

I. RECOMMENDATIONS FOR A STANDARD FOR PESTICIDE
MANUFACTURING AND FORMULATING INDUSTRIES

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to pesticides in manufacturing and formulating workplaces be controlled by adherence to the following sections. The recommended standard is designed to protect the health and safety of employees in pesticide manufacturing and formulating facilities over their working lifetime. Compliance with all sections of the recommendations will establish an increased level of control over the workplace environment of pesticide manufacturers and formulators and should thus prevent or greatly reduce adverse effects of pesticides on the health and safety of employees. Sufficient technology exists to permit compliance with the recommended standard. The criteria and standard will be subject to review and revision, as necessary.

Environmental (workplace air) limits are not included in the recommended standard. Such values have been promulgated for many pesticides by The Occupational Safety and Health Administration (OSHA), and NIOSH has previously recommended such limits individually for various pesticides (see Appendices III and IV). NIOSH recommends compliance with promulgated environmental limits and adoption of new environmental limits in those cases where the NIOSH recommended environmental limits

differ from those already promulgated. These include the limits recommended for substances such as parathion, methyl parathion, creosote, ethylene dibromide, and dinitro-o-cresol. In this document, emphasis has been placed on work practices, engineering controls, and medical surveillance programs to protect workers from the adverse effects of pesticide exposure in manufacturing and formulating operations. A number of factors led NIOSH to this decision. First, workers in pesticide manufacturing and formulating operations are exposed to a large number of different chemicals and substances. Sampling and analytical methods to determine airborne exposure levels for each substance would need to be highly sophisticated. Second, exposure via other routes, especially dermal, has proven to be of critical importance for many pesticides. The relationship between dermal exposure hazards and airborne levels is scientifically tenuous, and adherence to environmental (workplace air) limits does not always protect the employee from significant dermal exposure. Third, NIOSH believes that immediate action is needed to protect workers in pesticide manufacturing and formulating plants. The time required to evaluate all the documented toxic effects and to establish scientifically valid environmental (workplace air) limits for approximately 1,500 pesticides would be a matter of years. Consequently, reliance on engineering controls, work practices, medical examinations, and education of employers and employees is seen as the first step in attempting to prevent additional poisoning episodes similar to those involving Kepone and leptophos.

Because of the wide range of adverse health effects that can arise from employee exposure in manufacturing and formulating facilities, it was determined that a single set of work practices and engineering controls would not effectively protect health and safety and at the same time avoid placing unnecessary burdens on both employees and employers in such facilities. Therefore, various classification schemes used by organizations in the US and in other countries were examined for the purpose of grouping pesticides according to toxicity. A considerable degree of similarity was found among such schemes.

Given the similarity that exists among the various schemes examined and the absence of significant differences in scientific merit, the system used by the US Environmental Protection Agency (EPA) was selected as the basis for the approach recommended in this document.

These criteria for a pesticide standard apply only to occupations in pesticide manufacturing and formulating. This includes manufacturing, formulating, packaging, mixing, blending, or repackaging of any pesticide active ingredient. Occupational exposure is defined as contact with any pesticide or other chemical during the manufacture and formulation of pesticides. "Pesticide" is used herein as the generic term meaning any substance or mixture of substances intended for those uses described by definition in the Federal Environmental Pesticide Control Act (FEPCA): preventing, destroying, repelling, or mitigating any pest and regulating, defoliating, or desiccating any plant (40 CFR 162). All pesticide active ingredients

registered with the EPA are covered by this recommended standard. Other chemicals to which workers are potentially exposed in pesticide manufacturing and formulating operations (such as intermediates, impurities, diluents, emulsifiers, carriers, inerts, and propellants) are also covered by the provisions contained herein, as well as by provisions in any separate standards applicable for such chemicals, eg, xylene. In the case of conflicts between this recommended standard and any existing standard, NIOSH recommends that the more stringent standard apply.

The standard was not designed for the population-at-large, or for users of pesticides who are already regulated by other agencies such as the US Department of Transportation (DOT), EPA, and the Food and Drug Administration (FDA). Application of this recommended standard to situations other than the occupational settings specified above is not warranted.

Each section of the recommended standard contains three sets of requirements that pertain to the three groups of pesticides listed in Appendix I. Pesticides in Group III are the least toxic and therefore require the least stringent level of control. Group II pesticides produce acute effects at lower dose levels than Group III pesticides; controls for Group II include all of the Group III controls with some additional, more stringent requirements. Pesticides in Group I produce acute effects at extremely low-dose levels or serious irreversible effects; therefore, pesticides in Group I require those controls for Groups III and II and additional requirements where noted.

