DMTCE cu/1
Bldg 2.2

BLACK & VEATCH Waste Science, Inc.

4717 Grand Avenue, Suite 500, P.O. Box 30240, Kansas City, Missouri 64112, (913) 339-2900

Site: Des Moines TCE
ID#: IAD980687933
Break: 2.4 ou#4
Other: Bldg Removal
1-3-94

USEPA/ARCS V
Des Moines TCE, OU4

BVWS Project 71400.040
BVWS File C.3
June 3, 1994

U.S. Environmental Protection Agency, Region VII
Region VII Superfund Section
756 Minnesota Avenue
Kansas City, KS 66101

Subject: Site Health and Safety Plan

Attention: Mr. Glenn Curtis

Gentlemen:

Enclosed please find a copy of the Health and Safety Plan and the task-specific addenda that have been prepared by BLACK & VEATCH Waste Science personnel for the oversight activities to be conducted during the removal activities at the Des Moines TCE site.

A task-specific addenda will be prepared each time there is a change in the removal activities that will be occurring at the site.

If you have any questions or need additional information, please call me at 338-6656.

Very truly yours,

BLACK & VEATCH Waste Science, Inc.

Craig A. Willis

Craig A. Willis

rw
Enclosures

cc: Carl Norman, USEPA Region V, w/o enclosures
Larry Magill, BVWS-Chicago, w/o enclosures

BLACK & VEATCH Waste Science, Inc.
Site-Specific Health and Safety Plan
Des Moines TCE Site, OU4
Des Moines, Iowa

Prepared by: Robin D. Wankum Date: 4-11-94

Reviewed by: Craig A. Willis Date: 4-11-94
(Project Manager)

Approved by: [signature] Date: 19 May 94
(BVWS DHS)

Expiration Date: DEC 31, 94

This Health and Safety Plan is produced for the use of BVWS and specific designated contractors on the project indicated herein. This Health and Safety Plan is not intended or represented to be suitable for use by others on the project, or for use on any other project. Any use without written verification or adaptation by BVWS will be at the user's sole risk and without liability or legal exposure to BVWS. Any use of this Health and Safety Plan without the written approval of the BVWS Director of Health and Safety is not authorized.

Health and Safety Plan
Des Moines TCE Site, OU4

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Tables

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Acronyms and Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air-purifying respirator
BVWS	BLACK & VEATCH Waste Science, Inc.
CAS	Chemical Abstracts Service Registry Number
CFR	Code of Federal Regulations
CN	Cyanide
CPR	Cardio-pulmonary resuscitation
db	Decibel
DHS	BVWS Director of Health and Safety
DOT	Department of Transportation
FID	Flame ionization detector
HASP	Health and Safety Plan
IDLH	Immediately dangerous to life or health
LEL	Lower explosive limit
MSDS	Material safety data sheet
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OVA	Organic vapor analyzer
PCB	Polychlorinated biphenyl
PEL	Permissible exposure limit
PID	Photo ionization detector
PPE	Personal protective equipment
PPM	Parts per million
PVC	Polyvinyl Chloride
QAPP	Quality assurance project plan
RA	Remediation area
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
SCBA	Self-contained breathing apparatus
SSC	Site safety coordinator
TCE	Trichloroethlylene
TLV	Threshold limit value
TWA	Time-weighted average

I HAVE KEPT THE COVER SHEETS -

SSP FORMAT

HASP
ATTATCHMENTS
APPENDIX
① TASK SSP
② TASK SSP
etc

I move some attachments from the TASK SSP TO THE HASP.

I'll ON THE ROAD FROM 8:00 AM TO 2:00 PM. I MAKE ONE CONNECTION. I will call you THEN. OTHERWISE CALL THE HOTEL - see if to be for phone # — AND LEAVE MSG. YOU MIGHT WANT TO TALK WITH GEORGE — HE IS IN TODAY

Acronyms and Abbreviations (Continued)

USEPA	United States Environmental Protection Agency
UST	Underground storage tank
VDS	Vehicle decontamination station

1.0 Introduction

1.1 Purpose

This Site Health and Safety Plan (HASP) will establish the site specific health and safety guidelines and procedures for activities at the Des Moines TCE Site, OU4. The plan will be based on existing data and site reconnaissance and will be in accordance with Occupational Safety and Health Administration (OSHA). The plan will be approved by the BVWS Director of Health and Safety or designee.

1.2 Scope

Specific information or procedures that are applicable to all operations and tasks at the site are included in Sections 1 through 9 of the HASP. These procedures are applicable to all site activities unless otherwise stated in the appendices. The appendices address specific tasks and operations performed at the Des Moines TCE Site, OU4, detailing the hazards and control measures. The appendices will be referred to as task specific health and safety plan (Task HASP).

1.3 Compliance with Site HASP

Consistent with the contents of this Site HASP, work will be conducted in a safe and environmentally acceptable manner, and all BVWS personnel and subcontractors contractually under this HASP shall be required to comply with the health and safety requirements specified herein. All field personnel under this plan are required to read and familiarize themselves with the contents of this Site HASP and to document this competency through the entry of a signature and date as specified in the Certification Section (Section 11.0). Subcontractors who are not contractually under this Site HASP are responsible to develop and implement a Site HASP that will interface with this Site HASP.

2.0 Site Background

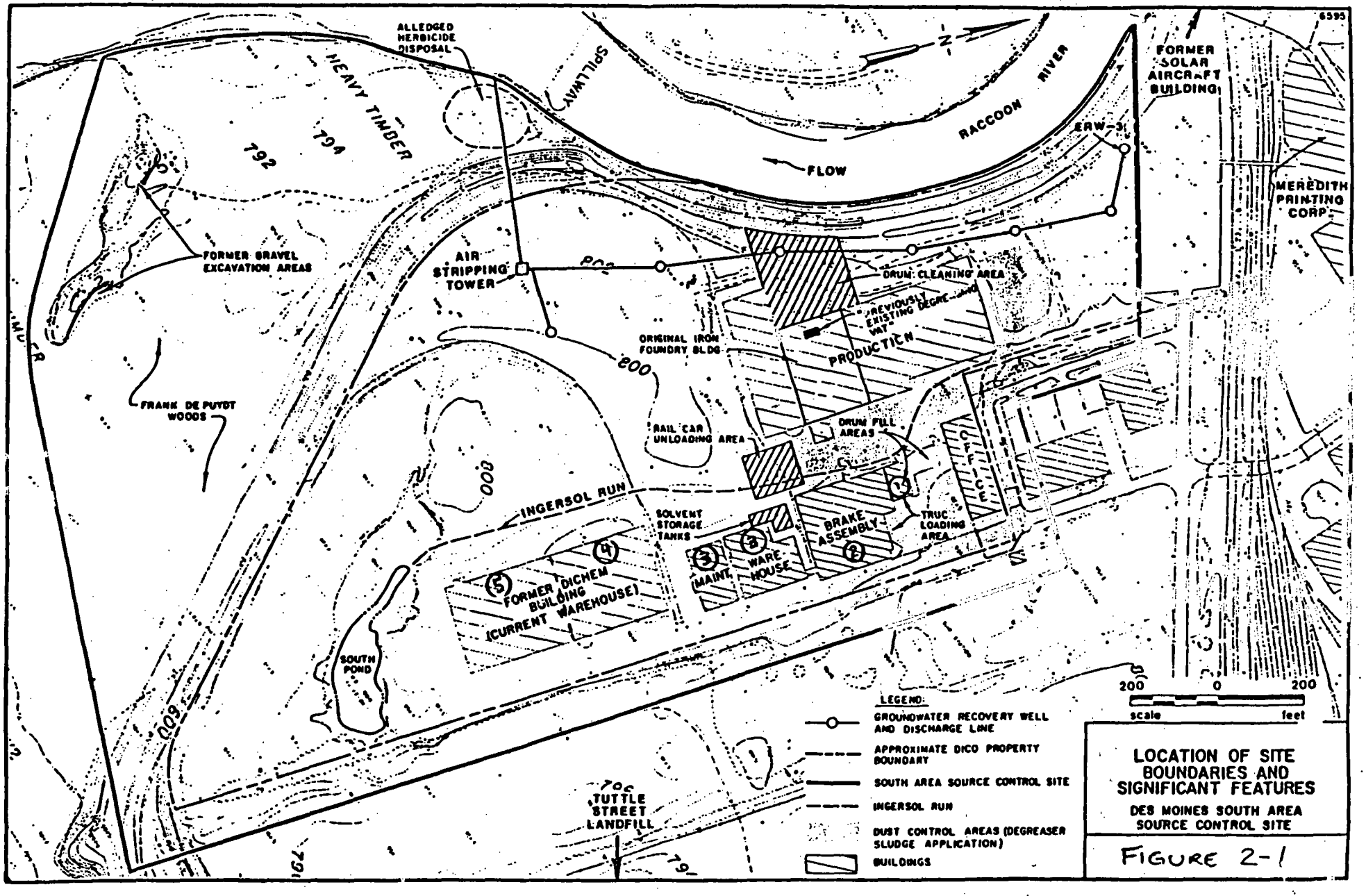
2.1 Facility Description

The Des Moines TCE Site originated as a plume of volatile organic compounds (VOCs) in the flood plain of the Raccoon River. The site is located southwest of downtown Des Moines, Polk County, Iowa, near where Fleur Drive crosses the Raccoon River. The area has industrial/commercial use and recreational land use. A vicinity map showing the general location of the site is included as part of Attachment 1. Figure 2-1 shows the layout of the site.

Investigations at the Des Moines TCE site were initiated in the late 1970s when chlorinated organic contaminants were detected in the Des Moines water supply at the Des Moines Water Works (DMWW). Water from the DMWW North gallery was found to be contaminated with trichloroethylene (TCE), dichloroethylene (DCE), and vinyl chloride. Early investigations were conducted in the area of the North and on property surrounding the DMWW, including the Dico facility located across the Raccoon River from the DMWW. The site was listed on the National Priorities List (NPL) on September 8, 1983.

Dico manufactures metal wheels and brakes. Manufacturing operation have been conducted at this location since at least 1961. In the past the solvent Tri-Cleen, of which TCE is a primary component, was used to degrease metal parts during the manufacturing process. Oily waste sludge containing TCE from the degreasing process was spread on the parking lot for dust control. Available information indicates that these practices stopped in 1979.

An entity called DiChem, Inc. previously used building at the site to formulate pesticide and herbicide products for numerous other companies. The manufacturers provided instructions and supervision for the formulation operations, and specified equipment, processes, and all other related procedures, furnished the packaging for the material, and marketed the finished product. Pesticide formulation apparently occurred during the 1950s through a portion of the 1970s. These practices resulted in the contamination of several buildings and soils at the site. As a result of these findings, USEPA requested that this area be separated from Operable Unit (OU) 2 and placed into OU4.



LOCATION OF SITE BOUNDARIES AND SIGNIFICANT FEATURES

DES MOINES SOUTH AREA SOURCE CONTROL SITE

FIGURE 2-1

② BUILDING NO. 2 (TYP.)

OU4 also includes the area known as the South Pond/Drainage Area. This area consists of pesticides detected in the sediments that drain the pond during heavy precipitation and the soil disking area near the air stripping tower, comprised of soil containing pesticides excavated during the installation of the stripping tower.

2.2 Status

The site is actively manufacturing wheels and rubber products, however, buildings that were found to be contaminated with pesticides are no longer in use.

2.3 Summary of Previous Site Activities

The following items presents the list of activities that have been conducted at the Des Moines TCE site throughout its history:

- 1976-1979, Groundwater samples obtained from the Dico production wells.
- 1978-1980, Series of sand points, shallow monitoring wells, installed around the Dico facility with subsequent analysis of samples.
- 1982, EPA Field Investigation (FIT):
  - Installation of monitoring wells.
  - Surface soil samples.
  - Soil borings.
- 1984-1985, Remedial Investigation:
  - Installation of monitoring wells.
  - Surface soil samples.
  - Soil borings.
- Protection of the Public Water Supply Operable Unit (OU) Remedy:
  - Extraction/Treatment Well System (hydraulic controls)
- 1989-1991, Source Control Operable Unit Remedial Investigation:
  - Groundwater sampling.
  - Sediment sampling.
  - Surface soil sampling.
  - Subsurface soil sampling.
  - Test pit excavation.
- 1991-1993, Building Interior Sampling:
  - Wipe sampling.
  - Dust sampling.
  - Insulation sampling.

- Surface sampling of manufactured products

- 1993, Post-Flood Sampling:
  - Wipe sampling inside of Buildings 1-5.
  - Dust sampling inside of Buildings 1-5.
  - Surface sampling of manufactured products (steel wheels).
  - Surface and shallow soil sampling (for OU4).

- 1994, Preliminary OU4 Sampling:
  - Surface soil and sediment sampling (South Pond vicinity).

2.4 Nature and Extent of Hazardous Materials

A review of the information available from previous sampling activities has been completed. The primary contaminants of concern at the Des Moines TCE site include pesticides, PCBs, and dioxin. A discussion of the actual concentrations detected is given in Section 3.0.

3.0 Chemicals of Concern

The concentrations detected during previous investigation activities at the Des Moines TCE site are listed below. The chemicals of concern are listed in Attachment 2. The table lists the allowable exposure levels for the chemicals, sign and symptoms of exposure, dermal absorption hazards, carcinogenicity, IDLH values, health hazards, physical hazards, CAS numbers, and physical characteristics. Task specific information related to the chemicals of concern are listed in Appendix A.

Compound	Range of Concentrations	Media
Aldrin	ND - 0.053 ug/L	Water
	ND - 97,000 mg/kg	Soil
	ND - 9.4 mg/kg	Sediment
	ND - 520,000 mg/kg	Dust
	ND - 6.98 ug/cm^2	Wipe
Chlordane	ND - 7.2 mg/kg	Soil
	ND - 7.2 mg/kg	Sediment
	ND - 45.0 mg/kg	Dust
	ND - 0.495 ug/cm^2	Wipe
4,4-DDT	ND - 0.140 mg/kg	Soil
	ND - 3.5 mg/kg	Sediment
Dieldrin	ND - 1,100 mg/kg	Soil
	0.015 - 17.0 mg/kg	Sediment
	ND - 8,800 mg/kg	Dust
	ND - 1.27 ug/cm^2	Wipe

Compound	Range of Concentrations	Media
Chlorodiphenyl	[illegible] mg/kg	[illegible]
	[illegible],000 mg/kg	Dust
Heptachlor	[illegible] - 1.4 mg/kg	Soil
	[illegible] ug/kg	Sediment
	[illegible] mg/kg	Dust
	[illegible].01 ug/cm^2	Wipe

4.0 Personnel Qualifications

4.1 Training Requirements

All personnel who will be engaged in hazardous waste operations must present to the Site Safety Coordinator (SSC) a certificate of completion of an initial hazardous waste operations training course or 8-hour refresher course. The course must have been completed within the 12 months prior to the beginning of site activities. The training must comply with OSHA regulations found at 29 CFR 1910.120(e). The certification must be presented before site activities begin.

All personnel must complete a minimum of three days on-the-job training under the direct supervision of a qualified SSC or site supervisor before they are qualified to work at a hazardous waste site unsupervised.

Consistent with OSHA 29 CFR 1910.120 paragraph (e)(8), individuals designated as field team leader or SSC require an additional 8 hours of training. BVWS policy requires the SSC to have at least 6 days of experience at the level of protection planned for this HASP. A SSC qualified at a given level of protection is qualified as a SSC at a lesser level of protection.

At least two people will be trained and currently certified in first aid and adult cardiopulmonary resuscitation (CPR).

Personnel who use air supplied respirators must provide the Director of Health and Safety (DHS) written certification that they have been trained in the proper use, inspection, emergency use, and limitations of the equipment by a competent person. The training must be current within 12 months prior to the use of the equipment.

Personnel who participate in confined space entry, radiation work, asbestos work or work involving lockout/tagout of energy sources must provide the Director of Health and Safety written certification that they have been trained in accordance with the applicable OSHA regulations before performing such work.

Personnel who use health and safety monitoring equipment other than those provided by the BVWS equipment center must provide written certification to the Director of Health and Safety that they have been trained in the use, maintenance, calibration and operation of the equipment by a competent person before using the equipment.

4.1.1 Safety Meetings

Safety meetings with field team members will be conducted prior to initiating any site activity. In addition, periodic briefings will be held throughout the project, especially when unsafe practices are noted or a change in site conditions require modifications of the HASP. Periodic meetings will be held at least weekly. Similar meetings will be held with individuals who later become a part of the field team before they take part in site activities.

The Safety Meeting Checklist in Attachment 4 provides a guide of topics that must be covered during the initial briefing and may be covered during periodic meetings. The Safety Meeting Checklist will be used to document the safety meeting topics discussed and attendance.

The SSC is responsible for conducting and documenting the pre-activity and periodic safety meetings.

4.2 Medical Surveillance Program

All personnel who participate in hazardous waste site investigations will be enrolled in a medical monitoring program prior to initiating site activities. The medical monitoring program will consist of an initial baseline examination, periodic monitoring examinations, and an exit examination.

All personnel who will be engaged in hazardous waste operations must present to the site safety coordinator a certificate of completion of a comprehensive medical monitoring examination. The medical examination must have been completed within 12 months prior to the beginning of site activities.

As a minimum, the medical monitoring examination will include those elements listed in Section 3.2 of BVWS's Health and Safety Manual for Hazardous Waste Site Investigations.

Site specific medical monitoring examinations or tests may be required to augment the standard examinations. Any additional examinations or tests required will be listed under the Site Specific Medical Monitoring Requirements section of the task specific section.

5.0 Personal Protective Equipment

5.1 General

All site activities require the following personal protective equipment (PPE) to be worn as a minimum.

- Safety glasses with sideshields meeting the requirements and specifications of the current applicable ANSI standard.
- Steel-toed boots meeting the requirements and specifications of the current applicable ANSI standard.

The following personal protective equipment shall be provided, used and maintained in a sanitary and reliable condition whenever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact.

- suitable eye protectors
- head protection
- extremities protection
- protective clothing
- shields and barriers
- face protection
- respiratory protection
- hearing protection

5.2 Chemical Protective Equipment

5.2.1 Levels of Protection

Personnel will wear chemical protective equipment when response activities involve known or suspected atmospheric contamination, when vapors, gases, or particulates may be generated by site activities, or when direct contact with skin-affecting substances may occur.

The specific level of protection and necessary components for each have been divided into four categories according to the degrees of protection afforded:

Level A: Should be worn when the highest level of respiratory, skin, and eye protection is needed.

NOTE: BVWS personnel are not authorized to work at Level A without additional training and written approval from the BVWS DHS.

Level B: Should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection. Level B is the primary level of choice when encountering unknown environments.

Level C: Should be worn when the criteria for using air-purifying respirators are met, and a lesser level of skin protection is needed.

Level D: Should be worn as a basic work uniform and not in any area with respiratory or skin hazards. It provides minimal protection against chemical hazards.

5.2.2 Chemical Ensembles

The following are the standard chemical protective equipment to be used for all hazardous waste operations. Combinations of chemical protective equipment other than those described for levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection. Deviations from this standard must be addressed in Appendix A.

Level B Personnel Protective Equipment:

- Supplied-air respirator (MSHA/NIOSH approved). Respirators may be positive pressure-demand, self-contained breathing apparatus (SCBA), or positive pressure-demand, airline respirator (with escape bottle for IDLH or potential for IDLH atmosphere)
- Hooded chemical-resistant one-piece suit [Saranex/Tyvek] with double bonded seams
- Long cotton underwear (optional)
- Outer gloves, chemical-resistant [11 mil nitrile]
- Inner gloves, chemical-resistant [4 mil nitrile or PVC]
- Boots, chemical-resistant, steel toe and steel shank

- Outer boot covers, chemical-resistant, disposable
- Faceshield (optional)

Level C Personnel Protective Equipment:

- Air Purifying respirator (MSHA/NIOSH approved) with an organic vapor/acid gas/high efficiency particulate filter cartridge
- Chemical-resistant one or two-piece suit [Saranex/Tyvek] with double bonded seams
- Long cotton underwear (optional)
- Outer gloves, chemical-resistant [11 mil nitrile]
- Inner gloves, chemical-resistant [4 mil nitrile or PVC]
- Boots, chemical-resistant, steel toe and steel shank
- Outer boot covers, chemical-resistant, disposable
- faceshield (optional)

Level D Personnel Protective Equipment:

- Coveralls [tyvek]
- Boots, steel toe and steel shank
- Outer boot covers, chemical-resistant, disposable
- Outer gloves, chemical resistant [11 mil nitrile]
- Inner gloves, chemical resistant [4 mil nitrile]

5.3 Hazards and Protection Level

The types of hazards for which levels A, B, C, and D protection are appropriate and described below:

I. *Level A*-Level A protection should be used when:

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the skin;

2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or
3. Operations are being conducted in confirmed, poorly ventilated areas, and the absence of conditions requiring level A have not yet been determined.

II. *Level B*-Level B protection should be used when:

1. The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection;
2. The atmosphere contains less than 19.5 percent oxygen; or
3. The presence of incompletely identified vapors or gases is indicated by a direct reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

Note: This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.

III. *Level C*-Level C protection should be used when:

1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin;
2. The types of air contaminants have been identified, concentrations measured and an air-purifying respirator is available that can remove the contaminants; and
3. All criteria for the use of air-purifying respirators are met.

IV. *Level D*-Level D protection should be used when:

1. The atmosphere contains no known hazard; and
2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

5.4 Reassessment of Protection Level

The Level of Protection provided by PPE selection shall be upgraded or downgraded based upon a change in site conditions or findings of investigations.

When a significant change occurs, the hazards should be reassessed. Some indicators of the need for reassessment are:

- Airborne concentrations of chemicals or physical hazards exceed action levels.
- Commencement of a new work phase, such as the start of drum sampling or work that begins on a different portion of the site.
- Change in job tasks during a work phase.
- Change of weather.
- When temperature extremes or individual medical considerations limit the effectiveness of PPE.
- Contamination other than those previously identified are encountered.
- Change in ambient levels of contaminants.
- Change in work scope which effects the degree of contact with contaminants.
- Detection of contamination by instrument, odor or sight.

5.5 Inspection of Personal Protective Equipment

The user of the personal protective equipment is responsible for inspecting the equipment prior to immediate use. The personal protective equipment will not be used if the user is not familiar with the equipments limitations.

The user's buddy is responsible for periodically checking on the proper use of the protective equipment while in use.

5.6 Respiratory Protection

Respiratory protection at hazardous waste sites consists of a fullface air purifying respirator as a minimum.

Any use of an air supplied system will be specifically addressed in the task specific section.

Personnel will not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The determination will be documented in writing and provided to the SSC in accordance with the section addressing medical monitoring.

Personnel who have the potential to wear the respirator on site must be trained in the proper use of the respirators and their limitations. The training will allow users to handle their respirator to become familiar with all components, select the proper size for a comfortable fit, wear it in normal air to become used to the

breathing resistance, visibly conduct a critical component inspection, self administer a positive and negative pressure fit check, and conduct a qualitative fit test.

Respirators are not to be worn when conditions prevent a good full seal. Such conditions may be a growth of beard, sideburns, bangs, a skull cap or other clothing that projects under the facepiece or temple pieces on glasses. To assure proper protection the respirator will be thoroughly inspected before each use and a positive and negative fit check will be performed each time the respirator is donned.

Respirators will be assigned to individuals for their exclusive use during the project. Air purifying respirators will be regularly cleaned and disinfected. As a minimum, respirators will be cleaned after each day's use or more often if necessary. Upon completion of the work task, the respirators will be disassembled, inspected and thoroughly cleaned and disinfected. Worn or deteriorated parts will be replaced and the respirators will be stored in a clean and sanitary location in individual plastic bags.

Selection of the respirator is the responsibility of the BVWS Director of Health and Safety and will be noted in the Action Level Tables. Selection will be based on the physical, chemical and physiological properties of the air contaminants and the concentration likely to be encountered. The quality of fit and the nature of the work being performed will also affect the choice of respirators. The capability of the respirators chosen is determined from appropriate governmental approvals, manufacturer's test, and BVWS's experience with respirators.

6.0 Monitoring Program

6.1 Real Time Monitoring

Direct reading instruments are used as real time air monitors. The results of the direct reading instruments are compared to the Monitoring Equipment Action Levels (Attachment 3) that describes the protective action that is to be taken to control exposure. The action levels describe the location of the real time monitoring activity and the action to be taken if predefined values are met or exceeded. Site specific operations or tasks may have other action levels established. Any change to the action level task will be noted in the appropriate task specific section.

The frequency and location of all real time monitoring activity is based upon the nature of the site activity. Periodic real time monitoring will be performed, at a minimum, whenever the following activities occur.

- at the beginning of site work
- operations change
- work begins on a different portion of the site
- beginning of invasive site activity
- contaminants other than those previously identified are being handled
- personnel begin to handle obviously contaminated materials
- personnel are handling leaking drums or containers
- personnel are performing tasks that are likely to expose then to peak levels of contaminants

6.2 Air Monitoring Result Logging

Before any field activities commence, the background levels of the site must be read and recorded. Daily background readings must be conducted away from areas of potential contamination to obtain accurate results.

All monitoring results must be recorded in the field log. The monitoring results should indicate the following information.

- range of readings
- mode of readings
- time
- location of reading
- activity during reading

- weather conditions
- wind direction
- action taken

6.3 Personnel Monitoring

Personnel monitoring will be performed whenever required by an OSHA chemical-specific standard found in 29 CFR 1910.1001-.1048 or when deemed necessary to protect the health of the field team members. All personnel monitoring will be performed in accordance with accepted sampling and analytical procedures as defined by the Director of Health and Safety. Specifics of the monitoring will be described in the task specific section of this plan.

6.4 Operation, Maintenance and Calibration

The Site Safety Coordinator is responsible for the proper operation, maintenance and calibration of each instrument to be used. The operation, maintenance and calibration instructions in the equipment manuals will be followed. The equipment manuals will be kept in the support zone during field activities. Calibration of instrumentation will be performed at the beginning and end of each day the instrument is used.

6.5 Initial Survey

Prior to any site activities, the SSC will conduct perimeter and general site monitoring, upwind and downwind, to establish background levels.

Upon initial entry to an area, representative air monitoring will be conducted to identify immediately dangerous to life and health (IDLH) conditions, exposures above OSHA-PELs or other allowable exposure levels, including exposure to radiation, flammable atmospheres, or oxygen deficient atmospheres.

6.6 Periodic Survey

After site activities have commenced, the selective monitoring of high-risk workers, i.e., those who are closest to the source of contaminant generation, is essential. High risk workers will be monitored at least every 30 minutes when the potential for exposure exists.

Those employees working closest with the source have the highest likelihood of being exposed to concentrations which exceed established exposure limits or action levels.

Monitoring efforts will focus on personnel most likely to receive the highest exposures and on all personnel likely to be exposed to any substance above the OSHA-Permissible Exposure Level (PEL).

6.7 Perimeter Monitoring

The Site Safety Coordinator is responsible for determining if site activities could negatively impact zones outside the contamination reduction zone. If action levels for airborne contaminants listed in the Action Level Table are exceeded, the Site Safety Coordinator will perform monitoring at the perimeter of the contamination reduction zone to determine if the contaminants are getting out of the controlled zones. If action levels are exceeded at these locations, the SSC must advise the project manager and the BVWS Director of Health and Safety. If necessary the control zones will be expanded to compensate for the presence of the contaminants.

If the release of contaminants could negatively impact the health and safety of the surrounding areas, the Site Safety Coordinator will contact the local emergency response organization responsible for protecting public health from chemical exposures. This agency will be identified prior to the beginning of site activities as part of the emergency preplanning procedures. The SSC will then notify the site representative, project manager, and BVWS Director of Health and Safety. The Project Manager will notify the client of the chemical release and the actions taken by the SSC. Notification will be made in accordance with Section 9.6, Spills or Leaks.

7.0 Site Control

The objective of site control is to control the activities and movement of people and equipment at hazardous waste sites to minimize the potential for worker or public exposure to hazardous substances or the spread of hazardous substance in the environment.

7.1 Site Mapping

A map of the site (Figure 7-1) has been provided on the following page to assist site personnel in planning and organizing response activities.

The task specific sections will contain site maps that are specific to the area where activities will take place. These maps will include the following information: prevailing wind direction, magnetic north, site drainage points, previous sampling locations, planned sampling locations, locations of expected contamination, planned control zones, all natural and man-made topographic features including the location of buildings, containers, impoundments, pits, ponds, tanks, and any other site features.

The task specific site map will be upgraded to reflect new information gained after initial site entry or from subsequent sampling and analysis activities, or changes in site conditions, including changes resulting from accidents, ongoing site operations, hazards not previously identified, new materials introduced on-site, unauthorized entry or vandalism, or weather conditions.

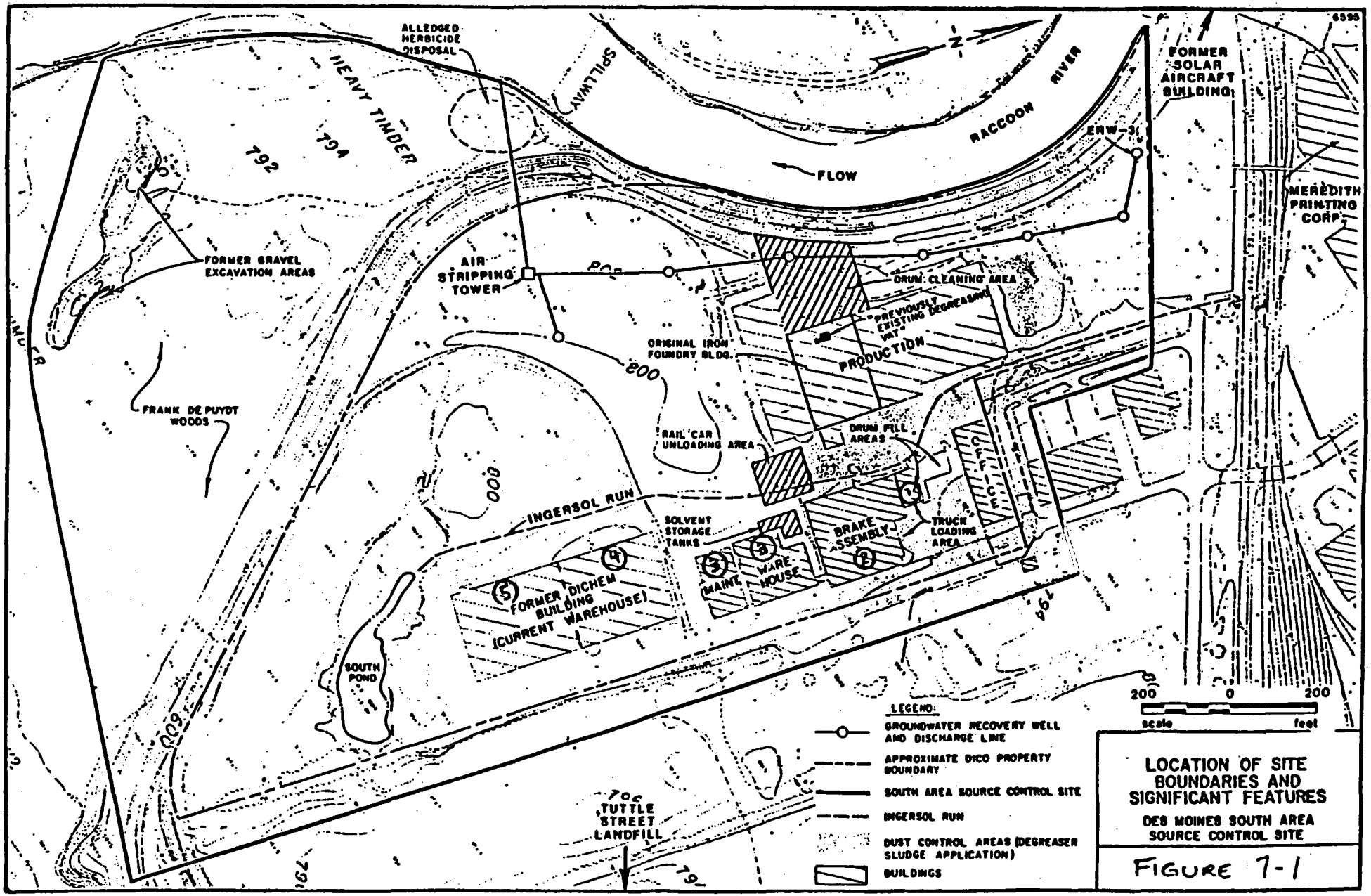
Use of overlays or other mapping techniques will be used to reduce cluttering of information.

7.2 Work Zones

Work zones will be established to:

- reduce the accidental spread of hazardous substances by workers or equipment from the contaminated areas to the clean areas.
- Confine work activities to the appropriate areas, thereby minimizing the likelihood of accidental exposure; and
- facilitate the location and evacuation of personnel in case of an emergency.

To accomplish this, the site will be divided into as many zones as necessary to ensure minimal employee exposure to hazardous substances. As a minimum, three zones will be identified. The Exclusion Zone, the Contamination Reduction Zone,



LOCATION OF SITE BOUNDARIES AND SIGNIFICANT FEATURES

DES MOINES SOUTH AREA SOURCE CONTROL SITE

FIGURE 7-1

② BUILDING NO. 2 (TYP.)

and the Support Zone. Movement of personnel and equipment between these zones should be minimized and restricted to specific Access Control Points to prevent cross-contamination from contaminated areas to clean areas.

Following is a description of each work zone, and the factors to be considered when establishing them.

7.2.1 Exclusion Zone

The Exclusion Zone is the innermost area of the three areas and is considered contaminated. Within this area, levels of protection prescribed in the HASP will be used by all personnel. An Access Control Point will be established at the periphery of the Exclusion Zone to control the flow of personnel and equipment between it and the Contamination Reduction Zone and to check that entrance and exit procedures are followed. The extent of the Exclusion Zone is determined by the following:

1) The location, nature, and toxicity of the waste materials.
2) Meteorological conditions affecting potential dispersion of contaminants.
3) Concern for minimal exposure of the unprotected public and investigation personnel.
4) Topography.

The Exclusion Zone boundary ("hot line") will be established at a reasonably safe distance from drums, tanks, ponds, liquid run-off, or other physical indicators of hazardous substances. This distance will be established by the SSC before site activities being and will take into account such factors as physical condition of site, weather conditions, sources of potential hazard and duration of activity. Subsequent to the start of operations, the boundary may be readjusted based on observation or measurements. The boundary will be physically secure and posted, well defined by geographical boundaries, or otherwise delineated.

The Exclusion Zone could be further divided into zones with different levels of protection for each zone; e.g., Zones A, B, and C where, for example, Zone A has a high relative level of contamination, Zone B has a moderate relative level of contamination, and Zone C has a low relative level of contamination. Based upon environmental measurements or expected on-site work practices, locations within the hot area would be defined in accordance with the level of protection required for that area. This procedure would allow for more flexibility in operation, decontamination procedures, and resource utilization.

7.2.2 Contamination Reduction Zone

The area between the Exclusion and Support Zones is the Contamination Reduction Zone. The purpose of this area is to prevent the transfer of contaminants that may have been picked up by personnel or equipment leaving the Exclusion Zone.

At the boundary between the Contamination Reduction Zone and the Exclusion Zone is the hot line and access control station. Entrance into the Exclusion Zone requires the wearing of the prescribed personal protection equipment and adherence to established site entry procedures. Equipment requirements for working in the Contamination Reduction Zone may be different than those for the hot area. At a point close to the hot line, a decontamination station will be established for both personnel (personnel decontamination station) and equipment exiting the Exclusion Zone. Another decontamination station will be established closer to the contamination control line for those working only in the Contamination Reduction Zone. In addition, a vehicle decontamination station will be established as necessary. The path that personnel or vehicles must take during decontamination is known as the Contamination Reduction Corridor. The Contamination Reduction Corridor must be laid with plastic sheeting.

The boundary between the Support Zone and the Contamination Reduction Zone is the contamination control line. Entry into the Contamination Reduction Zone from the Support Zone will be through an access control point. Personnel entering at this station must be wearing the prescribed personal protective equipment for working in the decontamination area. Exiting the Contamination Reduction Zone to the Support Zone requires the removal of any suspected contaminated personal protection equipment and compliance with decontamination procedures.

All facilities and operations located in the Contamination Reduction Zone will be positioned upwind of the actual waste location whenever possible.

7.2.3 Support Zone

The Support Zone is the outermost region and is considered a non-contaminated or clean area. It will contain the field office, first aid area, and other facilities necessary to support site activities. Change rooms, lunch and break areas, supplies, equipment storage, and maintenance areas will be located in this area. On-site

eating, drinking, and smoking will be allowed only in this area. Support facilities will be located upwind from the Exclusion and Contamination Reduction Zones in relation to the prevailing wind whenever possible.

A support center or command center will be established in the Support Zone for each activity and will include the following as a minimum:

- fully stocked industrial first aid kit
- 15 minute eye wash station
- fire extinguisher (10 pound ABC)
- telephone or radio communications capability
- posted emergency telephone numbers
- posted HASP
- posted OSHA "Job Safety and Health Protection" poster
- posted map with route to hospital
- instrument manuals
- binder of Material Safety Data Sheets (MSDS)
- BVWS "Health and Safety Manual for Hazardous Waste Site Investigations"
- B&V "Focus on Safety and Health"
- EPA Standard Operating Safety Guides

At the discretion of the SSC, the support center may be based in an onsite vehicle.

7.3 Visitors

BVWS recognizes that all visitors' employers are ultimately responsible for their compliance with all applicable OSHA regulations while on a hazardous waste site. BVWS personnel will be courteous to all visitors and adhere to the following procedures for the safety sake of the visitors.

- Visitors are expected to have the permission of the site owner to be on the site.
- The Site Safety Coordinator will advise all visitors of the nature, level, and degree of exposure likely as a result of BVWS related activities and the emergency response procedures that pertains to the visitors for the site.
- Visitors entering the Contamination Reduction Zone and Exclusion Zone at the Site will be offered an opportunity to read the applicable provisions of this HASP.

- Visitors will be expected to comply with OSHA requirements such as medical monitoring, training, and respiratory protection.
- Visitors will be expected to provide their own personal protective equipment.
- In the event that a visitor does not adhere to the provisions of the HASP, the SSC will request the visitor to leave the work area.
- If the visitor interferes with the work activity or poses a safety hazard to anyone on site, the SSC will terminate work activities and the BVWS Project Manager and Director of Health and Safety will be contacted immediately.
- All nonconformance incidents will be recorded in the site log by the SSC.

8.0 Safety and Emergency Procedures

8.1 Standing Safety Orders

The following standing orders are established to enforce safe work practices. Task specific standing orders are addressed in the appendices.

- Report any sign of radioactivity, explositivity or unusual conditions to the supervisor immediately.
- Check in and out at the entrance Access Control Point of the Exclusion Zone.
- Maintain close contact with your buddy in the Exclusion Zone.
- Eating, drinking, chewing gum or tobacco, smoking, or any practices that increases the probability of hand-to-mouth transfers and ingestion of material is prohibited in any controlled area such as Contaminant Reduction Zone and Exclusion Zone.
- Whenever decontamination procedures for outer garments are in effect, good personal hygiene will be practiced as soon as possible after the protective garment is removed, i.e., washing hands. A shower is recommended immediately after any work period.
- No facial hair that interferes with the effectiveness of a respirator will be permitted on personnel required or potentially required to wear respiratory protection equipment.
- Contact with potentially contaminated surfaces will be avoided whenever possible. Personnel should not walk through puddles, mud, or other discolored surfaces or kneel on the ground. Personnel should not lean, sit or place equipment on drums, containers, vehicles, or exposed surfaces without plastic covering.
- Medicine and alcohol can magnify the effect from exposure to certain compounds. It will be responsibility of each BVWS employee and each subcontractor to notify, on a daily basis, the Site Safety Coordinator of any individual who is using prescribed medication. Site personnel will not be allowed onsite while under the influence of alcohol or drugs that cannot be obtained over the counter without a physician's authorization.
- Personnel and equipment in the work areas will be minimized, but consistent with effective site operations.

