining undue exposures during these types of incidents, hazardous materials response teams should be established. The basic minimum elements for establishing such a response team must include:

   a. Comprehensive training for all team members and routine practice drills.

   b. State-of-the-art personal protective equipment.

   c. Protocols for addressing medical evaluation and decontamination issues.

   d. Industrial hygiene/environmental sampling capability.

   e. Coordination with other agencies involved in emergency/disaster response.

   Ideally, this activity should be supported by an underlying and ongoing process of targeting industrial areas in the city where these incidents are likely to occur and characterizing the potential hazards. Knowing this information in advance could guide decisions on selecting the best methods to protect initial response personnel. The emergency planning activities under the new federal legislation (Title III of SARA) provides an excellent opportunity to do this type of planning.

2. The establishment of a hazardous materials response team should not preclude appropriate training and equipment for other fire fighting units to handle chemical incidents. Often these other units must handle such incidents until the response team arrive or in the event of a large incident.

3. Because fire fighters (as well as other emergency and rescue personnel) are exposed to many hazardous materials during routine fire fighting and hazardous materials incidents, a program of routine medical surveillance should be established. The basic elements of this program should include:

   a. Examination - The baseline examination should begin with a complete medical history and physical examination. Primary focus should be on the pulmonary and cardiovascular systems, but other organ systems should also be assessed as should risk factors for cardiac and pulmonary diseases (e.g., cigarette smoking, family history, etc.)

   b. Pulmonary Function - Pulmonary function testing is also very important due to hazards from smoke and irritant chemical inhalation. Base-line testing is particularly important in order to track changes in pulmonary function over time. Such changes may only be apparent when current results are compared to results from prior tests.

   c. Chest X-ray - Although not advisable for routine periodic screening, baseline chest x-rays can be helpful for later follow-up, should pulmonary injury occur.

   d. Cardiac Testing - While a baseline electro-cardiogram can be helpful cardiac stress testing for asymptomatic individuals is probably not advisable at the current time. Positive testing in asymptomatic individuals may not be indicative of heart disease and can lead to further unnecessary testing.

   e. Blood and Urine Testing - Routine blood and urine testing may be useful for detecting individuals with specific problems such as diabetes or elevated lipid levels. Such testing is more important for hazardous materials response workers who are more likely to be exposed to hazardous chemicals. Baseline testing (e.g. liver function tests) may be useful in evaluating these fire fighters after a significant chemical exposure.

   f. Audiometry - Audiometric testing is also important because of the growing evidence that fire fighters may suffer significant noise-induced hearing loss from exposure to noise from sirens, etc.

g. Special Tests - For individuals with abnormalities on the other tests outlined above, or as indicated by their medical history, further testing may be necessary. In addition, the specific circumstances of some incidents may require some special testing. For example, if a group of fire fighters often respond to incidents involving pesticides, baseline cholinesterase levels may be useful for comparison with later tests should they be exposed to a pesticide fire or spill.

h. Periodic Testing - The medical examination and other tests (except for the x-rays) should be repeated periodically. A yearly examination is probably a good approach, particularly for older individuals.

4. Fire Fighters working on hazardous materials response teams or similar units (e.g., groups working in areas where such incidents are common) should have more extensive baseline and periodic examinations. Periodic examinations should occur at least every year and more often if indicated after significant exposures at several incidents.In addition to the items outlined above these exams should include:

   a. Baseline complete blood count, urinalysis, and serum biochemistry test battery. These tests provide useful information for detecting adverse effects from exposure to chemicals affecting the liver, kidneys, hematological system, etc.

   b. Baseline and periodic biological monitoring for chemical substances such as PCB's, pesticides, etc. The tests should be selected based on substances commonly encountered in these incidents and on the availability of suitable laboratory methods. The latter should include good quality control practices and the availability of data on usual levels found in different age groups, etc in order to be able to appropriately interpret and utitlize the data.

5. For both hazardous materials response teams and other fire fighters, the availability of good emergency and episodic medical care is very important. This should include prompt evaluation of fire fighters who are symptomatic after an incident or even asymptomatic persons exposed in a situation where significant toxic exposures might have occurred. The physicians providing this care should be familiar with the health affects from toxic exposures and the baseline medical data available for the fire fighter. To the extent possible, continuity of care by the same medical group is important. In addition, it should be noted that not all toxic effects are immediate; delayed respiratory, cardiovascular, and neurotoxic effects are not uncommon.