Classification by acute toxicity is based on oral and dermal LD50's and inhalational LC50's in mammals, and includes both systemic and local effects. Certain pesticides have been classified based on irreversible effects, including probable and potential carcinogenicity, and potential teratogenicity, mutagenicity, neurotoxicity, and reproductive effects, as demonstrated in animal test systems and human epidemiologic studies. Insecticides which inhibit cholinesterase (ChE) activity are also noted. Numeric definitions of the three pesticide groups are presented in Table VI-1. By necessity, only selected portions of the published literature on chronic adverse health effects of this extremely large and diverse group of chemicals were reviewed and evaluated in this document. As new data regarding toxicity and potential hazards are developed and evaluated, it is highly probable that pesticide classifications will change over time.

It should be emphasized that pesticides are an extremely diverse group of substances. There is a potential for a wide variety of toxic effects throughout the group. For many pesticides, the possibility of dermal exposure and subsequent absorption presents a greater problem to workers than does exposure through inhalation. In addition, many establishments by their nature manufacture or formulate a vast number of pesticides with varying toxicities; the possible synergisms of these combinations of substances are unknown. Consequently, there is a need for constant surveillance and monitoring and thorough recordkeeping to make sure that employees are following proper

procedures so that their health is not compromised.

Section 1 - Medical

GROUPS III, II, AND I

(a) Preplacement or initial medical examinations shall be made available as described below for all employees subject to exposure to pesticides:

(1) Comprehensive medical and work histories with emphasis directed toward the hepatic, renal, and central nervous systems and toward evidence of glaucoma, cardiovascular, or respiratory disease. The use of drugs or any illnesses resulting from past exposures to pesticides should also be noted.

(2) Comprehensive physical examination giving particular attention to the eyes, liver, kidneys, lungs, and the central and peripheral nervous systems.

(3) After a review of the type and amount of exposure, clinical tests such as pulmonary function, chest X-ray, liver enzyme determinations, and urinalysis may be carried out at the discretion of the responsible physician.

(4) A judgment of the worker's ability to use negative and positive pressure respirators.

(5) Red blood cell (RBC) ChE activity shall be measured for determination of a preexposure baseline if the employee will potentially be exposed, or for determination of a working baseline if the employee has previously been and will continue to be exposed to those pesticides indicated as ChE inhibitors in Appendix I.

"Preexposure baseline" for RBC ChE is defined as the mean of two ChE activity determinations, each of which is derived from a separate sample of blood taken at least 1 day apart after a period of at least 60 days without known exposure to any ChE-inhibiting compounds. If the determinations produce values differing by more than 15%, additional determinations on new samples must be performed until successive tests do not differ by more than 15%.

"Working baseline" for ChE is defined as the mean of two ChE activity determinations, each of which is derived from a separate sample of blood taken at least 1 day apart and differing by no more than 15%, or the arithmetic mean of normal values for an appropriate control population of adults for that laboratory, whichever is higher. A "working baseline" is determined only for an individual whose work history does not permit a preexposure baseline to be determined as specified in this section.

"Mean of normal values" is defined as the arithmetic mean of ChE activities for healthy adults as determined by the laboratory's experience with repeated analyses, but which is not inconsistent with the mean baseline activities presented in Appendix II. Working, or preexposure, baseline RBC ChE activities shall be determined within 60 days of promulgation of a standard based on this recommendation.

(b) Periodic examinations shall be made available on at least an annual basis and shall include at least:

- (1) Interim medical and work histories.
- (2) Physical examination as outlined in (a) (2)

and (3), above.

(c) Periodic measurement of RBC ChE activity shall be made available for workers exposed to organophosphorus (OP) insecticides as follows:

(1) Subsequent to the determination of a preexposure or working baseline, each employee occupationally exposed to OP insecticides, indicated in Appendix I as being ChE inhibitors, shall have his ChE activity determined at 1-week intervals. These intervals may be initially reduced to testing as frequently as every day, or may be increased after three weekly determinations to testing as frequently as every 8 weeks, based on the decision of the responsible physician after consideration of the following for each employee:

(A) The toxicity of the pesticides to which the employee may be exposed.

(B) The potential duration and concentration of the pesticide exposure.

(C) The state of health of the employee.

(D) The results of previous ChE determinations.

(2) Unacceptable exposure to OP insecticides indicated in Appendix I as ChE inhibitors is demonstrated when the activity of RBC ChE is decreased to below 70% of baseline. The employee shall be advised of such a finding, and an industrial hygiene survey shall be conducted in the workplace of the affected employee unless the cause of the exposure is known and corrective action has been initiated. This survey shall

include an assessment of the dermal exposure potential. Based on the results of this survey, necessary corrective action shall be accomplished.

In addition, an employee whose RBC ChE activity is decreased to below 60% of the employee's baseline level shall be removed from potential exposure and placed under medical observation.