- All unsafe or inoperable sampling or monitoring equipment left unattended will be identified by the Site Safety Coordinator by a "DANGER-DO NOT OPERATE" tag.
- Work will be restricted to daylight hours only.

8.2 Medical Emergencies

At least two BVWS team members conducting hazardous waste operations at the site will have successfully completed a Red Cross sponsored course in adult first aid and cardio-pulmonary resuscitation (CPR). Prior to the start of work, the SSC will make arrangements for medical facilities, ambulance service, and medical personnel to be available for prompt attention to the injured.

On-site activities will require a first-aid station which will be located within the Support Zone. First-aid kits will be, as a minimum, 16-unit first-aid kits and will be provided in the ratio of one for each 10 persons.

Portable 15-minute emergency eye-wash stations will be provided within the Support Zone. Identification markers will be provided to readily denote locations of the eyewash stations.

Emergency telephone numbers and reporting instructions for ambulance, local physician, hospital, poison control center, fire, and police will be conspicuously posted in the Support Zone.

The SSC will act as the emergency coordinator for all medical emergencies. If a person is injured or becomes ill, personnel identified as trained in first aid and CPR will be notified immediately. First aid and CPR will be administered immediately. In all cases, treatment for shock will considered. After attending to the victim, the SSC will be notified. Depending on the severity of the injury or illness, the SSC may notify medical emergency response organizations. If the victim is transferred off-site, the SSC will assign a field team member to accompany the victim.

If personnel experiences any adverse effects or symptoms during field activity, the individuals will notify the SSC. The SSC will assess the situation and make a determination on the extent of medical attention needed. If it is determined that the problem was due to chemical exposure, first aid for chemical exposure will be administered as soon as possible. If necessary to transport the individual to the hospital the individual(s) exposed to those chemicals will be transported by an unexposed individual. The MSDSs (Attachment 6) for the chemical(s) of concern will accompany the group to the hospital.

The following first aid for chemical exposures will be administered as soon as possible;

- Eye Exposure - If contaminated solid or liquid gets into the eyes, they will be washed immediately at the 15 minute emergency eyewash station using large amounts of water and lifting their lower and upper lids occasionally. Medical attention will be obtained immediately. (Use of contact lenses is not permitted in the designated Exclusion Zones).
- Skin Exposure - If contaminated solid or liquid gets on the skin, the affected individual will promptly flush the skin for at least 15 minutes, then wash with soap or mild detergent and water. If contaminated solids or liquids penetrate through the clothing, clothing will be immediately removed and treatment for skin exposure administered. Medical attention will be obtained if symptoms warrant.
- Inhalation - If a person breathes in a large volume of potentially toxic contaminants, the affected person will be moved to fresh air at once. If breathing has stopped, CPR will be performed. The affected person will be kept warm and at rest. Medical attention will be obtained immediately.
- Ingestion - If contaminated solid or liquid is swallowed, medical attention will be obtained immediately.

8.2.1 Accident Reporting

Injuries or illnesses that require attention beyond simple first aid or requiring attention by a physician must be reported to the B&V Worker's Compensation Administrator and BVWS Director of Health and Safety as soon as possible but no later than 24 hours after the accident. The site safety coordinator must complete the appropriate accident report forms and the required State Workers Compensation form. The Site Safety Coordinator is responsible for contacting the State Worker's Compensation Office to obtain the necessary report form. The Site Safety Coordinator is responsible for completing the forms and submitting the originals to the BVWS Director of Health and Safety. Copies should be sent to the B&V Workers Compensation Administrator and project manager. Copies must be filed in the project file.

All incidents that are near miss injury or illness accidents or physical accidents must be summarized on the hazardous waste site investigation activity report form and submitted to the project manager and BVWS Director of Health and Safety as soon as possible.

The Site Safety Coordinator is responsible for investigating the cause of all accidents and report on the findings and corrective actions taken in the manner described above. The SSC may request the assistance of the BVWS Director of Health and Safety or other personnel to investigate the accident. The final report on the accident is the responsibility of the SSC.

8.2.2 Hospital Route

The route to the hospital is shown and described in Attachment 1. Attachment 1 will be conspicuously posted in the Support Zone. The SSC and key field personnel will drive the route to the hospital emergency room door prior to the start of site activities to become familiar with the route. The route will be driven at least weekly to confirm an unobstructed route.

8.3 Temperature Extremes

8.3.1 Heat Stress Monitoring

Heat stress poses a serious health danger to site workers and may create secondary safety hazards by impairing a worker's coordination and judgement. Heat stress can occur at almost any temperature and is more likely when personal protective equipment is in use.

The use of protective equipment may create heat stress. Monitoring of personnel will commence when the ambient temperature is 70°F or above. Table 8-1 presents the suggested frequency for such monitoring. Monitoring frequency is dependent on the type of protection worn (permeable or impermeable clothing), the dry bulb temperature, and the amount of sunshine. Monitoring frequency should increase as the ambient temperature increases or as slow recovery rates are observed. Heat stress monitoring should be performed by a person with a current first aid certification who is trained to recognize heat stress symptoms. For monitoring the body's response to excess heat, one or more of the following techniques will be used.

Table 8-1
Suggested Frequency of Physiological Monitoring
for Fit and Acclimatized Workers[a]

Adjusted Temperature[b]	Normal Work Ensemble[c]	Impermeable Ensemble[d]
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5 to 90°F (30.8 to 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5 to 87.5°F (28.1 to 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5 to 82.5°F (25.3 to 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5 to 77.5°F (22.5 to 25.3°C)	After each 150 minutes of work	After each 120 minutes of work

a. For work levels of 250 kilocalories/hour.
b. Calculate the adjusted air temperature (ta adj) by using the equation: ta adj °F + (13 x (% ÷ 100) sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shield from radiant heat. Estimate percent sunshine by judging what percent of the time the sun is not covered by clouds that are thick enough to produce a shadow (100% sunshine = no cloud cover and a sharp distinct shadow; 0% sunshine = no shadows).
c. A normal work ensemble consists of cotton coveralls.
d. An impermeable ensemble consists of tyvek coveralls.

- **Heart rate.** Count the radial pulse before site activities and during a 30-second period as early as possible in the monitoring cycle.
  - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next cycle by one-third and keep the rest period the same.
  - If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following cycle by one-third.

- **Oral temperature.** Use a clinical thermometer (three minutes under the tongue) or similar device to measure the oral temperature before site activities and at the end of the monitoring cycle (before the worker drinks liquid).
    - If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
    - If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following cycle by one-third.
    - Do not permit a worker to wear a semipermeable or impermeable garment when oral temperature exceeds 100.6°F (38.1°C).

Heat stroke is a life-threatening heat disorder that requires life-saving first aid. Decontamination should be omitted prior to obtaining immediate medical attention.

Heat stress can become life threatening. Unless the victim is grossly contaminated, decontamination should be omitted or minimized and treatment begun immediately.

- Prevention of Heat Stress. Proper training and prevention measures will aid in averting loss of work production and serious illness. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion that person may be predisposed to additional heat-related illnesses. To avoid heat stress, the SSC has the authority to take the following steps.
    - Adjust work schedules
        - Modify work/rest schedules according to monitoring requirements.
        - Mandate work slowdowns as needed.
        - Perform work during cooler hours of the day if possible, or at night if adequate lighting can be provided.
    - Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
    - Maintain worker's body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, e.g., eight fluid ounces (0.23 liters) of water must be ingested for approximately every eight ounces (0.23 kg) of weight loss. The normal thirst mechanism is not sensitive enough to ensure that enough water

will be drunk to replace lost sweat. When heavy sweating occurs, the workers will be encouraged to drink more. The following strategies may be useful:

- Maintain water temperature at 50 to 60°F (10 to 16.6°C).
- Provide dedicated personal bottles or containers that hold about 1 quart of water.
- Dedicated personal bottles of water should be allowed in the Contamination Reduction Zone.
- Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or diluted drinks) before beginning work.
- Urge workers to drink a cup or two every 15 to 20 minutes, or at each break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per person per day are recommended, but more may be necessary to maintain body weight.
- An additional water source should be maintained outside of Contamination Reduction Zone.

- Train workers to recognize the symptoms of heat-related illnesses. Table 8-2 presents a summary of typical symptoms and treatment of heat stress.
- Source of water should be available to spray down a person as a measure of preventing heat stress.

8.3.2 Cold Stress Monitoring

When ambient temperature reaches 45° or below steps should be taken to prevent cold stress.

Excessive exposure to low environmental air temperatures or immersion in low temperature water are usually fatal unless quickly remedied. Workers must be protected from exposure to cold so that the deep core temperature of the body does not fall below 96.8°F.

Pain in the extremities may be the first early warning of danger to cold stress. Severe shivering may occur if the body temperature drops to 95°F. Workers exhibiting signs of cold stress or hypothermia must get to a warm area until they are safely able to resume their duties.

Table 8-2
Heat Stress Symptoms and Treatment

Type	Symptoms	Treatment
Heat Related Illness	Localized redness of skin and reduced sweating; reduced tolerance to heat	Keep skin clean and dry.
Heat Cramps	Muscle spasm and pain in extremities and abdomen.	Remove person to cool area. Give small amounts of salted water.
Heat Exhaustion	Weak pulse; shallow breathing; pale, cool, moist skin; profuse sweating; dizziness; fatigue.	Remove person to cool area, reduce body temperature. Cool by convection. Give small amounts of salted water. Do not allow person to become chilled.
Heat Stroke	Red, hot, dry skin; body temperature of 105°F or greater; nausea; dizziness; confusion; strong rapid pulse; coma. Convulsions may occur.	Seek medical attention immediately. Get victim cool quickly, wrap in wet cloth or immerse in cool water. Fan vigorously during transport to hospital. Apply cold packs, if available, avoiding direct contact between skin and pack/ice.

- At air temperatures of 2°C (35.6°F) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.
- Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (40°F). The workers shall wear cold protective clothing appropriate for the level of cold and physical activity.
- If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing in use may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and their outerwear should be changed as it becomes wetted. The outer garments must include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the

cold area, the employees shall make sure that their clothing is not wet as a consequence of sweating. If their clothing is wet, the employee shall change into dry clothes before entering the cold area.

- The workers shall change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of changes shall be determined empirically and will vary individually and according to the type of shoe worn and how much the individual's feet sweat.
- If extremities, such as toes, and nose, cannot be protected sufficiently to prevent sensation of excessive cold or frostbite by handware, footwear, and face masks, these protective items shall be supplied in auxiliary heated versions.
- If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve.
- The recommended limits for properly clothed workers for periods of work at temperatures below freezing are listed in Table 8-3.

8.4 Buddy System

Activities carried out in the Exclusion Zone will be performed using the buddy system to ensure rapid assistance is provided in the event of an emergency.

Each member of the field team will be designated to observe at least one other field team member. The SSC will implement the system at the Access Control Point for personnel entering the Exclusion Zone.

As part of the buddy system, workers will remain close together and maintain visual contact with each other to provide assistance in the event of an emergency. Should an emergency situation arise, workers will use the communication signals established and agreed upon prior to entering the contaminated area.

The responsibilities of workers utilizing the buddy system include:

- Providing their buddy with assistance.
- Observing their buddy for signs of chemical exposure.
- Observing their buddy for signs of stress due to temperature extremes.
- Periodically checking the integrity of their buddy's personal protective equipment.
- Notifying the site manager or other site personnel if emergency assistance is needed.

Table 8-3
Cold Work Environment Work Practice

Cooling Power of Wind on Exposed Flesh Expressed as an Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	32	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

*Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Work/Warm-up Schedule for Four-Hour Shift*

Air Temperature-Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
1. -26° to -28°	-15° to -19°	(Norm. Breaks)	1	(Norm. Breaks)	1	75 min.	2	55 min.	3	40 min.	4
2. -29° to -31°	-20° to -24°	(Norm. Breaks)	1	75 min.	2	55 min.	3	40 min.	4	30 min.	5
3. -32° to -34°	-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease	
4. -35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
5. -38° to -39°	-35° to -39°	40 min.	4	30 min.	5	Non-emergency work should cease					
6. -40° to -42°	-40° to -44°	30 min.	5	Non-emergency work should cease							
7. -43° & below	-45° & below	Non-emergency work should cease									

Notes

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity. If accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
3. If only the Wind Chill Factor is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill of about 1750 W/m^2/hr, 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m^2/hr. In general the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the absolute temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.

*From Occupational Health & Safety Division, Saskatchewan Dept. of Labor.

Workers should not rely entirely on the buddy system to ensure that help will be provided in the event of an emergency. To augment this system, workers in contaminated areas should remain in line-of-sight or communication contact with the or site safety coordinator whenever possible.

8.5 Decontamination Procedures

8.5.1 General

All personnel and equipment will be properly decontaminated prior to leaving a site. Decontamination methods could involve the following:

- Physically removing contaminants,
- Neutralizing contaminants by chemical detoxification or disinfection, or
- Removing contaminants through a combination of both physical and chemical means.

The types, locations, physical states, and concentrations of contaminations present will determine the degree of decontamination necessary.

As part of the system to prevent these physical transfers of contaminants by people or equipment from on-site to off-site areas, site specific procedures will be instituted for decontaminating all items leaving the Exclusion Zone and the Contamination Reduction Zone. These procedures will include the decontamination of personal protective equipment and all field equipment, and use of correct methods of removing personal protective equipment to avoid transfer of contaminants from the clothing to the body and decontamination or disposal. In addition to the decontamination procedures, specific entry and exit routes through the Contamination Reduction Zone will be established for personnel, equipment, and vehicles to minimize the possibilities of additional spread of contaminants. These site specific decontamination procedures are described in the task specific appendix.

Equipment that is not decontaminated or not completely decontaminated will be disposed on-site or transferred in a controlled manner for subsequent decontamination in controlled situation. Such equipment will be bagged or wrapped in plastic for transferring to the decontamination location. The outside container of the equipment must be labelled as contaminated, listing the potential contaminants and associated hazards. In order to minimize the need to decontaminate equipment, this type of equipment will be packaged or wrapped in a material that will protect them from contamination but does not interfere with their proper operation.

8.5.2 Emergency Decontamination

Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible before providing the necessary first aid or before permitting the person to enter the Support Zone. In an emergency, the primary concern is to prevent the loss of life or severe injury to site personnel. If the injury or illness is minor, full decontamination will be completed and first aid administered prior to transport.

If the patient's condition is serious, at least partial decontamination should be completed. This may be accomplished by:

- Complete derobing of the patient and redressing in clean coveralls.
- Wrapping patient in a blanket or plastic.
- Spot decontamination.

Any person, who is not fully decontaminated that requires transportation to the hospital will cover the surfaces of the vehicles with plastic to prevent contaminating the surfaces.

First aid should be administered while awaiting an ambulance or paramedics.

8.5.3 Personal Protective Equipment

Personnel leaving the Exclusion Zone must remove potential contaminants in an orderly and controlled manner in order to avoid contamination of the person. Primary means of avoiding contamination of the person is to minimize contact with contaminants during site activities.

Personal decontamination involves the sequential doffing of personal protective equipment, starting with the most heavily contaminated and working to the least contaminated. This progression, in combination with separating each step of the recontamination procedure by a minimum of three feet, ensures contamination decreases as the person moves from one station to another further along the line. Wash and rinse steps may be needed in order to reduce the level of contamination to a level safe to handle. The use of disposable chemical protective clothing may permit the omission of the wash and rinse steps. Since it is virtually impossible to prevent the transfer of contaminants on protective clothing to the wearer, thorough decontamination of the clothing is necessary. When done effectively the amount of substance remaining on the chemical protective clothing is greatly reduced and the

possibility of transfer is proportionately reduced. Therefore, heavily contaminated disposable chemical protective clothing should be washed and rinsed to minimize the spread of the contaminants during doffing.

Polyethylene plastic sheeting will be placed on the ground in the personal decontamination corridor and the decontamination stations arranged on the top of the plastic. The first station will be located within the Exclusion Zone and will be the station where gross contamination is removed.

As a minimum, the level of protection required for the personnel assisting with personnel decontamination will be the most protective Level D or one less than the level worn in the Exclusion Zone.

The Site Safety Coordinator is responsible for monitoring the effectiveness of the decontamination procedures.

8.5.4 Instruments

Instrument decontamination requires that all external surfaces and surfaces that came in contact with the contaminants, be wiped with a cloth dampened with a trisodium phosphate detergent (Alconox) and wiped dry. Contamination should be prevented by packaging or wrapping the instrument in a material that will protect them from contamination but does not interfere with the proper operation.

Instruments that are internally contaminated or not completely contaminated will be transferred in a controlled manner for subsequent decontamination. Such instruments will be bagged or wrapped in plastic for transferring to the decontamination location. The onsite container of the instrument must be labelled as contaminated, listing the potential contaminants and associated hazards.

8.5.5 Decontamination Solutions

The decontamination solutions will be solutions of water and chemical compounds designed to react with and neutralize the specific contaminants on the site. The temperature and contact time will also be considered to ensure complete neutralization. However, in situations where the contaminants on a particular site will not be known, and it will be necessary to use a decontamination solution that is effective for a variety of contaminants.

Generally, Alconox is sufficient for most site applications. The decontamination solution should be prepared in accordance with the manufacturer's instructions. In general, potable water is a sufficient rinse, although for specific equipment, decontamination may require the use of deionized or distilled water.

8.5.6 Vehicle Decontamination Station

At sites where drill rigs or other vehicles are used for on-site activities, it may be necessary to construct a vehicle decontamination station (VDS) to prevent the spread of contaminants to off-site locations. Typically, the VDS is a sloping area lined with plastic sheeting and gravel so that decontamination solutions can flow into a lined collection pit, sump, or trench. The pit contents can then be pumped into DOT approved 55 gallon drums or containers for later disposal. Other VDS configurations include plastic sheeting with wood runways to accommodate vehicles.

It is imperative that all vehicles used on-site be thoroughly decontaminated before being allowed to leave the site. Special attention should be paid to the treads or tracks and interior surfaces. Decontamination can be expedited if vehicle interiors are lined with plastic sheeting prior to commencing on-site activities.

8.6 Disposition of Decontamination Wastes

All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and other equipment that is contaminated must be secured in containers and labelled. Clothing not completely decontaminated on-site should be secured in plastic bags before being removed from the site. Spent decontamination soap/rinse solutions are transferred to drums which are labelled and disposed of with other substances on site.

Commercial laundries or cleaning establishments that clean protective clothing or equipment shall be informed of the potentially harmful effects of exposures to the contaminants.

8.6.1 Disposal Procedures

All wash and rinse water will be transferred to DOT approved 55 gallon drums, which will be sealed, labeled as to contents, and stored on-site. Disposal of decontamination solutions will be decided on a case-by-case basis.

Lids will be put on all drums in the event of rain and at the close of each work day. Drums will be supported on wood blocks or pallets to reduce corrosion.

8.6.2 Contamination Reduction Corridor Breakdown

When the Contamination Reduction Corridor is no longer needed, it must be closed down. All disposable clothing and plastic sheeting used during the operation must be double bagged and contained on site in a labelled DOT approved drum or container. All wash tubs, pails, containers, etc. must be thoroughly washed, rinsed and dried prior to removal from the site.

8.7 Communications

Communication systems will be established at the site for both internal and external communication for both routine and emergency operations.

8.7.1 Internal Communication

Internal communication refers to communication between workers operating in the Exclusion Zone or Contamination Reduction Zone, or to communication from the to these workers. Internal communication will be used to:

- Alert team members to emergency situations.
- Convey safety information (e.g., air time remaining in SCBA, heat stress check, hazards detected).
- Communicate changes in the work to be accomplished.
- Maintain site control.

The internal communication system may include such standard communication devices as radio, audible signals from noise makers, or visual signals from hand or body movements.

Identification of individual workers is necessary to ensure commands are addressed to the right worker. This may be accomplished by one of several methods, depending on the specifics of the site activities.

- Marking the suit with the worker's name.
- Color coding, numbering, or symbols for long-distance identification.
- Use of names for short distance, small work force tasks.

Standard audible and visual communication signals are listed in Section 8.9.3.

8.7.2 External Communications

External communications refers to communication between on-site and off-site personnel. An external communication system must be maintained in order to;

- Coordinate emergency response efforts with off-site responders.

- Report progress or problems to management.
- Maintain contact with essential off-site personnel.

The primary means of external communication are telephone and radio. Where telephones are not available immediately at the site, all team members will be notified of the location and dialing instructions of the nearest telephone. The correct change and necessary telephone numbers will be made readily available in the Support Zone. If radios are used, its location will be clearly marked. Clear instructions for its use will be posted with the radio at all times.

If access to external communications takes longer than five minutes to reach, the field team will be equipped to have immediate access to emergency response organizations.

Specifics of the internal and external communication methods will be detailed in the task specific appendix.

8.7.3 Communication Signals

Purpose: To alert members of emergencies, convey safety information, communicate changes in the work to be accomplished, and to maintain site control.

- Audible Internal Communications (whistle, vehicle horn, personal air horn)

Signal	Definition
1) one long blast	evacuate area
2) two short blasts	localized problem, be on the alert
3) two long blasts	all clear, reentry permitted
4) three short blasts	cease work operations

- Visual Internal Communications (hand signals)

Signal	Definition
1) Hands clutching throat	Out of air/cannot breath
2) Hands on top of head	Need assistance
3) Thumbs up	OK/I am alright/I understand
4) Thumbs down	No/negative

5) Arms waiving upright	Send backup support
6) Grip partners wrist	Exit area immediately
7) Cross arms above head	Cease work operations

8.7.4 *Hazard Communication*

The following apply to all chemicals where the chemical concentration exceeds 1% or 0.1% for a carcinogen. This section is applicable to all chemicals brought on-site, used on-site or present as a contaminant on-site.

All chemicals will be accompanied by a Material Safety Data Sheet (MSDS). All MSDS's will be kept in a conspicuous location in the and made available to all personnel.

All containers of chemicals will be properly labelled with the chemical name and appropriate hazard warning statement.

All team members will be trained in the following at the initial safety briefing or wherever the presence of the chemicals is identified.

- Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area.
- The physical and health hazards of the chemical in the work area.
- The measures employees can take to protect themselves from these hazards.
- Location of the MSDS's.
- Explanation of the labelling system.

8.8 Confined Space Entry Procedures

BVWS team members are not authorized to enter confined spaces without written authorization from the BVWS Director of Health and Safety. Confined spaces are defined as spaces that meet the following criteria.

- Large enough for a person to bodily enter.
- Limited or restricted means of entry or exit.
- Not designed for continuous employee occupancy.

NEED TO SEE THE MSDS — LIST HERE NEED TO BE

9.0 Emergency Action Plan

In the event of any emergency, the SSC will act as the Emergency Coordinator. The SSC will assess the emergency and determine if on-site resources are capable of responding to the emergency without exceeding the level of training and resources available. Otherwise, emergency response by BVWS field team members will be to immediately evacuate the site in the event of a non-medical emergency. No member of the field team is permitted to assist in responding to a major non-medical emergency.

9.1 Preplanning

Arrangements will be made with the local response community (i.e. fire department or local response services) for them to respond to emergencies that may occur during site operations. The local response community will be provided information regarding site activities, including the types of operations being conducted at the site, the type and degree of contamination at the site, the location of the work zone, and any other relevant information that may be necessary for an appropriate response. Such information will be provided to a supervisory level representative of the emergency response organization prior to the commencement of site operations.

9.2 Reporting Emergencies

Emergencies of all types must be reported to the SSC immediately through established communication means. If the SSC is not available, report the emergency to the nearest BVWS supervisory representative.

The SSC will assess the emergency and determine if on-site resources are capable of responding to the emergency without exceeding the level of training and resources available. If off-site emergency response organizations are needed, the appropriate notifications will be made in accordance with the preplanning arrangements made.

9.3 Notification

In the event of an emergency, personnel will take direction from the SSC. The SSC will notify the appropriate emergency response organization necessary to mitigate the emergency. As soon as possible, the SSC will make contact with the BVWS Project Manager and the BVWS Director of Health and Safety. If an emergency response organization is notified to respond, the SSC will dispatch a representative to the site entrance to escort the emergency response organization to the emergency scene. The SSC will act as the liaison with the officer-in-charge of the emergency response organization.

9.4 Emergency Contacts

Attachment 1 lists emergency telephone numbers and reporting instructions for ambulance, physician, hospital, poison control center, fire, police, local hazmat team, emergency rescue team, client contact, and site contact. Attachment 1 will be conspicuously posted in the Support Zone. Where phone numbers are not available for the above mentioned organization, the list will so indicate.

9.5 Fire or Explosion

In the event of a fire or explosion, the local fire department should be notified immediately. The Site Safety Coordinator or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials onsite. The SSC will maintain contact with the emergency response organization officer-in-charge.

If it is safe to do so, site personnel may:

- Use fire fighting equipment available onsite to control or extinguish incipient fires.
- Remove or isolate flammable or other hazardous materials they may contribute to the fire.
- Inform the site supervisor immediately.
- Inform the site contact immediately.

9.6 Spills or Leaks

In the event of a spill or a leak, site personnel will:

- Inform the site supervisor immediately.

- Inform the site contact immediately.
- Locate the source of the spillage and stop the flow if it can be done safely.
- Contain the spill.
- Notify the local emergency response organization if the spill cannot be controlled.
- Notify the local fire department if the chemical release has the potential of impacting the health or environment off site.
- Request off-site assistance in recovery of spilled material.

If the SSC determines that a situation exists that could threaten human health or the environment outside the site area, the local fire department will be notified immediately. The SSC will also immediately notify the National Response Center and the BVWS Project Manager. The telephone report will include:

(1) Name and telephone number or reporter.
(2) Name and address of facility.
(3) Time and type of incident (e.g., release, fire).
(4) Name and quantity of materials(s) involved, to the extent known, and the location of the discharge within the facility.
(5) The extent of injuries, if any.
(6) The possible hazards to human health, or the environment, outside of the site area.
(7) Actions the person reporting the discharge proposes to take to contain, clean up, and remove the substance.

9.7 Evacuation Procedures

At each work site, an evacuation route and rally point will be identified. The evacuation route will be selected to direct field personnel away from the exclusion zone to the nearest exit. During evacuation, every effort will be made to evacuate with their assigned buddy. The evacuation route will avoid high hazard areas and efficiently move personnel away from the emergency site.

The evacuation route will be towards a rally point. The rally point is a common area where all field team members are to meet following an evacuation. The purpose of the rally point is to remove personnel to a location a safe distance away from the emergency and away from high hazard areas and to give the SSC a location where all field personnel can be accounted. In the event of missing personnel, emergency response organizations will be notified immediately. The SSC will offer

whatever assistance is requested by the emergency response organizations in the event search and rescue is necessary. In the event that the rally point is proximate to the hazard, the SSC will authorize the evacuees to move to a safer rally point. All personnel will remain at the rally point until authorized to leave by the SSC.

9.8 Critique of Response and Follow-up

A follow-up meeting will be held after any emergency situation to assess the actions taken. The meeting will be attended by the SSC and other individuals as appropriate. A record of the meeting will be kept by the SSC. Recommendations from the meeting will be incorporated into the future responses to emergency situations.

10.0 Team Member Responsibilities

10.1 Managerial Responsibility

10.1.1 Director of Health and Safety

The Director of Health and Safety is responsible for providing the project manager with assistance and support with regard to all regulatory and safety aspects of site activity.

10.1.2 Project Manager

The BVWS project manager (PM) is responsible for technical direction and overall project administration. As a part of that function, the PM will ensure that, at a minimum, BVWS's project plans meet OSHA requirements, and that the health and safety of all site personnel are a primary concern.

10.2 Team Organization/Responsibility

The following personnel organization is critical to the planned activities at the site. The organizational structure is assigned, and will be reviewed and updated periodically, by the PM.

10.2.1 Site Manager

The BVWS site manager is responsible for leading the team in the planned field activities. The responsibilities include close attention to site conditions as they may affect the health and safety of all team members during their on-site activities. The SSC will assist the site manager in the site activities.

10.2.2 Site Safety Coordinator

The site safety coordinator has total responsibility for ensuring that the provisions of this HASP are adequate and implemented in the field. Changing field conditions may require decisions to be made concerning adequate protection programs. Therefore, it is vital that personnel assigned as SSC be experienced and meet the additional training requirements specified by OSHA in 29 CFR 1910.120 and the BVWS Safety and Health Program. The SSC is also responsible for conducting site inspections on a regular basis to ensure the effectiveness of the HASP.

10.2.3 Field Team

The field team is the PVWS team personnel responsible for data collection activities under the Site Manager's oversight. Each member is expected to handle the assigned duties with attention to the inherent hazards involved. All field team members agree to adhere to the provisions in the HASP.

11.0 Certifications

(Note: This page should be retained by the Project Manager and incorporated into the project file.)

By my signature, I certify that:

1. I have read,

2. I understand, and

3. I will abide by

the HASP for the Des Moines TCE Site, OU4.

Printed Name	Signature	Date	Affiliation

Attachment 1
Emergency Information

Hospital Emergency Route

Route to: **Iowa Methodist Hospital**

See the following page (Figure 2) for hospital route.

- Northwest on Sixteenth Street to Locust Street.
- Northeast on Locust Street to 10th Street.
- Northwest on 10th Street to Center Street.
- West on Center Street to Iowa Methodist Hospital

Emergency Contacts

1. Craig A. Willis/BVWS Site Manager
   Phone: (913) 338-6656 (W)
   (913) 341-2015 (H)

2. John T. Schill/BVWS Health and Safety Manager
   Phone: (913) 338-6595 (W)
   (816) 224-2406 (H)

3. Glenn Curtis/EPA Work Assignment Manager
   Phone: (913) 551-7726 (W)

4. Dr. Eugene Welter, MD/Business & Industry Health Group
   Phone: (913) 894-6600 (W)

5. Diane S. Mettenbrink/Worker's Compensation Administrator
   Phone: (913) 339- 8561 (W)

LOCAL EMERGENCY CONTACTS

Ambulance	(515) 244-4444
Iowa Methodist Hospital	(515) 283-6423
Des Moines Police Department	(515) 283-4824
Des Moines Fire Department	(515) 283-4237
National Response Center	(800) 424-8802

Attachment 2
Chemicals of Concern and Applicable Regulatory Standards at Des Moines TCE Site, OU4

Chemicals of Concern and Applicable Regulatory Standards at Des Moines TCE Site, OU4

Occupational Exposure Values									
Substance (CAS No.)	ACGIH-TLV TWA (mg/m^3)	OSHA-PEL TWA (mg/m^3)	Carcinogen	IDLH (mg/m^3)	Physical Description	Health Hazards			Maximum Concentration Detected in Soils(mg/kg)(a)
						Route	Symptoms	Target Organs	
Aldrin 309-00-2	0.25 Skin	0.25 Skin	EPA-B2 IARC-3 NIOSH-X	100	Colorless to dark brown crystalline solid with a mild chemical odor	Inh Abs Ing Con	Head, dizz; nau; vomit mal; myocyclonic jerk limbs; clonic, tonic convuls; coma; hema, azotemia; [carc]	Cancer, CNS, liver, kidneys, skin	97,000
Chlorodiphenyl (42% Chlorine) 53469-21-9	1 Skin	1 Skin	EPA-B2 IARC-2 MAK-B NIOSH-X NTP-2	10	Colorless to light colored, viscous liquid with a mild hydrocarbon odor	Inh Abs Ing Con	Irrit eyes; chloracne; liver damage; [carc]	Skin, eyes, liver	2.2
Chlorodiphenyl (54% Chlorine) 11097-69-1	0.5 Skin	0.5 Skin	EPA-B2 IARC-2 MAK-B NIOSH-X NTP-2	5	Colorless to pale yellow, viscous liquid or solid (below 50 F) with a mild hydrocarbon odor.	Inh Abs Ing Con	Irrit eyes, skin; acne-form derm; [carc]	Skin, eyes, liver	2.2
4,4-DDT 50-29-3	1	1 Skin	EPA-B2 IARC-2B NIOSH-X NTP-2	N.E.	Colorless crystals or off-white powder with a slight aromatic odor.	Inh Abs Ing Con	Pares tongue, lips, face; tremor; appre, dizz, conf, mal, head, fig; convuls; paresis hands; vomit; irrit eyes, skin; [carc]	CNS, kidneys, liver, skin, PNS	0.140
Dieldrin 60-57-1	0.25 Skin	0.25 Skin	EPA-B2 IARC-3 NIOSH-X	450	Colorless to light tan crystals with a mild chemical odor.	Inh Abs Ing Con	Head, dizz; nau, vomit, mal, sweat; myocyclonic limb jerks; clonic, tonic convuls; coma; [carc]	CNS, liver, kidneys, skin	1,100

Chemicals of Concern and Applicable Regulatory Standards at Des Moines TCE Site, OU4 (Continued)

Occupational Exposure Values									
						Health Hazards			
Substance (CAS No.)	ACGIH-TLV TWA (mg/m^3)	OSHA-PEL TWA (mg/m^3)	Carcinogen	IDLH (mg/m^3)	Physical Description	Route	Symptoms	Target Organs	Maximum Concentration Detected in Soils(mg/kg)(a)
Heptachlor 76-44-8	0.05 A3 Skin	0.5 Skin	EPA-B2 IARC-2B MAK-B NIOSH-X	700	White to light tan crystals with a camphor-like odor	Inh Abs Ing Con	In animals; tremors, convuls; liver damage; [carc]	In animals; CNS, liver	1.4

Notes and Abbreviations

IDLH Source:	U.S. Department of Health and Human Services, NIOSH Pocket Guide, 1990.
OSHA PEL/Carcinogen/ACGIH TLV Sources:	American Conference of Government Industrial Hygienists, Guide to Occupational Exposure Values 1992.
OSHA PELs:	Occupational Safety and Health Administration Permissible Exposure Limit.
TWA:	Time-weighted average exposure concentration for normal 8-hour (TLV, PEL) or up to a 10-hour (REL) workday and 40-hour workweek.
IDLH	Immediately dangerous to life or health concentrations.
NE	No evidence could be found for the existence of an IDLH.
CNS	Central Nervous System
CVS	Cardiovascular System
PNS	Peripheral Nervous System
GI Tract	Gastrointestinal Tract
RBC	Red Blood Cell
Ing	Ingestion
Inh	Inhalation
Abs	Skin Absorption
Con	Skin and/or eye contact
(a)	From BVWST compilation of existing data pertinent to RA 2 Site, September 1993.
skin	Danger of cutaneous absorption.

Carcinogen Designations:

TLV-A2:	Suspected human carcinogen, based on either limited epidemiologic evidence or demonstration.
EPA-B:	Probable Human Carcinogen; weight of evidence of human carcinogenicity based on epidemiologic studies is limited; agents for which weight of evidence of carcinogenicity based on animal studies is sufficient.
EPA-B-2:	Sufficient evidence from animal studies; inadequate evidence or no data from epidemiologic studies.
IARC-2A	Probably carcinogenic to humans; limited human evidence, sufficient evidence in experimental animals.
IARC-2B	Possibly carcinogenic to humans; limited evidence in humans in the absence of sufficient evidence in experimental animals.
MAK-A1	Capable of inducing malignant tumors as shown by experience with humans.
MAK-A2	Unmistakably carcinogenic in animal experimentation only.
NIOSH-X	Carcinogen defined with no further categorization.
NTP-2	Reasonably anticipated to be a carcinogen; limited evidence from studies in humans or sufficient evidence from studies in experimental animals.

Attachment 3
Monitoring Equipment Action Levels

Monitoring Equipment
Action Levels

Instrument	Reading	Action
O_2 Meter (measure at source for LEL Meter, in breathing zone for PPE).	Less than 19.5% O_2.	Withdraw. Ventilate with fresh air. Explosimeter readings not valid if O_2 < 10%.
	Greater than 23% O_2.	Withdraw. Explosion hazard. Consult with BVWS HSM.
LEL Meter (measure at source)	Up to 5% LEL.	Continue activities.
	5-10% LEL.	Continue: ID source.
	Greater than 10% LEL.	Withdraw. Explosion hazard. Consult with BVWS HSM.
Organic Vapor Detector (PID or FID) (measure in breathing zone)	Background	Level D
	Up to 5 ppm above background.	Level C
	Greater than 5 ppm above background.	Withdraw. Consult with BVWS HSM.
Radiation Meter	Background	Continue activities.
	Greater than background.	Withdraw. Consult with BVWS HSM.
Hydrogen Cyanide Draeger Tube Electrochemical Instrument	Any indication.	Withdraw. Consult with BVWS HSM.
Dust Meter	Up to 2 mg/m^3.	Level D, based on dust levels only.
	Greater than 2 mg/m^3.	Level C, based on dust levels only.
Noise Meter	Up to 85 db	Continue activities.
	Greater than 85 db	Hearing protection required.

Topic: DIELDRIN

U.S. Production:
1. (1977) NOT PRODUCED COMMERCIALLY IN USA **PEER REVIEWED** [SRI
2. (1982) NOT PRODUCED COMMERCIALLY IN USA **PEER REVIEWED** [SRI
3. (1987) Not produced commercially in the USA **PEER REVIEWED** [FARM CHEM HDBK 1987 p.C-89

U.S. Imports:
1. (1977) ND **PEER REVIEWED** [SRI
2. (1982) ND **PEER REVIEWED** [SRI
3. (1987) ND **PEER REVIEWED**

U.S. Exports:
1. (1978) ND **PEER REVIEWED** [SRI
2. (1983) ND **PEER REVIEWED** [SRI
3. (1987) ND **PEER REVIEWED**

CHEMICAL & PHYSICAL PROPERTIES

Color/Form:
1. COLORLESS CRYSTALS **PEER REVIEWED** [Worthing, C.R., S.B. Walker (eds.). The Pesticide Manual - A World Compendium. 7th ed. Lavenham, Suffolk, Great Britain: The Lavenham Press Limited, 1983. 191
2. Pale, tan flakes **PEER REVIEWED** [ITII. Toxic and Hazarous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. 171
3. White, crystalline substance **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.A-2 (1980) EPA 440/5-80-019

Odor:
1. Odorless **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 513
2. Mild chemical odor **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.

Melting Point:
1. 175-176 DEG C **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 203

Molecular Weight:
1. 380.93 **PEER REVIEWED** [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 450

Density/Specific Gravity:
1. 1.75 **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 203

Octanol/Water Partition Coefficient:
1. Log Koc= 3.87 (measured) **PEER REVIEWED** [Briggs GG et al; J Agric Food Chem 29: 1050-9 (1981)

Solubilities:
1. SLIGHTLY SOL IN MINERAL OILS, MODERATELY SOL IN ACETONE **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals

Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A144/Oct 83

9. ALVIT 55 **PEER REVIEWED**
10. DORYTOX **PEER REVIEWED**
11. DIELDRITE **PEER REVIEWED**
12. DIELMOTH **PEER REVIEWED**
13. SD 3417 **PEER REVIEWED**
14. OCTALOX **PEER REVIEWED**
15. PANORAM D-31 **PEER REVIEWED**
16. QUINTOX **PEER REVIEWED**
17. TERMITOX **PEER REVIEWED**
18. Red shield **PEER REVIEWED**
19. ALVIT **PEER REVIEWED** [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file.,p. 87/8704
20. Illoxol **PEER REVIEWED**
21. A CONTACT & STOMACH POISON. IT IS USED FOR CONTROL OF SOIL INSECTS, PUBLIC HEALTH INSECTS, TERMITES, & MANY OTHER PESTS. NOTE: EXCEPT FOR TERMITE CONTROL USE OF DIELDRIN HAS BEEN CANCELED IN THE USA. FORMULATIONS FORM: WETTABLE POWDERS, EMULSIFIBLE CONCENTRATES, DUSTS, GRANULES, SEED DRESSINGS, SOLUTIONS. **PEER REVIEWED** [Farm Chemicals Handbook 87. Willoughby, Ohio: Meister Publishing Co., 1987.,p. C-89
22. DIELDREX **PEER REVIEWED**

Manufacturers:

1. Signo Trading Int Ltd, Hq, 208 S 14 Ave, Mt Vernon, NY 10550 (212) 324-5445 **PEER REVIEWED** [Campbell, J.B. (ed.). Chemical Week Buyers' Guide '84. New York, NY* McGraw Hill, Inc., 1984. 312
2. Shell Chemical Co Agricultural Division, Hq, 2401 Crow Canyon Rd, San Ramon, CA 94583 **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Manual Two. Washington, DC: U.S. Government Printing Office, Oct., 1978.