VIII. REFERENCES

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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:

1. United Fire Fighters of Los Angeles City
2. IAFF
3. Los Angeles Fire Department
4. Los Angeles Police Department
5. NIOSH, Denver Region
6. OSHA, Region IX

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I

INVENTORY OF CHEMICALS STORED AT ROC/RIC

TYPE OF HAZARDOUS MATERIALS	MAX QUANTITY IN USE LBS., GAL., ETC.
Acetone, Methanol, Isopropyl Alcohol, THF, Benzene, Isopropylether, Hexane Methylene Chloride, Ethyl Alcohol, Ethyl Acetate	1 Gal.
Acetic Acid, Anhydrous, Acetic Anhydride, Naphthenic Acid	1 Gal.
Sulfuric Acid	1 Gal.
Hydrazine Anhydrous	1/4 lb.
Sodium Metal	1/4 lb.
Magnesium Turning	1/4 lb.
Vanadium Pentoxide	1 lb.
Phosphoric Acid	1 lb.
Sodium Hydride, Titanium Hydride	100 gram
Lead Powder	100 gram

TABLE I
(CONTINUED)
INVENTORY OF CHEMICALS STORED AT ROC/RIC

TYPE OF HAZARDOUS MATERIALS	MAX QUANTITY IN USE LBS., GAL., ETC.
Alumina	1 lb
Barium Chloride	1 lb
Copper Pyrophosphate	1 lb
Chromium Potassium Sulfate	2 lbs
Manganese Sulfate	1 lb
Calcium Citrate	1 lb
Yttrium Oxide	1 lb
Chromic Chloride, Basic	20 lbs
Chromium Chloride, Anhydrous	1 lb
Magnesium Chromate	1 lb
Magnesium Carbonate	1 lb
Lithium Hydroxide	1 lb
Lithium Carbonate	2 lb
Potassium Pyrophosphate	1 lb
Potassium Persulfate	1 lb
Potassium Iodide	2 lb
Potassium Meta-phosphate	1 lb
Potassium Ferricyanide	100 gram
Potassium Permanganate	1 lb
Iron Carbonate	2 lbs
Iron Chips	1 lb
Dimethylaminomethylferrocene	1 pt.
Tri-butyl Tin Oxide	1 lb
Cobalt Choride, Anhydrous	1 lb
Zirconium Hydroxide	1 lb
Titanium Sulfate	1 lb
Silica	1 lb
Sodium Selenite	1 lb
Sodium Hydroxide	1 lb
Cerium Hydrated	1 lb
Sodium Hydride	100 gram
Titanium Hydride	100 gram
Hydrazine	0

TABLE I
(CONTINUED)
INVENTORY OF CHEMICALS STORED AT ROC/RIC

TYPE OF HAZARDOUS MATERIALS	MAX QUANTITY IN USE LBS., GAL., ETC.
Ammonium Citrate, Dibasic	1 lbs.
Ammonium Ferric Oxalate	100 gram
Nickel Chloride, Hydrated	2 lbs
Sodium Hexafluorotitanate	1 lbs
Ammonium Borate	1 lbs
Ammonium Thiosulfate	0 lbs
Sodium Dithio, 40% aqu. solo.	1 pint
Sodium Permanganate	1 lb
Sodium Molybdate	2 lbs
Molybenum Trioxide	5 lbs
Copper Sulfate	10 lbs
Celite, Filtration Aid	1 lb
Oxalic Acid. Hydrated	1 lb
Citric Acid	2 lbs
Manganous Pyrophosphate	1 lb
Potassium Citrate	1 lb
Ammonium Alum	1 lb
Trimethoxy Borane	1 qt
Aniline Oil, Liquid	0
Trifluoroacetic Acid	1 qt.
Methyl Borate	1 qt.
Ammonium Chloride'	5 lbs
Polymethylhydrosiloxane	0
Potassium Hydroxide	1 lb
Zinc Chloride	1 lb
Zirconyl Sulfate	1 lb
Sodium Carbonate	5 lbs
Boric Acid	1 lb
Sodium Bicarbonate	5 lbs
Sodium Sulfide	1 lb
Formic Acid	1 pint
Phenol	1 lb
Pump Oil	2 qt.
Fluorosilic Acid	1 qt
Zirconium Acetate, Solution	1 gallon
Hydrogen Peroxide Solution, 35%	1 gallon
Cerium Ammonium Nitrate	5 lbs
Barium Titanate	2 lbs

TABLE II

INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS

Characteristics of Study Participants

	Fire Fighters (64)	Paramedics (5)	Police (30)
Sex:			
Males	64 (100%)	5 (100%)	23 (77%)
Females	0 (0%)	0 (0%)	7 (23%)
Race:			
White	56 (88%)	4 (80%)	27 (93%)
Black	4 (6%)	0 (0%)	0 (0%)
Hispanic	4 (6%)	1 (20%)	2 (7%)
Age (yrs.)			
Mean	38.0	33.4	36.8
Range	22-58	27-39	23-50
Years on job:			
Mean	14.4	8.0	13.5
Range	2-31	6-11	2-25