(3) An employee who has been removed from pesticide exposure shall not be allowed to return to work involving occupational pesticide exposure until his RBC ChE activity has returned to at least 75% of the working or preexposure baseline values or unless the responsible physician has approved his return.

(4) Each employee shall be given a copy of the results of his initial and periodic tests, and of any special ChE test results as soon as possible after the test, and an interpretation thereof.

(5) Procedures for collection and analysis of blood samples for ChE activity determinations shall be as provided in Appendix II or by any method shown to be at least equivalent in accuracy, precision, and sensitivity to that specified.

(d) Emergency first-aid services shall be established, under the direction of the responsible physician, to provide care to any worker acutely intoxicated by pesticides.

(e) Appropriate medical services and surveillance shall be provided to any worker with adverse health effects reasonably

assumed or shown to be due to occupational exposure to pesticides.

(f) During examinations, applicants or employees found to have medical conditions such as skin disease, chronic lung disease, glaucoma, or abnormalities of the central or peripheral nervous systems that could be directly or indirectly aggravated by exposure to pesticides shall be counseled as to the possible increased risk of impairment of their health from working with the substances. Employees should be further counseled about reproductive effects that have been noted in male workers and in laboratory animals involving certain pesticides. The significance to humans of the effects in laboratory animals are not fully known, but they do indicate that exposure should be minimized, particularly in women of child-bearing age. In addition, residues of some organochlorine (OC) and carbarate pesticides have been found in human breast milk. Therefore, women who may bear or nurse children should avoid any contact with these materials.

(g) A complete examination including all aspects of paragraph (a) shall be offered to all employees within 1 month after employment ends.

(h) The employer shall provide the consulting physician for each pesticide operation with information on the following items:

- (1) Plant layout and operations.
- (2) Hazardous substances used by workers.
- (3) Physical, chemical, and toxicologic

properties of hazardous substances used by workers.

(4) Symptoms of intoxication by hazardous substances.

(5) Treatment for accidental exposures to hazardous substances.

Section 2 - Labeling and Posting

GROUP III

(a) All containers of pesticides to be used within pesticide manufacturing or formulating facilities shall be labeled.

(1) Labels shall include the following information:

(A) Contents, by chemical and common names.

(B) Fire hazard.

(C) Toxicity hazard.

(D) Storage and handling precautions.

(E) First aid for inhalation, ingestion, and contact with skin or eyes.

(2) The information shall be arranged as in the following example:

PESTICIDE X

Chemical Name

MAY BE FATAL IF INHALED, ABSORBED THROUGH SKIN,
OR INGESTED. EXPLOSION MAY RESULT FROM HEAT OR SHOCK.

Store in cool place.
Protect from sunlight.
Avoid contact with skin and eyes.
Use only with adequate ventilation.

First Aid: In case of eye or skin contact wash immediately.
If clothes become contaminated, remove at once, wash body
with soap and water, and call physician without delay.
Pesticide X is a ChE inhibitor.

(b) All entrances to areas where pesticides are
manufactured, formulated, repackaged, stored, or otherwise
handled shall be posted with signs specifying:

(1) Special clothing and personal protective
equipment necessary for entry.

(c) All emergency-use personal protective clothing and
equipment shall be clearly labeled as to limitations in its use.

(d) All warning signs shall be printed both in English
and in the predominant language of non-English-reading workers.
Workers unable to read labels and signs provided shall receive
information regarding hazardous areas and shall be informed of
the instructions printed on labels and signs.

GROUP II

Group III Labeling and Posting requirements apply, with the
following additions:

(b) (2) Hazardous materials which may be encountered.

(b) (3) Restrictions on personnel who may enter and on activities (such as eating) which may be performed therein.

(e) All pesticide-processing equipment and pipes shall be properly identified by such means as labeling or color coding to indicate that pesticides are contained therein.

(f) All nondisposable routinely used personal protective equipment shall be labeled as to assignee.

(g) All working areas, lavatories, toilet rooms, shower rooms, locker rooms, eating areas, and smoking areas shall be posted to remind employees of applicable parts of Section 6.

GROUP I

Group II Labeling and Posting requirements apply with the following additions and changes:

(a) (1) (C) Toxicity hazard, including an indication of any probable or suspect carcinogenic, mutagenic, teratogenic, neurotoxic, or reproductive health effect.

(b) (4) A warning that the area is restricted.

(e) All pesticide-processing equipment shall be labeled by color code or other means to identify hazardous contents and any extremes in temperature or pressure.

Section 3 - Personal Protective Clothing and Equipment

(a) Work Clothing

GROUP III

Employers shall provide a means for storing contaminated work clothing in a location separate from street clothing to prevent contamination of street clothing.

GROUPS II AND I

(1) All employees working in potential exposure areas shall be required to wear the following set of work clothing:

(A) Washable socks and underwear.

(B) Washable or disposable coveralls or pants and long-sleeved shirts, aprons, or other special outerwear.