Other Manufacturing Information:

1. Manufacture discontinued in USA (1987) **PEER REVIEWED** [FARM CHEM HDBK 1987 p.C-89

Major Uses:

1. Broad spectrum insecticide used until 1974; EPA restricted its use to termite control by direct soil injection and non-food seed and plant treatment. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.A-1 (1980) EPA 440/5-80-019
2. Wool processing industry **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 513

Consumption Patterns:

1. From 1966-1970, amt of dieldrin used in the US declined from 1 million lb to approx 670,000 lb. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Dieldrin p.A-1 (1980) EPA 440/5-80-019

Topic: DIELDRIN

SIC Number:
1. 49 411 34; Dieldrin (agricultural insecticide, liquid)
2. 49 411 35; Dieldrin (agricultural insecticide, nonliquid)
3. 49 411 33; Dieldrin (insecticides other than agricultural)

EPA Hazardous Waste Number:
1. P037; An acute hazardous waste when a discarded commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate.

Associated Chemicals:
1. Photodieldrin;13366-73-9

MANUFACTURE/USE INFORMATION

Methods of Manufacturing:
1. SOLOWAY, USA PATENT 2,676,131 (1954 TO SHELL); FROM ALDRIN: BRITISH PATENT 794,373 (1958 TO NV BATAAFSCHE PETR MAATSCHAPPIJ); PAYNE, SMITH, USA PATENT 2,776,301 (1957 TO SHELL). SYNTHESIS: KORTE, RECHMEIER, ANN 656, 131 (1962). **PEER REVIEWED** [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 450
2. EPOXIDATION OF ALDRIN WITH PERACETIC OR PERBENZOIC ACID **PEER REVIEWED** [SRI

Impurities:
1. Technical dieldrin contains some aldrin and endrin. /Amounts not specified/ **PEER REVIEWED** [NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.1 (1978) DHEW Pub. NIOSH 78-201

Formulations/Preparations:
1. Technical, 85+% HEOD; 18% emulsifiable concentrate in petroleum hydrocarbons, which are combustible **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.
2. ILLOXOL **PEER REVIEWED**
3. INSECTLACK **PEER REVIEWED**
4. KOMBI-ALBERTAN **PEER REVIEWED**
5. Wettable powders, emulsifiable concentrates, dusts, granules, seed dressings, solutions **PEER REVIEWED** [Farm Chemicals Handbook 87. Willoughby, Ohio: Meister Publishing Co., 1987. 89
6. EC (150-200 g ai/l); WP (400 or 750 g/kg); GR (50 g/kg); oil solutions for ULV application (180-200 g/l) **PEER REVIEWED** [WORTHING. PESTICIDE MANUAL 8TH ED 1987 p.280
7. Dieldrin is available in the USA as a technical grade product containing 100% active ingredient (equivalent to 85% of HEOD & 15% of other, insecticidally-active, related cmpd) with 55-56% chlorine content, <0.4% free acid (as HCl) & < 0.1% water **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 126 (1974)
3. Mixed formulations: (dieldrin +) captan **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal

Topic: DIELDRIN

ACHLORO-1A,2,2A,3,6,6A,7,7A-OCTAHYDRO-,
(1AALPHA,2BETA,2AALPHA,3BETA,6BETA,
6AALPHA,7BETA,7AALPHA), **PEER REVIEWED**

5. DIELDRINE (FRENCH) **PEER REVIEWED**
6. ENT-16225 **PEER REVIEWED**
7. EXO-DIELDRIN **PEER REVIEWED**
8. HEOD **PEER REVIEWED**
9. HEXACHLOROEPOXYOCTAHYDRO-ENDO,EXO-DIMETHANONAPHTHALENE **PEER REVIEWED**
10. NCI-C00124 **PEER REVIEWED**
11. 1,8,9,10,11,11-Hexachloro-4,5-exo epoxy-2,3-7,6-endo-2,1-7,8-exo-tetracyclo(6.2.1.1 3,6 .0 2,7) dodec-9-ene **PEER REVIEWED** [NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.144 (1978) DHEW Pub. NIOSH 78201
12. Compound 497 **PEER REVIEWED** [NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.148 (1978) DHEW Pub. NIOSH 78-201
13. 3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-2,7: 3,6-dimethanonaphth[2,3-b] oxirene **PEER REVIEWED** [NIOSH; Special Occupational Hazard Review: Dieldrin p.149 (1984) DHEW Pub. NIOSH 78-201
14. AI3-16225 **PEER REVIEWED**
15. Caswell No 333 **PEER REVIEWED**
16. ENT 16,225 **PEER REVIEWED**
17. EPA pesticide Chemical Code 045001 **PEER REVIEWED**
18. 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-2, 7:3,6-dime-thanonaphth (2,3-b)oxirene **PEER REVIEWED** [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file.,p. 87/8704
19. SD 3417 **PEER REVIEWED**
20. Endo,exo-3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7, 7a-octahydro-2,7:3,6- dimethenapth(2,3-b) oxirene **PEER REVIEWED** [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. V13(81) 263

Molecular Formula:

1. C12-H8-C16-O **PEER REVIEWED**

Wiswessar Line Notation:

1. T E3 D5 C555 A D- FO KUTJ AG AG BG JG KG LG ENDO EXO **PEER REVIEWED** [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file.,p. 87/8704

RTECS Number:

1. NIOSH/IO1750000

OHM-TADS Number:

1. 7216516

Shipping Name/Number - DOT/UN/NA/IMCO:

1. NA 2761; Dieldrin

Topic: DIELDRIN

ADMINISTRATIVE INFORMATION
Hazardous Substance DataBank Number:
1. 322
Last Revision Date:
1. 930916
Review Date:
1. SRP review on 12/09/87
Update History:
1. Field Update on 09/16/93, 1 field added/edited/deleted.
2. Field Update on 08/05/93, 1 field added/edited/deleted.
3. Field Update on 08/03/93, 1 field added/edited/deleted.
4. Field update on 12/12/92, 1 field added/edited/deleted.
5. Complete Update on 12/03/92, 1 field added/edited/deleted.
6. Complete Update on 09/03/92, 1 field added/edited/deleted.
7. Complete Update on 04/27/92, 1 field added/edited/deleted.
8. Complete Update on 01/23/92, 1 field added/edited/deleted.
9. Complete Update on 09/26/91, 1 field added/edited/deleted.
10. Complete Update on 10/05/90, 9 fields added/edited/deleted.
11. Field Update on 05/14/90, 1 field added/edited/deleted.
12. Field Update on 03/06/90, 1 field added/edited/deleted.
13. Field Update on 01/15/90, 1 field added/edited/deleted.
14. Complete Update on 01/11/90, 7 fields added/edited/deleted.
15. Field Update on 05/05/89, 1 field added/edited/deleted.
16. Field Update on 03/01/89, 1 field added/edited/deleted.
17. Complete Update on 12/09/88, 2 fields added/edited/deleted.
18. Complete Update on 09/21/88, 99 fields added/edited/deleted.
19. Complete Update on 07/18/85

SUBSTANCE IDENTIFICATION
Name of Substance:
1. DIELDRIN
CAS Registry Number:
1. 60-57-1
Related HSDB Records:
1. (Precursor) 199 [ALDRIN
2. (Isomer) 198 [ENDRIN
Synonyms:
1. 1,2,3,4,10,10,-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8, 8a-octa-hydro-endo,exo 1,4:5,8-dimethanonaphthalene. **PEER REVIEWED** [ITII. Toxic and Hazarous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. 171
2. 1,2,3,4,10,10-HEXACHLORO-EXO-6,7-EPOXY-1,4,4A,5,6,7,8,8 A-OCTAHYDRO-1,4-ENDO,EXO-5,8-DIMETHANONAPHTHALENE **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 203
3. 1,4:5,8-DIMETHANONAPHTHALENE, 1,2,3,4,10,10-HEXACHLORO-6,7-EPOXY-1,4,4A,5,6,7,8, 8A-OCTAHYDRO-, ENDO,EXO- **PEER REVIEWED**
4. 2,7:3,6-DIMETHANONAPHTH(2,3-B)OXIRENE,3,4,5,6,9,9-HEX

Topic: ALDRIN

4. CLEGG DJ; DEV TOXICOL ENVIRON SCI 4: 45-59 (1979) ANIMAL REPRODUCTION & CARCINOGENICITY STUDIES ARE REVIEWED.
5. STERNBERG SS; PHARMACOL THER 6 (1): 147-66 (1979) STUDIES RELATED TO SPECIFIC PESTICIDES (INCL ALDRIN) ARE REVIEWED.
6. ASHWOOD-SMITH MJ; MUTAT R6 (2): 137-54 (1981) CHEMISTRY OF DIELDRIN & ALDRIN, THEIR CARCINOGENIC & MUTAGENIC CAPABILITIES ARE REVIEWED.
7. USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin (1980) EPA 440/5-80-019
8. NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin (1978) DHEW Pub No. 78-201
9. USEPA/CAG; Carcinogen Risk Assessment for Aldrin and Dieldrin. (1985) EPA Contract No. 68-02-4131
10. USEPA/ECAO; Hazard Assessment Report on Aldrin/Dieldrin (Draft) (1980)
11. DHHS/ATSDR; Toxicological Profile for Aldrin/Dieldrin (1989) ATSDR/TP-88/01
12. Govt Reports Announcements & Index (GRA&I) 13: 80 (1985). Assessment of the Health Risks of Seven Pesticides Used for Termite Control.
13. DHEW/NCI; Bioassays of Aldrin and Dieldrin for Possible Carcinogenicity (1978) Technical Rpt Series No. 21 DHEW Pub No. (NIH) 78-821

EXPRESS DATA

Express Update Data:

1. Different fish species from Abu Qir Bay, Idku Lake, and Maryut Lake in Alexandria, Egypt, were assayed for residues of organochlorine insecticides and polychlorinated biphenyls (PCBs). The fish were obtained from commercial fishermen in 1985: Pagellus erythrinus, Sargus vulgaris, Siganus rivulatis, Sphyraena sphyraena, and Trigla herundo from Abu Qir Bay; and Tilapia fish from Idku and Maryut Lakes. Twenty grams of dorsal fish muscle were extracted and the residues analyzed by GLC; reagent blanks and spike samples were included with each sample. The waters from which the fish were obtained receive drainage from industrial, agricultural and urban activities. Water samples were not assayed for specific components. Assays for aldrin indicated it was present in low concentrations. The highest value obtained was 19.9 ug/kg in Sargus vulgarius from Abu Qir Bay. Aldrin was present in low and similar amounts (1.1-3.5 ug/kg) in small and medium sized Tilapia nilotica. Size ranges of Tilapia zilli showed variation of 5.7 ug/kg (small) to 13.1 ug/kg (large) in the concentration of aldrin in muscle tissue. From a health standpoint, all samples were well below permissible levels for aldrin. [El Nabawi A et al; Arch Environ Contam Toxicol 16 (6): 689-96 (1987)

must be avoided. Maximum sample holding time after extraction is 40 days. Detection is achieved by an electron capture detector (ECD) or a halogen-specific detector (HSD). Column 1 contains Supelcoport (100/120 mesh) coated with 1.5% SP-2250/1.95% SP-2401 packed in a 1.8-m by 4-mm ID glass column or equivalent. Colomn 2 contains Supelcoport (100/120 mesh) coated with 3% OV-1 in a 1.8-m by 4-mm ID glass column or equivalent. Under the prescribed conditions, aldrin has a detection limit of 0.004 ug/l, an average recovery range of four measurements of 1.08-2.24 ug/l, and a limit for the standard deviation of 0.42 ug/l. **PEER REVIEWED** [USEPA; Test Methods for Evaluating Solid Waste SW-846 (1986)

9. Method 8250: Gas Chromatography/Mass Spectrometry for Semivolatile Organics, Packed Column Technique. This gas chromatography/mass spectrometry method is used to determine the concentration of semivolatile organic compounds in extracts prepared from all types of solid waste matrices, soils, and ground water. The practical quantitation limit for determining an individual compound is approximately 1 mg/kg (wet weight) for soil/sediment samples, 1-200 mg/kg for wastes, and 10 ug/l for ground water samples. This method is applicable to quantify most neutral, acidic, and basic organic compounds that are soluble in methylene chloride, including the title compound, and capable of being eluted without derivatization as sharp peaks from a gas chromatographic packed column. For base/neutral compound detection, a 2-m by 2-mm ID stainless or glass column packed with 3% SP-2250-DB on 100/120 mesh Supelcoport or equivalent is used. For acid compound detection, a 2-m by 2-mm ID glass column packed with 1% SP-1240-DA on 100/120 mesh Supelcoport or equivalent is used. A representative sample is collected in a glass container equipped with a Teflon-lined cap. Care is taken to avoid sample contact with any plastic. Under the prescribed conditions, aldrin has a detection limit of 1.9 ug/l, a range for the average recovery of four measurements of 7.2-152.2 ug/l, and a limit for the standard deviation of 39.0 ug/l. **PEER REVIEWED** [USEPA; Test Methods for Evaluating Solid Waste SW-846 (1986)

Clinical Laboratory Methods:

1. HUMAN MILK SAMPLES WERE ANALYZED BY ELECTRON-CAPTURE GAS-LIQUID CHROMATOGRAPHY. **PEER REVIEWED** [DILLION JC ET AL; FOOD COSMET TOXICOL 19 (4): 437-42 (1981)

ADDITIONAL REFERENCES

Special Reports:

1. RITPER DL; J ASSOC OFF ANAL CHEM 62 (4): 900-3 (1979) REVIEW: CROSS COMPARISON OF 6 CANCER STUDIES IN RATS & MICE ADMIN ALDRIN & DIELDRIN.
2. REUBER MD; TOXICOL ANNU 3: 231 (1979) A REVIEW OF CARCINOGEN STUDIES IN MICE.
3. JRB ASSOC INC MCLEAN; US NTIS PB REP 532 (PB80-811): 51 (1980) REVIEW ON ALDRIN/DIELDRIN MANUFACTURE, USAGE, PHARMACOLOGY & OCCUPATIONAL HAZARDS.

capture detection, and a 5% methane/95% argon mixture as the carrier gas at a flow rate of 60 ml/min, is an EPA approved method. A sample injection volume of 2 to 5 ul is suggested, the column temperature is held isothermal at 200 deg C. This method has a detection limit of 0.004 ug/l and an overall precision of 0.20 times the average recovery - 0.01, over a working range of 0.5 to 30 ug/l. **PEER REVIEWED** [40 CFR 136 (7/1/87)

6. Method 625: A gas chromatographic/mass spectrometry method for the analysis of Aldrin in municipal and industrial discharges, consists of a glass column, 1.8 m x 2 mm ID, packed with Supelcoport (100/120 mesh) coated with 3% SP-2250, with the detection performed by the mass spectrometer, and helium as the carrier gas at a flow rate of 30 ml/min, is an EPA approved method. A sample injection volume of 2 to 5 ul is suggested, the column temperature is held isothermal at 50 deg C for 4 minutes and then programmed immediately at 8 deg/min to a final temperature of 270 deg C. This method has a detection limit of 1.9 ug/l and an overall precision of 0.43 times the average recovery + 1.13, over a working range of 5 to 1300 ug/l. **PEER REVIEWED** [40 CFR 136 (7/1/87)
7. A gas chromatographic method with electrolytic conductivity detection for the analysis of Aldrin, consists of a glass column, 1.2 m x 3 mm OD, packed with Chromosorb (80/100 mesh acid DMCS) coated with 5% SE-30, and nitrogen as the carrier gas at a flow rate of 140 ml/min, is a NIOSH approved method. A sample volume of 15 ul is suggested, and the column temperature is 160 to 190 deg C. The detector must be equipped with a quartz reduction furnace, at a temperature of 750-770 deg C with hydrogen at a flow rate of 150 to 160 ml/min, the in-line vent temperature is 205 deg C, and the transfer temperature is 225 deg C. This method has an estimated detection limit of 3 ug and a relative standard deviation of 0.012, over a working range of 5 to 135 ug/sample. **PEER REVIEWED** [U.S. Department of Health, Education Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety Health. NIOSH Manual ofAnalytical Methods. 2nd ed. Volumes 1-7. Washington, DC: U.S. Government Printing Office, 1977-present.,p. 5502-1-3
8. Method 8080: Organochlorine Pesticides and PCBs The sensitivity and reliability of Method 8080 usually depends on the level of interferences rather than on instrumental limitations. If interferences prevent detection of the analytes, Method 8080 may also be performed on samples that have undergone cleanup. Method 3620, Florisil Column Cleanup, by itself or followed by Method 3660, Sulfur Cleanup, may be used to eliminate interferences in the analysis. This method is used to determine the concentration of organochlorine pesticides and PCBs in solid waste. A representative sample is collected in a glass container equipped with a Teflon-lined cap. Due to the possibility of contamination, any contact with plastic

oils for animal feed (0.3); fish and shellfish (0.3 edible portion); figs (0.5); hay (0.03); melons (0.15); milk (0.3 fat basis); small fruits (0.05); and sugarbeet pulp for animal feed (0.1). **PEER REVIEWED** [Food & Drug Admin/Office of Enforcement; Compliance Policy Guide No. 7141 Attachment B.1 (9/15/86)

MONITORING AND ANALYSIS METHODS

Sampling Procedures:

1. Air samples containing Aldrin are taken with an organic binder-free, 37 mm glass fiber filter, held without backup pad in a two-piece polystyrene cassette filter holder connected in series with a midget bubbler containing 15 ml of isooctane. This system is also connected to a sampling pump, calibrated at 0.5 l/min for 1 to 6 hr (30 to 180 l). This technique has an overall precision of 0.092 for a range of 0.15 to 0.5 mg/cu m. **PEER REVIEWED** [U.S. Department of Health, Education Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety Health. NIOSH Manual ofAnalytical Methods. 2nd ed. Volumes 1-7. Washington, DC: U.S. Government Printing Office, 1977-present.,p. 5502-1-3

Analytic Laboratory Methods:

1. GAS CHROMATOGRAPHIC ANALYSIS OF AIR; RANGE: 0.15-0.50 MG/CU M. **PEER REVIEWED** [U.S. Department of Health, Education Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety Health. NIOSH Manual ofAnalytical Methods. 2nd ed. Volumes 1-7. Washington, DC: U.S. Government Printing Office, 1977-present.,p. V3 S275-1
2. IDENTIFICATION BY MASS SPECTROMETRY: MUMMA RO, KANTNER TR; J ECON ENTOMOL 59: 491 (1966). **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 30 (1974)
3. RESIDUES IN ANIMAL FEED ARE MEASURED BY GLC & IDENTIFIED BY COMBINATION OF GAS & THIN LAYER CHROMATOGRAPHY. **PEER REVIEWED** [Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 12/518 29.001
4. ... A method /to test for aldrin and endrin/ ... involves dilution of sludge aliquots to 0.1% total solids and extraction with hexane. Concentrated extracts were cleaned up by column chromatography on alumina/silver nitrate and then separated into polar and non-polar components. The method proved to be applicable to aldrin and endrin content detection in sewage sludges. **PEER REVIEWED** [Garcia-Gutierrez A et al; Env Tech Lett 3 (12): 541 (1982)
5. Method 608: A gas chromatographic method for the analysis of Aldrin in municipal and industrial discharges, consists of a glass column, 1.8 m x 4 mm, packed with Supelcoport (100/120 mesh) coated with 1.5% SP-2401, with electron

and Physical Agents [illegible] ices for 1992-1993. Cincinna[illegible], 1992.

2. Excursion Limit Recommendation: Excursions in worker exposure levels may exceed three times the TLV-TWA for no more than a total of 30 min during a work day and under no circumstances should they exceed five times the TLV-TWA, provided that the TLV-TWA is not exceeded. **PEER REVIEWED** [American Conference of Governmental Industrial Hygienists. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 1992-1993. Cincinnati, OH: ACGIH, 1992.

Other Occupational Permissible Levels:

1. FAO/WHO Residue tolerance limit: 0.03-0.[illegible] mg/kg/day **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 772

Other Standards and Regulations

Water Standards:

1. Based on consumption of 2 l of drinking water and consumption of 6.5 gm of fish and shellfish the risk levels and corresponding criteria is as follows 1x10-7: 0.0074 ng/l; 1x10-6: 0.074 ng/l; 1x10-5: 0.74 ng/l; consumption of fish and shellfish only: the risk levels and corresponding citeria is as follows: 1x10-7: 0.0079 ng/l: 1x10-6: 0.079 ng/l; 1x10-5: 0.76 ng/l. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin p.C-64 (1980) EPA 440/5-80-019
2. For saltwater aquatic life, the concentration of aldrin should not exceed 1.3 ug/l at any time. For freshwater aquatic life, the concentration of aldrin should not exceed 3.0 ug/l at any time. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-12 (1980) EPA 440/5-80-019
3. Designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. **PEER REVIEWED** [40 CFR 116.4 (7/1/87)

RCRA Requirements:

1. As stipulated in 40 CFR 261.33, when aldrin, as a commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate, becomes a waste, it must be managed according to federal and/or state hazardous waste regulations. Also defined as a hazardous waste is any container or inner liner used to hold this waste or any residue, contaminated soil, water, or other debris resulting from the cleanup of a spill, into water or on dry land, of this waste. Generators of small quantities of this waste may qualify for partial exclusion from hazardous waste regulations (40 CFR 261.5(e)). **PEER REVIEWED** [53 FR 13382 (4/22/88)

FDA Requirements:

1. Action levels (in ppm) is as follows: animal feeds, processed (0.03); artichokes (0.05); eggs (0.03); fats &

INTAKE IS PERCUTANEOUS. AMT DEPOSITED ON SKIN IS MUCH GREATER & MUCH MORE IMPORTANT THAN AMT INHALED. THIS HAS BEEN MEASURED FOR ENDRIN, & CONSIDERING PHYSICO-CHEMICAL PROPERTIES, SAME MUST BE TRUE FOR ALDRIN ... RESP EXPOSURE IS ONLY FEW PERCENT OF TOTAL INTAKE. **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3707

2. Individuals residing in countries where aldrin is still used are expected to be exposed to the compound by ingestion of contaminated food and drinking water. (SRC) **PEER REVIEWED**

Body Burdens:

1. Aldrin was identified but not quantified in human adipose tissue(1). **PEER REVIEWED** [(1) Anderson HA; Environ Health Persp 60: 127-31 (1985)
2. ALDRIN (0.041 +/- 0.068 MG/KG) EXCEEDED THE CODEX ALIMENTARIUS COMMISSION MAXIMUM RESIDUE LIMITS IN 3% OF 154 SAMPLES OF HUMAN MILK COLLECTED 3-6 DAYS AFTER PARTURITION FROM MOTHERS AT 4 HOSPITALS IN QUEBEC. **PEER REVIEWED** [DILLION JC ET AL; FOOD COSMET TOXICOL 19 (4): 437-42 (1981)
3. IN 45 SAMPLES OF HUMAN MILK, MEAN CONTENT OF ALDRIN & DIELDRIN WAS 0.002 & 0.020 PPM. **PEER REVIEWED** [POZO LORA R ET AL; REV ESP PEDIATR 35 (206): 93-110 (1979)

EXPOSURE STANDARDS & REGULATIONS

Standards & Regulations

Immediately Dangerous to Life or Death:

1. NIOSH has recommended that aldrin be treated as a potential human carcinogen. **QC REVIEWED** [NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS(NIOSH) Publication No. 90-117. Washington, DC: U.S. Government Printing Office, June 1990 34

Acceptable Daily Intake:

1. ACCORDING TO 1978 FAO/WHO STANDARDS PROGRAMME CODEX COMMITTEE ON PESTICIDE RESIDUES, THE ADI OF ALDRIN & DIELDRIN (SINGLY & IN COMBINATION) IS 0.0001 MG/KG BODY WEIGHT. **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3708
2. Estimated daily dietary intake of a young male is as follows: 1965: 0.001 mg; 1966: 0.002 mg; 1967: 0.001 mg; 1968: trace; 1969: trace; 1970: trace. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.C-8 (1980) EPA 440/5-80-019

Occupational Permissible Levels

OSHA Standards:

1. Meets criteria for OSHA medical records rule. **PEER REVIEWED** [29 CFR 1910.20 (7/1/87)

Threshold Limit Values:

1. Time Weighted Avg (TWA) 0.25 mg/cu m, skin (1986) **QC REVIEWED** [American Conference of Governmental Industrial Hygienists. Threshold Limit Values for Chemical Substances

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components. Assays for aldrin indicated it was present in low concentrations. The highest value obtained was 19.9 ug/kg in Sargus vulgaris from Abu Qir Bay. Aldrin was present in low and similar amounts (1.1-3.5 ug/kg) in small and medium sized Tilapia nilotica. Size ranges of Tilapia zilli showed variation of 5.7 ug/kg (small) to 13.1 ug/kg (large) in the concentration of aldrin in muscle tissue. From a health standpoint, all samples were well below permissible levels for aldrin. **PEER REVIEWED** [El Nabawi A et al, Arch Environ Contam Toxicol 16 (6): 689-96 (1987)

Animal Concentrations:

1. Water snakes taken in Louisiana contained ND-0.02 ppm (wet weight) aldrin(1). Beaked whale - blubber 0.0005 mg/kg, ND in liver(2). Measurements were made on fresh tissue of cetaceans taken off Chile(2). **PEER REVIEWED** [(1) Sabourin TD et al; Bull Environ Contam Toxicol 32: 460-8 (1984) (2) Pantoja S et al; Marine Pollut Bull 16: 255 (1985)
2. Hooded seal, Greenland: Fat: 0.028 mg/g **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 173

Milk Concentrations:

1. Fluid milk - domestic 4639 samples, 0.3% pos, 0.0002 ppm aldrin avg(1). **PEER REVIEWED** [(1) Duggan RE et al; Pest Res Levels in Foods in US from July 1, 1969 to June 30, 1976 FDA and AOAC (1983)
2. ALDRIN (0.041 + or - 0.068 MG/KG) EXCEEDED THE CODEX ALIMENTARIUS COMMISSION MAXIMUM RESIDUE LIMITS IN 3% OF 154 SAMPLES OF HUMAN MILK COLLECTED 3-6 DAYS AFTER PARTURITION FROM MOTHERS AT 4 HOSPITALS IN QUEBEC. **PEER REVIEWED** [DILLION JC ET AL; FOOD COSMET TOXICOL 19 (4): 437-42 (1981)
3. IN 45 SAMPLES OF HUMAN MILK, MEAN CONTENT OF ALDRIN & DIELDRIN WAS 0.002 & 0.020 PPM. **PEER REVIEWED** [POZO LORA R ET AL; REV ESP PEDIATR 35 (206): 93-110 (1979)

Human Exposure

Probable Routes of Human Exposure:

1. ... POISONING ... /IN/ PEOPLE ... /HAS OCCURRED/ BY CONSUMPTION OF SEED GRAIN CONTAMINATED WITH ALDRIN, SOMETIMES IN COMBINATION WITH OTHER PESTICIDES. **PEER REVIEWED** [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 235
2. Cessation of aldrin production and use is expected to eventually eliminate human exposure to the insecticide in the USA but will result in dieldrin exposure. (SRC) **PEER REVIEWED**

Average Daily Intake:

1. FOOD: 0.053 ug(1). **PEER REVIEWED** [(1) Duggan RE et al; Pest Res Levels in Foods in US from July 1, 1969 to June 30, 1976 FDA and AOAC (1983)

Probable Exposures:

1. ... IN INDUSTRIAL & OTHER OCCUPATIONAL (AGRICULTURAL & PUBLIC HEALTH USE) SITUATIONS, THE PRINCIPAL ROUTE OF

Cheese - domestic 784 samples, 0.7% pos, 0.004 ppm avg, imported 5471 samples, 0.08% pos, <0.0001 ppm avg(1). Red meat - 15200 samples (1972-76 only), 0.0% pos, 0.0007 ppm avg, fat basis(1). Poultry (1972-76 only), 0.7% pos, 0.0005 ppm avg, fat basis(1). Large fruits - domestic 3281 samples, 0.8% pos, 0.0002 ppm avg, imported 1048 samples, 0.3% pos, <0.0001 ppm avg(1). Small fruits - domestic 1445 samples, 0.3% pos, <0.0001 ppm avg, imported 2119 samples, 0.4% pos, <0.0001 ppm avg(1). Vine and ear vegetables - domestic 2954 samples, 0.2% pos, <0.0001 ppm avg, imported 4117 samples, 0.3% pos, 0.0001 ppm avg(1). Root vegetables - domestic 3248 samples, 0.7% pos, 0.0002 ppm avg, imported 609 samples, 0.3% pos, <0.0001 ppm avg(1). Whole grains - domestic 947 samples, 0.1% pos, <0.0001 ppm avg, imported 85 samples, 1.2% pos, 0.0002 ppm avg(1). Corn - 280 samples, 0.4% pos, <0.0001 ppm(1). Cottonseed - 54 samples, 4.3% pos, 0.409 ppm avg(1). Peanuts and peanut products - 148 samples, 0.7% pos, 0.0005 ppm avg(1). Aldrin was infrequently found in eggs and egg products, leaf and stem vegetables, and nuts(1). These values were determined on foods prior to the cessation of aldrin use(SRC). One August 1973-July 1984 food composite (fruits) contained 0.001 ppm aldrin(2). **PEER REVIEWED** [(1) Duggan RE et al; Pesticide Res Levels in Foods in US from July 1, 1969 to June 30, 1976 FDA and AOAC (1983) (2) Manske DD, Johnson RD; Pest Monit J 10: 134-48 (1977)

Plant Concentrations:

1. Aquatic vascular plants collected from Lake Pajjanne, Finland during 1972-1973 the concn for aldrin was 2 ug/kg + or - 5 ug/kg (dry weight) n= 114. **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 170

Fish/Seafood Concentrations:

1. Fish - domestic 2901 samples, 0.5% pos, 0.0002 ppm avg(1). Mussel - 1 ppb(2). Crab - 16 ng/g(2). Aldrin was detected but not quantified in bottom-dwelling fish taken from the Puget Sound, WA(3). **PEER REVIEWED** [(1) Duggan RE et al; Pest Res Levels in Foods in US from July 1, 1969 to June 30, 1976 FDA and AOAC (1983) (2) Reish DJ et al; J Water Pollut Cont Fed 54: 786-812 (1982) (3) Malins DC et al; Environ Sci Technol 18: 705-13 (1984)
2. Different fish species from Abu Qir Bay, Idku Lake, and Maryut Lake in Alexandria, Egypt, were assayed for residues of organochlorine insecticides and polychlorinated biphenyls (PCBs). The fish were obtained from commercial fishermen in 1985: Pagellus erythrinus, Sargus vulgaris, Siganus rivulatis, Sphyraena sphyraena, and Trigla herundo from Abu Qir Bay; and Tilapia fish from Idku and Maryut Lakes. Twenty grams of dorsal fish muscle were extracted and the residues analyzed by GLC; reagent blanks and spike samples were included with each sample. The waters from which the fish were obtained receive drainage from industrial, agricultural and urban activities. Water samples were not assayed for specific

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Geneva: World Health Organization, International Agency for Research on Cancer, [illegible]. (Multivolume work).,p. V5 29 (1974)

3. SEDIMENT: Niagara-on-the-lake suspended sediments, 1979-81, 70 samples, [illegible]% pos, 2 ng/g avg(1). Unspecified US sediments - 2,048 samples, 3.0% pos, 0.1 ng/kg dry weight median(2). Detected but not quantified in sediments from the Puget Sound, WA(3). SOIL: Nebraska soils - 1969, 106 sites, 1% pos, ND-0.[illegible] ppm, <0.01 ppm avg; 1970, 106 samples, 3.77% pos, 0.01 ppm max and min, [illegible] ppm avg, 1971, 106 samples, 0.[illegible] pos, ND-0.02 ppm, [illegible] ppm avg, 1973, 101 samples, 2% pos, 0.01-0.06 ppm, [illegible].01 ppm(4). Ontario, Canada - 1976 agricultural soils. ND-0.06 ppm(5). **PEER REVIEWED** [(1) Kuntz KW; Toxic Contam in the Niagara River 1975-82 Burlington, Ontario Tech Bull No.134 (1984) (2) Staples CA et al; Environ Toxicol Chem 4: 131-42 (1985) (3) Malins DC et al; Environ Sci Technol 18: 705-13 (1984) (4) Ball HJ; J Environ Sci Health B18: 735-44 (1983) (5) Miles JRW, Harris CR; J Environ Sci Health B13: 199-209 (1978)

Atmospheric Concentrations:

1. Aldrin was detected within 800 m of two formulation plants in Arkansas in 1970 and 1971(1). Residues were: 1970 - 66 samples, 24% pos, 0.6-1.4 ng/cu m, 0.9 ng/cu m avg; 1971 - 60 samples, 10% pos, 0.4-6.3 ng/cu m, 1.5 ng/cu m avg(1). Among air samples taken in Iowa City, Iowa during 1967-68, only one was positive for aldrin and contained 8.0 ng/cu m(1). Air samples taken in Miami were 14.3% pos, and ranged from ND-1.1 ng/cu m with a 0.2 ng/cu m avg and in the Everglades National Park were 7.1% pos, and ranged from ND-0.5 ng/cu m with a 0.04 ng/cu m avg(1). The aldrin concentration in the air of a South Florida Formulation plant was 437.0 ng/cu m in 1974(1). Aldrin concentrations in the air above a hazardous liquid waste impoundment at an unspecified location ranged from ND-380 ng/cu m(2). Unspecified US urban location - 1-10 ng/cu m (vapor/particulate)(3). Unspecified US rural location - 0.1-1 ng/cu m (vapor/particulate)(3). **PEER REVIEWED** [(1) Lewis RG, Lee RE Jr; pp 5-51 in Air Pollut From Pesticides and Agricultural Processes, Lee RE Jr ed CRC Press Cleveland, OH pp 5-51 (1976) (2) Guzewich DC et al; Air Pollut Cont Assoc 76th Ann Mtg Atlant, GA pp 1-14 (1983) (3) Miller JM; The Potential Atmospheric Impact of Chemicals Released to the Environ (1981) USEPA-560/5-80-001

Food Survey Results:

1. IT IS TRANSLOCATED SHORT DISTANCES IN SOME PLANTS, & IT GIVES AN OFF FLAVOR TO ... /SOME/ FOODS, NOTABLY JAM MADE FROM STRAWBERRIES RAISED IN TREATED SOIL. **PEER REVIEWED** [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 234
2. Average dietary intake 0.5 ng/kg body weight/day(1). Year-positive composites (daily intake in ug) for aldrin: 1971 - not found, 1972 - 0.2 (Trace), 1973 - 0.3 (0.006), 1974 - 0.3 (0.006), 1975 - 0.4 (0.2), 1976 - not found(1).