TABLE III

INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS

DERMATITIS AFTER THE FIRE

	Fire Fighters[1]	Police
Rash[2]	18 (26.5%)	9 (29%)*
Location:		
Head, Face, Neck	13 (18.8%)	7 (23.3%)
Trunk	1 (1.5%)	1 (3.3%)
Arm	8 (11.6%)	4 (13.3%)
Hand	5 (7.3%)	1 (3.3%)
Leg	6 (8.7%)	0 (0.0%)
Foot	7 (10.1%)	5 (16.7%)

[1] Includes Paramedics

[2] Rash lasting over one day after exposure

* Statistically significant association with reported skin wetness after fire

TABLE IV

INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS

NEUROLOGIC SYMPTOMS

Symptom	Fire Fighters		Police	
	May 1985	June 1986	May 1985	June 1986
More easily tired	16 (23.2%)*	14 (20.3%)	11 (36.7%)*	12 (40.0%)*
Forgetfulness	11 (15.9%)	11 (15.9%)	9 (30.0%)*	10 (33.3%)*
Forgetfulness note by family or friends	7 (10.1%)	9 (13.0%)	9 (30.0%)	7 (23.3%)
Difficulty concentrating	5 (7.2%)	6 (8.7%)	9 (30.0%)	8 (26.7%)
Confused or disoriented	5 (7.2%)	4 (5.8%)	8 (26.7%)	4 (13.3%)
Depressed	4 (5.8%)	2 (2.9%)	8 (26.7%)	5 (16.7%)
Irritable	11 (15.9%)	5 (7.2%)	7 (23.3%)	3 (10.0%)
Nervous	11 (15.9%)	3 (4.3%)	8 (26.7%)*	7 (23.3%)*
Sleeping more	5 (7.2%)	6 (8.7%)	3 (10.0%)	3 (10.0%)
Difficulty sleeping	8 (11.6%)	8 (11.6%)	6 (20.0%)	7 (23.3%)
Headaches	18 (26.1%)	13 (18.8%)	12 (40.0%)*	10 (33.3%)
Dizziness	12 (17.4%)*	6 (8.7%)	11 (36.7%)*	8 (26.7%)
Difficulty driving	4 (5.8%)	3 (4.3%)	10 (33.3%)	7 (23.3%)
Loss of balance	2 (2.9%)	5 (7.2%)	6 (20.0%)	7 (23.3%)
Poor coordination	2 (2.9%)	2 (2.9%)	3 (10.0%)	3 (10.0%)
Numbness of tingling in fingers	3 (4.3%)	2 (2.9%)	2 (6.7%)	0 (0.0%)
Numbness or tingling in feet	2 (2.9%)	1 (1.4%)	1 (3.3%)	1 (3.3%)
Mood changes	10 (14.5%)	5 (7.2%)	7 (23.3%)*	6 (20.0%)*
Lower alcohol tolerance	1 (1.4%)	0 (0.0%)	3 (10.0%)	3 (10.0%)
Blurred or double vision	10 (14.5%)	9 (13.0%)	7 (23.3%)*	5 (16.7%)
Slurred speech	1 (1.4%)	0 (0.0%)	5 (16.7%)	1 (3.3%)

* Association with reported exposure at fire statistically significant by Fishers Exact Test $p < 0.05$

TABLE V

INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS

OTHER SYMPTOMS

Weakness	12 (17.4%)	6 (8.7%)	11 (36.7%)	10 (33.3%)
Loss of appetite	2 (2.9%)	1 (1.4%)	5 (16.7%)	3 (10.0%)
Unexplained weight loss	1 (1.4%)	0 (0.0%)	1 (3.3%)	3 (10.0%)
Diarrhea	2 (2.9%)	4 (5.8%)	5 (16.7%)	4 (13.3%)
Indigestion	4 (5.8%)	3 (4.3%)	3 (10.0%)	3 (10.0%)
Nausea	4 (5.8%)	2 (2.9%)	6 (20.0%)	4 (13.3%)
Loss of strength in arms	3 (4.3%)	3 (4.3%)	6 (20.0%)	4 (13.3%)
Loss of strenght in legs	3 (4.3%)	2 (2.9%)	4 (13.3%)	4 (13.3%)
Neck stiffiness	4 (5.8%)	7 (10.1%)	5 (16.7%)	8 (26.7%)

TABLE VI

INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS

RESPIRATORY SYMPTOMS AND PULMONARY FUNCTION ABNORMALITIES

	Fire Fighters		Police	
Symptom	May 1985	June 1986	May 1985	June 1986
Shortness of breath*	12 (17.4%)	10 (14.5%)	12 (40.0%)	8 (26.7%)
Chronic cough ,	10 (14.5%)	6 (8.7%)*	7 (23.3%)*	3 (10.0%)
Chest pain or tightness*	8 (11.6%)	5 (7.2%)	6 (20.0%)	4 (13.3%)

Finding	Fire Fighters	Police
Obstructive	15 (21.2%)	8 (26.7%)
Restrictive	1 (1.4%)	1 (3.3%)

* Association with reported exposure at fire statistically significant by Fishers Exact Test $p < 0.05$