(C) Washable work footwear or disposable footwear covers.

(D) Washable cap, if a hard hat is not required.

(2) Employees shall be required to wear a clean set of work clothing each day. A complete second set of clean work clothing shall be provided and used to replace any that becomes obviously contaminated during the workshift.

(3) Employers shall provide a means for storing contaminated work clothing from the time it is removed by employees until its disposal or laundering. Such means shall:

(A) Clearly identify the nature of contamination.

(B) Prevent the contamination from being disseminated.

(4) Employers shall also provide a means for the disposal or laundering of all contaminated garments. All persons engaged in laundering such garments shall be instructed as to the pesticide hazard. For garments worn while handling carbamates or

OP's, laundering shall include presoaking in an alkaline solution (preferably of pH 10 or greater), washing, and subsequent rinsing. Garments laundered by other than the employer shall be reused only by the employer.

(b) Personal Protective Equipment

GROUP III

(1) Employees who may be exposed to pesticides in a dust or powdered form shall wear, in addition to their set of work clothing:

(A) Washable gloves.

(2) Employees who may be exposed to pesticides in a liquid or in a wet or hygroscopic solid form shall wear, in addition to their set of work clothing, the following:

(A) Chemical goggles, and where chemical burns are a hazard, a face shield.

(B) Gloves made of minimally permeable material.

(C) Footwear or footwear covers made of minimally permeable material.

(D) An apron or similar body covering made of minimally permeable material to prevent contamination of clothing.

(E) A type of hat whose configuration prevents spilled liquids from dripping on the neck or into the face of the wearer.

(3) All personal protective equipment shall be

inspected at least quarterly by the employer to check for contamination, deterioration, or loss of function and shall be replaced if necessary.

GROUP II

Group III requirements for Personal Protective Equipment apply with the following additions and change:

(3) Inspection frequency shall be at least monthly.

(4) Personal protective equipment shall be cleaned or replaced each time it is used. Extra issues of clean protective equipment shall be provided and used to replace any which becomes obviously contaminated during the workshift.

(5) Employers shall make appropriate provisions for the washing of personal protective equipment, including:

(A) Sink with running water.

(B) Decontamination solution to remove or neutralize pesticides.

(C) Disinfectant or sanitizing rinse.

(D) Drying rack or disposable towels.

GROUP I

Group II requirements for Personal Protective Equipment apply with the following changes:

(3) Inspection frequency shall be at least weekly.

(5) Employers shall be responsible for decontamination, sterilization, and maintenance of protective equipment.

(c) Respiratory Protection

GROUPS III AND II

(1) Protection of employees from exposure to airborne pesticides may not be achieved by the use of respirators except:

(A) During the development, installation, testing, maintenance, or repair of required engineering controls.

(B) For conducting operations such as maintenance, repair, or cleanup of spills.

(C) During emergencies.

(2) Employers shall use the survey data required in Section 8(a)(1) to determine which locations and employees shall be provided with emergency-use respirators.

(3) Respirators shall be those approved by NIOSH and the Mine Safety and Health Administration (MSHA) as specified under 30 CFR 11.

(4) Employers shall prepare written procedures for use of respirators. The procedures for each type of respirator shall include, but not be limited to, the following:

(A) By whom and where the respirator is to be worn.

(B) Limits as to materials and concentrations against which the respirator affords protection.

(C) Manner in which the respirator is to be put on, worn, and taken off.

(D) Frequency of servicing, disinfecting,

cleaning, inspecting, and replacing parts of the respirator.

(E) Manner and location of respirator storage.

(5) Employers shall maintain a written log for all nondisposable respirators which includes:

(A) Date of purchase; shelf-life information.

(B) Dates of issue, wearing and servicing, and suitable identification of persons responsible for these actions.

(C) Dates and conditions of tests and inspections.

(6) Employers shall supervise the respiratory protective program according to the following schedule:

(A) Observe at least monthly each employee wearing a non-emergency-use respirator while he is performing work tasks.

(B) Inspect each non-emergency-use respirator at least monthly.

(C) Inspect and test each emergency-use respirator at least monthly and after each use.

(D) Conduct a practice drill at least quarterly with each employee who would wear emergency-use respirators.

GROUP I

Group II requirements for Respiratory Protection apply with the following additions and changes:

(6) (A) and (6) (B) Inspection frequencies shall be at least weekly.

(7) Except for emergency-escape-use respirators, all respirators shall be a full-face, air-supplied or self-contained type, unless respirators of other types are certified under 30 CFR 11.

(8) Quantitative fit tests shall be administered to all employees who may be required to wear respirators.

Section 4 - Informing Employees of Hazards from Pesticides

GROUPS III AND II

(a) Before employees are exposed to any pesticide, pesticide formulation, inert, or raw material, they shall be fully apprised of the following:

(1) Identification by name, characteristics (smell, appearance, etc), and physical properties.