317-65 (1977) (2) Kuntz KW; Toxic Contam in the Niagara River, 1975-82 Burlington, Ontario Tech Bull No.134 (1984) (3) Page WG; Environ Sci Technol 15: 1475-81 (1981) (4) Ohio River Valley Sanitation Committee; Assess of Water Qual Conditions Ohio River Mainstem 1978-9 (1980) (5) McFall JA et al; Chemosphere 14: 1253-65 (1985) (6) Staples CA wt al; Environ Toxicol Chem 4: 131-42 (1985)

2. DRINKING WATER: United States (unspecified location) - 5.4 ug/l, The Hague, Netherlands - 0.01 ug/l, Ottawa, Canada - Tap water, 0.7 ug/l(1). Aldrin was detected but not quantified in USA drinking water from unspecified locations(2,3). **PEER REVIEWED** [(1) Kraybill HF; NY Acad Sci Ann 298: 80-9 (1977) (2) Kopfler FC et al; Adv Environ Sci Technol 8: 419-33 (1977) (3) Kool HJ et al; CRC Crit Rev Environ Cont 12: 307-57 (1982)
3. GROUNDWATER: New Jersey -1076 samples, 26% pos, 1.2 ppb max(1). **PEER REVIEWED** [(1) Page WG; Environ Sci Technol 15: 1475-81 (1981)
4. RAIN/SNOW: Unspecified urban location - 7 ng/cu m (rain/snow) (1). Unspecified USA rural location - 0.5-3 ng/cu m (rain/snow)(1). Aldrin was detected but not quantified in snow samples collected in Finland and at the North Pole(2). **PEER REVIEWED** [(1) Miller JM; The Potential Atmospheric Impact of Chemicals Released to the Environ USEPA-560/5-80-001 (1981) (2) Herve S; Chemosphere 14: 1741-8 (1985)

ffluents Concentrations:

1. . Aldrin residues in treated wastewater effluents from a variety of industries were as follows: coal mining - 47 samples, 4.3% pos, 2.2 ppb avg; Foundries - 10 samples, 100% pos, 5-10 ppb, 5.5 ppb avg; nonferrous metals manufacturing - ND-0.5 ppb, 0.2 ppb avg(1). Unspecified industrial effluents - 677 samples, 3.1% pos, <0.010 ug/l median(2). Urban runoff samples from Washington, DC were 20% positive and contained 0.0027-0.1 ug/l aldrin(3). Flint, MI - municipal plant effluent, 0.04-0.06 ppb(4). Owossa, MI - municipal plant effluent, 0.22 ppb(4). **PEER REVIEWED** [(1) USEPA; Treatability Manual Vol 1 Treatability data USEPA-600/2-81-011a (1981) (2) Staples CA et al; Environ Toxicol Chem 4: 131-42 (1985) (3) Cole RH et al; J Water Pollut Cont Fed 56: 898-908 (1984) (4) Konasewich D et al; Status Report on Org and Heavy Metal Contaminants in the Lake Erie, Michigan, Huron and Superior Basins. Great Lakes Water Quality Board (1978)

Sediment/Soil Concentrations:

1. ALDRIN UP TO 25.5 PPB WAS DETECTED AMONG SEDIMENT SAMPLES FROM 20 RIVERS IN TAIWAN. NO CORRELATION WAS OBSERVED BETWEEN RESIDUE LEVEL & ORG MATTER OR PH OF SEDIMENTS. **PEER REVIEWED** [WU TC ET AL; CHUNG-KUO NUNG YEH HSUEH HUI CHIH 20 (1-2): 1-8 (1982)
2. /IT WAS SHOWN/ ... THAT APPLICATION UP TO 25 LB ALDRIN/ACRE OF CORN SOILS RESULTED IN RETENTION OF 10% OF APPLIED LEVEL AFTER 4 YR, THIS REMAINING MAINLY IN FORM OF DIELDRIN. **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man.

the vapor from the q[illegible] and [illegible] loam, respectively, and 5[illegible] and 7[illegible] from the two soils, respectively(2). Volatilization rates of aldrin from sand, loam, and humus were 1.08%, [illegible]% and 0.8%/ml evaporated water after the first hour and 0.59%, 0.18%, and 0.09%/ml evaporated water in the second hour, respectively(2). Aldrin was assigned a volatilization index of 1 (<0.1 kg/ha/yr) for volatilization from soil(3). WATER: After 20 hr at 25.5 deg C, 93% of the aldrin initially present (24 ppb), had codistilled with water(4). Half-lives for the volatilization of aldrin from pure water and waters of the San Franscisco Bay, the American River and the Sacramento River are 0.58 hr, 0.59 hr, 0.60 hr, and 0.60 hr, respectively(5). The volatilization rate of aldrin from water was 16.3%/ml evaporated water after one hour and 6.03%/ml evaporated water in the second hour(2). The estimated volatilization half-life of aldrin from 1 m deep water at 25 deg C is 7.7 days(6). Using a water solubility of 0.20 mg/l and a vapor pressure of 6X10-6 mm Hg, both measured at 25 deg C, a Henry's Law constant of 1.27X10-5 can be estimated(7). Using these parameters, half-lives for the volatilization of aldrin from model streams, rivers and lakes were estimated(7). The wind velocity was assumed to be 3 m/s, the current velocities of the streams, rivers and lakes to be 2,1, and 0.01 m/s, respectively, the depths of the streams and rivers to be 1 m and that of the lakes, 50 m. The estimated half-lives were 105.5 hr, 133.9 hr, and 6873.1 hr (285.6 days), for the streams, rivers and lakes, respectively. **PEER REVIEWED** [(1) Harris CR, Lichtenstein EP; J Econ Entomol 54: 1038-45 (1961) (2) Kilzer L et al; Chemosphere 10: 751-61 (1979) (3) Faust SD; Adv Environ Sci Technol 8: 317-65 (1977) (4) Huang JC; Eng Bull Purdue Univ Eng Ext Series p 449-57 (1970) (5) Callahan MA et al; Water Related Environ Fate of 129 Priority Pollut pp 21-1 to 21-13 USEPA-440/4-79-029a (1979) (6) Mackay D, Leinonen PJ; Environ Sci Technol 9: 1178-80 (1975) (7) Lyman WJ et al; Handbook of Chem Property Estimation Methods Environ Behavior of Org Compounds McGraw-Hill NY pp 15-11, 15-21 (1982)

Environmental Concentrations

Water Concentrations:

1. SURFACE WATER: Major USA rivers - 100 sites, maximum residue 0.085 ug/l(1). Niagara-on-the-Lake, 1980-82, 75 samples, 1% pos, <0.1 ng/l avg(2). New Jersey - 604 samples, 23.5% pos, 0.6 ppb max(3). Ohio River (various sites) - 11 samples, 9% pos, <0.1 ug/l max, 12 samples, 8, 35 pos, <0.1 ug/l max, 21 samples, 57% pos, 2.0 ug/l max, 11 samples, 54.5% pos, 1.3 ug/l max, 11 samples, 36.3% pos, 0.5 ug/l max, 11 samples, 18.2% pos, 0.5 ug/l max(4). Inner Harbor Navigation Canal, Lake Pontchartrain, LA - Ebb tide: 0.3 ppt (1.5 m), Flood Tide: 5.6 ppt (1.5 m) and 2.6 ppt (10 m)(5). Unspecified US surface waters - 7891 samples, 40.0% pos, 0.001 ug/l median(6). **PEER REVIEWED** [(1) Faust SD; Adv Environ Sci Technol 8:

a silt loam soil(3). The percent distribution of aldrin after 10 years in nondisked soil was 0-2" - 11%, 2-4" - 33%, 4-6" - 33%, and 6-9" - 23% and in disked (for one summer only) soil was 0-2" - 13%, 2-4" - 29%, 4-6" - 29%, and 6-9" - 29%(3). Aldrin in soil was quantified 5, 6, 4, and 3 months following its application at 2.9, 3.0, 3.0, and 3.0 kg/ha to soils used for growing maize in Germany, England, Spain, and the United States, respectively(4). For soil depths of 0-10 cm, 10-20 cm, 20-40 cm, and 40-60 cm, respective residue levels in ppm (% total aldrin extractble) were: Germany - 0.78 ppm (78%), 0.18 ppm (18%), 0.03 ppm (3%), and <0.01 ppm (<1%); England - 1.30 ppm (ca 100%), <0.01 ppm (<1%) at all other levels; Spain - 0.83 ppm (96.5%), 0.02 ppm (2.3%), 0.01 ppm (1.2%) and <0.01 ppm (<1%); US - 0.50 ppm,(98%), 0.01 ppm (1.96%), <0.01 ppm (<1%) at all other levels(4). Aldrin in soil was quantified 5 and 4 months following application of aldrin at 2.9 and 3.2 kg/ha to soils used for growing wheat in Germany and England, respectively(4). For soil depths of 0-10 cm, 10-20 cm, 20-40 cm, and 40-60 cm, respective residue levels in ppm (% total aldrin residues) were: Germany - 1.09 ppm (66.9%), 0.45 ppm (27.6%), 0.09 ppm (5.5%), <0.01 ppm (<1%); England - 2.00 ppm (ca 100%), <0.01 ppm (<1%) at all other levels(4). A leaching index of 1 (<10 cm leaching through soil column with 150 cm annual rainfall) was assigned to aldrin(5). Experimentally determined log soil sorption coefficients (Koc) for aldrin ranged from 2.61-4.45(6). Soil sorption coefficients of these magnitudes suggest that aldrin will not be highly mobile in soil(7). Minimal leaching to groundwater is expected from these results(SRC). **PEER REVIEWED** [(1) Pionke HB, Chesters G; J Environ Qual 2: 29-45 (1973) (2) Harris CI; J Agric Food Chem 17: 80-2 (1969) (3) Lichtenstein EP et al; J Agric Food Chem 19: 718-21 (1971) (4) Weisgerber I et al; J Agric Food Chem 22: 609-12 (1974) (5) Faust SD; Adv Environ Sci Technol 8: 317-65 (1977) (6) Sabljic A; J Agric Food Chem 32: 243-6 (1984) (7) Kenaga EE; Ecotox Env Safety 4: 26-38 (1980)

Volatilization from Water/Soil:

1. SOIL: Aldrin was applied at 4 ppm to wet and dry quartz and Plainfield sands. Analysis of air passed over the sand at 1 l/min windspeed for 6 hrs at 22 deg C and 38% relative humidity revealed no volatilization of aldrin from the dry Plainfield sand and only a trace from the dry quartz sand (<0.50% of initial aldrin). Four percent and 2.19% of the initial aldrin volatilized from wet quartz and Plainfield sands, respectively, at the same relative humidity. At 100% relative humidity, 1.28% and 6.16% of the aldrin volatilized from dry Plainfield and quartz sands, respectively, and 4.52% and 7.33% of the aldrin volatilized from the wet Plainfield and quartz sands, respectively(1). Following passage of air at 1 l/min windspeed at 22 deg C and 100% relative humidity over quartz sand and Miami silt loam treated with 4 ppm aldrin, 37.9% and 16.3% of the initial aldrin were recovered in

constituents of natural waters(6). Irradiation of aldrin in 0.05 M hydrogen peroxide for 12 hr at 290 nm reduced the aldrin concentration by 79.5% compared to a dark control in which the aldrin concentration decreased by 32.9%(7). Photoaldrin, dieldrin, and one unidentified product were isolated from the 0.05 M hydrogen peroxide solution(7). **PEER REVIEWED** [(1) Crosby DG, Moilanen KW; Arch Environ Contam Toxicol 2: 62-74 (1974) (2) Callahan MA et al; Water Related Environ Fate of 129 Priority Pollut pp 21-1 to 21-13 USEPA 440/4-79-029a (1979) (3) Rosen JD; pp 352-80 in Org Compounds in Aquatic Environ Faust SJ ed, Dekker, NY (1971) (4) Chen ZM et al; Ind Eng Chem Prod Res Rev 23: 5-11 (1984) (5) Korte F et al; Chemosphere 1: 79-102 (1978) (6) Ross RD, Crosby DG; Environ Toxicol Chem 4: 773-8 (1985) (7) Dawson WM, Crosby DG; J Agric Food Chem 32: 291-7 (1984)

4. Aqueous reactions: persistence in river water in a sealed glass jar under sunlight and artificial fluorescent light-initial concn of 10 ug/l: after 1 hr: 100%; 1 wk: 100%; 2 wk: 80%; 4 wk: 40%; 8 wk: 20%. **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 170

Environmental Transport

Bioconcentration:

1. SUSCEPTIBLE MOSQUITOFISH, GAMBUSIA AFFINIS, EXPERIENCED GREATER ACCUM OF ALDRIN IN TISSUES THAN RESISTANT MOSQUITOFISH. PROBABLE CAUSES FOR RESISTANCE IN DECR ORDERS OF IMPORTANCE: MODIFIED SITE INSENSITIVITY; BARRIERS TO PENETRATION; & BIOTRANSFORMATION. **PEER REVIEWED** [YARBROUGH JD, CHAMBERS JE; ACS SYMP SER 99 (CH 9): 145 (1979)
2. BLUE MUSSELS (MYTILUS SPECIES) USED AS INDICATORS FOR MONITORING POLLUTION OF LAGOON WATERS SHOWED ALDRIN TO BE PRESENT UP TO 0.4 MUG/KG IN WET TISSUE. **PEER REVIEWED** [BATTAGLIA B; COMM EUR COMMUNITIES (REP) EUR (EUR 6388 ENVIRON RES PROGRAMME): 384-8 (1980)
3. The bioconcentration factor of aldrin in molluscs is 4571(1), in the golden orfe is 3890(2), in an unspecified fish is 10715(3) and in the alga, Chlorella fusca, is 12,260(4). Bioconcentration of aldrin is expected to be significant(SRC). **PEER REVIEWED** [(1) Hawker DW, Connell DW; Ecotoxicol Environ Safety 11: 184-97 (1986) (2) Freitag D et al; Ecotoxicol Environ Safety 6: 60-81 (1982) (3) Garten CT, Trabalka JR; Environ Sci Technol 17: 590-5 (1983) (4) Geyer H et al; Chemosphere 13: 269-84 (1984)

Soil Adsorption/Mobility:

1. Aldrin was applied to silty soil at 1.5 kg/ha as a surface spray. Following one simulated rainfall, 5.2% of the aldrin was lost in runoff(1). Aldrin was immobile in columns containing Hagerstown silty clay loam or Lakeland sandy loam up through which water moved for 3 days(2). The amount of water which moved up the columns was not specified(2). Aldrin was applied to the upper 5 inches of

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RESIDUE-SOIL BIOTA INTERACTIONS. FINAL REPORT FOR THE PERIOD 1 MARCH 1978-30 JUNE 1982; REPORT (IAEA-R-2161-F): 10 (1982)

2. No biodegradation of aldrin at 5 and 10 mg/l was observed through the third subculture of a mixed culture inoculum from sewage(1). Activated sludge biodegraded 1.5% of the initial aldrin in an unspecified amount of time(2). Aldrin incubated for 30 days in a water surface film collected off of Hawaii was degraded by 8.1% to the diol(3). A pure culture of the marine alga, Dunaliella sp, degraded 23.3% of the initial aldrin to dieldrin and 5.2% to the diol(3). A pure culture of Aerobacter aerogenes degraded 36-46% of the initial amount of aldrin in 24 hours(4). Aldrin was classified as refractory to biodegradation(5,6). **PEER REVIEWED** [(1) Tabak HH et al; Proc Sym Assoc Off Anal Chem 94th Ann Mtg p 267-328 (1981) (2) Freitag D et al; Chemosphere 14: 1589-1616 (1985) (3) Patil KC et al; Environ Sci Technol 6: 629-32 (1972) (4) Mendel JL et al; J Assoc Off Anal Chem 50: 897-903 (1967) (5) Okey RW, Bogan RH; J Water Pollut Cont Fed 37: 692-712 (1965) (6) Thom NS, Aff AR; Proc R Soc Land B 189: 347-57 (1975)

Abiotic Degredation:

1. INSECTIDES SUCH AS ALDRIN MINERALIZE DURING IRRADIATION WITH PYREX-FILTERED UV LIGHT; AMT OF MINERALIZATION INCR WITH USE OF SHORT-WAVE UV LIGHT. **PEER REVIEWED** [GAEB S ET AL; NATURE 270 (5635): 331 (1977)
2. NO REACTION OF OZONE WITH CHLORINATED DOUBLE BOND OF ALDRIN HAS BEEN FOUND. IT IS BELIEVED THAT SHIELDING OF CHLORINATED DOUBLE BOND BY BULKY CHLORINE SUBSTITUENTS & ENDO-SUBSTITUENTS PREVENTS SUCH AN ATTACK. **PEER REVIEWED** [GAEB S; GEISSBUEHLER H, ED (PERGAMON PRESS: OXFORD, ENGLAND) (3): 608-612 (1979)
3. Treatment of saturated aldrin vapor (5000 ug) with a sunlamp for 45 hours resulted in 14-34% degradation (based on the amount aldrin recoverable from the reactor walls)(1). Dieldrin (50-60 ug) and photoaldrin (20-30 ug) were the photoproducts. Irradiation of 1 ug of aldrin vapor with the sunlamp for 168 hours resulted in 60% degradation compared to 16% degradation in a dark control(1). Dieldrin (0.63 ug) was the primary photoproduct and photoaldrin (0.02 ug) and photodieldrin (0.02 ug) were also detected(1). A photolysis half-life of 1.1 day was determined for 0.33 ppb aldrin in San Francisco Bay water exposed to sunlight, although insufficient detail concerning the experimental conditions is available to conclude that this result was due solely to direct photolysis(2). Exposure of an aldrin film to sunlight for 1 month resulted in a solution containing 2.6% unchanged aldrin and 9.6% photoaldrin, 4.1% dieldrin, 24.1% photodieldrin and 59.7% of an unidentified product(3). Photolysis half-lives of thin films of aldrin irradiated at >300 nm were 4.7, 8.3, and 11 days, respectively(4). Solid aldrin adsorbed on silica gel irradiated at >290 nm for 6 days was 11% mineralized(5). A 0.07 M aqueous solution of aldrin was 25% photooxidized by

in the lower layer was 63% and in the upper layer was 49%(5). Aldrin was converted into dieldrin in these studies(5). When aldrin was applied to agricultural soils in Germany, Spain, England and the United States, significant amounts of dieldrin derived from the applied aldrin were detected in the soils within 6 months of aldrin application(6). Aldrin was classified as moderately persistent meaning its half-life in soil ranged from 20-100 days(7). **PEER REVIEWED** [(1) Singh G et al; Ecotoxicol Environ Safety 9: 294-9 (1985) (2) Lichtenstein EP, Schulz KR; J Econ Entomol 52: 124-31 (1959) (3) Castro TF, Yoshida T; J Agr Food Chem 19: 1168-70 (1971) (4) Lichtenstein EP et al; J Agr Food Chem 18: 100-6 (1970) (5) Carter FL, Stringer CA; Pest Cont 39: 13-22 (1971) (6) Weisgerber I et al; J Agr Food Chem 22: 600-1 (1974) (7) Willis GH, McDowell LL; Environ Toxicol Chem 1: 267-79 (1982)

5. AQUATIC FATE: A river die away test was conducted in capped bottles with aldrin in raw water from the Little Miami River in Ohio. The river receives domestic and industrial wastes and farm runoff. After 2, 4, and 8 weeks, 20, 60, and 80% of the initial amount of aldrin had degraded(1). Volatilization from water is also expected to be significant and will occur at a rate directly proportional to the rapidity of wind and current velocity and inversely proportional to the depth of the water body(SRC). Bioconcentration and adsorption to sediments are expected to be significant. Photooxidation is expected to be significant. Biodegradation is expected to be slow(SRC). **PEER REVIEWED** [(1) Eichelberger JW, Lichtenberg JJ; Environ Sci Technol 5: 541-4 (1971)
6. ATMOSPHERIC FATE: The half-life for the reaction of vapor phase aldrin with photochemically generated hydroxyl radicals in the atmosphere was estimated to be 35.46 min(1). Slow photolysis of aldrin vapor (60% in one week vs 16% in a dark control) was observed(2). This is expected due to the weak absorption of aldrin above 290 nm(3). Direct photolysis, therefore, is not expected to be significant compared to reaction with hydroxyl radicals(SRC). **PEER REVIEWED** [(1) GEMS; Graphical Exposure Modeling System Fate of Atmospheric Pollut data base Office of Toxic Substances USEPA (1986) (2) Crosby DG, Moilanen KW; Arch Environ Contam Toxicol 2: 62-74 (1974) (3) Gore RC et al; J Assoc Off Anal Chem 54: 1040-82 (1971)

Environmental Transformations

Biodegredation:

1. ABILITY OF FUNGI ISOLATED FROM SOILS TO DEGRADE (14)C-ALDRIN & ITS METABOLITES WAS ASSAYED IN CULTURE GROWTH MEDIUM. PENICILLIUM METABOLIZED PARENT CMPD OR ONE OF ITS METABOLITES. FIELD STUDIES PERFORMED WITH SOILS PACKED INTO PVC TUBES SHOWED THAT ADDED (14)C-ALDRIN LEACHED FASTEST IN SOIL POOR IN ORGANIC MATTER. **PEER REVIEWED** [FLORES-RUEGG E; PART OF A COORDINATED PROGRAM ON ISOTOPIC-TRACER-AIDED STUDIES OF AGROCHEMICAL

WAS HIGHER IN SANDY LOAM THAN IN CLAY LOAM SOIL. ALDRIN RESIDUES LEACHED INTO SOIL WITH RAIN WATER. NEITHER ALDRIN NOR DIELDRIN TRANSLOCATED IN MAIZE, PEARL MILLET PLANTS & GRAINS. **PEER REVIEWED** [GUPTA H CL ET AL; INDIAN J ENTOMOL 41 (1): 47-57 (1979)

2. ... UNDER MOST ENVIRONMENTAL CONDITIONS ALDRIN IS GRADUALLY CONVERTED TO DIELDRIN. **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 26 (1974)
3. AFTER ADDITION OF ALDRIN TO SOIL SAMPLES, WATER-SOL DICARBOXYLIC ACID WAS ISOLATED. AFTER PREPARATIVE ISOLATION & METHYLATION, GAS CHROMATOGRAPHY, MASS SPECTROMETRY ... SHOWED MATERIAL TO BE IDENTICAL WITH AUTHENTIC DIHYDROCHLORDENDICARBOXYLIC ACID DIMETHYL ESTER ... **PEER REVIEWED** [Menzie, C. M. Metabolism of Pesticides, An Update. U.S. Department of the Interior, Fish, Wild-life Service, Special Scientific Report - Wildlife No. 184, Washington, DC: U.S. GovernmentPrinting Office, 1974. 14
4. TERRESTRIAL FATE: Aldrin was applied at 1.5 kg ai/ha to flooded soil. After 30, 90, 120, 240, and 270 days, 44.2%, 55.4%, 74.13%, 88.07%, and 100% of the aldrin had dissipated from the soil(1). Aldrin applied at 20 lb/6" acre to muck and loam had respective half-lives of 3.75 and 2.40 months for the first half-year and 13.0 and 9.7 months for the following three years(2). Three and one-half years following the application to a Miami silt loam of 20 and 200 lb aldrin/6" acre, 1.12% and 2.55%, respectively, of the calculated initial amount of aldrin remained(2). Aldrin was applied 20 lb/6" acre to Miami silt loam and at 100 lb/6" acre to Plainfield sand(2). After incubation for 56 days at 6, 26, and 46 deg C, 83.8%, 55.7% and 13.7% of the initial amount of recoverable aldrin remained on the Miami silt loam and 63%, 38%, and 10.2% remained on the Plainfield sand, respectively(2). After 2 months incubation at 30 deg C, 44%, 58%, and 33% of about 15 ppm of aldrin applied remained in the Maahas, Luisiana, and Casiguran soils under upland (80% water saturated), respectively, and under flooded conditions, 65%, 81%, 74%, and 64% remained in the Pila, Maahas, Luisiana and Casiguran soils, respectively(3). Soils were treated with aldrin at 5 lb/acre from 1958-62(4). Dieldrin was formed from aldrin in the soil and constituted 50 and 90% of the aldrin plus dieldrin residues recovered in 1959 and 1963, respectively(4). Soils from AR, FL, HI, MD, MT, OR, and SC were treated with 10 ml of 0.5% aqueous aldrin emulsion/10 g soil(5). The preparations were placed randomly around a test site in the Harrison Experimental Forest in southern Mississippi. In all preparations except the Hawaiian soil, the percent degradation in the upper 0.5 inch layer (36-72%) was greater than in the lower layer (unspecified depth) (11-33%). In the Hawaiian soil samples, degradation

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and any past releases have probably been converted to dieldrin. Aldrin residues in soil and plants will volatilize from soil surfaces or be slowly transformed to dieldrin in soil. Biodegradation is expected to be slow and aldrin is not expected to leach to groundwater. Aldrin was classified as moderately persistent meaning its half-life in soil ranged from 20-100 days. Aldrin residues in water will volatilize from the water surface and photooxidization is expected to be significant. Photolysis has been observed in water, although the absorption characteristics of aldrin indicate it should not extensively directly photolyze in the environment. Bioconcentration will be significant. Adsorption to sediments is expected and biodegradation is expected to be slow. Vapor phase aldrin residues in the atmosphere are expected to react with photochemically generated hydroxyl radicals with an estimated half-life of 35.45 min. Aldrin in the atmosphere is expected to be adsorbed to particulate matter and no rate can be estimated for the reaction of adsorbed aldrin with hydroxyl radicals. Direct photolysis may also occur, in spite of the low absorption of aldrin at >290 nm. Photolysis, however, is expected to be a slow process relative to reaction with hydroxyl radicals. Due to the cessation of aldrin manufacture and use in the USA, exposure of humans in the USA to the chemical is expected to be low. (SRC) **PEER REVIEWED**

Pollution Sources

Natural Occurring Sources:

1. None. (SRC) **PEER REVIEWED**

Artificial Sources:

1. Aldrin is an insecticide formerly used against termites and soil-dwelling pests such as ants(1), wireworms, whitegrubs, etc(5). Aldrin in the environment has resulted from these insecticidal uses(SRC). The manufacture and use of aldrin has been discontinued in the United States(2). Based upon monitoring data, mean loadings of aldrin in kg/day are coal mining - 0.0081, foundries - 0.019 and nonferrous metals manufacturing - 0.0016(3). Loading of aldrin in kg/yr to Lake Ontario by Niagara River unfiltered water were: 1980 - <83, 1981 - <79, 1982 - <79(4). **PEER REVIEWED** [(1) Worthing CR; The Pesticide Manual 7th ed Worthing ed p 6 (1983) (2) Merck Index; An Encyclopedia of Chemicals, Drugs and Biologicals 10th ed p 36 (1983) (3) USEPA; Treatability Manual Vol 1 Treatability data USEPA-600/2-81-011a (1981) (4) Kuntz KW; Toxic Contaminants in the Niagara River, 1975-82 Burlington, Ontario Tech Bull No.134 (1984) (5) Hartley D et al; The Agrochemicals Handbook. Surry, UK: Unwin Bros Ltd (1985)

Environmental Fate

Environmental Fate:

1. TERRESTRIAL FATE: APPLICATION OF ALDRIN AT 3, 9, & 15 KG AI/HA IN CLAY LOAM & SANDY LOAM SOIL EVERY YEAR FROM 1972-1974 SHOWED RESIDUES REMAINED LONGER IN CLAY LOAM THAN IN SANDY LOAM SOIL. RATE OF CONVERSION TO DIELDRIN

dinucleotide had no effect on aldrin epoxidation. ... Apparently, in the liver, aldrin is epoxidized by monooxygenase pathway, in granulation tissue and seminal vesicles by prostaglandin synthase-mediated pathway, and in the lung by both pathways. **PEER REVIEWED** [Lang B et al; Biochem Pharmacol 35 (20): 3643-5 (1986)

Interactions:

1. ... REPORTED THAT HEPTACHLOR, 1,1,1-TRICHLORO-2,2-BIS(P-CHLOROPHENYL)ETHANE, ENDRIN, & ALDRIN WERE TERATOGENIC IN CHICKEN **PEER REVIEWED** [Casarett, L.J., and J. Doull. Toxicology: The Basic Science of Poisons. New York: MacMillan Publishing Co., 1975. 329
2. Experiments were conducted to detect whether interactions in diposition between 2 insecticides might occur within the first few hours of exposure. Levels of both (14)C-labeled endrin and (3)H-labeled 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane were monitored in serum, gall bladders, and whole bodies during pre- and post-exposures to each cmpd in mosquitofish. (3)H-labeled 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane for 4 hr generally reduced (14)C-labeled endrin accumulation in serum, gall bladders and whole bodies, whereas prior exposure to (14)C-labeled endrin exerted little effect on (3)H-labeled 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane accumulation. Simultaneous exposure to3H-labeled 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane and (14)C-labeled endrin reduced (3)H-labeled 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane accumulation in the gall bladder at all times and in the whole body during the first 2 hr; (14)C-labeled endrin accumulation was generally reduced in the gall bladder and whole body. (14)C-labeled endrin levels in fish exposed subsequently to only (3)H-labeled 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane or 1,1-dichloro-2,2-bis(p-chlorophenyl)ethene were significantly higher in the gall bladder at all times after 0.5 hr and were reduced in the whole body at all times tested, compared to fish exposed subsequently only to uncontaminated water. While (14)C-labeled endrin post-treatment had no effect on (3)H-labeled 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane levels in the gall bladder, aldrin and dieldrin exposure resulted in significantly higher gall bladder levels of 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane compared to fish exposed subsequently only to uncontaminated water. The insecticide interactions observed may be the result of competition for and/or displacement of insecticides from mutual binding sites. **PEER REVIEWED** [Denison MS et al; Arch Environ Contam Toxicol 14 (3): 315-20 (1985)

ENVIRONMENTAL FATE/EXPOSURE POTENTIAL

Summary

Environmental Fate/Exposure Summary:

1. Aldrin is no longer produced or used in the United States

VERSA. **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3705

9. Contact, stomach and respiratory action **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A007/Oct 83
10. Normal level in human blood: 0.00015 mg% or 0.0015 ug/ml **PEER REVIEWED** [Winek, C.L. Drug and Chemical Blood-Level Data 1985. Pittsburgh, PA: Allied-Fischer Scientific, 1985. 1

Metabolism/Metabolites:

1. DOMINANT REACTION OF ALDRIN IS EPOXIDATION AT DOUBLE BOND TO FORM 6,7-EPOXIDE B DIELDRIN. ... /PRC: THIS OXIDN CAN BE PHOTOCHEMICAL OR BIOLOGICAL (MIXED-FUNCTION OXIDASES) & OCCURS/ IN SOILS, PLANT TISSUES, & IN ALL ANIMALS STUDIED. ... ALDRIN IS ALSO DEGRADED IN PLANTS & ANIMALS TO HEXACHLORO-HEXAHYDRO-1,4-ENDO-METHYLENE-INDENE-5, 7-DICARBOXYLIC ACID & TO ALDRIN-TRANS-DIOL. IN ANIMALS 5-HYDROXYDIELDRIN, 9-KETO-DIELDRIN & KETO-PHOTODIELDRIN ARE ... FORMED AS EXCRETORY METABOLITES. BEFORE EXCRETION THE HYDROXY METABOLITES ARE LARGELY CONJUGATED. **PEER REVIEWED** [National Research Council. Drinking Water & Health Volume 1. Washington, DC: National Academy Press, 1977. 562
2. THE MOST EXTENSIVELY DEGRADED EXCRETION PRODUCT OF ALDRIN & DIELDRIN REPORTED ... IS A HEXACHLORINATED DICARBOXYLIC ACID /4,5-SECO-ALDRIN-4,5-DICARBOXYLIC ACID/, & IT HAS BEEN WIDELY ASSUMED THAT THIS IS A TERMINAL MAMMALIAN METABOLITE. THIS ASSUMPTION ... /IS/ DISCREDITED BY IDENTIFICATION OF TWO PENTACHLORINATED DICARBOXYLIC ACIDS (22%) IN URINE OF RATS DOSED IV (3.5 MG/KG) WITH ... /4,5-SECO-ALDRIN-4,5-DICARBOXYLIC ACID/. **PEER REVIEWED** [The Chemical Society. Foreign Compound Metabolism in Mammals. Volume 4: A Review of the Literature Published during 1974 and 1975. London: The Chemical Society, 1977. 205
3. TIME COURSES (0-100 DAYS) OF UPTAKE & METABOLISM OF ALDRIN & DIELDRIN ADDED AT SUBCULTURE TO SUSPENSION CULTURES FROM PHASEOLUS VULGARIS (FRENCH BEAN) ROOT & SHOOT & SOLANUM TUBEROSUM (POTATO) TUBER WERE COMPARABLE, WITH RAPID DIELDRIN PRODN & DELAYED APPEARANCE OF OTHER METABOLITES. WHEN ALDRIN & DIELDRIN WERE ADDED TO PHASEOLUS CULTURES AT 10 OR 20 DAYS AFTER SUBCULTURE, USUAL EXTENT OF CONVERSION OF ALDRIN TO DIELDRIN OCCURRED, BUT WITH REDUCED PRODN OF OTHER METABOLITES. DIELDRIN PRODN WAS MAXIMUM DURING RAPID GROWTH PHASE & PROBABLY INDEPENDENT OF OTHER CONVERSIONS. **PEER REVIEWED** [BRAIN KR, LINES DS; PLANT CELL REP 2 (1): 11-4 (1983)
4. In microsomes from rat liver, aldrin epoxidation into dieldrin was stimulated by reduced nicotinamide adenine dinucleotide . ... In microsomes from seminal vesicles and granulation tissue, reduced nicotinamide adenine

AREA OF RESIDENCE OF PREGNANT WOMEN. **PEER REVIEWED** [SAXENA MC ET AL; ARCH TOXICOL 48 (2-3): 127-34 (1981)

3. IN PLASMA, BOTH ALDRIN & DIELDRIN ARE ASSOCIATED MAINLY WITH ALPHA- & BETA-LIPOPPOTEIN FRACTIONS ... **PEER REVIEWED** [Hayes, W. J., Jr. Toxicology of Pesticides Baltimore: Williams & Wilkins, 1975. 132
4. ... ALDRIN HAS NOT BEEN FOUND IN ... GENERAL POPULATION OR ... IN BODY FAT OF MEN ENGAGED IN MANUFACTURING IT; ONLY TRACES ARE FOUND IN BLOOD OF SUCH MEN. PERSONS ACUTELY POISONED ... MAKE THE CONVERSION /TO DIELDRIN/ ... RAPIDLY ... **PEER REVIEWED** [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 234
5. (36)CL-ALDRIN ... IS RAPIDLY ABSORBED AFTER ORAL ADMIN TO RATS & WEANLING PIGS & BECOME LOCALIZED IN LIVER & FAT DEPOTS, FROM WHICH ... IT IS ONLY SLOWLY EXCRETED. (14)C-ALDRIN FED TO RATS IS EXCRETED IN FECES (90% OF DOSE IN TWELVE WK) & URINE (10%), AS MIXT OF HYDROPHILIC METABOLITES TOGETHER WITH SMALL AMT OF UNCHANGED ALDRIN & DIELDRIN. **PEER REVIEWED** [Parke, D. V. The Biochemistry of Foreign Compounds. Oxford: Pergamon Press, 1968. 200
6. STUDIES WITH (14)C LABELED ALDRIN & DIELDRIN SHOWED THAT, AFTER IV INJECTION IN RATS, RADIOACTIVITY INCR IN ORDER OF LIVER, DUODENUM, INTESTINE, & FECES & PERCENTAGE OF METABOLITES INCR IN SAME FASHION. **PEER REVIEWED** [Menzie, C.M. Metabolism of Pesticides. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Publication 127. Washington, DC: U.S. Government Printing Office, 1969. 25
7. In humans, dermal absorption of aldrin was reported to 7.8 + or - 2.9% of the applied dose in acetone over a period of 5 days. **PEER REVIEWED** [Feldmenn RJ, Maiback HI; Toxicol Appl Pharm 28: 126-32 (1974) as cited in USEPA/CAG; Carcinogen Risk Assessment for Aldrin and Dieldrin. p.4-3 (1985) EPA Contract No. 68-02-4131
8. ADMIN OF ALDRIN /BY CAPSULES AT/ (0.6 MG/KG/DAY) /TO PURE-BRED BEAGLES/ RESULTED IN CONSTANTLY INCREASING CONCN OF DIELDRIN IN BLOOD & ... BODY FAT WHICH, AFTER 10 MO, REACHED BODY FAT CONCN OF 75 PPM. DISCONTINUATION ... RESULTED IN GRADUAL DECLINE IN DIELDRIN FAT CONCN TO 25 PPM AFTER 12 ADDNL MONTHS. ADMIN ... AT HALF THIS DOSAGE (0.3 MG/KG/DAY) BUT IN COMBINATION WITH 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane (12 MG/KG/DAY) RESULTED IN RETENTION OF ROUGHLY SAME CONCN OF DIELDRIN IN BODY FAT (70 PPM). ... AT 10 MONTHS, /FEEDING/ 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane ALONE (24 MG/KG/DAY) HAD PRODUCED RETENTION OF 550 PPM OF P,P'-1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane IN BODY FAT. FEEDING ... ONLY HALF THIS DOSE (12 MG/KG/DAY), BUT IN COMBINATION WITH ALDRIN /BY CAPSULES/ (0.3 MG/KG/DAY), RESULTED IN BODY FAT CONCN OF 1200 PPM OF 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane. ... IN DOG, THE FATE OF ALDRIN (DIELDRIN) IS SIGNIFICANTLY INFLUENCED BY PRESENCE OF 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane, & VICE

of each sex; pooled controls, used for statistical evaluation, consisted of the matched control groups combined with 58 untreated males and 60 untreated females from similar bioassays of other chemicals. All surviving rats were killed at 111-113 wk. Groups of 50 mice of each sex were administered aldrin at one of two doses for 80 wk, then observed for 10-13 wk. Time-weighted avg doses were 4 or 8 ppm for the males and 3 or 6 ppm for females. Matched controls consisted of 20 untreated male mice and 10 female mice; pooled controls, used for statistical evaluation, consisted of matched-control groups combined with 92 untreated male and 79 untreated female mice from similar bioassays of other chemicals. All surviving mice were killed at 90-93 wk. ... Under the conditions of /this bioassay/, none of the tumors occurring in Osborne-Mendel rats treated with aldrin ... could be clearly be associated with treatment. Aldrin was carcinogenic for the liver in male B6C3F1 mice producing hepatocellular carcinomas. **QC REVIEWED** [DHEW/NCI; Bioassays of Aldrin and Dieldrin for Possible Carcinogenicity p.vii (1978) Technical Rpt Series No. 021 DHEW Pub No. (NIH) 78-821

IARC Summary and Evaluation:

1. Inadequate evidence of carcinogenicity in humans. Limited evidence of carcinogenicity in animals. OVERALL EVALUATION: Group 3: The agent is not classifiable as to its carcinogenicity to humans. **QC REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. S7 56 (1987)

Populations at Special Risk:

1. SEVERE SYMPTOMS MAY RESULT FROM INGESTION OR PERCUTANEOUS ABSORPTION OF 1 TO 3 G, ESPECIALLY IN PRESENCE OF LIVER DISEASE. **PEER REVIEWED** [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 36
2. Individuals who have a history of convulsive disorders may be at an increased risk. /Endrin/ **PEER REVIEWED** [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) PublicationNo. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. 1

Pharmacokinetics

Absorption, Distribution and Excretion:

1. ... INHALED ALDRIN CAN BE ABSORBED. **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3703
2. MATERNAL BLOOD, PLACENTA, & UMBILICAL CORD BLOOD OF SAME MOTHER/CHILD PAIR WERE ANALYZED TO DETERMINE ORGANOCHLORINE PESTICIDE TRANSFER FROM MOTHER TO FETUS IN STUDY OF 100 WOMEN. ALDRIN WAS DETECTED IN ALL SAMPLES ANALYZED, INDICATING PLACENTAL TRANSFER. CORRELATION WAS FOUND BETWEEN PESTICIDE CONCN & AGE, DIETETIC HABITS &

Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10

17. EC50 DAPHNIA PULEX (DAPHNID) 28 UG/L/48 HR, FIRST INSTAR, AT 15 DEG C, (95% CONFIDENCE LIMIT 20-39 UG/L) /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
18. EC50 CYPRIDOPSIS VIDUA (SEED SHRIMP) 18 UG/L/48 HR, MATURE, AT 21 DEG C (95% CONFIDENCE LIMIT 15-21 UG/L) /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
19. LC50 Leiostomus xanthurus (spot) 3.2 ug/l/2 days /Conditions of bioassay not specified/ **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-42 (1980) EPA 440/5-80-019
20. LC50 Mugil curema (white mullet) 2.8 ug/l/2 days /Conditions of bioassay not specified/ **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-42 (1980) EPA 440/5-80-019
21. LC50 Mugil cephalus (striped mullet) <2.0 ug/l/2 days /Conditions of bioassay not specified/ **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-42 (1980) EPA 440/5-80-019
22. LC50 Aeroneuria pacifica (stonefly) 22 ug/l/30 days /Conditions of bioassay not specified/ **PEER REVIEWED** [Jensen LD, Gaufin AR; Jour Water Pollut Cont Fed 38: 1273 (1966) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-39 (1980) EPA 440/5-80-019
23. LC50 Anguilla rostrata 5 ppb/96 hr in a static bioassay **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 172
24. TLm Gasterosteus aculeatus (threespine stickleback) 27.4 ppb/96 hr in a static bioassay **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 172
25. LC50 Sphaeroides maculatus (Northern puffer) 36 ppb/96 hr in a static bioassay **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 171

National Toxicology Program Reports:

1. A bioassay of technical grade aldrin for possible carcinogenicity was conducted by administering the test /cmpd/ in feed to Osborne-Mendel rats and B6C3F1 mice. Groups of 50 rats of each sex were administered aldrin at one of two doses, either 30 or 60 ppm. Male rats were treated for 74 wk, followed by 37-38 wk of observation. Matched controls consisted of groups of 10 untreated rats

8. LC50 CHINOOK SALMON 14.3 UG/L/96 HR, WT 0.8 G, AT 15 DEG C /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
9. LC50 RAINBOW TROUT 2.6 UG/L/96 HR, WT 0.6 G, AT 13 DEG C (95% CONFIDENCE LIMIT 2.3-2.9 UG/L) /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
10. LC50 FATHEAD MINNOW 8.2 UG/L/96 HR, WT 0.6 G, AT 18 DEG C /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
11. LC50 BLACK BULLHEAD 19 UG/L/96 HR, WT 1.5 G, AT 24 DEG C /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
12. LC50 CHANNEL CATFISH 53 UG/L/96 HR, WT 5.2 G, AT 18 DEG C /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
13. LC50 BLUEGILL 6.2 UG/L/96 HR, WT 0.7 G, AT 18 DEG C (95% CONFIDENCE LIMIT 5.2-7.7 UG/L) /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
14. LC50 LARGEMOUTH BASS 5 UG/L/96 HR, WT 2.5 G, AT 18 DEG C /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
15. EC50 SIMOCEPHALUS SERRULATUS (DAPHNID) 23 UG/L/48 HR, FIRST INSTAR, AT 15 DEG C (95% CONFIDENCE LIMIT 17-30 UG/L) /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
16. EC50 SIMOCEPHALUS SERRULATUS (DAPHNID) 32 UG/L/48 HR, FIRST INSTAR, AT 21 DEG C (95% CONFIDENCE LIMIT 22-36 UG/L) /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife

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21. ... REPORTED THAT [illegible]CHLOR, 1,1,1-TRICHLORO-2,2-BIS(P-CHLOROPHENYL)ETHANE, ENDRIN, & ALDRIN WERE TERATOGENIC IN CHICKEN EGGS ... **PEER REVIEWED** [Casarett, L.J., and J. Doull. Toxicology: The Basic Science of Poisons. New York: MacMillan Publishing Co., 1975. 329

Toxicity Values

Ecotoxicity Values:

1. LD50 MALLARD DUCK ORAL 520 MG/KG, 3-4 MO OLD FEMALES (95% CONFIDENCE LIMIT: 229-1210 MG/KG) **PEER REVIEWED** [U. S. Department of the Interior, Fish & Wildlife Service, Bureau of Sport Fisheries & Wildlife. Handbook of Toxicity of Pesticides to Wildlife. Washington, D. C.: U. S. Government PrintingOffice, 1970. 17
2. LD50 PHEASANT ORAL 16.8 MG/KG, 3-4 MO OLD FEMALES **PEER REVIEWED** [U. S. Department of the Interior, Fish & Wildlife Service, Bureau of Sport Fisheries & Wildlife. Handbook of Toxicity of Pesticides to Wildlife. Washington, D. C.: U. S. Government PrintingOffice, 1970. 17
3. LD50 BOBWHITE QUAIL ORAL 6.59 MG/KG, 3-4 MO OLD FEMALES **PEER REVIEWED** [U. S. Department of the Interior, Fish & Wildlife Service, Bureau of Sport Fisheries & Wildlife. Handbook of Toxicity of Pesticides to Wildlife. Washington, D. C.: U. S. Government PrintingOffice, 1970. 17
4. LD50 FULVOUS TREE DUCK ORAL 29.2 MG/KG, 3-6 MO OLD MALES **PEER REVIEWED** [U. S. Department of the Interior, Fish & Wildlife Service, Bureau of Sport Fisheries & Wildlife. Handbook of Toxicity of Pesticides to Wildlife. Washington, D. C.: U. S. Government PrintingOffice, 1970. 17
5. LC50 GAMMARUS FASCIATUS (SCUD) 4300 UG/L/96 HR, MATURE, AT 21 DEG C (95% CONFIDENCE LIMIT 3500-5300 UG/L) /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
6. LC50 PALAEMONETES KADIAKENSIS (GLASS SHRIMP) 50 UG/L/96 HR, MATURE, AT 21 DEG C (95% CONFIDENCE LIMIT 38-65 UG/L) /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10
7. LC50 PTERONARCYS CALIFORNICA (STONEFLY) 1.3 UG/L/96 HR, SECOND YEAR CLASS, AT 15 DEG C (95% CONFIDENCE LIMIT 0.8-2.2 UG/L) /TECHNICAL MATERIAL, 90%/ /Static bioassay/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 10

BE SELECTIVELY INHIBITED BY ALDRIN, BUT NOT BY ITS STRUCTURAL ANALOGS. **PEER REVIEWED** [MEHENDALE HM ET AL; J APPL TOXICOL 2 (6): 278-83 (1982)

13. ALDRIN WAS NONMUTAGENIC AT DOSES UP TO 5000 UG/PLATE IN TESTS FOR MUTAGENICITY USING BACTERIAL REVERSION-ASSAY SYSTEMS WITH 5 SALMONELLA TYPHIMURIUM STRAINS (TA100, TA98, TA1535, TA1537, & TA1538) & AN ESCHERICHIA COLI STRAIN, WP2 HCR. **PEER REVIEWED** [MORIYA M ET AL; MUTAT RES 116 (3-4): 185-216 (1983)
14. Acanthamoeba castellianii (amoeba) exposed to 10,000 ug/l/6 days no effect on survival /was observed/. **PEER REVIEWED** [Prescott LM; Bull Environ Contam Toxicol 18: 29 (1977) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-38 (1980), EPA 440/5-80-019
15. Feeding of aldrin at 1 mg/kg/day or by inhalation at 0.1 mg/cu m for an unspecified period caused marked lowering of conditioned reflexes and of unconditioned orientation reflexes. These reflexes required as much as 6-8 days to return to normal after exposure. **PEER REVIEWED** [Medved LI et al; Residue Rev 6: 42-74 (1964) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.46 (1978) DHEW Pub No. 78-201
16. IN FEMALE OSBORNE-MENDEL RATS, SINGLE ORAL DOSE OF 20 MG/KG OF ALDRIN (APPROX 25% OF LD50) INCR LIVER ENZYME ACTIVITIES AS FOLLOWS: O-DEMETHYLASE, 320%; O-DEARYLASE, 410%; N-DEMETHYLASE, 350%; AZOREDUCTASE, 190%; & NITROREDUCTASE, 300%. ORAL ADMIN OF 1.5 MG/KG PARATHION 1 HR AFTER ... ALDRIN DECR ABOVE ... ACTIVITIES SIGNIFICANTLY. HIGHEST LEVELS REACHED WERE 110, 100, 105, 95 & 81%, RESPECTIVELY. ... PRETREATMENT OF MALE OSBORNE-MENDEL RATS WITH ORAL DOSE OF 30 MG/KG OF ALDRIN ... PROVIDED SIGNIFICANT DEGREE OF PROTECTION AGAINST TOXIC EFFECTS OF AN LD50 OF PARATHION. **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3705
17. ... EPOXIDATION OF ... ALDRIN WAS SHOWN TO BE INHIBITED BY SKF 525A & PIPERONYL BUTOXIDE, EACH KNOWN TO BE INHIBITORS OF MICROSOMAL OXIDASES. **PEER REVIEWED** [White-Stevens, R. (ed.). Pesticides in the Environment: Volume 1, Part 1, Part 2. New York: Marcel Dekker, Inc., 1971. 209
18. N-ALKYL HOMOLOGUES OF PARAQUAT (VIOLOGENS) WERE NONCOMPETITIVE INHIBITORS OF ALDRIN EPOXIDATION. **PEER REVIEWED** [ROSS JH ET AL; TOXICOL APPL PHARMACOL 48 (1): A80 (1979)
19. ALDRIN PRODUCED MARKED INHIBITION OF C3H 10T1/2 CELL TRANSFORMATION CAUSED BY 3-METHYLCHOLANTHRENE OR BENZO(A)PYRENE. **PEER REVIEWED** [MILLER C ET AL; PROC AM ASSOC CANCER RES 22: 118 (1981)
20. The neurotoxic insecticide (... endrin or aldrin ...) inhibited gamma-aminobutyric acid-dependent (36) Cl- uptake by mouse brain vesicles. **PEER REVIEWED** [Bloomquist JR and Soderlund DM; Biochem Biophys Res

ADRENAL GLANDS & IN PROTEIN SYNTH WERE NOTED. YOUNGER RATS WERE MORE STRONGLY AFFECTED THAN OLDER RATS. **PEER REVIEWED** [GIURGEA R ET AL; ARCH EXP VETERINARMED 32 (5): 769 (1978)

9. MINIMAL IP DOSAGE /OF ALDRIN/ ... THAT INDUCED CHROMOSOMAL ABERRATIONS IN BONE MARROW CELLS OF RATS & MICE WAS 9.56 MG/KG. THIS ... IS CONTRADICTORY TO NEGATIVE RESULTS REPORTED FOR DIELDRIN. DOGS WERE ABLE TO REPRODUCE WHEN RECEIVING ORAL DOSES AT ... 0.2 TO 2.0 MG/KG/DAY /OF ALDRIN/, BUT PUPS DIED EARLY, PROBABLY BECAUSE OF HIGH LEVELS OF /SRP: THE METABOLITE/ DIELDRIN IN MILK OF DAMS. IN 3 GENERATION TEST IN RATS, NUMBER OF PREGNANCIES WAS REDUCED & MORTALITY OF PUPS WAS SEVERELY INCR AT MATERNAL DIETARY LEVELS OF 12.5 PPM & 25 PPM (ABOUT 0.65 & 1.3 MG/KG/DAY EXCEPT DURING LACTATION WHEN DOSAGE ... WAS MUCH HIGHER). AT DIETARY LEVEL OF ... 2.5 PPM (ABOUT 0.4 MG/KG/DAY DURING LACTATION) THERE WAS SLIGHT TO MODERATE INCR IN MORTALITY OF PUPS. **PEER REVIEWED** [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 235
10. MICROSOCOPIC EXAM OF COSTOCHONDRAL JUNCTION OF GOATS AFTER CHRONIC ALDRIN INTOXICATION REVEALED DRASTIC REDUCTION IN WIDTH OF PROLIFERATING, MATURING & DEGENERATING CARTILAGE CELLS. ZONE OF PROVISIONAL CALCIFICATION WAS ALMOST NEGLIGIBLE, & APPOSITIONAL BONE GROWTH SHOWED MARKED REDUCTION. IT WAS CONCLUDED THAT DECR IN RATE OF APPOSITIONAL BONE GROWTH AT ENDOSTEAL PERIOSTEAL & OSTEONIC SURFACES MIGHT BE DUE TO POOR SYNTHESIS OF BONE MATRIX BY OSTEOBLASTS. **PEER REVIEWED** [SINGH KK, JHA GJ; VET SCI 32 (3): 283-8 (1982)
11. IN 1972 & 1974, 112 DEAD OR MORIBUND SNOW GEESE (CHEN C CAERULESCENS), MOSTLY IMMATURE WHITE-PHASE MALES, WERE FOUND IN AREA OF GARWOOD PRAIRIE, TEXAS. DYING GEESE WERE OBSERVED WITHIN 2 DAYS AFTER RICE FIELDS PLANTED WITH ALDRIN-TREATED SEED WERE FLOODED BY HEAVY RAINS. BRAINS FROM 8 MORIBUND SNOW GEESE CONTAINED AVG OF 8.2 PPM (4.9-14.0 PPM) DIELDRIN; BRAINS OF 14 DEAD GEESE SHOWED AVG OF 14.1 PPM (2.1-31 PPM). IT APPEARED CERTAIN THAT ALDRIN CAUSED THE MORTALITIES. **PEER REVIEWED** [FLICKINGER EL; J WILDL MANAGE 43 (1): 94-101 (1979)
12. COMPARATIVE EFFECTS OF ALDRIN, DIELDRIN, ENDRIN, ISODRIN, & TELODRIN, ON DIFFERENT ATPASE ACTIVITIES IN BEEF HEART MITOCHONDRIAL & RAT BRAIN SYNAPTOSOMAL FRACTIONS WERE DETERMINED IN VITRO. BEEF HEART MITOCHONDRIAL (OLIGOMYCIN-SENSITIVE) MG(2+) ATPASE ACTIVITY WAS INHIBITED BY ALL CHEM AT ALL CONCN TESTED. ALDRIN WAS THE MOST POTENT INHIBITOR WITH IC50 OF 40 UMOLAR; ABOUT 30% WAS OBSERVED WITH DIELDRIN & INHIBITION WAS NOT CONCN-DEPENDENT. RAT BRAIN SYNAPTOSOMAL ATPASES WERE MOST SENSITIVE TO ALDRIN & TELODRIN. A 50% INHIBITION OF OLIGOMYCIN-SENSITIVE MG(2+) ATPASE ACTIVITY WAS OBTAINED AT 80 UMOLAR OF ALDRIN. NA+K+ ATPASE & OLIGOMYCIN-INSENSITIVE MG(2+) ATPASE ACTIVITIES SHOWED MAX INHIBITION OF 40% AT HIGHEST CONCN TESTED FOR ALDRIN. RESULTS SUGGEST THAT ATPASE SYSTEM IN RAT HEART & CNS MAY

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3. ACUTE SYMPTOMS /OBS[illegible] DUCKS, PHEASANTS, & BOBWHITE QUAIL FOLLOWING AC[illegible] EXPOSURE W[illegible] ATAXIA, ... LOW CARRIAGE, NICTITA[illegible]G MEMBRANE CLOSED FOR LONG PERIODS, FLUFFED FEATHE[illegible], TREMORS, PHONATION, VIOLENT WING-BEAT CONVULSIONS, SEIZURES, & OPISTHOTONOS. DEATH OCCURRED 1/2 HOUR TO 10 DAYS POST-TREATMENT. WT LOSSES OCCURRED AMONG SURVIVORS OF HIGHER LEVELS. GROSS AUTOPSIES REVEALED OCCASIONAL LIVER ADHESIONS TO PARIETAL PERITONEUM. **PEER REVIEWED** [U. S. Department of the Interior, Fish & Wildlife Service, Bureau of Sport Fisheries & Wildlife. Handbook of Toxicity of Pesticides to Wildlife. Washington, D. C.: U. S. Government PrintingOffice, 1970. 1
4. GROUPS OF 12 MALE & 12 FEMALE OSBORNE-MENDEL RATS WERE FED DIETS CONTAINING 0, 0.5, 2, 10, 50, 100, OR 150 PPM RECRYSTALLIZED ALDRIN FOR 2 YR. ... CONSIDERING TOGETHER GROUPS GIVEN 0.5, 2, OR 10 PPM ... (IE, THE GROUPS SHOWING SURVIVAL RATES AT 2 YR COMPARABLE TO THOSE OF CONTROLS), NUMBER OF TUMOR-BEARING ANIMALS WAS 25/60 ... COMPARED WITH 3/17 CONTROLS. AMONG TREATED ... 12 DEVELOPED LYMPHOMAS (9 ... LOCATED IN LUNGS), 13 HAD MAMMARY TUMORS (MALIGNANT IN 4 RATS), 2 HAD FIBROSARCOMAS & 3 HAD TUMORS AT OTHER SITES. THE 3 TUMOR-BEARING CONTROL RATS, HAD, RESPECTIVELY, A PULMONARY LYMPHOMA, A BENIGN MAMMARY TUMOR & A TUMOR AT ANOTHER SITE. **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 31(1974)
5. ... VERY LOW DOSAGES AFFECT CNS, PRODUCING ENCEPHALOGRAPHIC CHANGES & ALTERING BEHAVIOR. ... CATS FED ALDRIN AT 1 MG/KG/DAY OR MADE TO INHALE 0.1 UG/L OF AIR HAD MARKED LOWERING OF CONDITIONED REFLEXES & OF UNCONDITIONED FOOD & ORIENTATION REFLEXES, WHICH REQUIRED UP TO 8 DAYS TO RETURN TO NORMAL. **PEER REVIEWED** [National Research Council. Drinking Water & Health Volume 1. Washington, DC: National Academy Press, 1977. 565
6. FOR CALVES 1-2 WK OLD MIN TOXIC /ORAL/ DOSE ... WAS 5.0 MG/KG & FOR CATTLE & SHEEP 25 MG/KG. ALDRIN ALSO HAS HIGH LEVEL OF CHRONIC DIETARY TOXICITY. ... FOLLOWING REPEATED ADMIN TOTAL DOSE PROVING TOXIC TO FARM ANIMALS ... /IS ABOUT/ SAME AS THAT REQUIRED TO PRODUCE TOXIC EFFECTS WHEN GIVEN AS SINGLE DOSE, IE, 15-30 MG/KG. CUTANEOUS TOXICITY ... IS HIGH: MIN TOXIC DOSE APPLIED AS SPRAY TO CALVES IS 0.25% OR LESS. **PEER REVIEWED** [Clarke, M. L., D. G. Harvey and D. J. Humphreys. Veterinary Toxicology. 2nd ed. London: Bailliere Tindall, 1981. 141
7. ALDRIN HAD NO EFFECT ON REPRODUCTIVE FUNCTION IN MALE & FEMALE OFFSPRINGS OF FEMALE RATS WHICH HAD BEEN FED ALDRIN DURING PREGNANCY. **PEER REVIEWED** [GELLERT RJ, WILSON C; ENVIRON RES 18 (2): 437 (1979)
8. ALDRIN WAS ADMIN DAILY TO 30 & 90 DAY-OLD WISTAR RATS AT 8 OR 11 PPM IN DIET. AT 60 DAYS, RATS WERE INOCULATED WITH ESCHERICHIA COLI. CAPACITY TO FORM ANTIBODIES AT 90 & 150 DAYS WAS CHANGED. ... FUNCTIONAL DISORDERS OF THYMUS &

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31: 103-8 (1975) as cited in USEPA/CAS; Carcinogen Risk Assessment for Aldrin and Dieldrin. p.4-57 (1985) EPA Contract No. 68-02-4131

7. EPIDEMIOLOGICAL STUDY WHICH WAS CARRIED OUT ON OCCUPATIONALLY EXPOSED WORKERS DOES NOT ALLOW ANY CONCLUSIONS TO BE DRAWN CONCERNING EXISTENCE OF EXCESS RISK OF DEVELOPING CANCER. **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. 75 33 (1974)
8. Vital status and cause of death were assessed for 232 of a group of 233 workers engaged in the manufacturing and formulation of aldrin, dieldrin, endrin and (for a limited period) Telodrin. This group is part of the total exposed population of more than 100 workers and was selected for follow up on account of the high exposures in the initial years of manufacturing and formulation and of the long exposure (mean 11 years) and observation (mean 24 years) periods. Total observed mortality was 25 versus 38 expected on the basis of the death statistics of the male Dutch population. Of the 9 cancer deaths, 3 were caused by lung cancer, while the remaining 6 were each of a different nature. Although in this group exposures have been high and exposure, as well as observation periods, were long enough for meaningful evaluation, this study revealed no indication of a specific carcinogenic activity of aldrin, dieldrin or endrin in manufacturing plant workers exposed to these products. **PEER REVIEWED** [Ribbons PH; Int Arch Occup Environ Health 56 (2): 75-80 (1985)
9. TOXICITY ... IS BELIEVED TO DIFFER TO SOME EXTENT ACCORDING TO METHOD OF PREPN, POSSIBLY OWING TO PRESENCE ... OF VARIABLE QUANTITY OF MORE HIGHLY TOXIC IMPURITY. **PEER REVIEWED** [Clarke, M. L., D. G. Harvey and D. J. Humphreys. Veterinary Toxicology. 2nd ed. London: Bailliere Tindall, 1981. 141

Non-Human Toxicity Excerpts:

1. ... ALDRIN ... FREQUENTLY PRODUCE ILLNESS IN WHICH CONVULSION IS FIRST SIGN OF INJURY. ... INCOORDINATION OBSERVED IN ANIMALS ... /FROM ALDRIN/ IS DIFFERENT FROM TREMOR CAUSED BY 1,1,1-TRICHLORO-2,2-BIS(P-CHLOROPHENYL)ETHANE ... **PEER REVIEWED** [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 172
2. ... RATS /WERE FED/ FOR A PERIOD OF 2 YR AT CONCN OF 2.5, 12.5, & 25 PPM BY WT OF DIET. ... NO INCR IN MORTALITY OR DECR IN GROWTH AT ANY ... LEVELS ... /WERE OBSERVED/. AT 12.5 PPM & ABOVE, SOME ANIMALS SHOWED INCR LIVER WT & SOME DEGENERATIVE HEPATIC CELL CHANGES. ... RATS FED CONCN OF 5, 10, & 20 PPM /OF PURE COMPD/ IN DIET ... /SHOWED/ NO RESPONSE OVER 6-WK PERIOD ... **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3703

hr after ingestion)[1]. 1. Malaise, headache, nausea, vomiting, dizziness, and tremors. 2. Clonic and tonic convulsions, sometimes without premonitory symptoms. 3. Convulsive episodes may alternate with periods of severe central nervous depression. Death from respiratory arrest may occur during coma, which commonly outlasts the convulsive phase and may persist for a few days. /Dieldrin/ **PEER REVIEWED** [Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. II-285

3. SYMPTOMATOLOGY: 4. During the acute phase, leukocytosis, rise in blood pressure, tachycardia, arrhythmias, metabolic acidosis, and fever have been described; Presumably they represent the consequences of hyperactivity of the sympathetic nervous system. 5. Disturbances of sleep, memory, and behavior may persist for several days or weeks after the acute phase of dieldrin poisoning. 6. Generalized cerebral dysrhythmia persisting for months, and both hematuria and albuminuria of about 2 weeks duration have been described in one aldrin poisoning in man. Transient hematuria occurred on the second day of an acute dieldrin poisoning. /Dieldrin/ **PEER REVIEWED** [Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. II-285
4. INDUSTRIAL WORKERS (MOSTLY MEN) ... ENGAGED IN MANUFACTURE, HANDLING, & SPRAYING ... ALDRIN ... HAVE BEEN EXPOSED TO VERY CONSIDERABLY HIGHER CONCN & QUANTITIES ... THAN GENERAL US PUBLIC. AMONG THESE POPULATION GROUPS, ASIDE FROM EYE, SKIN, OR RESP IRRITATION ... FROM DUST MATERIALS ... INSTANCES OF ACUTE OVEREXPOSURE ... OR INDUCTION OF MICROSOMAL ENZYMES & ABILITY OF SOME HIGHLY EXPOSED WORKERS TO INCR THEIR DRUG-METABOLIZING ABILITY, FRANK & UNDISPUTED INJURY TO LIVER OR OTHER ORGANS HAS NOT BEEN REPORTED IN US, CANADA, & WESTERN EUROPEAN LITERATURE. **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3686
5. Toxic level in human blood: 0.00035 mg% or 0.0035 ug/ml **PEER REVIEWED** [Winek, C.L. Drug and Chemical Blood-Level Data 1985. Pittsburgh, PA: Allied Fischer Scientific, 1985. 1
6. Seventy-two hour human lymphocyte cultures exposed to 9.68, 19.1, and 38.3 ug/ml of aldrin. At the high dose, complete cytotoxicity was reported. At 19.1 ug/ml, 0.20 chromosomal aberrations per cell were scored as compared to 0.01 /SRP: in untreated cells/ and 0.30 for positive control, mitomycin C (1 ug/ml). The aberrations observed included both chromosomal and chromatid gaps, breaks, and fragments. ... Aldrin /exhibited/ a narrow range of clastogenic doses, between 19.1 and 38.3 ug/ml, and that since these doses are near the limit for cell survival, the observed lesions are probably not perpetuated in other abnormal cells. **PEER REVIEWED** [Georgian L; Mutat Res

legal under Department of Transportation regulations (eg 49 CFR 173.28). Containers that are not to be reused should be punctured ... and transported to a scrap metal facility for recycling, disposal, or burial in a designated landfill. **PEER REVIEWED** [40 CFR 165 (7/1/87)

4. Group I Containers: Combustible containers from organic or metallo-organic pesticides (except organic mercury, lead, cadmium, or arsenic compounds) should be disposed of in pesticide incinerators or in specified landfill sites. /Organic or metallo-organic pesticides/ **PEER REVIEWED** [40 CFR 165 (7/1/87)
5. Aldrin is very stable thermally with no decomposition noted at 250 deg C. Aldrin is remarkably stable to alkali. Refluxing with aqueous or alcoholic caustic has no effect. Incineration methods for aldrin disposal have been recommended and the combustion of aldrin in polyethylene on a small scale gave more than 99% decomposition. A disposal method suggested for materials contaminated with aldrin consists of burying 8-12 ft underground in an isolated area away from water supplies, with a layer of lye and a second layer of clay beneath the wastes. Recommendable methods: Incineration & landfill. Peer-review: Small amt of aldrin may be sprayed over a landfill (Peer-review conclusions of an IRPTC expert consultation (May 1985)) **UNREVIEWED** [United Nations. Treatment and Disposal Methods for Waste Chemicals (IRPTC File). Data Profile Series No. 5. Geneva, Switzerland: United Nations Environmental Programme, Dec. 1985. 163

TOXICITY/BIOMEDICAL EFFECTS

Summary

Medical Surveillance:

1. Initial Medical Examination: A complete history and physical examination: The purpose is to detect existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. ... Examination of the nervous system and liver should be stressed. The aforementioned medical examination should be repeated on an annual basis. /Endrin/ **PEER REVIEWED** [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) PublicationNo. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. 1

Toxicity Excerpts

Human Toxicity Excerpts:

1. WORKERS EXPOSED TO DUSTS OF ALDRIN ... /COMPLAINED/ OF HEADACHE, DIZZINESS, NAUSEA, & VOMITING ... NO EVIDENCE OF LIVER INJURY /WAS FOUND/ IN THESE INDIVIDUALS. ... ONLY MINOR ERYTHEMA IS OBSERVED FROM SKIN CONTACT ... **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3707
2. SYMPTOMATOLOGY: (Onset of symptoms between 20 min and 12

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3. The effectiveness of reverse osmosis for removing toxic substances from municipal effluents was investigated. Laboratory and pilot plant studies on the removal of such substances as arsenic, cyanide, nitrilotriacetic acid, phenols, aldrin, 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane, chlordane, malathion, and parathion are described. Reverse osmosis system permeation rates, variations in permeation rates with time, and removal efficiencies for various substances are presented. Chlorinated hydrocarbon and organic phosphate pesticides were almost completely removed by reverse osmosis, while heavy metal removal was consistently greater than 95%. Removal rates for other substances varied from 43-90%, depending on the substance and on the type of membrane used. **PEER REVIEWED** [Johnston H et al; Env Canada Res Rept 8[illegible] (1978)
4. The applicability of carbon to remove toxicants on EPA's published list and fish kill due to influent and effluent from five industrial plants currently using adsorption as a treatment method are examined. In the laboratory, activated carbon can achieve levels of less than 1 mg/l of aldrin, dieldrin, endrin, 1,1-dichloro-2,2-bis(p-chlorophenyl)ethene, 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane, 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane, toxaphene, and aroclors 1254. In operating plants, the toxicity of wastes to fish due to unknown constituents is significantly reduced or totally removed by activated carbon treatment. **PEER REVIEWED** [Bernardin FE, Froelich EM; Purdue Univ 30th Ind Waste Conf, May 6-8 p.548 (1975)

Disposal Methods:

1. SRP: At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices. **UNREVIEWED**
2. Potential candidate for rotary kiln incineration with a temperature of 820-1600 deg C with residence times for liquids and gases: seconds; solids: hours. Also, a potential candidate for liquid injection incineration with a temperature range of 650-1600 deg C with a residence time of 0.1-2 seconds. Also, a potential candidate for fluidized bed incineration with a temperature range of 450-980 deg C with residence times for liquids and gases: seconds; Solids, longer. **PEER REVIEWED** [USEPA; Engineering Handbook for Hazardous Waste Incineration p.3-8 (1981) EPA 68-03-3025
3. Group II Containers: Non-combustible containers from organic or metallo-organic pesticides (except organic mercury, lead, cadmium, or arsenic compounds) must first be triple-rinsed. Containers that are in good condition may be returned to the manufacturer or formulator of the pesticide product, or to a drum reconditioner for reuse with the same type of pesticide product, if such reuse is

standard eye protection, eg face shields; however, more data are needed to establish the value of contact lenses. **QC REVIEWED** [Randolph SA, Zavon MR; J Occup Med 29: 237-42 (1987)

9. Contaminated protective clothing should be segregated in such a manner so that there is no direct personal contact by personnel who handle, dispose, or clean the clothing. Quality assurance to ascertain the completeness of the cleaning procedures should be implemented before the decontaminated protective clothing is returned for reuse by the workers. **PEER REVIEWED** [SRP

Other Safety & Handling

Stability/Shelf Life:

1. STABLE IN PRESENCE OF ORG & INORG BASES & STABLE TO ACTION OF HYDRATED METAL CHLORIDES AND MILD ACIDS **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 26 (1974)

Shipment Methods and Regulations:

1. Whenever hazardous materials are to be transported, Title 49 CFR, Transportation, Parts 100-180, published by the US Dept of Transportation, contain the regulatory requirements and must be consulted. **PEER REVIEWED** [52 FR 16482 (5/5/87)
2. Shipping description: Aldrin, IMO 6.1, NA 2761, NA 2762. Label(s) required: poison. Acceptable Modes of transportation: Air, rail, road, and water. **PEER REVIEWED** [52 FR 16523 (5/5/87)

Storage Conditions:

1. Protect containers against physical damage. Store in well-ventilated, cool, dark place separated from sources of ignition. Outdoor or detached storage is preferred. **PEER REVIEWED** [ITII. Toxic and Hazarous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. 19

Cleanup Methods:

1. A PROCESS FOR REMOVING POLLUTANTS FROM DU PONT'S CHAMBERS WORKS PLANT IN DEEPWATER, NJ IS DESCRIBED. PROCESS CALLS FOR TREATMENT OF WASTES FROM ORG CHEM MFR PROCESSES BY NEUTRALIZATION & SETTLING, FOLLOWED BY A COMBINED POWDERED CARBON-BIOLOGICAL PROCESS. **PEER REVIEWED** [HUTTON DG; IND WASTES (CHICAGO) 26 (2): 22, 24, 26 (1980)
2. Survey reports six case histories employing EPA's hazardous materials spills treatment trailer are reviewed. The trailer's ... treatment system has three mixed-media filters and three activated carbon columns to remove suspended, precipitated, and organic soluble materials. Spills of PCB, pentachlorophenol, kepone, termide (chlordane), heptachlor, aldrin, and dieldrin, toxaphene, and dinitrobutylphenol were treated by the EPA trailer, which was generally successful in mitigating environmental effects by filtering and carbon-adsorption. 90% removal was achieved for 21 of 23 compounds. **PEER REVIEWED** [Lafornara JP; WPCF J 50 (4): 617 (1978)

In addition to respirator selection, a complete respirator protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation. /Endrin/ **PEER REVIEWED** [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) PublicationNo. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. 2

4. Clothing which has had any possibility of being contaminated ... should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of /material/ from the clothing. ... If clothing has had any possibility of being contaminated ... employees should change into uncontaminated clothing before leaving the work premises. If the clothing is to be laundered or otherwise cleaned to remove the endrin, the person performing the operation should be informed of its hazardous properties. /Endrin/ **PEER REVIEWED** [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) PublicationNo. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. 2
5. Employees should be provided with and required to use impervous clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact. ... /Endrin/ **PEER REVIEWED** [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) PublicationNo. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. 2
6. /In case of a spill/ notify local health and wildlife officials. Also, notify operators of nearby water intakes. **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.
7. Contact lenses should not be worn when working with this chemical. **QC REVIEWED** [NIOSH. Pocket Guide to Chemical Hazards. 2nd Printing. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt.of Documents, GPO, February 1987. 47
8. Contact lens use in industry is controversial. A survey of 100 corporations resulted in the recommendation that each company establish their own contact lens use policy. One presumed hazard of contact lens use is possible chemical entrapment. Many authors found that contact lens minimized injury or protected the eye. The eye was afforded more protection from liquid irritants. The authors concluded that soft contact lenses do not worsen corneal damage from strong chemicals and in some cases could actually protect the eye. Overall, the literature supports the wearing of contact lenses in industrial environments as part of the

with an organic vapor cartridge and high efficiency particulate filter, including pesticide respirators which meet the requirements of this class, or a type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. 200 mg/cu m or less: a type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode. Greater than 200 mg/cu m or entry and escape from unknown concentrations: Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode, or a combination respirator which includes a type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. Escape: Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class, or any escape self-contained breathing apparatus. /Endrin/ **PEER REVIEWED** [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) PublicationNo. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. 5

Other Protective Measures:

1. Provide an eyewash station. Where there is any possibility of exposure of an employee's body to endrin or liquids containing endrin, facilities for quick drenching of the body should be provided within the immediate work area for emergency use. /Endrin/ **PEER REVIEWED** [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) PublicationNo. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. 3
2. Eating and smoking should not be permitted in areas where endrin or liquids containing endrin are handled, processed, or stored. Wash hands with soap and water before eating, smoking, or using toilet facilities. /Endrin/ **PEER REVIEWED** [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) PublicationNo. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. 3
3. Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure levels. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented.

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Chemical Hazards. DHHS(NIOSH) PublicationNo. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. 5

2. Fire extinguishing agents: dry chemical, foam, or carbon dioxide **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.
3. USE WATER TO KEEP FIRE EXPOSED CONTAINERS COOL. IF LEAK OR SPILL HAS NOT IGNITED, USE WATER SPRAY TO DISPERSE THE VAPORS & TO /PROTECT WORKMEN REPAIRING LEAK/. WATER SPRAY ... TO FLUSH SPILLS AWAY FROM EXPOSURES. /ENDRIN/ **PEER REVIEWED** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-146
4. Cool fire-exposed containers with water. **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.
5. Fire extinguishing agents: Water spray, dry chemical, foam, or carbon dioxide for fires involving solutions of aldrin in hydrocarbon solvents. **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.

Toxic Combustion Products:

1. EMITS HIGHLY TOXIC FUMES OF HYDROGEN CHLORIDE & CHLORINATED BREAKDOWN PRODUCTS. **PEER REVIEWED** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-37

Preventive Measures

Protective Equipment and Clothing:

1. WHEN OPENING CONTAINERS, MIXING, & APPLYING PRODUCT, WEAR PROTECTIVE RUBBER OR PVC GLOVES, RUBBER BOOTS, & CLEAN OVERALLS. WEAR DUST MASK WHEN HANDLING DUST CONCENTRATES. **PEER REVIEWED** [Farm Chemicals Handbook 1986. Willoughby, Ohio: Meister Publishing Co., 1986.,p. C-9
2. Particulate Concentration: 1 mg/cu m or less: Any chemical cartridge respirator with an organic vapor cartridge(s) dust and mist filter(s) including pesticide respirators which meet the requirements of this class, or any supplied-air respirator, or any self-contained breathing apparatus. 5 mg/cu m or less: A chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and dust and mist filter(s), including pesticide respirators which meet the requirements of this class, or a gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust and mist filter, including pesticide respirators which meet the requirements of this class, or any supplied-air respirator with a full facepiece, helmet, or hood, or any self-contained breathing apparatus with a full facepiece. 100 mg/cu m or less: A powered air-purifying respirator

Topic: ALDRIN

FLAMMABLE OR COMBUSTIBLE LIQUIDS ... **PEER REVIEWED** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-37

NFPA Hazard Classification:

1. Health 3, 3= Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing, including self-contained breathing apparatus, rubber gloves, boots and bands around legs, arms, and waist should be provided. No skin surface should be exposed. /Aldrin solution/ **PEER REVIEWED** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-37
2. Health 2, 2= Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus. /Aldrin dry/ **PEER REVIEWED** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-37
3. Flammability 1, 1= Materials that must be preheated before ignition can occur. Water may cause frothing of liquids with this flammability rating number if it gets below the surface of the liquid and turns to steam. However water spray gently applied to the surface will cause a frothing which will extinguish the fire. Most combustible solids have a flammability rating of 1. /Aldrin solution/ **PEER REVIEWED** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-37
4. Flammability 0, 0= Materials that will not burn. /Aldrin dry/ **PEER REVIEWED** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-37
5. Reactivity 0, 0= Materials which are normally stable even under fire exposure conditions, and which are not reactive with water. Normal fire fighting procedures may be used. /Aldrin solution & dry/ **PEER REVIEWED** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.

Flash Point:

1. APPROX 150 DEG F OR HIGHER (CLOSED CUP) **PEER REVIEWED** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-37

Fire Fighting Information

Fire Fighting Procedures:

1. Fire Fighting: Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. /Endrin/ **PEER REVIEWED** [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for

U.S. Government Printing Office, 1987.,p. G-55

3. Emergency Action: Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Self-contained breathing apparatus and chemical protective clothing which is specifically recommended by the shipper or producer may be worn but they do not provide thermal protection unless it is stated by the clothing manufacturer. Structural firefighter's protective clothing is not effective with these materials. Remove and isolate contaminated clothing at the site. CALL CHEMTREC AT 1-800-424-9300 AS SOON AS POSSIBLE, especially if there is no local hazardous materials team available. /Aldrin and its mixtures/ **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55
4. Fire: Small Fires: Dry chemical, CO2, Halon, water spray or standard foam. Large Fires: Water spray, fog or standard foam is recommended. Move container from fire area if you can do it without risk. Fight fire from maximum distance. Stay away from ends of tanks. Dike fire control water for later disposal; do not scatter the material. /Aldrin and its mixtures/ **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55
5. Spill or Leak: Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal. Small Dry Spills: With clean shovel place material into clean, dry container and cover; move containers from spill area. Large Spills: Dike far ahead of liquid spill for later disposal. /Aldrin and its mixtures/ **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55
6. First Aid: Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Speed in removing material from skin is of extreme importance. Remove and isolate contaminated clothing and shoes at the site. Keep victim quiet and maintain normal body temperature. Effects may be delayed; keep victim under observation. /Aldrin and its mixtures/ **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55

Flammable Properties

Fire Potential:

1. DRY POWDER WILL NOT BURN ... COMMERCIAL SOLN MAY CONTAIN

period dieldrin use decreased from 1 million lb to about 670,000 lb. The decrease has been attributed primarily to increased insect resistance of the two chemicals and to development and availability of better and safe substitute /chemicals/. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.A-1 (1980) EPA 440/5-80-019

Major Uses:
1. INSECTICIDE (ESP AGAINST TERMITES); INSECTICIDE AGAINST SOIL & COTTON INSECTS, TURF PESTS, WHITE GRUBS & CORN ROOTWORMS. /SRP: FORMER USE/ **PEER REVIEWED** [SRI
2. NON-SYSTEMIC & PERSISTENT INSECTICIDE, EFFECTIVE AGAINST SOIL INSECTS AT RATES OF 0.5 TO 5.0 KG/HA & IS NON-PHYTOTOXIC. /SRP: FORMER USE/ **PEER REVIEWED** [Worthing, C.R., S.B. Walker (eds.). The Pesticide Manual - A World Compendium. 7th ed. Lavenham, Suffolk, Great Britain: The Lavenham Press Limited, 1983. 6

Consumption Patterns:
1. ESSENTIALLY 100% AS AN INSECTICIDE **PEER REVIEWED** [SRI

U.S. Production:
1. (1977) NOT PRODUCED COMMERCIALLY IN USA **PEER REVIEWED** [SRI
2. (1982) NOT PRODUCED COMMERCIALLY IN USA **PEER REVIEWED** [SRI
3. (1987) Not produced commercially in the USA **PEER REVIEWED** [FARM CHEM HDBK 1987 p.C-11

U.S. Imports:
1. (1977) ND **PEER REVIEWED** [SRI
2. (1982) 7.70X10+8 G (PRINCPL CUSTMS DISTS) **PEER REVIEWED** [SRI
3. (1987) ND **PEER REVIEWED**

U.S. Exports:
1. (1978) ND **PEER REVIEWED** [SRI
2. (1982) ND **PEER REVIEWED** [SRI
3. (1987) ND **PEER REVIEWED**

CHEMICAL & PHYSICAL PROPERTIES

Color/Form:
1. COLORLESS CRYSTALLINE SOLID **PEER REVIEWED** [Worthing, C.R., S.B. Walker (eds.). The Pesticide Manual - A World Compendium. 7th ed. Lavenham, Suffolk, Great Britain: The Lavenham Press Limited, 1983. 6
2. White crystalline substance. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.A-2 (1980) EPA 440/5-80-019

Odor:
1. Mild chemical odor **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.