(2) Hazards of toxicity.

(3) Signs and symptoms of overexposure.

(4) Fire and explosion hazards.

(5) Precautions for safe handling.

(6) Emergency first-aid treatment for overexposure.

(7) Plant layout and emergency escape routes.

(b) Employees shall be trained in the use, limits of use, storage, and maintenance of all personal protective clothing and equipment which they may use.

(c) Employees shall be trained to recognize and control

the hazards arising from materials handling, housekeeping, waste disposal, and maintenance.

(d) Employees shall be trained in all emergency procedures.

(e) Employees shall be trained in the reasons for, and the practice of, personal hygiene.

(f) All training shall be conducted on a preassignment basis. Retraining shall be conducted semiannually or whenever necessitated by changes in equipment, processes, materials, or employee work assignments.

(g) A Material Safety Data Sheet, shown in Appendix V, or a similar form approved by OSHA shall be prepared for each pesticide or other chemical used or stored in the plant. A copy of each sheet shall be posted in a conspicuous place accessible to all employees.

GROUP I

Group II requirements for Informing Employees of Hazards from Pesticides apply, with the following change and addition:

(a) (8) A thorough explanation of all probable or suspect carcinogenic, neurotoxic, teratogenic, or reproductive health effects attributable to the pesticides to which workers may be exposed.

(h) A Material Safety Data Sheet shall be posted at all entrances for each Group I pesticide found in that area.

Section 5 - Work Practices

(a) Materials Handling

GROUP III

(1) General. No employee shall be permitted to routinely handle any pesticide with bare skin. Pesticides shall be handled in such a manner as to minimize their dissemination.

(2) Containers. All pesticides shall be handled in conformance with the labels on the containers as required in Section 2(a)(4). Any employee engaged in moving, filling, or emptying containers of pesticides shall wear the protective clothing and equipment as specified in Section 3. Emptied containers of pesticides shall be assumed to contain a residue of the material until decontaminated.

(3) Storage. Pesticides shall be stored in containers constructed and arranged so as to minimize leakage. Pesticide storage areas shall be so designated and separated from other plant areas. Such areas and containers therein shall be inspected at least quarterly to ensure that their integrity is not compromised. No person shall be permitted to eat, drink, smoke, or sleep in pesticide storage areas. Storage areas shall not be directly connected to adjacent work areas by heating ducts, ventilation ducts, doors, or windows.

GROUP II

Group III requirements for Materials Handling apply with the following change:

(3) Inspection frequency shall be at least monthly.

GROUP I

Group II requirements for Materials Handling apply with the following changes and addition:

(1) No employee shall be permitted to handle any pesticide with bare skin.

(3) Inspection frequency shall be at least weekly.

(4) Storage areas shall be of sound construction with restricted access.

(b) Housekeeping

GROUPS III AND II

(1) Areas where pesticides are manufactured, formulated, repackaged, stored, or otherwise handled shall be inspected at least daily for pesticide residues. Any equipment with pesticide leaks or residues shall be inspected for any indications of malfunction or structural damage, and such faults shall be promptly corrected.

(2) A pesticide that is spilled, leaked, or otherwise released shall be cleaned up or contained immediately. Fallout, condensates, and all other accumulations from airborne pesticide emissions shall be cleaned from employee work surfaces (such as handrails and workbenches) at least daily, and from all workroom surfaces (including walls, ceilings, and floors) at least monthly.

(3) Pesticides and pesticide-contaminated residues shall be flushed to a collecting sump, vacuumed,

absorbed by cleaning materials, or collected by other nondispersive means.

GROUP I

Group II requirements for Housekeeping apply with the following change:

(2) Workroom surfaces shall be cleaned at least weekly.

(c) Waste Disposal

GROUPS III AND II

(1) No disposal method shall be used which contravenes local, state, or Federal regulations.

(2) Pesticide-contaminated solids and liquids shall be decontaminated before disposal unless other approved disposal methods are used.

(3) Pesticide-contaminated waste gases shall be treated before release to the outside atmosphere to prevent return of pesticides into work atmospheres.

(4) Pesticide containers shall retain their warning labels until such time as they are decontaminated.

(5) Pesticide catch basins, drip pans, and other open collectors shall be checked regularly and emptied when necessary to prevent their acting as a secondary source of pesticide exposure.

GROUP I

Groups III and II requirements for Waste Disposal apply with the following change:

Delete (5). (Open containers should not be used to collect pesticide leakage. See Section 7, Part G.)

(d) Maintenance

GROUP III

(1) Employers shall institute a program of preventive maintenance which includes:

(A) Inspections, conducted at least quarterly, of all pesticide-processing equipment whose failure would subject employees to pesticide exposure. Lubrication, repair, or replacement of the equipment shall be performed whenever indicated by such inspections.