Melting Point:
1. 104 DEG C **PEER REVIEWED** [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 36

Molecular Weight:
1. 364.93 **PEER REVIEWED** [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 36

Wilkins, 1982. 234

2. EMULSIFIABLE CONCENTRATE: 2 LB TECHNICAL ALDRIN/IMPERIAL GALLON & (EPICHLORHYDRIN MAY BE INCORPORATED ... TO PREVENT CORROSION BY HYDROCHLORIC ACID ...) 20-25%. /PRC: NOTE THAT EPICHLOROHYDRIN IS A KNOWN CARCINOGEN/. WETTABLE POWDERS DEHYDROCHLORINATION BY SOME CATALYTICALLY-ACTIVE CARRIERS PREVENTED BY ADDITION OF UREA. 2% & 5% DUSTS. 5% & 20% GRANULES. 75% WETTABLE POWDERS FOR SEED TREATMENT. INSECTICIDAL LACQUERS. AQUEOUS EMULSIONS CONTAINING ALDRIN & THE SULFOSUCCINIC ACID ESTER OF OLEIC ACID ... **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 6
3. Seedrin Liquid **PEER REVIEWED** [VERSCHUEREN. HDBK ENVIRON DATA ORG CHEM 1983 p.168
4. Urea may be added to prevent dehydrochlorination by certain carriers **PEER REVIEWED** [WORTHING. PESTICIDE MANUAL 8TH ED 1987 p.11

Manufacturers:

1. SHELL CHEMICALS UK LDT, AGRICULTURAL DIV 39/41 ST MARY'S STREET, ELY, CAMBRIDGESHIRE, UNITED KINGDOM CB7 4HG **PEER REVIEWED** [Farm Chemicals Handbook 1986. Willoughby, Ohio: Meister Publishing Co., 1986.,p. C-10
2. SHELL INTERNATIONAL CHEMICAL CO, LDT, AGROCHEMICAL DIV, SHELL CENTRE, LONDON SE1 7PG, ENGLAND **PEER REVIEWED** [Farm Chemicals Handbook 1986. Willoughby, Ohio: Meister Publishing Co., 1986.,p. C-10

Other Manufacturing Information:

1. IN USA, UNITED KINGDOM, & NUMBER OF OTHER COUNTRIES ALDRIN (BSI, ISO) STANDS FOR FORMULATIONS CONTAINING NOT LESS THAN 95% OF /PURE/ CMPD ... & NOT MORE THAN 5% OF INSECTICIDALLY ACTIVE RELATED COMPOUNDS. IN CANADA, DENMARK, & USSR ALDRIN STANDS FOR PURE CMPD. ... HHDN (ISO) ALSO IS RECOGNIZED AS A NON-PROPRIETARY NAME & MEANS ... PURE CHEMICAL. **PEER REVIEWED** [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 234
2. COMPATIBLE WITH MOST FERTILIZERS, HERBICIDES, FUNGICIDES, & INSECTICIDES. **PEER REVIEWED** [Hawley, G.G. The Condensed Chemical Dictionary. 10th ed. New York: Van Nostrand Reinhold Co., 1981. 29
3. MANUFACTURE DISCONTINUED IN USA. **PEER REVIEWED** [Farm Chemicals Handbook 1986. Willoughby, Ohio: Meister Publishing Co., 1986.,p. C-10
4. AS OF AUGUST, 1974 EPA SUSPENDED MFR OF ALL PESTICIDES CONTAINING ALDRIN OR ITS METABOLITE DIELDRIN AS "IMMINENT HAZARD TO PUBLIC". HOWEVER, EPA WILL CONTINUE USE OF THESE CMPDS AGAINST TERMITES, AS DIP FOR ROOTS & TOPS OF NONFOOD PLANTS, & AGAINST CLOTHES MOTHS UNDER CERTAIN CIRCUMSTANCES. **PEER REVIEWED** [Osol, A. (ed.). Remington's Pharmaceutical Sciences. 16th ed. Easton, Pennsylvania: Mack Publishing Co., 1980. 1200
5. Aldrin use in the USA peaked at 19 million lb in 1966 and dropped to about 10.5 million lb in 1970. During that same

Topic: ALDRIN

Weber. Mass Spectral and GC Data of Drugs, Poisons and their Metabolites. Parts I and II. Mass Spectra Indexes. Weinheim, FederalRepublic of Germany. 1985. 617

Vapor Pressure:

1. 7.5X10-5 MM HG AT 20 DEG C; 1.4X10-4 MM HG AT 25 DEG C **PEER REVIEWED** [Worthing, C.R., S.B. Walker (eds.). The Pesticide Manual - A World Compendium. 7th ed. Lavenham, Suffolk, Great Britain: The Lavenham Press Limited, 1983. 6

Other Chemical/Physical Properties:

1. OCCURS AS FOUR ISOMERS **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3702
2. EPOXIDATION OF ALDRIN WITH PERACETIC OR PERBENZOIC ACID FORMS THE 6,7-EPOXY DERIVATIVE, DIELDRIN **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 26 (1974)
3. MP: 40-60 DEG C /TECHNICAL GRADE/ **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 6
4. TAN TO DARK BROWN SOLID /TECHNICAL GRADE/ **PEER REVIEWED** [Worthing, C.R., S.B. Walker (eds.). The Pesticide Manual - A World Compendium. 7th ed. Lavenham, Suffolk, Great Britain: The Lavenham Press Limited, 1983. 6
5. Conversion factor: 1 ppm= 14.96 mg/cu m at 25 deg and 760 mm Hg **PEER REVIEWED** [USEPA/CAG; Carcinogen Risk Assessment for Aldrin and Dieldrin. p.3-2 (1985) EPA Contract No. 68-02-4131
6. Vapor pressure: 6X10-6 mm Hg at 25 deg C. **PEER REVIEWED** [Lyman WJ et al; Handbook of Chem Property Estimation Methods Environ Behavior of Org Compounds McGraw-Hill NY pp 15-11, 15-21 (1982)

SAFETY & HANDLING

Emergency Guidelines

DOT Emergency Guidelines:

1. Health Hazards: Poisonous; may be fatal if inhaled, swallowed or absorbed through skin. Contact may cause burns to skin and eyes. Runoff from fire control or dilution water may give off poisonous gases and cause water pollution. Fire may produce irritating or poisonous gases. /Aldrin and its mixtures/ **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55
2. Fire or Explosion: Some of these materials may burn, but none of them ignites readily. Container may explode violently in heat of fire. /Aldrin and its mixtures/ **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC:

Topic: ALDRIN

Corrosivity:

1. NONCORROSIVE TO STEEL, BRASS, MONEL, COPPER, NICKEL, ALUMINUM **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3702

Octanol/Water Partition Coefficient:

1. Log kow= 3.01 **PEER REVIEWED** [Hansch, C., A. Leo. Substituent Constants for Correlation Analysis in Chemistry and Biology. New York, NY: John Wiley and Sons, 1979. 267

Solubilities:

1. 27 UG/L IN WATER AT 27 DEG C; MODERATELY SOL IN PETROLEUM OILS; READILY SOL IN ACETONE, BENZENE, XYLENE **PEER REVIEWED** [Worthing, C.R., S.B. Walker (eds.). The Pesticide Manual - A World Compendium. 7th ed. Lavenham, Suffolk, Great Britain: The Lavenham Press Limited, 1983. 6
2. SOL IN AROMATICS, ESTERS, KETONES, PARAFFINS AND HALOGENATED SOLVENTS **PEER REVIEWED** [Sax, N.I. Dangerous Properties of Industrial Materials. 6th ed. New York, NY: Van Nostrand Reinhold, 1984. 152
3. 0.20 mg/l at 25 deg C. **PEER REVIEWED** [Lyman WJ et al; Handbook of Chem Property Estimation Methods Environ Behavior of Org Compounds McGraw-Hill NY pp 15-11, 15-21 (1982)

Spectral Properties:

1. SADTLER REFERENCE NUMBER: 1935 (IR, PRISM) **PEER REVIEWED** [Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. C-104
2. Intense mass spectral peaks: 66 m/z (100%), 79 m/z (43%), 91 m/z (34%), 263 m/z (32%) **UNREVIEWED** [Hites, R.A. Handbook of Mass Spectra of Environmental Contaminants. Boca Raton, FL: CRC Press Inc., 1985. 100
3. IR: 15178 (Sadtler Research Laboratories IR Grating Collection) **UNREVIEWED** [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 52
4. UV: 8-224 (Organic Electronic Spectral Data, Phillips et al, John Wiley & Sons, New York) **UNREVIEWED** [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 52
5. NMR: 6239 (Sadtler Research Laboratories Spectral Collection) **UNREVIEWED** [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 52
6. MASS: 2832 (National Bureau of Standards EPA-NIH Mass Spectra Data Base, NSRDS-NBS-63) **UNREVIEWED** [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 52
7. Intense mass spectral peaks: 261 m/z, 291 m/z, 327 m/z, 362 m/z **UNREVIEWED** [Pfleger, K., H. Maurer and A.

8a-hexahydro-1,4:5,8-di methanonaphthalene, Not less than 95% **PEER REVIEWED** [FARM CHEM HDBK (1987) p.C-11
8. HHDN **PEER REVIEWED**
9. COMPOUND 118 **PEER REVIEWED**
10. SD 2794 **PEER REVIEWED**
11. ALDROSOL **PEER REVIEWED**
12. ALDOCIT **PEER REVIEWED**
13. ALDRINE **PEER REVIEWED**
14. ALDRITE **PEER REVIEWED**
15. KORTOFIN **PEER REVIEWED**
16. OCTALENE **PEER REVIEWED**
17. SEEDRIN **PEER REVIEWED**
18. TATUZINHO **PEER REVIEWED**
19. TIPULA **PEER REVIEWED**
20. Aldrex 40 **PEER REVIEWED**

Molecular Formula:
1. C12-H8-C16 **PEER REVIEWED**

RTECS Number:
1. NIOSH/IO2000000

OHM-TADS Number:
1. 7215090

Shipping Name/Number - DOT/UN/NA/IMCO:
1. IMO 6.1; Aldrin
2. NA 2761; Aldrin
3. NA 2762; Aldrin

STCC Number:
1. 49 214 03; Aldrin
2. 49 214 06; Aldrin mixture, liquid (with more than 60% aldrin)
3. 49 214 07; Aldrin mixture, dry (with more than 65% aldrin)
4. 49 411 07; Aldrin, cast solid
5. 49 411 08; Aldrin mixture, liquid, with 60% or less aldrin
6. 49 411 09; Aldrin mixture, dry, with 65% or less aldrin

EPA Hazardous Waste Number:
1. P004; An acute hazardous waste when a discarded commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate.

MANUFACTURE/USE INFORMATION

Methods of Manufacturing:
1. DIELS-ALDER ADDITION OF HEXACHLOROCYCLOPENTADIENE WITH EXCESS OF BICYCLOHEPTADIENE **PEER REVIEWED** [SRI
2. ... /INCL/ ALDRIN & ENDO, ENDO ISOMER: LIDOV, USA PATENT 2,635,977 (1953 TO SHELL) ... SCHMERLING, USA PATENT 2,911,447 (1959 TO UNIVERSAL OIL PROD). SYNTH: KORTE, RECHMEIER; ANN 656: 131 (1962). **PEER REVIEWED** [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 36

Formulations/Preparations:
1. TECHNICAL ALDRIN CONTAINS NOT LESS THAN 90% OF ALDRIN DEFINED AS MIXTURE ... NOT LESS THAN 85.5% OF MAIN INGREDIENT, NOT LESS THAN 4.5% OF /SRP: OTHER IMPURITIES WITH INSECTICIDAL ACTIVITY/, & NOT MORE THAN 10% OF OTHER COMPOUNDS. **PEER REVIEWED** [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and

Topic: ALDRIN

ADMINISTRATIVE INFORMATION
Hazardous Substance DataBank Number:
1. 199
Last Revision Date:
1. 930914
Review Date:
1. SRP review on 09/15/87
Update History:
1. Field Update on 09/14/93, 1 field added/edited/deleted.
2. Field Update on 09/08/93, 1 field added/edited/deleted.
3. Field Update on 08/03/93, 1 field added/edited/deleted.
4. Field Update on 01/22/93, 1 field added/edited/deleted.
5. Field update on 12/11/92, 1 field added/edited/deleted.
6. Field Update on 12/03/92, 1 field added/edited/deleted.
7. Field Update on 12/02/92, 1 field added/edited/deleted.
8. Complete Update on 09/03/92, 1 field added/edited/deleted.
9. Complete Update on 04/27/92, 1 field added/edited/deleted.
10. Complete Update on 01/23/92, 1 field added/edited/deleted.
11. Complete Update on 09/26/91, 1 field added/edited/deleted.
12. Complete Update on 05/21/90, 3 fields added/edited/deleted.
13. Field Update on 03/06/90, 1 field added/edited/deleted.
14. Field Update on 01/15/90, 1 field added/edited/deleted.
15. Complete Update on 01/11/90, 2 fields added/edited/deleted.
16. Complete Update on 08/08/89, 91 fields added/edited/deleted.
17. Complete Update on 07/24/85

SUBSTANCE IDENTIFICATION
Name of Substance:
1. ALDRIN
CAS Registry Number:
1. 309-00-2
Related HSDB Records:
1. (metabolite) 322 [DIELDRIN
2. (analog) 6049 [ISODRIN
Synonyms:
1. 1,4:5,8-DIMETHANONAPHTHALENE, 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-, (1ALPHA,4ALPHA,4ABETA,5ALPHA,8ALPHA,8ABETA)- **PEER REVIEWED**
2. 1,4:5,8-DIMETHANONAPHTHALENE, 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-, ENDO,EXO- **PEER REVIEWED**
3. HEXACHLOROHEXAHYDRO-ENDO-EXO-DIMETHANONAPHTHALENE **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 25 (1974)
4. NCI-C00044 **PEER REVIEWED**
5. ENT 15,949 **PEER REVIEWED**
6. 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-endo, exo-5,8-dimethan onaphthalene **PEER REVIEWED** [VERSCHUEREN. HDBK ENVIRON DATA ORG CHEM (1983) p.168
7. (1R,4S,5S,8R)-1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,

MSDS
Table of Contents

Attachment 5
Material Safety Data Sheets (MSDS)

I NEED TO SEE MSDS FOR PAINTS

I NEED TO SEE THE COMPONENTS — IT WILL DRIVE THE MONITORING REQUIREMENTS AND ACTION LEVELS USED

Des Moines TCE Site, OU4
Safety Meeting Checklist

_____ _____
Site Safety Coordinator Date

Attendee Initials _____ _____ _____ _____ _____
_____ _____ _____ _____ _____

SSC *Initials*

_____ Review Immediate and Pertinent Work Plans
_____ Collect Current Medical Monitoring Certificates
Collect Current Training Certificates
_____ Hazardous Waste Operations (OSHA 1910.120)
_____ Confined Space Entry
_____ Air Supplied Respirators
_____ Monitoring Equipment (other than BVWS supplied)
_____ First Aid/CPR
_____ Other
_____ Identify First Aid/CPR Trained Personnel Team Members
_____ Review Standing Orders
_____ Review Emergency Action Plan
Conduct Chemical Hazard Training for Team Members
_____ Detection Methods
_____ Protective Measures
_____ Location of MSDS
_____ Labeling System used on site
_____ Signs/Symptoms of Overexposure
Review Communication Systems with Team Members
_____ Internal System
_____ External System
_____ Review Evacuation and Rally Procedures with Team Members
_____ Review Changes to HASP
_____ Point Out Postings
_____ Emergency Phone List
_____ Hospital Emergency Route\Map
_____ OSHA Poster
_____ HASP

Note: If an item is not applicable, insert "N/A".

Attachment 4
Safety Meeting Checklist

Topic: DIELDRIN

Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 203

2. SLIGHTLY SOL IN PETROLEUM ETHER, FREELY SOL IN BENZENE **PEER REVIEWED** [Sunshine, I. (ed.). CRC Handbook of Analytical Toxicology. Cleveland: The Chemical Rubber Co., 1969. 510
3. SLIGHTLY SOL IN ALCOHOL **PEER REVIEWED** [Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. C-276
4. Insol in methanol and aliphatic hydrocarbons. **PEER REVIEWED** [ITII. Toxic and Hazarous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. 171
5. 186 ug/l H2O at 25 deg C **PEER REVIEWED** [USEPA; Hazard Profile: Dieldrin p.1 (1980)
6. 22 g/100 ml acetone at 20 deg C **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A144/Oct 83
7. 4 g/100 ml ethanol at 20 deg C **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A144/Oct 83
8. 48 g/100 ml ethylene dichloride at 20 deg C **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A144/Oct 83
9. 40 g/100 ml benzene at 20 deg C **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A144/Oct 83
10. 41 g/100 ml toluene at 20 deg C **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A144/Oct 83
11. 38 g/100 ml carbon tetrachloride at 20 deg C **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A144/Oct 83
12. 1 g/100 ml methanol at 20 deg C **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A144/Oct 83

Spectral Properties:

1. Intense mass spectral peaks: 79 m/z (100%), 82 m/z (42%), 81 m/z (35%), 108 m/z (21%) **QC REVIEWED** [Hites, R.A. Handbook of Mass Spectra of Environmental Contaminants. Boca Raton, FL: CRC Press Inc., 1985. 102

2. IR: 15769 (Sadtler Research Laboratories Prism Collection) **QC REVIEWED** [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 554
3. MASS: 2951 (National Bureau of Standards EPA-NIH Mass Spectra Data Base, NSRDS-NBS-63) **QC REVIEWED** [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 554

Vapor Density:

1. 13.2 (/SRP: air=1/) **PEER REVIEWED** [Sax, N.I. Dangerous Properties of Industrial Materials. 6th ed. New York, NY: Van Nostrand Reinhold, 1984. 975

Vapor Pressure:

1. 7.78X10-7 MM HG @ 25 DEG C **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 203

Other Chemical/Physical Properties:

1. BUFF TO LIGHT BROWN FLAKES /TECHNICAL GRADE/ **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 203
2. ... Reacts with anhydrous hydrogen bromide to give the bromohydrin. **PEER REVIEWED** [Farm Chemicals Handbook 87. Willoughby, Ohio: Meister Publishing Co., 1987.,p. C-89

SAFETY & HANDLING

Emergency Guidelines

DOT Emergency Guidelines:

1. Health Hazards: Poisonous; may be fatal if inhaled, swallowed or absorbed through skin. Contact may cause burns to skin and eyes. Runoff from fire control or dilution water may give off poisonous gases and cause water pollution. Fire may produce irritating or poisonous gases. **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55
2. Fire or Explosion: Some of these materials may burn, but none of them ignites readily. Container may explode violently in heat of fire. **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55
3. Emergency Action: Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Self-contained breathing apparatus and chemical protective clothing which is specifically recommended by the shipper or producer may be worn but they do not provide thermal protection unless it is stated by the clothing manufacturer. Structural firefighter's protective clothing is not effective with these materials. Remove and isolate

contaminated clothing at the site. CALL CHEMTREC AT 1-800-424-9300 AS SOON AS POSSIBLE, especially if there is no local hazardous materials team available. **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55

4. Fire: Small Fires: Dry chemical, CO2, Halon, water spray or standard foam. Large Fires: Water spray, fog or standard foam is recommended. Move container from fire area if you can do it without risk. Fight fire from maximum distance. Stay away from ends of tanks. Dike fire control water for later disposal; do not scatter the material. **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55
5. Spill or Leak: Do not touch spilled material; stop leak if you can do it without risk. Use water spray to reduce vapors. Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal. Small Dry Spills: With clean shovel place material into clean, dry container and cover; move containers from spill area. Large Spills: Dike far ahead of liquid spill for later disposal. **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55
6. First Aid: Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Speed in removing material from skin is of extreme importance. Remove and isolate contaminated clothing and shoes at the site. Keep victim quiet and maintain normal body temperature. Effects may be delayed; keep victim under observation. **QC REVIEWED** [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987.,p. G-55

Flammable Properties

Fire Potential:

1. Not flammable **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.

Fire Fighting Information

Fire Fighting Procedures:

1. If material is on fire: Extinguish fire using agent suitable for type of surrounding fire. Material itself does not burn or burns with difficulty. **PEER REVIEWED** [Bureau of Explosives; Emergency Handling of Haz Matl in Surface Trans p.191 (1981)

Toxic Combustion Products:

1. Toxic and irritating hydrogen chloride fumes may form in

fire. **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.

Hazardous Reactions

Reactivities and Incompatibilities:

1. Incompatibilities: strong oxidizers, active metals like sodium, strong acids, phenols **PEER REVIEWED** [NIOSH. Pocket Guide to Chemical Hazards. 5th Printing/Revision. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services,NIOSH/Supt. of Documents, GPO, Sept. 1985. 102

Warning Properties

Odor Threshold:

1. 0.041 ppm **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.

Preventive Measures

Protective Equipment and Clothing:

1. Wear rubber gloves, air breathing apparatus, and overalls. **PEER REVIEWED** [ITII. Toxic and Hazarous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. 172
2. Goggles or face shield. **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.
3. When opening containers, mixing, or applying the product, wear protective rubber or PVC gloves, rubber boots, and clean overalls. Wear dust mask when handling dust concentrates. **PEER REVIEWED** [Farm Chemicals Handbook 87. Willoughby, Ohio: Meister Publishing Co., 1987.,p. C-89
4. Personnel protection: Wear boots, protective gloves, and goggles. **PEER REVIEWED** [Bureau of Explosives; Emergency Handling of Haz Matl in Surface Trans p.191 (1981)
5. The following types of respirators should be selected under the prescribed concentrations: Greater than at any detectable concentration: Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode. Any supplied-air respirator with a full face piece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. Escape: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister having a high-efficiency particulate filter. Any appropriate escape-type self-contained breathing apparatus. Any appropriate escape-type self-contained breathing apparatus. **PEER REVIEWED** [NIOSH. Pocket Guide to Chemical Hazards. 5th Printing/Revision. DHHS (NIOSH)

Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services,NIOSH/Supt. of Documents, GPO, Sept. 1985. 102

ther Protective Measures:

1. Contact lenses should not be worn when working with this chemical. **QC REVIEWED** [NIOSH. Pocket Guide to Chemical Hazards. 2nd Printing. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt.of Documents, GPO, February 1987. 103
2. Contact lens use in industry is controversial. A survey of 100 corporations resulted in the recommendation that each company establish their own contact lens use policy. One presumed hazard of contact lens use is possible chemical entrapment. Many authors found that contact lens minimized injury or protected the eye. The eye was afforded more protection from liquid irritants. The authors concluded that soft contact lenses do not worsen corneal damage from strong chemicals and in some cases could actually protect the eye. Overall, the literature supports the wearing of contact lenses in industrial environments as part of the standard eye protection, eg face shields; however, more data are needed to establish the value of contact lenses. **QC REVIEWED** [Randolph SA, Zavon MR; J Occup Med 29: 237-42 (1987)
3. Provide adequate ventilation. **PEER REVIEWED** [ITII. Toxic and Hazarous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. 172
4. Employees should wash immediately when skin is wet or contaminated. Working clothing should be changed daily if it is possible that clothing is contaminated. Remove nonimpervious clothing immediately if wet or contaminated. Provide emergency showers and eyewash. **PEER REVIEWED** [Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985. 340
5. Remove contaminated ... shoes. Flush affected areas with plenty of water. **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.
6. If material is not on fire: Keep material out of water sources and sewers. Build dikes to contain flow as necessary. **PEER REVIEWED** [Bureau of Explosives; Emergency Handling of Haz Matl in Surface Trans p.191 (1981)
7. Keep upwind. Avoid breathing vapors or dusts. Wash away any material which may have contacted the body with copious amounts of water or soap and water. **PEER REVIEWED** [Bureau of Explosives; Emergency Handling of Haz Matl in Surface Trans p.191 (1981)
8. Stop discharge if possible. Isolate and remove discharged material. Notify local health and wildlife officials. Notify operators of nearby water intakes. **PEER REVIEWED** [U.S. Coast Guard, Department of

Topic: DIELDRIN

Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.

Other Safety & Handling

Stability/Shelf Life:

1. STABLE TO LIGHT **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada Ottawa, Canada: Information Canada, 1982. 203
2. Resistant to moisture and alkalis. ... **PEER REVIEWED** [Hartley, D. and H. Kidd (eds.). The Agrochemicals Handbook. Old Woking, Surrey, United Kingdom: Royal Society of Chemistry/Unwin Brothers Ltd., 1983.,p. A144/Oct 83
3. Stable to ... mild acids. ... **PEER REVIEWED** [Farm Chemicals Handbook 87. Willoughby, Ohio: Meister Publishing Co., 1987.,p. C-89

Shipment Methods and Regulations:

1. The United States Dept of Transportation has recently revised the Hazardous Materials Transport regulations in order to accommodate both North American and International regulations. Whenever hazardous materials are going to be transported, Title 49 CFR, Transportation, Parts 100-180, published by the US Dept of Transportation, contain the regulatory requirements and must be consulted. **PEER REVIEWED** [52 FR 16482 (5/5/87)
2. Shipping description: Dieldrin, 6.1, NA 2761. Label(s) required: Poison. Acceptable Modes of transportation: Air, rail, road, and water. **PEER REVIEWED** [52 FR 16572 (5/5/87)
3. Int'l Air Shipments: Shipping description: Organochlorine pesticides, solid, toxic, not otherwise specified, 6.1, UN 2761. Label(s) required: Poison. Packaging Instructions: 5.6.613 (passenger); 5.6.615 (cargo). **PEER REVIEWED** [IATA; International Air Transport Association Dangerous Goods Regulations 28th ed p.184 (1987)
4. Water shipments: Shipping description: Dieldrin, 6.1, UN 2761. Label(s) required: Poison. **PEER REVIEWED** [IMDG; International Maritime Dangerous Goods Code; International Maritime Organization (1986)

Storage Conditions:

1. Storage temp: ambient; venting: Open (flame arrester) (for liquid form) **PEER REVIEWED** [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.

Cleanup Methods:

1. Absorb spills with paper towels. **PEER REVIEWED** [ITII. Toxic and Hazarous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. 172
2. Environmental conditions - Land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. Dike surface flow using soil, or sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with

fly ash or cement powder. **PEER REVIEWED** [Bureau of Explosives; Emergency Handling of Haz Matl in Surface Trans p.191 (1981)

3. Environmental considerations - Water spill: Use natural barriers or oil spill control booms to limit spill motion. If dissolved, apply activated carbon at ten times the spilled amount in region of 10 ppm or greater concn. Use mechanical dredges or lifts to remove immobilized masses of pollutants and precipitates. **PEER REVIEWED** [Bureau of Explosives; Emergency Handling of Haz Matl in Surface Trans p.191 (1981)
4. Survey reports six case histories employing EPA's hazardous materials spills treatment trailer are reviewed. The trailer's ... treatment system has three mixed-media filters and three activated carbon columns to remove suspended, precipitated, and organic soluble materials. Spills of PCB, pentachlorophenol, kepone, termide (chlordane), heptachlor, aldrin, and dieldrin, toxaphene, and dinitrobutylphenol were treated by the EPA trailer, which was generally successful in mitigating environmental effects by filtering and carbon-adsorption. 90% removal was achieved for 21 of 23 compounds. **PEER REVIEWED** [Lafornara JP; WPCF J 50 (4): 617 (1978)
5. The applicability of carbon to remove toxicants on EPA's published list and fish kill due to influent and effluent from five industrial plants currently using adsorption as a treatment method are examined. In the laboratory, activated carbon can achieve levels of less than 1 mg/l of aldrin, dieldrin, endrin, 1,1-dichloro-2,2-bis(p-chlorophenyl)ethene, 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane, 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane, toxaphene, and aroclors 1254. In operating plants, the toxicity of wastes to fish due to unknown constituents is significantly reduced or totally removed by activated carbon treatment. **PEER REVIEWED** [Bernardin FE, Froelich EM; Purdue Univ 30th Ind Waste Conf, May 6-8 p.548 (1975)

Disposal Methods:

1. SRP: At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices. **PEER REVIEWED**
2. Incineration (1500 deg F, 0.5 second minimum for primary combustion; 3200 deg F, 1.0 second for secondary combustion) with adequate scrubbing and ash disposal facilities. **PEER REVIEWED** [Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985. 340
3. A good candidate for rotary kiln incineration at a temperature range of 820 to 1,600 deg C and residence times of seconds for liquids and gases, and hours for solids. **PEER REVIEWED** [USEPA; Engineering Handbook for

Hazardous Waste Incineration p 3-8 (1981) EPA 68-03-3025

4. Dieldrin (15% emulsifiable concentrate and 72% chlordane emulsfiable concentrates. Mixed 1:3 ratio) /placed into a/ liquid injection incinerator with a temperature range of 877-1038 deg C and residence time of 0.153-1.71 sec with 45.8-51% excess air produced a destruction efficiency of >99.98%. **PEER REVIEWED** [USEPA; Engineering Handbook for Hazardous Waste Incineration p.F-3 (1981) EPA 68-03-3025
5. Chemical Treatability of Dieldrin; Concentration Process: Chemical Precipitation; Chemical Classification: Pesticides; Scale of Study: Laboratory Scale/Continuous Flow; Type of Wastewater Used: River Water with Pure Compound; Influent Concentration: 10 ppb; Results of Study: 55% reduction with aluminum (chemical coagulation was followed by sand filtration). **PEER REVIEWED** [Becker DL, Wilson SC; Carbon Adsorption Handbook p.167-213 (1978) as cited in USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-76 (1982)
6. Chemical Treatability of Dieldrin; Concentration Process: Reverse Osmosis; Chemical Classification: Pesticides; Scale of Study: Batch Flow; Type of Wastewater Used: Pure Compound; Influent Concentration: 321 ug; Results of Study: 99.9% reduction with CA membrane, 100% reduction with C-PEI membrane (membranes operated at 600 psig and room temperature). **PEER REVIEWED** [Chian EK et al; Environmental Science and Technology (9) 1: 52-59 (1975) as cited in USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-89 (1982)
7. Chemical Treatability of Dieldrin; Concentration Process: Activated Carbon; Chemical Classification: Pesticides; Scale of Study: Isotherm Test; Type of Wastewater Used: Synthetic Wastewater; Influent Concentration: 19 ppb; Results of Study: 15 mg/g carbon capacity for a final concn of 0.05 ppb. **PEER REVIEWED** [Hager DG; Chemical Enginering Progress 72 (10): 57-60 (1976) as cited in USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-170 (1982)
8. Chemical Treatability of Dieldrin; Concentration Process: Activated Carbon; Chemical Classification: Pesticides; Scale of Study: Laboratory Scale/Batch Flow/Isotherm Test; Type of Wastewater Used: Pure Compound; Influent Concentration: 19 ppb; Results of Study: 15 mg/g carbon capacity for a final concn of 0.08 ppb (pulverized FS-300). **PEER REVIEWED** [Bernardin FE, Froelich EM; Proceeding 30th Industrial Waste Conference p.548-60 (1975) as cited in USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-171 (1982)
9. Chemical Treatability of Dieldrin; Concentration Process: Activated Carbon; Chemical Classification: Pesticides; Scale of Study: Pilot Scale/Continuous Flow; Type of Wastewater Used: Hazardous Material Spill; Influent Concentration: 11 ppb at 0.1 mg treated; Results of Study: No detectable level in effluent with 17 min contact time

(treated by EPA mobile trailer). **PEER REVIEWED** [Becker DL, Wilson SC; Carbon Adsorption Handbook p.167-213 (1978) as cited in USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-171 (1982)

10. Chemical Treatability of Dieldrin; Concentration Process: Activated Carbon; Chemical Classification: Pesticides; Scale of Study: Pilot Scale/Continuous Flow; Type of Wastewater Used: Hazardous Material Spill; Influent Concentration: 60.5 ppb at 3000 gal treated; Results of Study: No detectable level in effluent with 240 min contact time (treated by EPA mobile trailer). **PEER REVIEWED** [Becker DL, Wilson SC; Carbon Adsorption Handbook p.167-213 (1978) as cited in USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-171 (1982)
11. Chemical Treatability of Dieldrin; Concentration Process: Activated Carbon; Chemical Classification: Pesticides; Scale of Study: Batch Flow/Laboratory Scale/Literature Review; Type of Wastewater Used: River Water with Pure Compound; Influent Concentration: 10 ppb; Results of Study: 75% removal with carbon concn of 5 mg/l, 85% removal with carbon concn of 10 mg/l, and 92% removal with carbon concn of 20 mg/l (cumulative removal following prechlorination and coagulation-sedimentation). **PEER REVIEWED** [Becker DL, Wilson SC; Carbon Adsorption Handbook p.167-213 (1978) as cited in USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-171 (1982)
12. Chemical Treatability of Dieldrin; Concentration Process: Activated Carbon; Chemical Classification: Pesticides; Scale of Study: Continuous Flow/Laboratory Scale/Literature Review; Type of Wastewater Used: River Water with Pure Compound; Influent Concentration: 10 ppb at 0.5 gpm/cu ft; Results of Study: > 99% reduction was achieved (cumulative removal following prechlorination and coagulation-sedimentation). **PEER REVIEWED** [Becker DL, Wilson SC; Carbon Adsorption Handbook p.167-213 (1978) as cited in USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-171 (1982)
13. Chemical Treatability of Dieldrin; Concentration Process: Activated Carbon; Chemical Classification: Pesticides; Scale of Study: Isotherm Test; Type of Wastewater Used: Industrial Wastewater; Influent Concentration: 19 ppb at pH= 7; Results of Study: 130 mg/g carbon for a final concentration of 0.1 ppb. **PEER REVIEWED** [Nathan MF; Chemical Engineering 85 (3): 93 (1978) as cited in USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-171 (1982)
14. Dieldrin like aldrin (from which it is derived by oxidation) is quite stable to heat (no decomposition @ 250 deg C) and to refluxing aqueous or alcoholic caustic. The instability of dieldrin to acids is similar to that of aldrin. Dieldrin is more resistant to oxidation than is aldrin, but is attacked by ozone. Reaction would be expected to occur @ the double bond and @ the epoxide to

give the tetracarboxylic acid. Dieldrin is 100% degraded by sodium or lithium in liquid ammonia but this is not a practical disposal method. The MCA /Manufacturing Chemists Association/ recommends incineration methods for the disposal of dieldrin. Recommended method: Incineration. Recommendable method: Landfill. Peer-review: For dieldrin-mercury seed dressings long term storage is recommendable if they cannot be used. (Peer-review conclusions of an IRPTC expert consultation (May 1985)) **QC REVIEWED** [United Nations. Treatment and Disposal Methods for Waste Chemicals (IRPTC File). Data Profile Series No. 5. Geneva, Switzerland: United Nations Environmental Programme, Dec. 1985. 163

TOXICITY/BIOMEDICAL EFFECTS

Summary

Toxic Hazard Rating:

1. There is sufficient evidence that dieldrin is carcinogenic in experimental animals. The molecular potency index for dieldrin is 7.8 X 10+3 per mmol/kg/day. This places dieldrin in the most potent quartile of suspect carcinogens ranked by CAG. **PEER REVIEWED** [USEPA/CAG; Carcinogenic Risk Assessment for Aldrin and Dieldrin. (1985)
2. Classification of carcinogenicity: 1) evidence in humans: inadequate; 2) evidence in animals: inadequate; 3) evidence for activity in short-term tests: limited. Summary evaluation of carcinogenic risk to humans 3: The chemical cannot be classified as to its carcinogenicity to humans. /From table/ **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. S4 19 (1982)

Medical Surveillance:

1. Consider the points of attack /CNS, liver, kidneys, skin/ in preplacement and periodic physical exam. **PEER REVIEWED** [Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985. 340

Toxicity Excerpts

Human Toxicity Excerpts:

1. ... Pesticide workers in a Shell plant in Holland ... had occupational exposure to dieldrin over periods of up to 12.3 yr with a mean of 6.6 yr. The average time that had elapsed from the end of exposure was 7.4 yr (maximum 16 yr). The average age was 47.4 yr ... 223 long-term workers were involved in this epidemiology study and no permanent adverse effects (including cancer) on workers health were observed. **PEER REVIEWED** [Versteeg JPJ, Jager KW; Br J Ind Med 30: 201 (1973) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.C-58 (1980) EPA 440/5-80-019
2. ... After repeated exposures /to dieldrin/ spraymen developed a syndrome indistinguishable from idiopathic epilepsy, except that it ceased when exposure was

terminated. **PEER REVIEWED** [Hayes WJ; Public Health Reports 72: 1087-91 (1957) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.84 (1978) DHEW Pub. NIOSH 78-201

3. ... Significantly higher C-reactive protein levels /were noted/ in the sera of workers chronically exposed to dieldrin and pentachlorophenol than in controls. Serum levels of gamma 2-globulin were associated with concn of dieldrin in the serum. **PEER REVIEWED** [Takahashi W et al; Life Sci 19: 1645-51 (1976) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.93 (1978) DHEW Pub. NIOSH 78-201
4. In a study of 5 male farmworkers exposed to a mixture of herbicides and pesticides including dieldrin, four were found to have suffered impotence after chronic exposure; sexual function recovered after termination of exposure. **PEER REVIEWED** [Espir ML et al; Br Med J 1: 423-5 (1970) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.93 (1978) DHEW Pub. NIOSH 78-201
5. ... Dieldrin, at concn as low as 25 ug/ml, was toxic to ... human kidney cell line B in vitro. **PEER REVIEWED** [Sheinman R, Yannai S; Toxicol Appl Pharmacol 30: 266-74 (1974) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.81 (1978) DHEW Pub. NIOSH 78-201
6. ... unscheduled DNA synthesis (UDS) in SV40 transformed VA-4 human fibroblasts in vitro with and without an uninduced rat liver activating system using /dieldrin/ ... produced a significant incr in UDS either with or without the activating system at all doses used. **PEER REVIEWED** [Ahmed FE et al; Mutat Res 42: 161 (1977) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.C-44 (1980) EPA 440/5-80-019
7. At 1, 10, and 30 ug/ml dieldrin caused chromosomal interchanges and rings in human lung cell cultures (WI-38 cells). Cytotoxic studies using WI-38 cells revealed dose-response and time-response relations to dieldrin. **PEER REVIEWED** [Majumdar SK et al; J Hered 67: 303-7 (1976) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.79 (1978) DHEW Pub. NIOSH 78-201
8. SYMPTOMATOLOGY: (Onset of symptoms between 20 min and 12 hr after ingestion): 1. Malaise, headache, nausea, vomiting, dizziness, and tremors. 2. Clonic and tonic convulsions, sometimes without premonitory symptoms. 3. Convulsive episodes may alternate with periods of severe central nervous depression. Death from respiratory arrest may occur during coma, which commonly outlasts the convulsive phase and may persist for a few days. **PEER REVIEWED** [Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. III-144
9. SYMPTOMATOLOGY: 4. During the acute phase, leukocytosis, rise in blood pressure, tachycardia, arrhythmias, metabolic acidosis, and fever have been described; Presumably they represent the consequences of hyperactivity of the sympathetic nervous system. 5.

Disturbances of sleep, memory, and behavior may persist for several days or weeks after the acute phase of dieldrin poisoning. 6. Generalized cerebral dysrhythmia persisting for months, and both hematuria and albuminuria of about 2 weeks duration have been described in one aldrin poisoning in man. Transient hematuria occurred on the second day of an acute dieldrin poisoning. **PEER REVIEWED** [Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. I 144

10. According to a Canadian study, exposure to certain pesticides may weaken the immune system, resulting in incr susceptibility to infection. ... dieldrin ... may damage the mammalian immune system. **PEER REVIEWED** [Kavaler, A.R. (ed.). Chemical Marketing Reporter. New York, NY: Schnell Publishing Co., Inc., 1984,p. V230(7) 4
11. ... ocular disturbance so far noted in human beings has been "blurred vision" of undetermined cause, and nystagmus accompanying incoordination and tremor. ... One case is reported of dense central scotomas 20 deg in diameter in both eyes with slight congestion of the nerveheads, in a man who had prolonged and recent intense exposure to a proprietary misture containing dieldrin ... in a wood preservative spray. Deterioration of vision occurred during 2 wk and did not recover in spite of corticosteroid treatment. Whether dieldrin itself was responsible could not be proved. ... A review and discussion of instances of dieldrin poisoning suggest that if dieldrin has serious effects on vision in human beings, this must be rare. **PEER REVIEWED** [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986. 332
12. Thirteen volunteers were given dieldrin by mouth for 18 months; in 9 of them the daily dose ranged 10 to 211 ug. None showed evidence of ill health and results of clinical and lab investigations remained within the normal range and showed no significant change. The avg concn of dieldrin in fat was 156 times that in the blood. **PEER REVIEWED** [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. 836
13. Vital status and cause of death were assessed for 232 of a group of 233 workers engaged in the manufacuturing and formulation of aldrin, dieldrin, endrin and (for a limited period) telodrin. This group is part of the total exposed population of more than 1000 workers and was selected for follow up on account of the high exposures in the initial years of manufacturing and formulation of the long exposure (mean 11 years) and observation (mean 24 years) periods. Total observed mortality was 25 versus 38 expected on the basis of the death statistics of the male Dutch population. Of the 9 cancer deaths, 3 were caused by lung cancer, while the remaining 6 were each of a different nature. Although in this group exposures have been high and exposure as well as observation periods,

were long enough for meaningful evaluation, this study revealed no indication of a specific carcinogenic activity of aldrin, dieldrin or endrin in manufacturing plant workers exposed to these products. **PEER REVIEWED** [Ribbens PH; Int Arch Occup Environ Health (56) 2: 75-9 (1985)

14. Studies of the carcinogenicity, mutagenicity and teratogenicity of insecticides in animals and humans are reviewed. ... Aldrin and dieldrin are of questionable carcinogenicity in animals but do not appear to be mutagenic in humans. ... **PEER REVIEWED** [Sternberg SS; Int Encyclo Pharm Ther 113: 561-80 (1984)
15. A study was conducted to determine whether men suffering from impaired fertility of unknown etiology exhibited increased blood levels of dieldrin. Dieldrin blood residues were measured in 29 infertile males and in 14 matched control subjects at a hospital in Jerusalem, Israel. The patients' ages ranged from 25 to 45 years. The patients exhibited one or more impaired semen characteristics such as decreased spermatozoa count, lower sperm motility, or a greater proportion of morphologically abnormal spermatozoa. The control group, matched by age and smoking habits, consisted of randomly selected patients with minor illnesses. Each of them had at least one child not older than two years of age. None of the subjects had a history of occupational exposure to organochlorine compounds. The dieldrin levels were measured by GC-ECD. The mean concentration of dieldrin in the infertile patients was 3.65 +/- 3.71 ng/g blood serum (range 0 to 15.9 ng/g) compared with 2.69 +/- 2.47 ng/g (range 0 to 7.1 ng/g) in the control group. This difference was not considered statistically significant. **QC REVIEWED** [Pines A et al; Arch Environ Contam Toxicol 16: 587-97 (1987)
16. The lethal dose of dieldrin in man was estimated as 65 mg/kg body wt. ... Dieldrin was less ... toxic by ingestion as by skin absorption. ... Dermal rather than respiratory exposure was the major source of occupational poisoning in man. **PEER REVIEWED** [Reynolds, J.E.F., Prasad, A.B. (eds.), Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. 836

Non-Human Toxicity Excerpts:

1. MUTAGENICITY: MUTATION RESEARCH 87: 81 (1981). CHINESE HAMSTER LUNG (V79) CELLS IN CULTURE - GENE MUTATION, OUABAIN LOCUS STUDIES: POSITIVE. **PEER REVIEWED** [GENE-TOX Program: Current Status of Bioassay in Genetic Toxicology. U.S. Environmental Protection Agency, Washington, DC. Office of Toxic Substances and Pesticides.(For program information, contact Environmental Mutagen Information Center, Oak Ridge National Laboratory, Post Office Box Y, Oak Ridge, Tennessee 37830. Telephone (615) 574-7871)
2. DIELDRIN FED TO MICE (CF1) FOR 2 YR PRODUCED DOSAGE-DEPENDENT INCIDENCE OF HEPATOMAS. IN MALES INCIDENCES WERE: CONTROLS, 7%; ON 0.1 PPM ... 21%; ON 1

PPM ... 28%; & ON 10 PPM ... 53%. IN FEMALES, INCIDENCES WERE: CONTROLS, 4%; ON 0.1 PPM ... 30%; ON 1 PPM ... 42%; & ON 10 PPM ... 62%. **PEER REVIEWED** [National Research Council. Drinking Water & Health Volume 1. Washington, DC: National Academy Press, 1977. 565

3. SINGLE ORAL DOSES OF APPROX 1/2 ... LD50 DOSES WERE GIVEN ON DAYS 7, 8 OR 9 /OF GESTATION/ IN HAMSTER & ON DAY 9 /OF GESTATION/ IN MOUSE. SIGNIFICANT NUMBER OF DEFECTS ... PRODUCED IN BOTH SPECIES ON ALL DAYS TREATED. MALFORMATIONS IN BOTH SPECIES WERE OPEN EYES, WEBBED FEET & CLEFT PALATE. /DIELDRIN WAS 1 OF PESTICIDES ADMIN/ **PEER REVIEWED** [Shepard, T. H. Catalog of Teratogenic Agents. 3rd ed. Baltimore, MD.: Johns Hopkins University Press, 1980. 87
4. /Dieldrin/ ... was admin orally to pregnant sows during periods in the last month of gestation. Doses up to 15 mg/kg produced no fetal changes but the cmpd was detected in the fetal tissues. **PEER REVIEWED** [Shepard, T.H. Catalog of Teratogenic Agents. 5th ed. Baltimore, MD: The Johns Hopkins University Press, 1986. 197
5. ... RACCOONS FED DIELDRIN @ 2 & 6 PPM IN DIET PRODUCED 20.0 & 20.2%, RESPECTIVELY AS MANY YOUNG AS DID UNTREATED CONTROLS. LITTER SIZE ... REDUCED. IN FURTHER STUDY, RACCOONS FED DIELDRIN @ 2 PPM HAD ABNORMAL ESTROUS CYCLE, REDUCED OVULATION RATE, REDN OF PREGNANCY TO 25-30% OF THAT OF CONTROLS, INCR RESORPTION OF EMBRYOS ... RACCONS FED ... 2 PPM ... DIELDRIN ... INFLUENCED SPERMATOGENSIS, SPERM QUALITY, & FERTILITY ADVERSELY IN MALE RACCONS. **PEER REVIEWED** [National Research Council. Drinking Water & Health Volume 1. Washington, DC: National Academy Press, 1977. 567
6. ACUTE SYMPTOMS: TAIL FEATHERS SPREAD & POINTED EITHER UPWARD OR DOWNWARD, HYPEREXCITABILITY, JERKINESS IN GAIT, ATAXIA, DYSPNEA, MYASTHENIA, FLUFFED FEATHERS, IMMOBILITY, TERMINAL WING-BEAT CONVULSIONS OR OPISTHOTONOS. MORTALITIES USUALLY OCCURRED 1-9 DAYS FOLLOWING TREATMENT. /BIRDS; ORAL/ **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31
7. ... FED TO MALE & /FEMALE/ OSBORNE-MENDEL RATS AT DIETARY CONCN OF 29 & 65 PPM ... ALL CONCN ... TIME-WEIGHTED AVG DOSES. ... SIGNIFICANT DIFFERENCE IN COMBINED INCIDENCE OF ADRENAL CORTICAL ADENOMA OR CARCINOMA IN LOW-DOSE FEMALES & POOLED CONTROLS: "ALTHOUGH ... TUMOR ... FOUND ... IT IS NOT CLEARLY ASSOC WITH TREATMENT ..." /NCI/ **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3715
8. MUTAGENIC POTENTIAL ... INVESTIGATED THROUGH DIRECT BACTERIAL TESTS WITH & WITHOUT MICROSOMAL ACTIVATION, HOST-MEDIATED ASSAY, BLOOD & URINE ANALYSIS ... MICRONUCLEI TEST, METAPHASE ANALYSIS, & DOMINANT LETHAL TEST. CONCN ... 0.08, 0.9, & 8 MG/KG/MOUSE. ... EVALUATION

OF DATA INDICATED THAT DIELDRIN WAS NEG IN ALL 4 ANIMAL TESTS. **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3717

9. IN ... TERATOLOGY STUDY, DIELDRIN & PHOTODIELDRIN ... ADMIN IN DOSES OF 1.5, 3.0, & 6.0 MG/KG/DAY ON DAYS 7-16 OF GESTATION, TO CDI MICE & CD RATS. IN MICE, HIGHEST DOSE PRODUCED INCR PERCENTAGE OF SUPERNUMARY RIBS & DECR IN NUMBER OF CAUDAL OSSIFICATION CENTERS. NO CHANGES WERE OBSERVED IN RATS. **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3717
10. ... VARIOUS DIETARY CONCN OF DIELDRIN /FED/ TO FEMALE SWISS-VANCOUVER MICE ... /CAUSED/ DOSE-RELATED HEPATOMEGALY, INCR IN CYTOCHROME P-450 & MICROSOMAL PROTEIN, & DECR IN PENTOBARBITAL SLEEPING TIME. ... REPORTED DECR IN LIVER GLYCOGEN & INCR IN LIVER CHOLESTEROL IN RABBITS TREATED WITH DIELDRIN. **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3709
11. ... SIGNIFICANT EFFECTS WERE FOUND IN /SWISS MICE/ 1ST & 2ND GENERATIONS & THEIR OFFSPRING AFTER FEEDING ... 3 & 10 PPM ... HISTOLOGICAL EXAM ... REVEALED CHANGES IN LIVERS ... & IN KIDNEYS, LUNGS, & BRAINS ... **PEER REVIEWED** [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3711
12. 3-18 WK DIETARY ADMIN TO MICE. @ 18 WK SIGNIFICANT INCR IN SPONTANEOUS CELL SPREADING OF POYLMORPHONUCLEAR NEUTROPHILS (PMNS) BUT NOT MACROPHAGES. WITH DECR IN SERUM FIBRONECTIN WAS AN INCR SUSCEPTIBILITY TO TUMOR CELLS. **PEER REVIEWED** [LOOSE ET AL; BIOL RELEVANCE IMMUNE SUPPR INDUCED GENET, THER ENVIRON FACTORS, (PAP WORKSHOP) 259-74 (1981)
13. IN RHESUS MONKEYS ADMIN SINGLE ORAL DOSE OF DIELDRIN (20 MG/KG), THERE WAS AN INCR ACCUM OF LIPIDS AFTER 24 HR, PARTICULARLY TRIACYLGLYCEROLS IN ADIPOSE TISSUE, LIVER & KIDNEY. LEVEL IN THE PLASMA DID NOT CHANGE. **PEER REVIEWED** [AGARWAL ET AL; TOXICOL APPL PHARMACOL 58 (1): 100-4 (1981)
14. ORAL ADMIN OF A SINGLE DOSE (20 MG/KG) TO RHESUS MONKEYS GREATLY INCR THE INTAKE OF GLUCOSE & THE ACTIVITIES OF BRUSH BORDER SUCRASE, LACTASE, MALTASE & ALKALINE PHOSPHATASE IN INTESTINE COMPARED TO CONTROLS. **PEER REVIEWED** [MAHMOOD ET AL; CHEM BIOL INTERACT 37 (1-2): 165-70 (1981)
15. IN RAT DIELDRIN CAN EVOKE PROGRESSIVE INCR IN SEVERITY OF CONVULSIVE RESPONSES (KINDLING) DURING REPETITIVE EXPOSURES THAT CANNOT BE ATTRIBUTED TO SIMPLE ACCUM OF DIELDRIN IN THE BRAIN. CHRONIC EXPOSURE FACILITATES

KINDLING PRODUCED BY DAILY ELECTRICAL STIMULATION OF AMYGDALA. **PEER REVIEWED** [JOY ET AL; NEUROBEHAV TOXICOL 2 (2): 117-24 (1980)

16. ... lifetime feeding studies /were conducted with/ Syrian golden hamsters. ... Groups of nearly equal size (ie 32-41 per group) of male and female hamsters were fed a diet containing 0, 20, 60, or 80 mg/kg for up to 120 wk at which time the remaining survivors were killed. While there was no decr in survival at 50 wk, the numbers of females remaining at 70 wk was one-half or less than that of the males. At 90 wk the survival rate was about 10% for all groups except the males of the 180 mg/kg level which had 32 % survivors. Both males and females at the low and high doses demonstrated a marked retardation of growth ... There was no significant difference between the percentage of control animals with tumors and the treated animals with tumors. However, in the treated groups, /the number of tumors per animal was increased over that of controls. Although there was an incr in the number of animals with adrenal tumors, especially males, ... this was not statistically significant. In the animals receiving the high dose of dieldrin, there was one male and one female which had hepatomas. It was also noted ... that there was a dose-related incr in the incidence of hepatic cell hypertrophy in the dieldrin-treated hamsters. **PEER REVIEWED** [Cabral JRP et al; Cancer Lett 6: 241 (1979) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.C-55 (1980) EPA 440/5-80-019
17. Mallory bodies were noted in hepatic tumors following admin for up to 85 wk of a diet containing 10 ppm dieldrin to 50 C3H/He and 62 C57BL/6J6C3F1 male mice. Mallory bodies were seen in 15 of 28 (54%) mice which developed benign hepatic tumors and 33 of 45 (75%) mice with hepatocellular carcinoma, but in only 3 of 39 (8%) mice without hepatic tumors. In mice with tumors the mallory bodies were predominately confined to tumor tissue ... /They/ were not observed in hepatic tumors of 67 C57BL/6J, 49 C3H/He, or 81 B6C3F1 mice given 12 ug diethylnitrosamine ip on days 0, 3, 9, and 15. ... One control had a tumor with a mallory body. **PEER REVIEWED** [Meierhenry EF et al; Hepatology 3 (1): 90-5 (1983)
18. Groups of 10 /white-tailed/ deer and their progeny were given dieldrin at 5 or 25 ppm /for 3 yr/. No signs of overt intoxication were observed, and 9 of 10 adult deer in each group survived the 3 yr. Growth was slower and remained reduced in dieldrin-exposed females that were immature when the study began. Hematologic values and serum protein concn were not significantly related to treatment. Liver-to-body weight ratios were significantly larger in deer given dieldrin at 25 ppm; pituitary glands were smaller and thyroids were larger in deer fed dieldrin. **PEER REVIEWED** [Murphy DA, Korschgen LF; Wildlife Mgmt 34: 887-903 (1970) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.37 (1978) DHEW Pub. NIOSH 78-201

19. Morphologic changes and an incr in SER and atypical mitochondria /were observed/ in adult male rats fed technical grade dieldrin at 50 or 100 ppm for 8 wk. **PEER REVIEWED** [Kimbrough RD et al; Arch Environ Health 16: 333-41 (1971) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.39 (1978) DHEW Pub. NIOSH 78-201
20. Single doses of dieldrin caused a marked proliferation of smooth endoplasmic reticulum in the liver of rats given 8 mg/kg and in dogs given 2 mg/kg, but caused less marked effects in mice given 0.16-7.5 mg/kg. **PEER REVIEWED** [Wright AS; Statement of Testimony at Public Hearings on Suspension of Registrations of Aldrin/Dieldrin (Shell exhibit S-6) USEPA (1974) and Jager KW; Aldrin, Dieldrin, Endrin and Telodrin: An Epidemiological and Toxicological Study of Long-Term Occupational Exposure. Elsevier Publishing Co, Amsterdam, London, New york (1970) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.39 (1978) DHEW Pub. NIOSH 78-201
21. ... purified dieldrin /was admin/ at concn between 0.08 and 40 ppm in the diet to Wistar rats for up to 2 yr ... Nonspecific neural lesions, cranial edema, convulsions, and dieldrin residues in the brain /were reported/ in most exposed rats. ... Cranial edema was observed at 0.63 ppm, and cerebral, cerebellar, brainstem, and vascular lesions were noted at all dietary levels. Dieldrin residue levels of 9-11 ppm in the brain were associated with convulsions. **PEER REVIEWED** [Harr JR et al; Amer J Vet Res 31: 1853-62 (1970) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.44 (1978) DHEW Pub. NIOSH 78-201
22. In 39- to 140-day-old female Wistar rats fed dieldrin at 2.5-10.0 ppm in the diet /in a reproductive toxicity study/. Parental mortality /and reduced fecundity was noted at 10 ppm/. Proliferation of reticuloendothelial components and pancreatic ductal cells /were noted/. Fibrinoid degeneration, arteritis, endothelial proliferation, and perivascular edema were observed in small to medium sized arteries. /Convulsions in pups was observed at 2.5 ppm/. **PEER REVIEWED** [Harr JR et al; Amer J Vet Res 31: 181-9 (1970) as cited NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.46 (1978) DHEW Pub. NIOSH 78-201
23. Dieldrin at 1, 2, or 4 mg/kg/day produced hyperplastic goiters in the thyroids of pigeons. ... Visual examination indicated that the thyroids were significantly enlarged and microscopic examinations revealed small follicles with decreased amount of colloid, epithelial hyperplasia, and vascular congestion. **PEER REVIEWED** [Jefferies DJ, French MC; J Wildl Mgmt 36: 24-30 (1972) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.46-47 (1978) DHEW Pub. NIOSH 78-201
24. /Dieldrin/ produces changes in the levels of serum luteinizing hormone (LH). Levels of LH were not affected when the rats were fed dieldrin at 0.7 ppm. At 6.2 ppm,

dieldrin produced significant elevations in serum LH. Even in castrated rats, dieldrin (6.2 ppm) caused an incr in the serum levels of this gonadotropin. Dieldrin also caused a slight decr in the ratio of body weight to pituitary gland weight and a small incr in the ratio of body weight to prostate gland weight. **PEER REVIEWED** [Blend MJ, Lehnert BE; In WB Deichman Ed, Pesticides and the Environment: A Continuing Controversy; p.189-98 (1973) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.54 (1978) DHEW Pub. NIOSH 78-201

25. 1,500 CF1 mice /were/ segregated into groups containing the following numbers of animals of each sex: 300, 0.01 ppm dieldrin (control); 125, 0.1 ppm; 125, 1 ppm; 200, 10 ppm. At 10 ppm from 9 months onward palapable abdominal masses were detected. 50% of the mice fed dieldrin at 10 ppm were dead at 15 months and 50% in the other groups were at 20 months. Statistically significant and dose-related increases in liver tumors occurred in dieldrin-exposed mice in both sexes independent. Liver tumors included nodular growths of solid cords of parenchymal cells and papilliform and adenoid growths with cells proliferating in confluent sheets with necrosis and incr mitoses. Lung metastases were observed in animals with liver tumors that had the papilliform and adenoid type growth in 12/138 animals. Incidences of pulmonary adenomas and pulmonary carcinomas in males and females exposed to dieldrin at 0.1 and 1 ppm were incr above those in controls. Differences were statistically significant in females. **PEER REVIEWED** [Walker AIT et al; Food Cosmet Toxicol 11: 415-32 (1972) NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.60 (1978) DHEW Pub. NIOSH 78-201
26. ... the effects of exposure to dieldrin at 10 ppm were compared in CF1 mice, LACG mice, and in hybrids of the two strains. Forty mice of each sex were used in each treatment group, with groups of 60 controls. Age-adjusted incidence of liver tumors was significantly incr in all six treated groups. The incidence of lung tumors also was incr in all six treated groups, although not significantly so in any one considered alone. However, the incidence of other tumors was significantly incr in treated female CF1 mice. **PEER REVIEWED** [Hunt PF; Statement of Testimony at Public Hearings on Suspension of Registrations of Aldrin/Dieldrin (Shell exhibit S-3). USEPA (1974) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.66-67 (1978) DHEW Pub. NIOSH 78-201
27. /Dieldrin was/ neg for mutagenicity in recombination assays with Bacillus subtilis strains H17 Rec+ and M45 Rec-. /It was also/ neg for four strains of Salmonella typhimurium /TA 1535, TA 1536, TA 1537, and TA 1538/ and in two tryptophaneless strains of E coli ... **PEER REVIEWED** [Shirasu Y et al; Mutat Res 40: 19-30 (1976) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.79 (1978) DHEW Pub. NIOSH 78-201
28. ... recrystallized dieldrin caused chromosome damage in

bone marrow cells of mice in vivo and in human embryonic cells in vitro. Single ip injections of dieldrin at 1, 30, or 50 mg/kg into STS mice caused pronounced mitotic inhibition and produced twofold to sixfold incr in chromosome abnormalities, primarily breaks and fragments in bone marrow cells; these changes were statistically significant at dose of 1 mg/kg and above. **PEER REVIEWED** [Majumdar SK et al; J Hered 67: 303-7 (1976) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.79 (1978) DHEW Pub. NIOSH 78-201

29. Recrystallized dieldrin inhibited incorporation of amino acid precursors of DNA, RNA, and protein into Ehrlich ascites tumor cells in vitro. ... Daily injections of dieldrin at 1.5 mg/kg for 5 days into mice inhibited the growth of Ehrlich ascites tumor cells in vivo. **PEER REVIEWED** [Walker EM et al; Arch Environ Contam Toxicol 5: 333-341 (1977) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.81 (1978) DHEW Pub. NIOSH 78-201
30. /Dieldrin/ gave negative results with gene conversion in Saccharomyces cerevisae, back-mutation in Serratia marcescens, forward mutation in E coli and forward mutation to streptomycin resistance in E coli. ... **PEER REVIEWED** [Fahrig R; Chem Carcinogenesis Essays 1: 161 (1973) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.C-39 (1980) EPA 440/5-80-019
31. Experimental feeding of dieldrin to rabbits at 60 to 110 mg/kg weekly for 12 wk caused convulsions and apparent "blindness". ... In mice, retinal photoreceptor electrical responses have been disturbed by 20 mg intraperitoneally. **PEER REVIEWED** [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986. 332
32. Fish are highly susceptible to dieldrin and pollution of streams must be avoided. Birds are also susceptible and dressed seeds may be regarded as a source of poisoning ... dogs and other animals feeding on the carcasses of poisoned birds may also be affected. **PEER REVIEWED** [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. 836
33. Animals were exposed to 0.1, 1, 5, or 10 ppm dieldrin in C-1000 diet. Animals were killed after 1.85, 3, 6, 9, and 14 months of treatment. A linear incr was noted in the proportion of octaploid nuclei over the observaiton period. Dieldrin enhancement of polyploidization was proportional to dietary concn and independent of duration of exposure. A virtually constant ploidy status is suggested at the time of liver tumor formation. ... Tumor formation appears imminent at a constant biological age of mouse liver, and tumor promoters may operate by advancing the biological age of their target organ during the initial phases of treatment. **PEER REVIEWED** [van Ravenzwaay B et al; Carcinogenesis 8 (2): 265-69 (1987)
34. The effect of single, sublethal ip injection of dieldrin

on the primary antibody response to thymodependent (sheep red blood cells, SRBC) and T-cell-independent (lipopolysaccharide, LPS) antigens were investigated in inbred C57Bl/6 mice. Time-course studies showed significant suppression of the anti-SRBC IgM and anti-LPS IgM response at 7-24 days and at 4-14 days, respectively, after exposure to 0.6 LD50 of dieldrin. The anti-SRBC IgG response was also suppressed by dieldrin exposure, however, maximal suppressory effect was found at 48 days after the pesticide exposure. Similar patterns of the dieldrin-induced suppression of the primary IgM response to the thymodependent and T-cell- independent antigens, in addition to the overall control of cytotoxicity of lymphoid cell populations, suggest rather dysfunction of cellular cooperation during the inductory phase of the immune humoral response. **PEER REVIEWED** [Bernier J et al; Toxicol Lett 35 (2-3): 231-40 (1987)

35. Rats were given acute doses (0, 0.5, 1.5, 4.5 mg/kg) of ... dieldrin and subsequently exposed to a series of 40 escapable shocks, identical inescapable shocks, or no shock in an operant chamber. Eight hours later, the subjects were re-exposed in a shuttlebox to footshock which was escapable upon performance of an FR-2 shuttle response. Escape deficits which were related in magnitude to the size of the dieldrin dose were found in the inescapable shock group but not in the escapable shock or no shock groups. The data suggest that experience with the lack of control over stress is critical in determining the behavioral effects of the agent and that the behavioral effects caused by uncontrollable stress may be exacerbated by concurrent exposure to such compounds. **PEER REVIEWED** [Carlson JN et al; Psychopharmacology 91 (1): 122-6 (1987)
36. Dieldrin (5 m uM) increased the electron opacity of the cytoplasm and nucleoplasm of cockroach glial cells without inducing such a change in the fine structure of perineurial cells. Mitochondria in nerve cell bodies and neuropile of dieldrin-treated ganglia were swollen with broken cristae and devoid of normal morphological appearance. Dieldrin treatment also caused notable depletion of synaptic vesicles from presynaptic terminals in the neuropile. Depleted terminals accumulated membranous residual bodies and lysosomes indicative of insecticide-induced neuronal deterioration. These ultrastructural alterations were prevented by pretreatment of ganglia with 10 mM Mg 2+, suggesting that the action of dieldrin upon the ganglion was mediated by an increased Ca flux. **PEER REVIEWED** [Singh GJ; Singh B; Pestic Biochem Physiol 21 (1): 102-26 (1984)

Toxicity Values

Non-Human Toxicity Values:

1. LD50 CFE Rat oral 38.3 mg/kg **PEER REVIEWED** [Jager KW; Aldrin, Dieldrin, Endrin, Telodrin: An Epidemiological and Toxicological Study of Long-Term Occupational Exposure (1970) as cited in NIOSH; Special Occupational Hazard

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2. LD50 Sheep oral 50-75 mg/kg **PEER REVIEWED** [Jager KW; Aldrin, Dieldrin, Endrin, Telodrin: An Epidemiological and Toxicological Study of Long-Term Occupational Exposure (1970) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.32 (1978) DHEW Pub. NIOSH 78-201
3. LD50 CFE Rat (male) dermal (20% emulsification concn) 213.8 mg/kg **PEER REVIEWED** [Jager KW; Aldrin, Dieldrin, Endrin, Telodrin: An Epidemiological and Toxicological Study of Long-Term Occupational Exposure (1970) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.32 (1978) DHEW Pub. NIOSH 78-201
4. LD50 CFE Rat (female) dermal (20% emulsification concn) 119.9 mg/kg **PEER REVIEWED** [Jager KW; Aldrin, Dieldrin, Endrin, Telodrin: An Epidemiological and Toxicological Study of Long-Term Occupational Exposure (1970) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.32 (1978) DHEW Pub. NIOSH 78-201
5. LD50 CFE Rat, dermal (50% wettable powder) 213.4 mg/kg **PEER REVIEWED** [Jager KW; Aldrin, Dieldrin, Endrin, Telodrin: An Epidemiological and Toxicological Study of Long-Term Occupational Exposure (1970) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.32 (1978) DHEW Pub. NIOSH 78-201
6. LD50 Rabbit dermal 150 mg/kg **PEER REVIEWED** [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. V13(8) 435
7. LD50 DOMESTIC GOAT ORAL 100-200 MG/KG, 6-8 MO OLD MALES **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31

Ecotoxicity Values:

1. LC50 Tubifex and Limnodrilus (mixed cultures) 6700 ug/l/96 hr /Conditions of bioassay not specified/ **PEER REVIEWED** [Whitten BK et al; Jour Water Pollut Control Fed 38: 227 (1966) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-37 (1980) EPA 440/5-80-019
2. LC50 Cypretta kawati (ostracod) 185 ug/l/24 hr; 12.3 ug/l/72 hr /Conditions of bioassay not specified/ **PEER REVIEWED** [Hansen CR, Kawatski JA; J Fish Res Board Can 33: 1198 (1976) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-37 (1980) EPA 440/5-80-019
3. LC50 Chironomus tentans 0.9 ug/l/24 hr /Conditions of bioassay not specified/ **PEER REVIEWED** [Karnak RE, Collins WJ; Bull Environ Contam Toxicol 12: 62 (1974) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-37 (1980) EPA 440/5-80-019
4. LC50 Pseudacris triseriata (frog, tadpoles) 100 ug/l/96 hr /Conditions of bioassay not specified/ **PEER REVIEWED** [Sanders HO; Copeia 2: 246 (190) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-38

(1980) EPA 440/5-80-0

5. LD50 MALLARD ORAL 381 MG/KG (95% CONFIDENCE LIMIT: 141-1030 MG/KG), 6-7 MO OLD FEMALES **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31
6. LD50 PHEASANT ORAL 79.0 MG/KG (95% CONFIDENCE LIMIT: 33.3-187 MG/KG), 10-23 MO OLD MALES **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31
7. LD50 PARTRIDGE ORAL 23.4 MG/KG (95% CONFIDENCE LIMIT: 15.2-36.0 MG/KG), 8-11 MO OLD **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31
8. LD50 HOUSE SPARROW ORAL 47.6 MG/KG (95% CONFIDENCE LIMIT: 34.3-66.0 MG/KG), FEMALES **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31
9. LD50 CANADA GOOSE ORAL 50-150 MG/KG, ADULTS **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31
10. LD50 FULVOUS TREE DUCK ORAL 100-200 MG/KG, FEMALES **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31
11. LD50 GRAY PARTRIDGE ORAL 8.84 MG/KG (95% CONFIDENCE LIMIT: 3.32-23.6 MG/KG), 3-10 MO OLD FEMALES **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31
12. LD50 MULE DEER ORAL 75-150 MG/KG, 8-18 MO OLD MALES **PEER REVIEWED** [U.S. Department of the Interior, Fish and Wildlife Service. Handbook of Toxicity of Pesticides to Wildlife. Resource Publication 153. Washington, DC: U.S. Government Printing Office, 1984. 31
13. LC50 CUTTHROAT TROUT 6.0 UG/L/96 HR (95% CONFIDENCE LIMIT: 4.6-8.0 UG/L), WT 1.1 G, WATER TEMP 9 DEG C /TECHNICAL, 85% HEOD/ /STATIC BIOOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
14. LC50 RAINBOW TROUT 1.2 UG/L/96 HR (95% CONFIDENCE LIMIT: 0.9-1.7 UG/L), WT 1.4 G, WATER 13 DEG C /TECHNICAL, 85%

HEOD/ /STATIC BIOASSY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30

15. LC50 GOLDFISH 1.8 UG/L/96 HR (95% CONFIDENCE LIMIT:1.2-2.8 UG/L), WT 1.0 G, WATER 18 DEG C /TECHNICAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
16. LC50 FATHEAD MINNOW 3.8 UG/L/96 HR (95% CONFIDENCE LIMIT: 3.1-4.6 UG/L), WT 0.6 G, WATER 18 DEG C /TECHNICAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
17. LC50 CHANNEL CATFISH 4.5 UG/L/96 HR (95% CONFIDENCE LIMIT: 2.5-7.9 UG/L), WT 1.4 G, WATER 18 DEG C /TECHNICAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
18. LC50 BLUEGILL 3.1 UG/L/96 HR (95% CONFIDENCE LIMIT: 2.1-4.6 UG/L), WT 1.3 G, WATER 18 DEG C /TECHNICAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
19. LC50 LARGEMOUTH BASS 3.5 UG/L/96 HR (95% CONFIDENCE LIMIT: 2.7-4.5 UG/L), WT 2.5 G, WATER 18 DEG C /TECHNICAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
20. LC50 CUTTHROAT TROUT 12 UG/L/96 HR (95% CONFIDENCE LIMIT: 11-14 UG/L), WT 1.3 G, HARD WATER 8 DEG C, /PHOTO-DIELDRIN 98%/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
21. LC50 BLUEGILL 11 UG/L/96 HR (95% CONFIDENCE LIMIT: 9.3-13 UG/L), WT 1.4 G, WATER 18 DEG C /PHOTO-DIELDRIN 98%/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30

2. LC50 CHANNEL CATFISH 19 UG/L/96 HR (95% CONFIDENCE LIMIT:

13-27 UG/L), WT 1.4 G, HARD WATER 18 DEG C /PHOTO-DIELDRIN 98%/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30

23. LC50 ASELLUS 5.0 UG/L/96 HR (95% CONFIDENCE LIMIT: 3.2-10.0 UG/L), MATURE, WATER TEMP 21 DEG C /TECHNICAL MATERIAL 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
24. LC50 GAMMARUS FASCIATUS 640 UG/L (95% CONFIDENCE LIMIT: 460-880 UG/L), MATURE, WATER TEMP 21 DEG C /TECHNICAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
25. LC50 ORCONECTES 740 UG/L (95% CONFIDENCE LIMIT: 680-1,200 UG/L), MATURE, WATER TEMP 21 DEG C /TECHNICAL MATERIAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
26. LC50 PTERONARCYS 0.5 UG/L (95% CONFIDENCE LIMIT: 0.4-0.7 UG/L), 2ND YR CLASS, WATER TEMP 15 DEG C /TECHNICAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
27. LC50 PTERONARCELLA 0.5 UG/L/96 HR (95% CONFIDENCE LIMIT: 0.4-0.7 UG/L), 1ST YR CLASS, WATER TEMP 15 DEG C /TECHNICAL/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
28. LC50 CLAASSEMIA 0.6 UG/L/96 HR (95% CONFIDENCE LIMIT: 0.4-0.8 UG/L), 2ND YR CLASS, WATER TEMP 15 DEG C /TECHNICAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
29. LC50 ISCHNURA 12 UG/L/96 HR, JUVENILE, WATER TEMP 24 C /TECHNICAL MATERIAL, 85% HEOD/ /STATIC BIOASSAY/ **PEER REVIEWED** [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government PrintingOffice, 1980. 30
30. LC50 Japanese quail (Young coturnix) 60 ppm (95%

confidence limit 57-63 ppm) (5 day-diet) **PEER REVIEWED** [Hill, E.F. and Camardese, M.B. Lethal Dietary Toxicities of Environmental Contaminants and Pesticides to Coturnix. Fish and Wildlife Technical Report 2.Washington, DC: United States Department of Interior Fish and Wildlife Service, 1986. 60

31. LC50 Aedes aegypti (mosquito) late 3rd instar larvae 6 ppb/24 hr /Conditions of bioassay not specified/ **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 516
32. LD50 Musca domestica (housefly) 3 day old female 9.8 ug/fly **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 516
33. Sphaeroides maculatus (northern puffer) 34 ppb/96 hr in a static lab bioassay utilizing 100% material **PEER REVIEWED** [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 517
34. LC50 Bufo woodhousi (toad, tadpoles) 150 ug/l/96 hr /Conditions of bioassay not specified/ **PEER REVIEWED** [Sanders HO; Copeia 2: 246 (190) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-38 (1980) EPA 440/5-80-019

National Toxicology Program Reports:

1. A bioassay of technical grade dieldrin for possible carcinogenicity was conducted by administering the test /cmpd/ in feed to Osborne-Mendel rats and B6C3F1 mice. Groups of 50 rats of each sex were administered dieldrin at one of two doses. Low dose rats and both low and high dose mice were treated for 80 wk, followed by observation periods of 30-31 wk for rats and 10-13 wk for mice. Treatment of high dose rats was terminated after 59 wk and followed by 51-52 wk of observation. Time-weighted avg doses for rats were 29 or 65 ppm; doses for mice were 2.5 or 5 ppm. Matched controls consisted of groups of 10 untreated rats of each sex and 20 untreated male mice and 10 female mice; pooled controls, used for statistical evaluation, consisted of the matched control groups combined with untreated animals from similar bioassays of other chemicals (58 male and 60 female rats,92 male and 79 female mice). All surviving rats were killed at 110-111 wk, and all surviving mice at 90-93 wk. ... Under the conditions of /this bioassay/, none of the tumors occurring in Osborne-Mendel rats treated with dieldrin ... could be clearly be associated with treatment. ... There was a significant increase in the incidence of hepatocellular carcinomas in the high-dose male /mice/ which may be associated with treatment. **QC REVIEWED** [DHEW/NCI; Bioassays of Aldrin and Dieldrin for Possible Carcinogenicity p.vii (1978) Technical Rpt Series No. 021 DHEW Pub No. (NIH) 78-821

IARC Summary and Evaluation:

1. Inadequate evidence of carcinogenicity in humans. Limited

evidence of carcinogenicity in animals. OVERALL EVALUATION: Group 3: The agent is not classifiable as to its carcinogenicity to humans. **QC REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. S7 62 (1987)

Pharmacokinetics

Absorption, Distribution and Excretion:

1. ... IN OIL SOLN /IT/ IS ABSORBED VERY READILY THROUGH SKIN, RESP MUCOSA & GI TRACT. **PEER REVIEWED** [Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. III-143
2. ... (36)CL-DIELDRIN ... RAPIDLY ABSORBED AFTER ORAL ADMIN TO RATS & WEANLING PIGS ... LOCALIZED IN LIVER & FAT DEPOTS, FROM WHICH ... /IT IS/ ONLY SLOWLY EXCRETED. **PEER REVIEWED** [Parke, D. V. The Biochemistry of Foreign Compounds. Oxford: Pergamon Press, 1968. 200
3. CONCN OF DIELDRIN IN PLASMA OF ... PREGNANT WOMEN RANGED FROM 0.0001-0.0061 PPM, & CONCN IN WHOLE-CORD BLOOD OF NEWBORN BABIES RANGED FROM 0.0002-0.0015 PPM. SIMILAR BLOOD LEVELS IN MOTHERS & NEWBORN BABIES WERE ... REPORTED ... **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 140 (1974)
4. WHOLE-BODY AUTORADIOGRAPHY OF PREGNANT MICE DOSED IM WITH (14)C-DIELDRIN SHOWED ... UPTAKE OF (14)C OCCURRED IN ADIPOSE TISSUE. DIELDRIN CROSSED PLACENTA, & UPTAKE INTO FETAL TISSUES, ALTHOUGH MODERATE, PARALLELED THAT IN MATERNAL TISSUES. **PEER REVIEWED** [The Chemical Society. Foreign Compound Metabolism in Mammals. Volume 1: A Review of the Literature Published Between 1960 and 1969. London: The Chemical Society, 1970. 76
5. DIELDRIN IS STORED IN ADIPOSE TISSUE, LIVER, BRAIN & MUSCLE OF MAMMALS, FISH & BIRDS, IN ALGAE, PLANKTON, INSECTS, EARTHWORMS & IN EGGS OF MANY BIRD SPECIES. FISH CAN BUILD UP MG/KG CONCN OF DIELDRIN FROM NG/L CONCN IN WATER ... **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 130 (1974)
6. IN PLASMA ... DIELDRIN ... ASSOCIATED MAINLY WITH ALPHA- & BETA-LIPOPROTEIN FRACTION. **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 238
7. DIELDRIN RESIDUES IN GRAY SEALS SAMPLED DURING BREEDING SEASON. MEAN BLUBBER ORGANOHALOGEN CONCN OF MALES WAS GREATER THAN FEMALES. DIELDRIN WAS DETECTED IN LIVER OF MOTHER/FETUS PAIRS DEMONSTRATING TRANSPLACENTAL MOVEMENT OF THESE RESIDUES. **PEER REVIEWED** [DONKIN ET AL; SCI

TOTAL ENVIRON 19 (2): 121-42 (1981)

8. SIMPLE CORRELATIONS BETWEEN BRAIN & CARCASS CONCN OF DIELDRIN WERE MOST SIGNIFICANT. BRAIN RESIDUE LEVELS WERE NEG CORRELATED WITH CARCASS LIPID LEVELS & WERE PREDICTABLE WITHIN FACTOR OF APPROX 2. PESTICIDES TESTED VARIED IN PROPENSITY TO ACCUM IN BRAIN. **PEER REVIEWED** [BARBEHENN KR & REICHEL WL; J TOXICOL ENVIRON HEALTH 8 (1-2): 325-30 (1981)
9. DERMAL PENETRATION OF LABELED DIELDRIN. T/2 FOR DIELDRIN 71.7 +/- 17.3%. AT 8 HR 82.6% HAD LEFT SITE OF APPLICATION IN MICE WITH SIGNIFICANT RADIOACTIVITY IN STOMACH 1.4%; INTESTINE 8.5%; LIVER 3.1%. EXCRETORY PRODUCTS, PRIMARILY FECES, CONTAINED 3.6%; CARCASS HAD 61.7%. **PEER REVIEWED** [SHAH ET AL; TOXICOL APPL PHARMACOL 59 (3): 414-23 (1981)
10. EXPOSURE OF BLUEGILL FISH TO 50 PPB IN STATIC SYSTEM RESULTED IN ABSORPTION OF 73% OF RADIOACTIVITY IN 48 HR. WHEN TRANSFERRED TO CLEAN WATER ONLY 16.20% OF ABSORBED RADIOLABEL ELIM IN 23 DAYS. TWO METAB ISOLATED INCL PENTACHLOROKETONE & ALDRIN-TRANS-DIOL. **PEER REVIEWED** [SUDERSHAN P, KHAN MAS; PESTIC BIOCHEM PHYSIOL 15 (29): 192-9 (1981)
11. HUMAN MILK SAMPLES FROM 1436 WOMEN RESIDING IN USA WERE ANALYYZED BY GLC FOR PESTICIDES. DIELDRIN WAS FOUND ABOVE THE DETECTION LIMIT (1.0 PPB) IN MORE THAN 80% OF ALL THE SAMPLES COLLECTED. **PEER REVIEWED** [SAVAGE ET AL; AM J EPIDEMIOL 113 (4): 413-22 (1981)
12. Dieldrin is slowly excreted in the bile. Samples taken from a pest control operator during surgery contained dieldrin at concn of 24.6 ppm in adipose tissue, 165 ppb in blood serum, and 159 ppb in bile. **PEER REVIEWED** [Paschal EH et al; Bull Environ Contam; Toxicol 12: 547-54 (1974) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.27 (1978) DHEW Pub. NIOSH 78-201
13. 14 aldrin/dieldrin workers exhibited a statistically significant incr over controls in urinary excretion of D-glutaric acid. ... Dieldrin levels in the blood of workers averaged 0.026 ug/ml but were not significantly correlated with D-glutaric acid excretion. **PEER REVIEWED** [Hunter J et al; Nature 237: 339-401 (1972) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.88 (1978) DHEW Pub. NIOSH 78-201