(B) Inspections, conducted at least quarterly, of ventilation systems and pesticide collection systems to ensure their maximum effectiveness.

(2) No pesticide-processing equipment shall be disassembled, opened, or otherwise modified or repaired in a manner which could expose any employee to the contents until the following precautions have been taken:

(A) The equipment shall be disconnected from sources of mechanical and/or electrical power and from flow of materials. Such cutoff shall be secured and posted.

(B) Any part of the equipment contaminated by pesticides shall be decontaminated, flushed, or purged prior to modification or repair.

(C) Employees performing modifications, repair, or maintenance shall wear appropriate personal protective

clothing and equipment.

(3) All newly installed, repaired, replaced, or reassembled pesticide-handling equipment shall be tested for leaks and mechanical function before being returned to general use.

(4) No employee shall be allowed to enter a vessel or confined space without first obtaining a permit signed by the supervisor.

(5) The supervisor shall not sign an entry permit until the following have been completed:

(A) The flow of material to the space has been cut off, the cut-off valve secured by the lock of each worker to enter the confined space, and the area posted.

(B) The area has been thoroughly flushed, ventilated, and tested for the concentration of oxygen.

(6) The employee entering the space shall use appropriate personal protective equipment and shall also wear a lifeline.

(7) During the time period that an employee is working within a confined space, visual and voice contact shall be maintained with a second person outside the space. That second person shall also be equipped with a lifeline and appropriate personal protective equipment and shall be in contact with a third person.

GROUP II

Group III requirements for Maintenance apply, with the following addition and changes:

(1) (A) and (1) (B) Inspection frequencies shall be at least monthly.

(1) (C) Keeping written records of maintenance, repair, and replacement histories of process equipment as long as the equipment is on the plant site. The records shall be used to determine a schedule of servicing and component replacement that is frequent enough to avoid equipment failures.

GROUP I

Group II requirements for Maintenance apply with the following changes and addition:

(1) (A) and (1) (B) Inspection frequency shall be at least weekly.

(2) (D) Local lubrication and other minor maintenance procedures performed on closed systems shall be carried out only when appropriate employee protection is provided.

(e) Emergency Procedures

GROUPS III AND II

(1) First Aid. Emergency first-aid services shall be established to provide care to any worker manifesting effects of pesticide exposure. Whenever possible, first-aid services shall be delivered by persons trained in emergency medical services. Records of such services shall be included in the employee's medical history and other plant medical records. These services shall include but not be limited to:

(A) Deluge showers and eyewash fountains

within close proximity to all locations where exposure to pesticides may occur including, but not limited to, packaging, unpackaging, maintenance, loading and unloading areas, and sampling ports. These facilities shall be checked periodically to make certain they are operating properly and have not been contaminated. All runoff from use of showers and eyewash fountains shall drain to a sump for decontamination. Pathways leading to showers and eyewash fountains shall be kept free of all obstacles.

(B) Provisions for emergency transportation to health care facilities.

(C) Oxygen and resuscitation equipment.

(2) Provisions for medical treatment of overexposure to pesticides shall be made, including appropriate arrangements with a local physician, clinic, or hospital.

(3) Leaks and spills

(A) Materials for absorption or hoses with running water shall be available so that spilled or leaked pesticides may be removed from work areas for decontamination, disposal, or reuse.

(B) Emergency-escape personal protective equipment shall be readily available to employees working in areas where leaks or spills may occur.

(C) Employers shall provide for the warning and evacuation of employees in the case of leaking gaseous pesticides.

(4) Fire and Explosion

(A) A system for informing employees and notifying fire-fighting personnel in case of fire shall be installed.

(B) Personal protective equipment and first-aid supplies shall be available in the plant for dealing with exposure to the materials formed by combustion and pyrolysis of pesticides.

(C) Fire-fighting personnel shall be provided with a map and data reflecting all information obtained by the employer in Section 8(a) - Monitoring.

(D) Drills shall be conducted to thoroughly familiarize employees with escape, rescue, fire-fighting, and power- and materials-shutoff procedures in case of fire.

(5) All procedures in Section 5(e) - Emergency Procedures shall be incorporated in a written emergency action plan.

GROUP I

Group II requirements for Emergency Procedures apply with the following changes:

(3) (B) Emergency-escape personal protective equipment shall be carried by employees or shall be immediately at hand for employees working in areas where leaks or spills may occur. Emergency rescue equipment shall be available just outside such areas.

(3) (C) Employers shall provide a warning system for informing employees of leaking pesticide gases or

vapors. Such a system may include continuous monitors connected to audible alarms, pressure-loss sensors coupled with visual indicators, etc. The system must be capable of warning all potentially exposed employees before a hazardous concentration is reached. Warning systems shall be tested at least monthly.

Section 6 - Sanitation and Personal Hygiene

GROUP III

(a) Eating and food preparation or dispensing (including vending machines) shall be prohibited where there is occupational exposure to pesticides.

(b) Smoking shall be prohibited in areas where pesticides are present.

(c) Employees who handle pesticides or equipment contaminated with pesticides shall be instructed to wash their face, hands, and forearms with soap or mild detergent and water before eating, drinking, smoking, or using toilet facilities.

(d) To prevent skin absorption of pesticides, employers shall instruct employees not to use solvents to clean their hands or other exposed areas of the body.

(e) The employer shall provide clean change rooms equipped with storage facilities for street clothes and separate storage facilities for protective clothing and equipment whenever employees are required to wear protective clothing and equipment in accordance with Section 3.

GROUPS II and I

Group III Requirements for Sanitation and Personal Hygiene

apply, with the following change and additions:

(e) Employees occupationally exposed to pesticides shall not wear work clothing away from their place of employment.

(f) Facilities for shower baths shall be provided for employees occupationally exposed to pesticides. Workers should shower before changing into street clothes.

(g) Employers shall instruct employees exposed to pesticides to wear clean work clothing daily, and cleaning establishments shall be informed as to the hazards of handling pesticides and proper disposal procedures for pesticide-contaminated wastewater.

(h) A separate walled change area for removal and storage or disposal of contaminated clothing with exit to shower shall be provided.

(i) Showers with potable warm running water shall be provided. The exit from showers shall open into a clean change area free from pesticide contamination.

Section 7 - Engineering Controls

GROUPS III AND II

Employee exposure to pesticides, intermediates, and solvents shall be minimized through the use of engineering controls and work practices.

(a) Engineering controls shall be used to seal or isolate process equipment in order to minimize the escape of pesticides into the workplace. In the case of isolation, appropriate ventilation shall be used to prevent the accumulation

of pesticide emissions.

(b) Local exhaust ventilation shall be used to control airborne process emissions which are not amenable to control by sealing or isolation. These ventilation systems shall be vented to appropriate air cleaning devices.

(c) Appropriate measures shall be implemented in order to prevent any leakage of liquid process streams from spreading into the workplace. These measures may include the use of physical barriers such as containment dikes or splash shields in addition to specified work practice cleanup and decontamination procedures.

(d) Threaded pipe connections shall not be used for pesticide-contaminated streams.

GROUP I

Group II requirements for engineering controls apply, with the following additions:

(e) Process leaks shall be minimized through the selection of hardware which presents a minimum potential for leakage consistent with the required process performance. Types of hardware may include internally pressurized double mechanical seals, "canned" pumps, welded pipe connections, or pressure-tested piping and vessels (at least 2.5 times maximum working pressure). Emissions from all potential process leak points shall be controlled, including but not limited to:

(1) Seals on pumps, vessel agitator shafts, mixer drive shafts, compressors and other similar pieces of equipment.

(2) Valves, including process control valves.

(3) Flanges, gaskets, and other such connections.

(4) Process piping and reactor manways.

(f) Where possible, process and piping systems shall be designed such that anticipated equipment failure or operator errors will not result in workplace emissions of pesticides. For example, pressure relief valves on positive displacement pumps may be piped to release to the pump intake. Automatic process control valves may be installed so that failure would occur in a fail-safe (non-emission) position. Automatic cutoff valves actuated by level indicators on receiving vessels may be installed on process pumps.

(g) In the case of process leak points which cannot be eliminated using the procedures outlined in (e) and (f) above, controls shall be implemented so that leaks can be detected and controlled immediately in order to minimize occupational exposure. These controls may include a series of flexible local exhaust takeoffs to be used on an "as needed" basis, warning devices to detect loss of pressure in the internal pressurizing fluid of double mechanical seals, or similar controls.

(h) Ventilation ductwork and pneumatic transfer systems for pesticides shall be under negative pressure during operation. Exhaust air from ventilation or pneumatic transfer systems shall not be recycled to the workplace, either intentionally or through inadvertent positioning of air intakes in relation to exhaust vents.

(i) Chemical sewers or sumps shall be kept sealed or shall be equipped with appropriate one-way flow devices to

prevent the evaporation of pesticide vapors into the workplace.

Section 8 - Monitoring and Recordkeeping

(a) Monitoring

GROUPS III, II, AND I

(1) Employers shall conduct a survey of the plant to determine:

(A) The names and approximate quantities of all pesticides used or stored in the plant.

(B) Places where pesticides might escape from containers or equipment and the expected distribution of pesticide contamination in the event of such escape.

(C) All locations and operations in which employees may be exposed to pesticides and the nature of their potential exposure. Airborne concentrations of pesticides to which workers are exposed shall be measured.

(D) The movement and location of pesticides in plant processes and storage.

(2) The survey shall be repeated at least annually.

(b) Recordkeeping

GROUPS III, II, AND I

(1) The following records shall be maintained by the employer for at least 30 years after termination of employment of the employee:

(A) Survey data from Section (a) -

Monitoring.

(B) Medical examinations.

(C) Emergency treatment.

(D) Documentation of overexposure of any employee to pesticides or any other chemical in the workplace.

(2) All records shall be stored and accessible in a manner that permits comparison between medical records and exposure data.

(3) Medical records shall be made available to designated medical representatives of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, and of the employee or former employee.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were developed to protect employees engaged in pesticide manufacturing and formulating operations against occupational illnesses. The criteria and the resulting standard have been designed to afford improved worker protection from exposures to pesticide active ingredients and to other substances used in manufacturing and formulating processes, such as raw materials, intermediates, inerts, and solvents. The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare, under Section 22(c)(1) of the Occupational Safety and Health Act of 1970, to "...develop and establish recommended occupational safety and health standards..."

NIOSH, after a review of data and consultation with others, formalized a system for the development of criteria upon which standards can be established to protect the health and to provide for the safety of workers exposed to hazardous chemical and physical agents. These criteria and the recommended standard for occupational exposure to pesticides during their manufacture and formulation are part of a continuing series being developed by NIOSH. The methodology of this study consisted of developing, evaluating, and recording information from literature searches,

from visits to pesticide manufacturing and formulating plants, and from consultations with external sources including other Federal agencies, professional occupational health societies, and an advisory group. The advisory group consisted of knowledgeable individuals from industry, labor, government, and academia. These sources assisted NIOSH by identifying additional information for consideration and by reviewing the adequacy and soundness of the critique of existing scientific information and the feasibility of the recommended standard based thereon. A draft of the criteria document was reviewed in March 1978 by the advisory group.

The recommended standard is intended to protect against development of systemic and local adverse health effects, and to be attainable with existing technology and techniques. Emphasis has been placed on effective work practices, engineering controls, employee training, and medical surveillance. Permissible exposure limits have not been developed in this document; however, NIOSH recommends compliance with promulgated Federal occupational exposure limits (see Appendix III) and adoption of new environmental limits in those cases where the NIOSH recommended limit differs from those already promulgated. These include the environmental limits recommended for substances such as parathion, methyl parathion, creosote, ethylene dibromide, and dinitro-o-cresol (see Appendix IV).

The standard is not intended to inhibit flexibility in the way a task is performed or to restrict the development of safer techniques. Instead, any criteria and recommended standard

should encourage management and labor to develop safer equipment, more effective work practices and engineering controls, and more appropriate training programs that will result in more healthful work environments. Simply complying with the recommended standard should not be the final goal.

The criteria and recommended standard were developed from an overall process point of view and are designed to protect employees from exposure to pesticides and other substances used in the manufacture and formulation of pesticides. The document specifies proper work practices as a means of minimizing the risk of adverse health effects and identifies appropriate biologic monitoring and medical surveillance programs for employees who work with pesticides during their manufacture and formulation. The recommended standard indicates the importance of providing a clean workplace and of apprising all employees of the hazards of pesticides and of the need to utilize proper work practices. Within each of the eight sections of the recommended standard, requirements vary according to the pesticides to which they apply: (1) the most stringent work practices and engineering controls are specified for Group I pesticides, which pose a significant risk of adverse acute health effects at low concentrations, or risk of carcinogenic, teratogenic, neurotoxic, or reproductive effects; (2) less stringent requirements apply to Group II pesticides which pose adverse acute health risks at moderate doses; and (3) the least stringent practices and controls are specified for Group III pesticides, which, based on present data, pose minimal risk of adverse acute effects even at

relatively high-dose levels. The basis for establishing these three groups and for assigning pesticides to each is contained in Chapter VI, along with a discussion of the rationale for selecting specific work practices and control requirements for each group.

These criteria for a pesticide standard apply only to occupations in pesticide manufacturing and formulating. This includes manufacturing, formulating, packaging, mixing, blending, or repackaging of any pesticide active ingredient. Application of this recommended standard to situations other than the occupational settings specified above is not warranted.

The development of the recommended standard for the manufacture and formulation of pesticides has revealed that additional research is needed in the following areas: (1) studies to determine whether particular pesticidal chemicals have carcinogenic, teratogenic, mutagenic, neurotoxic, behavioral, or other delayed toxic effects, (2) effective decontamination of work clothing, (3) more effective engineering controls to limit pesticide emissions and exposures in manufacturing and formulating processes, and (4) more effective personal protective equipment and clothing for pesticide workers. A more complete discussion of these and other research areas is presented in Chapter VII.