Metabolism/Metabolites:

1. IN MALE RATS & MICE, TRANS-4,5-DIHYDROXY-4,5-DIHYDROALDRIN ... IS FECAL METABOLITE & 4,5-SECO-ALDRIN-4,5-DICARBOXYLIC ACID IS A URINARY METABOLITE OF DIELDRIN. **PEER REVIEWED** [The Chemical Society. Foreign Compound Metabolism in Mammals Volume 3. London: The Chemical Society, 1975. 402
2. WHEN LABELED DIELDRIN ... ADMIN TO RABBIT VIA STOMACH TUBE, SIX METABOLITES ... ISOLATED ... MAIN METABOLITE ... IDENTIFIED AS ONE OF TWO ENANTIOMORPHIC ISOMERS OF 6,7-TRANS DIHYDROXY-DIHYDRO-ALDRIN (ALDRIN DIOL). **PEER REVIEWED** [Menzie, C.M. Metabolism of Pesticides. U.S. Department of the Interior, Bureau of Sport Fisheries and

Wildlife, Publication 127. Washington, DC: U.S. Government Printing Office, 1968. 24

3. AFTER FEEDING LABELED DIELDRIN TO SHEEP, SIX METABOLITES ... FOUND IN URINE. ... ONE WAS GLUCURONIC ACID CONJUGATE OF TRANS-DIOL & OTHER CONJUGATE CONTAINING GLUCURONIC ACID & POSSIBLY GLYCINE. ... FOUR WERE HEXANE SOL. ONE ... /WAS/ TRANS-DIOL. OTHER ... SYN-EPOXY-HYDROXYDIELDRIN. **PEER REVIEWED** [Menzie, C. M. Metabolism of Pesticides, An Update. U.S. Department of the Interior, Fish, Wild-life Service, Special Scientific Report - Wildlife No. 184, Washington, DC. U.S. GovernmentPrinting Office, 1974. 16
4. ... IV TO RHESUS MONKEYS. ... THREE /METABOLITES/ ... IDENTIFIED: 12-HYDROXYDIELDRIN; 4,5-ALDRIN-TRANS-DIHYDRODIOL & GLUCURONIC ACID CONJUGATE OF DIOL. ... PENTACHLOROKETONE ... EXCRETED BY RATS ... RHESUS MONKEYS EXCRETED 9-HYDROXYDIELDRIN. BILE CONTAINED GLUCURONIDE OF 9-HYDROXYDIELDRIN BUT NO PENTACHLOROKETONE. **PEER REVIEWED** [Menzie, C.M. Metabolism of Pesticides, Update II. U.S. Department of the Interior, Fish Wildlife Service, Special Scientific Report - Wildlife No. 212.Washington, DC: U.S. Government Printing Office, 1978. 5
5. ... (14)C-DIELDRIN ... ADMIN TO RATS ... AS SINGLE DOSE BY GAVAGE ... ONE OF THE FECAL METABOLITES ... IDENTIFIED AS 6,7-TRANS-DIHYDROALDRINDIOL & ONE OF URINARY METABOLITES AS HEXACHLOROHEXAHYDROMETHANOINDENE-1,3-DICARBOXYLIC ACID. **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 139 (1974)
6. Four metabolic products of dieldrin in rodents include: 6,7-trans-dihydroxy-dihydroaldrin, tricyclic dicarboxylic acid, syn-1,2-hydroxy-dieldrin, and pentachloroketone. **PEER REVIEWED** [Bedford CT, Hutson DH; Chem Ind 10: 440 (1976) as cited in USEPA; Hazard Profile: Dieldrin p.5 (1980)
7. Time courses (0-100 days) of uptake and metabolism of aldrin and dieldrin added as a subculture to suspension cultures from Phaseolus vulgaris (French bean) root and shoot and Solanom tubersum (potato) tuber were comparable with rapid dieldrin production and delayed appearance of other metabolites. When aldrin and dieldrin were added to cultures 10 or 20 days after subculture, usual extent of conversion of aldrin to dieldrin occurred, but with reduced production of other metabolites. Increased vol of 2-methoxyethanol had detrimental effects on growth and uptake and metabolism. Dieldrin production was maximal during the rapid growth phase and probably independent of other conversions. **PEER REVIEWED** [Brain KR, Lines DS; Plent Cell Rep 2 (1): 11-4 (1983)
8. Rats fed 200 ppm dieldrin in the diet showed cellular changes within 24 hours. These changes were correlated with an increased activity of certain enzymes, such as those capable of hydroxylating aniline or catalyzing the

o-dealkylation of chlorofenviphos, but activity of ... acid phosphatase or glucose-6-phosphatase did not change. **PEER REVIEWED** [Jager KW; Aldrin, Dieldrin, Endrin, Telodrin: An Epidemiological and Toxicological Study of Long-Term Occupational Exposure (1970) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.42 (1978) DHEW Pub. NIOSH 78-201

9. ... WORKERS WITH OCCUPATIONAL EXPOSURE TO DIELDRIN & ALDRIN EXCRETED 9-HYDROXY-DIELDRIN IN FECES. **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 140 (1974)

Biological Half-Life:

1. Biological half-life of dieldrin in blood of humans ranges from 141-592 days with a mean of 369 days. **PEER REVIEWED** [Hunter CG et al; Arch Environ Health 18: 12 (1969) as cited in USEPA; Hazard Profile: Dieldrin p.6 (1980)
2. Male volunteers ingested 50 or 211 ug of dieldrin daily for 2 yr. The rate constants for uptake were est ... to be about 0.007, corresponding to a half-time of about 100 days. **PEER REVIEWED** [Hunter CG et al; Arch Ind Health 18: 12-21 (1969) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.27 (1978) DHEW Pub. NIOSH 78-201

Mechanism of Action:

1. ... dieldrin at 1.25, 2.5, or 5 mg/kg/day in mice for 5 days significantly reduced the total uptake and subsequent metabolism in androgens in the anterior prostate. Dieldrin at concn as low as 4x10-7 M in vitro effectively decr the formation of dehydrotestosterone in the mouse anterior prostate and of androstanediol in the rat ventral prostate. **PEER REVIEWED** [Schein LG, Thomas JA; Environ Res 9: 26-31 (1975) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.53-54 (1978) DHEW Pub. NIOSH 78-201
2. The enhancement of in vitro small intestinal transcellular glucose transport in NMRI mice after oral admin of ... dieldrin was ... due to an increased active transport at the site of the brush border membrane. Intestinal disaccharidase activities were ... elevated in the dieldrin group ... and intestinal alkaline phosphatase activity was enhanced after ... dieldrin ... treatment. ... Dieldrin apparently exerts /its/ stimulating effect on intestinal glucose transport by a mechanism different from general induction of metabolic pathways. **PEER REVIEWED** [Reymann A et al; Biochem Pharmacol 32 (11): 1759-64 (1983)
3. Dieldrin interferes with the binding of dihydrotestosterone to male sex hormone receptors in the nuclear and cytosol fractions of the rat prostate. **PEER REVIEWED** [Wakeling AE et al; Fed Proc 31: 725 (1972) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.53 (1978) DHEW Pub. NIOSH 78-201

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4. Dieldrin interferes with the in vitro binding of 5-alplha-dihydrotestosterone to its androphilic molecule by a mechanism involving noncompetitive inhibition. **PEER REVIEWED** [Wakeling AE, Visek WJ; Science 181: 659-61 (1973) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.53 (1978) DHEW Pub. NIOSH 78-201
5. The toxicity to mice of ip administered polychlorocycloalkane (PCCA) insecticides is generally correlated with their potency as in vitro inhibitors of the brain specific (35)S-t-butylbicyclophosphorothionate (35)S-TBPS binding site with correction for metabolic activation and detoxification. These findings from our earlier studies are extended here to in vivo investigations relating convulsant action to inhibition of the TBPS binding site in poisoned mice. Radioligand binding assays involved brain P2 membranes washed three times with 1 mM EDTA to remove endogenous gamma-aminobutyric acid (GABA) or other modulators(s) which otherwise serves as a noncompetitive inhibitor of (35)S-TBPS binding at the GABA-regulated chloride ionophore. Examination of lindane, technical toxaphene, toxaphene toxicant A, and 10 polychlorocycloqdiene insecticides revealed 62 (+/-) 4% binding site inhibition 30 min after their LD50 doses with 32 (+/-) 3% inhibition at one-half and 6 (+/-) 3% inhibition at one-quarter of their LD50 doses. This correlation between binding site inhibition and convulsant action is also evident in dose- and time-dependency studies with endosulfan sulfate. The brain P2 membranes of treated mice contain the parent compound with each of the PCCAs plus activation products of some of the cyclodienes, ie endosulfan sulfate from alpha- and beta-endosulfan and 12-ketoendrin from isodrin and endrin. The finding that the brains of treated mice contain sufficient PCCA or its activation products to achieve a magnitude of (35)S-TBPS binding site inhibition correlated with the severity of the poisoning signs supports the hypothesis that the acute toxicity of PCCA insecticides to mammals is due to disruption of the GABA-regulated chloride ionophore. **PEER REVIEWED** [Cole LM et al; Life Science (39) 20: 1855-62 (1986)
6. An in vitro assay, using cocultures os Chinese hamster cells to measure metabolic cooperation between V-79 6-thioguanine-sensitive (6TGs) and resistant (6TGr) cells, was developed to detect noncytotoxic and nonmutagenic chemicals that inhibit, quantitatively, gap junctional communication. The insecticide, dieldrin, is known to have pleiotropic toxic effects in animals, inhibited gap junctional communication. Chemical inhibition of gap junctional communication could be a possible mechanism explain their tumor promoting and neurotoxic effects. **PEER REVIEWED** [Trosko JE et al; Mol Toxicol 1 (1): 83-93 (1987)

Interactions:

1. TREATMENT OF RODENTS WITH ... HALOGENATED HYDROCARBON INSECTICIDES INCR ACTIVITY OF ENZYMES IN LIVER MICROSOMES

THAT OXIDATIVELY METABOLIZE DRUGS SUCH AS HEXOBARBITAL ... CHLORPROMAZINE & INCR ENZYME LEVELS COMPARED WITH DECR ACTION OF HEXOBARBITAL. EXAMPLES ... INCL ... DIELDRIN ... **PEER REVIEWED** [LaDu, B.N., H.G. Mandel, and E.L. Way. Fundamentals of Drug Metabolism and Disposition. Baltimore: Williams and Wilkins, 1971. 256

2. Incr of smooth endoplasmic reticulum and atypical mitochondria were more pronounced in rats fed DDT and dieldrin simultaneously. **PEER REVIEWED** [Kimbrough RD et al; Arch Environ Health 16: 333-41 (1971) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.39 (1978) DHEW Pub. NIOSH 78-201
3. ... A single dose of aldrin and dieldrin at 1 mg/kg body weight administered to rats caused a reduction in the toxicity of parathion, paraoxon, and several other organophosphates admin 4 days later. **PEER REVIEWED** [Triolo AJ, Coon JM; J Pharmacol Exp Ther 154: 613-22 (1966) as cited in NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin p.41 (1978) DHEW Pub. NIOSH 78-201
4. The pretreatment of calves with a single dose of 10 mg kg dieldrin or 21 daily doses of 10 mg kg phenobarbitone increased the toxicity of diazinon as reflected by the development of more severe clinical signs and greater depression in whole blood cholinesterase activity in the pretreated calves. Induction by dieldrin or phenobarbital of the hepatic microsomal enzyme aminopyrine-N-demethylase was also accompanied by a concurrent rise in the liver carboxylesterase activity. **PEER REVIEWED** [Abdelsalam EB et al; Res Vet Sci 41 (3):336-9 (1986)

ENVIRONMENTAL FATE/EXPOSURE POTENTIAL

Summary

Environmental Fate/Exposure Summary:

1. Dieldrin has been used extensively in the past as an insecticide for corn and for termite control, although it is no longer registered for general use. Dieldrin is extremely persistent, but it is known to slowly photorearrange to photodieldrin (water half-life - 4 months). Dieldrin release to soil will persist for long periods (> 7 yr), will reach the air either through slow evaporation or adsorbtion on dust particles, will not leach to groundwater, and will reach surface water with surface runoff. Once dieldrin reaches surface waters it will adsorb strongly to sediments, bioconcentrate in fish and slowly photodegrade. Biodegradation and hydrolysis are unimportant processes. Fate of dieldrin in the atmosphere is unknown but monitoring data has demonstrated that it can be carried long distances. Monitoring data demonstrates that dieldrin continues to be a contaminant in air, water, sediment, soil, fish, and other aquatic organisms, wildlife, foods, and humans. Human exposure appears to come mostly from food.(SRC) **PEER REVIEWED**

lution Sources

tural Occurring Sources:

1. None. (SRC) **PEER REVIEWED**

tificial Sources:

Topic: DIELDRIN

1. Dieldrin has been used as an insecticide mostly for corn and in smaller amounts for termite control(1). It is also an environmental degradation product of the insecticide, aldrin(2). Aldrin and dieldrin are no longer registered as general use insecticides(2). **PEER REVIEWED** [(1) IARC; Some Organochloride Pesticides 5: 127 (1973) (2) USEPA; Ambient Water Quality Criteria for Aldrin/Dieldrin USEPA 440/5-80-019 (1980)

Environmental Fate

Environmental Fate:

1. . SORPTION ISOTHERMS OF DIELDRIN ON SEVERAL FRACTIONS OF ESTUARINE SEDIMENT DETERMINED @ SEVERAL SALINITIES. ORG MATTER CONTENT MAJOR FACTOR DETERMINING SORPTION COEFFICIENT. EFFECT OF SORPTION ON LETHALITY STUDIED. **PEER REVIEWED** [RAY ET AL; TOXICOL HALOGENATED HYDROCARBONS: HEALTH ECOL EFF, PAP SYMP 356 (1981)
2. TERRESTRIAL: Dieldrin released to soils will persist for extremely long periods of time (>7 yr). Its low water solubility and strong adsorption to soil makes leaching into groundwater unlikely. Small amounts may volatilize from soil or be carried on dust particles into the air. Soil runoff will carry particle-associated dieldrin to water systems(1).(SRC) **PEER REVIEWED** [(1) Schnoor JL et al; Verification of a Toxic Organic Substance Transport and Bioaccumulation Model USEPA 600/3-83-007 (1983)
3. AQUATIC: Dieldrin released to water systems will not undergo hydrolysis or biodegrade. It will photorearrange to photodieldrin with a half-life of approximately 4 months, or somewhat faster in waters containing photosensitizers. Adsorption to sediments and bioconcentration in aquatic organisms are likely to be important aquatic processes. Evaporation from water may be an important process, but conflicting data are available (half-life of hr to months). In a modeling study of a reservoir, it was concluded that 40% of the inflow was lost to the bottom via sedimentation, 50% released through the outflow because of the short detention time, and 10% will go to fish because of the high biomass concentration(1). At low flow conditions, the sediment will become a net source of dieldrin(1).(SRC) **PEER REVIEWED** [(1) Schnoor JL et al; Verification of a Toxic Organic Substance Transport and Bioaccumulation Model USEPA 600/3-83-007 (1983)
4. ATMOSPHERIC: Little is known about the fate of dieldrin in the atmosphere. Because of its low vapor pressure and high Koc, dieldrin is probably associated with particulate matter. Vapor phase photodegradation has been noted but its rate has not been reported. (SRC) **PEER REVIEWED**

Environmental Transformations

Biodegredation:

1. Dieldrin is not biodegraded in standard screening tests(1) and is extremely persistent in soils(2) under both aerobic and anerobic conditions(3). It took 7 yr for half of the dieldrin to disappear from soil field plots(4). No biodegradation in river waters has been noted(5,7).

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Biodegradation of dieldrin is extremely slow. There is some evidence that microorganisms can form photodieldrin from dieldrin(4,6). **PEER REVIEWED** [(1) Tabak HH et al; J Water Poll Control Fed 53: 1503-18 (1981) (2) Sanborn JR et al; The Degradation of Selected Pesticides in Soil: A Review of the Published Literature USEPA 600/9-77-022 (1977) (3) Castro TF, Yoshida T; J Agric Food Chem 19: 1168-70 (4) Nash RG, Woolson EA; Science 157: 924-7 (1967) (5) Eichelberger JW, Lichtenberg JJ; Environ Sci Technol 5: 501-4 (1971) (6) Matsumura F et al; Science 170: 1206-7 (1970) (7) Sharom MS et al; Water Res 14: 1089-93 (1980)

Abiotic Degredation:

1. Hydrolysis is not an important degradation process for dieldrin in water(1,2); half-life is greater than 4 years(1). When irradiated with sunlight, dieldrin degrades to photodieldrin(1); in distilled water, the half-life is approximately 2 months(1). Dieldrin photodegradation to photodieldrin is aided by triplet sensitizers(3) and natural sensitizers may also be effective(SRC). Vapor phase photodegradation of dieldrin to photodieldrin has also been noted(4), but no data are available to estimate the rate of atmospheric photodegradation(1). **PEER REVIEWED** [(1) Callahan MA et al; Water-related fate of 129 priority pollutants p 26-1 to 26-12 USEPA 440/4-79-029a (1979) (2) Eichelberger JW, Lichtenberg JJ; Environ Sci Technol 5: 541-4 (1971) (3) Ivie GW, Casida TE; Science 167: 1620-22 (1970) (4) Crosby DG, Moilanen KW; Arch Environ Contam Toxicol 2: 62-74 (1974)

vironmental Transport
ioconcentration:

1. Moderate to significant bioconcentration (100 to 10,000) in various aquatic species(1). BCF of 3-6000 in fish(2,3). **PEER REVIEWED** [(1) Callahan MA et al; Water-Related Fate of 129 Priority Pollutants p 26-1 to 26-12 USEPA 440/4-79-029a (1979) (2) Sanborn TR, Yu C-C; Bull Environ Cont Toxicol 10: 340-6 (1973) (3) Metcalf RL et al; Environ Health Perspect. 1973 No. 4: 35-44 (1973)

Soil Adsorption/Mobility:

Measured log Koc= 3.87(1). Rf value for soil thin layer chromatography= 0.00(1,3). Even with high temperatures and prolonged leaching dieldrin is immobile(2). **PEER REVIEWED** [(1) Briggs GG et al; J Agric Food Chem 29: 1050-9 (1981) (2) El-Beit, IOD et al; Inter J Environ Stud 16: 189-96 (1981) (3) Helling CS; Soil Sci Soc Amer Proc 35: 737-43 (1971)

Volatilization from Water/Soil:

1. Evaporation of dieldrin from water is not completely understood and conflicting data exist on the subject(1). Its experimental volatilization rate is 5% of the oxygen reaeration rate(1). Using oxygen reaeration rates for ponds, rivers, or lakes(2), the half-life for evaporation would be 72, 14, and 57 days, respectively. However, in another study using distilled and natural waters with gentle agitation, the half-lives for evaporation were 6 to 9 hr(3). Dieldrin's low vapor pressure (1.8x10-7 torr at

20 deg C)(3), suggests only limited evaporation from soil which agrees with terrestrial microcosm studies(4) and various field studies(5). Volatilization increased as moisture content of the soil increased(5). **PEER REVIEWED** [(1) Atlas E et al; Environ Sci Technol 16: 283-6 (1982) (2) Smith JH et al; Environmental Pathways of Selected Chemicals in Freshwater Systems Part I Background and Experimental Procedures USEPA 600/7-77-113 (1977) (3) Callahan MA et al; Water-Related Fate of 129 Priority Pollutants p 26-1 to 26-12 USEPA 440/4-79-029a (1979) (4) Gile JD, Gillett JW; J Agric Food Chem 27: 1159-64 (1979) (5) Sanborn JR et al; The Degradation of Selected Pesticides in Soil: A Review of the Published Literature USEPA 600/9-77-022 (1977)

Environmental Concentrations

Water Concentrations:

1. DRINKING WATER: Hawaii 0.3 parts/trillion avg, 1970-71, Virgin Islands 0.19 ppb in 50% of cistern waters(1); New Orleans - 3 plants 0.05-0.07 ppb(5). Rural counties, SC 37% pos, 0-153 parts/trillion, 55 parts/trillion mean(9). GROUNDWATER: Nebraska, 1978 below detection limit (5 parts/trillion)(3). NJ 1977-79 604 samples - trace (0.1 ppb)-90th percentile, highest value 0.9 ppb(4). SURFACE WATER: US rivers and lakes 0-0.1 ppb 1960's-1972(1). Dutch rivers 1967-1977 0.02-0.06 ppb max values, not detectable in last 2 yr(2). NJ 1977-79 (604 samples) trace (0.1 ppb)-90th percentile(4). Ontario 11 agricultural watersheds 1.6-1.7 parts/trillion overall mean 1975-77(6). South Florida 1968-72 367 samples 11% pos(7). RAINWATER: Lake Erie 2.6 parts/trillion 7 samples 1976-77(8) 5-42 parts/trillion avg(1). **PEER REVIEWED** [(1) IARC; Some Organochlorine Pesticides 5: 130 (1973) (2) Wegman RCC, Greve PA; p 405-45 in Hydrocarbons and Halogenated Hydrocarbons in the Aquatic Environment. Plenum Press, NY (1980) (3) Spalding RF et al; Post Monit J 14: 70-3 (1980) (4) Page GW; Environ Sci Technol 15: 1475-81 (1981) (5) Keith LH et al; p 329-73 in Identification and analysis of organic pollutants in water. Keith LH ed, Ann Arbor Press, Ann Arbor MI (1976) (6) Frank R et al; J Environ Qual 11: 497-505 (1982) (7) Mattraw HC Jr; Pest Monit J 9:106-114 (1975) (8) Konasewich D et al; Status report on organic and heavy metal contaminants in the lakes Erie, Michigan, Huron and Superior basins. p 273 Great Lakes Qual Board (1978) (9) Sandu SS et al; J Amer Water Works Assoc 70: 41-5 (1978)

Effluents Concentrations:

1. Municipal effluent 0.004-0.052 ppb(1). Foundries water effluent 5 ppb, textile mills 50 samples, 1 pos 0.2 ppb(2). **PEER REVIEWED** [(1) Konasewich D et al; Status report on organic and heavy metal contaminants in the lakes Erie, Huron and Superior basins p 273 Great Lakes Qual Board (1978) (2) USEPA; Treatability Manual p I.13.9-3 USEPA 600/2-82-001a (1981)

Sediment/Soil Concentrations:

1. SEDIMENT: Illinois lakes 0-34 ppb(1); South Florida

1968-72 287 samples 55% pos, 0.1-900 ppb, median 1 ppb(2); Lake Erie 255 samples 1.6 ppb mean, Lake Huron 0-4.5 ppb, Lake Michigan <5 ppb(3). SOILS: US Agricult - 1972, 1481 samples, 27% pos, 0.04 ppm mean(4). Urban, 1971, 5 cities, 380 total samples 7-29% pos, < 0.01-0.06 ppm, mean(5). **PEER REVIEWED** [(1) Roseboom DP et al; Effect of Agriculture on Cedar Lake Quality. Illinois State Water Survey ISWS/CIA-138/79 (1979) (2) Mattraw HC Jr; Pest Monit J 9: 106-14 (1975) (3) Konasewich D et al; Status Report on Organic and Heavy Metal contaminants in the lakes Erie, Huron and Superior basins p 273 Great Lakes Qual Board (1978) (4) Carey HE et al; Pest Monit J 12: 209-29 (1979) (5) Carey AE et al; Pest Monit J 13: 17-22 (1979)

Atmospheric Concentrations:

1. Airborne dust 0-8.1 ppb(1). Orlando, FL 1.9 parts/trillion(2). USA 1970-71 98% pos 0.1 parts/trillion mean(3). Great Lakes 0.0006-0.006 parts/trillion, 0.003 parts/trillion mean(4). Barbados 1977-78 19 samples, 13 pos 0.00033 parts/trillion, total mean; Newfoundland, 1977 6 samples, 6 pos, 0.00055 parts/trillion mean(5) Boston, MA and Columbia, SC, June-Aug 1978, 0.002 parts/trillion and 0.025 parts/trillion, respect.(6). Enewetak Atoll, N Pacific - 17 samples, 0.00063 parts/trillion mean(7). **PEER REVIEWED** [(1) IARC; Some Organochlorine Pesticides 5: 129 (1973) (2) Stanley CW et al; Environ Sci Technol 5: 430-5 (1971) (3) Lee RE Jr; 4th Int Clean Air Congr Proc Kasuga S et al eds p 37-40 (1977) (4) Eisenreich SJ; Environ Sci Technol 15: 30-8 (1981) (5) Bidleman TF et al; J Mar Res 39: 443-64 (1981) (6) Bidleman TF; Atmos Environ 15: 619-24 (1981) (7) Atlas E, Giam CS; Science 211: 163-5 (1981)

Food Survey Results:

1. Cheese - domestic 784 samples, 34.2% pos, 0.031 ppm avg, imported 5471 samples, 22.7% pos, 0.015 ppm, avg(1). Red meat 15200 samples, 50.7% pos, 0.047 ppm avg(1). Poultry 11340 samples, 72.5% pos, 0.054 ppm, avg(1). Eggs - domestic 2303 samples, 15.5% pos, 0.012 ppm, avg(1). Large fruits - domestic 3281 samples, 7.4% pos, 0.002 ppm avg, imported 1048 samples, 7.9% pos, 0.002 ppm, avg; small fruits - domestic 1445 samples, 6.4% pos, 0.002 ppm, avg, imported - 2119 samples, 2.1% pos, 0.0007 ppm, avg(1). Leaf and stem vegetables domestic 5319 samples, 2.5% pos, 0.0006 ppm, avg, imported 312 samples, 1.8% pos, 0.0003 avg(1). Vine and ear vegetables domestic 2954 samples, 10.5% pos, 0.003 ppm, avg, imported 4117 samples, 17.6 pos, 0.004 ppm avg(1). Also frequently detected in beans, root vegetables, whole grains, corn and corn products, cotton seeds and cotton seed products, peanuts and peanut products, soybeans and soybean products, miscellaneous animal feed and hay and dehydrated hay(1). 1971-76 average dietary intake 0.00004 mg/kg body weight/day(1). Positive composites - % daily intake (ug): 1971-30.8% (3.0), 1972-26.2 (2.0), 1973-29.7 (3.0), 1974-25.8 (4.0), 1975-23.8 (3.0), 1976-24.6 (3.0)(1). **QC REVIEWED** [(1)

Duggan RE et al; Pesticide Residue Levels in Foods in the US from July 1, 1969 to June 30, 1976 FDA and AOAC (1983)

Plant Concentrations:

1. USA 1972 variety crops means of <0.01-0.21 ppm(1). **PEER REVIEWED** [(1) Carey AE et al; Pest Monit J 12: 209-29 (1979)

Fish/Seafood Concentrations:

1. Illinois lakes ND-410 ppb(1); Lake Superior trout 0.028 ppm mean, all stations (24 fish)(2); Wisconsin river fish 0.008-0.022 ppm(3); Great Lakes fish 0.01-0.25 ppm(4) Fish fat 0.002-6.7 ppm, whole fish 0-1.59 ppm(5); Great Lakes whitefish 13-215 ppb(6); Fish in Lake Texonia, TX and OK 0-144 ppb(7); USA 1972-76 Nat Pest Monit Program, estuarine fish 1972-7% pos, 140 ppb max, 1976 0% pos(8); US 1970-74 Nat. Pest. Monit. Prog freshwater fish 1970-100% pos 1.1 ppb lipid mean, 1974-53% pos 0.6 ppb lipid, mean(9). Pacific oysters 1972-73 ND-0.39(10); Marine fish and seafood 0.1-140 ppb(11); Marine fish and seafood 1-12000 ppb(12); Fish 1970-76 domestic 2901 samples, 46.3% pos, 0.045 ppm, avg, imported - 361 samples, 23.5 pos, 0.013 ppm, avg(13); Shellfish 1970-76 domestic 291 samples, 27.5% pos, 0.005 ppm, avg imported 152 samples, 12.4% pos, 0.002 ppm avg(13). **PEER REVIEWED** [(1) Roseboom DP et al; Effect of Agriculture on Cedar Lake Water Quality. Illinois State Water Survey ISWS/CIR-138/79 (1979) (2) Swain WR; J Great Lakes Res 4: 398-407 (1978) (3) Peterman PH et al; p 145-60 in Hydrocarbons and Halogenated Hydrocarbons in the Aquatic Environment Afghan BK, Mackay D eds, New York, NY, Plenum Press (1980) (4) Konasewich D et al; Status Report on Organic and Heavy Metal Contaminants in the Lake Erie, Huron and Superior basins p 273 Great Lakes Qual Board (1978) (5) IARC; Some Organochlorine Pesticides 5: 130 (1973) (6) Kaiser KLE; Can J Fish Aquat Sci 39: 571-9 (1982) (7) Hunter RG et al; Pest Monit J 14: 102-7 (1980) (8) Butler PA, Schutzmann RL; Pest Monit J 12: 51-9 (1978) (9) Schmitt CJ; Pest Monit J 14: 136-206 (1981) (10) Sumner CE; Pest Monit J 12: 87-90 (1978) (11) Reish DJ et al; J Water Pollut Control Fed 53: 925-49 (1981) (12) Reish DJ et al; J Water Pollut Control Fed 54: 786-812 (1982) (13) Duggan RE et al; Pesticide Residue Levels in Foods in the US from July 1, 1969 to June 30, 1976 FDA and AOAC (1983)
2. Different fish species from Abu Qir Bay, Idku Lake, and Maryut Lake in Alexandria, Egypt, were assayed for residues of organochlorine insecticides and polychlorinated biphenyls (PCBs). The fish were obtained from commercial fishermen in 1985: Pagellus erythrinus, Sargus vulgarius, Siganus rivulatus, Sphyraena sphyraena, and Trigla hirundo from Abu Qir Bay; and Tilapia fish from Idku and Maryut Lakes. Twenty grams of dorsal fish muscle were extracted and the residues analyzed by GLC; reagent blanks and spike samples were included with each sample. The waters from which the fish were obtained receive drainage from industrial, agricultural and urban

activities. Water samples were not assayed for specific components. Assays for dieldrin indicated it was present in all fish. There were marked differences in the distribution in the different size groups studied, but concentration increased with size. Sphyraena sphyraena from Abu Qir Bay contained the highest (11.3 ug/kg) amount of dieldrin and Tilapia nilotica (Idku Lake) contained the lowest (0.74 ug/kg) amount of dieldrin. All samples were well below permissible levels for dieldrin. **QC REVIEWED** [El Nabawi A et al; Arch Environ Contam Toxicol 16 (6): 689-96 (1987)

Animal Concentrations:

1. Seabirds - Bay of Fundy, Canada 0.01-3.56 ppm(1) Missouri, gray bats, 1976-78 600-900 ppm lipid(2); Great Lakes birds ND-0.36 ppm(3). Birds 0.01-0.4 ppm, fatty tissue, 0.6-4.3 ppm liver, eagles - trace - 6 ppm, birds eggs 0.01-1.5 ppm(4). USA Ospreys, 1964-73, ND-3.8 ppm(5). Seals - Gulf of St. Lawrence 1971 <0.002-0.32 pmm(6); Herons, 1966-73 Great Lakes 103 samples, 62 pos, 0.14-14 ppm(7); loons, Ontario, Canada 1968-80 0.13-1.57 ppm(8) USA Nationwide starlings 1970-76 1970-125 samples, 0.117 ppm mean, 1976-96 samples, 0.059 ppm mean(9). **PEER REVIEWED** [(1) Gaskin DE et al; Arch Environ Contam Toxicol 7: 505-13 (1978) (2) Clark DR Jr et al; Environ Toxicol Chem 2: 387-93 (1983) (3) Kowasewich D et al; Status Report on Organic and Heavy Metal Contaminants in the Lakes Erie, Huron, and Superior Basins p 273 Great Lakes Qual Board (1978) (4) IARC; Some Organochlorine Pesticides 5: 130 (1973) (5) Wiemeyer SN et al; Estuaries 3: 155-67 (1980) (6) Rosewell KT et al; Pest Monit J 12: 189-92 (1979) (7) Ohlendorf HM et al; Pest Monit J 14: 125-35 (1981) (8) Frank R; Arch Environ Contam Toxicol 12: 641-54 (1983) (9) White DH; Pest Monit J 12: 193-7 (1979)

Milk Concentrations:

1. USA Domestic 1970-76 4638 samples, 22.5% pos, 0.031 ppm avg(1). In a 10-year study of chlorinated hydrocarbons in bovine milk in Illinois, the percent positive samples for dieldrin and aldrin combined between 1972 and 1978 ranged from 92.3-100% with avg residues of 0.04-0.09 ppm. This dropped radically to 61.4% pos and 0.07 ppm avg in 1979 to 4.5% and 5.9% pos in 1980 and 1981 with (0.001 ppm avg residues(2) **PEER REVIEWED** [(1) Duggen RE et al; Pesticide Residue Levels in Foods in the US from July 1, 1969 to June 30, 1976 FDA and AOAC (1983) (2) Sleffey KL et al; J Environ Sci Health B 19: 49-65 (1984)

Human Exposure

Probable Routes of Human Exposure:

1. Dieldrin is a very persistent insecticide and even though it is not used extensively now, residues are still detected in water, soils, sediments, fish, and food. Major general population exposure will occur through consumption of food. Consumption of fish from water bodies that have high levels of dieldrin may also provide significant exposure. (SRC) **PEER REVIEWED**
2. Inhalation, skin absorption, ingestion, eye and skin

contact. **PEER REVIEWED** [Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985. 340

Average Daily Intake:

1. AIR INTAKE (assume 0.002-0.02 ppt) 0.0007-0.008 ug(SRC). WATER INTAKE (assume 0-0.07 ppt) 0-0.00014 ug(SRC). FOOD INTAKE 3 ug(1). **PEER REVIEWED** [(1) Duggan RE et al; Pesticide Residue Levels in Foods in the US from July 1, 1969 to June 30, 1976 FDA and AOAC (1983)

Probable Exposures:

1. Intake by occupationally-exposed workers was estimated to range from 0.72-1.10 mg/man/day (Hayes & Curley, 1968) compared to 0.025 mg/man/day for the general population (Hunter & Robinson, 1967). Orchard spraying - dermal 14.2-15.5 mg/hr exposure, respiratory 0.03-0.25 mg/hr (Wolfe et al., 1963, 1967). **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V5 129 (1974)

Body Burdens:

1. HUMAN MILK - mainland USA 102 samples, 91.2% pos, 0.062 ppm lipid basis, mean; Hawaii 54 samples, 94.4% pos, 0.042 ppm, mean(1); Canada, 16 samples, 1.0-1.8 ppb whole milk(2). Alberta, Canada 1966-70 - 59 samples, 39% pos, 0.180 ppm lipid basis, mean, 1977-78 - 33 samples 97% pos, 0.025 ppm, mean(3) USA 1975 1436 samples, 80% pos, 0.16-0.44 ppm milk fat(4) Various countries 0.009-3.78 ppm milk fat(4). HUMAN FAT - Various countries 1971-77 0.069-0.29 ppm(5). BLOOD - Canadian, maternal, during lactation, trace-0.2 ppb(2). **PEER REVIEWED** [(1) Takei GH et al; Bull Environ Contam Toxicol 30: 606-13 (1983) (2) Mes J et al; Arch Environ Contam Toxicol 13: 217-23 (1984) (3) Currie RA et al; Pest Monit J 13: 52-5 (1979) (4) Jensen AA; Residue Res 89: 1-128 (1983) (5) Abbott DC et al; Brit Med J 283: 1425-8 (1981)
2. It has ... been demonstrated that human milk contains dieldrin residues and that some infants may be exposed to high concn of dieldrin from this source alone. **PEER REVIEWED** [Savage EP; National Study to Determine Levels of Chlorinated Hydrocarbons Insecticides in Human Milk: 1975-1976 and Supplementary Report to National Human Milk Study: 1975-1976 EPA/540/9-78/005 (1976) as cited in USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.C-62 (1980) EPA 440/5-80-019

EXPOSURE STANDARDS & REGULATIONS

Standards & Regulations

Immediately Dangerous to Life or Death:

1. NIOSH has recommended that dieldrin be treated as a potential human carcinogen. **QC REVIEWED** [NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS(NIOSH) Publication No. 90-117. Washington, DC: U.S. Government Printing Office, June 1990 90

Acceptable Daily Intake:

1. World Health Organization's acceptable daily intake of

dieldrin is 0.0001 mg/kg/day. **QC REVIEWED** [USEPA. Hazard Profile: Dieldrin p.1 (1980)

Allowable Tolerances:

1. EPA is recommending to FDA the following action levels for the sum of aldrin and dieldrin residues, expressed in ppm, to replace the following tolerances that are being revoked for residues of aldrin and dieldrin; (Recommended action levels) 0.5 ppm for: peanuts.0.1 ppm for: Beets, garden, beets, sugar; carrots; cucumbers; garlic; horseradish; leeks; onions; parsnips; potatos; pumpkins; radishes; rutabagas; salsify roots; shallots; squash, summer; squash, winter; and turnips. 0.05 for: Beets,.garden, tops; beets, sugar, tops; blackeyed peas; broccoli; collards; cowpeas; eggplant; endive; kale; kohlrabi; mustard greens; peas; pimentos; salsify topsy; soybeans; swiss chard; tomatos; turnips, and tops. **PEER REVIEWED** [51 FR 46664 (12/24/86)
2. EPA is recommending to FDA the following action levels for the sum of aldrin and dieldrin residues, expressed in ppm, to replace the tolerances that are being revoked for residues of aldrin and dieldrin; (Recommended action levels) 0.03 for: alfalfa; apples; apricots; asparagus; barley, straw; brussel sprouts; cabbage; cantaloupe; celery; cherries; clover; corn, forage; cranberries; grain sorghum, forage; lespedeza; lettuce; mangoes; nectarines; oats, straw; peanuts, hay; pears; peas, hay; pineapple; plums (fresh prunes); quinees; radishes, tops; rice, straw; rye, straw; soybeans, hay; and wheat, straw. 0.02 for: bananas; barley, grain; corn, grain; corn, pop; grain, sorghum; grapefruit; lemons; limes; oats, grain; oranges; peaches; rice, grain; tangerines; wheat, grain. **PEER REVIEWED** [51 FR 46664 (12/24/86)
3. Action levels to remain in effect (in ppm): 0.3 for: fat, meat, and meat byproducts of cattle, goats, horses, sheep, swine, poultry, and rabbits (fat basis), milk raw, (fat basis). 0.05 for artichokes, figs, small fruits and berries. 0.03 for: eggs, and hay. **PEER REVIEWED** [51 FR 46664 (12/24/86)
4. Recommended replacement action level for melons has been changed from 0.15 ppm (existing standard) to 0.10 ppm. **PEER REVIEWED** [51 FR 46664 (12/24/86)
5. Action levels to remain in effect (in ppm): 0.1: Sugarbeet, pulp. 0.05: artichokes; figs; small fruits and berries; **PEER REVIEWED** [51 FR 46664 (12/24/86)

Occupational Permissible Levels

OSHA Standards:

1. In any 8-hr work shift of a 40-hr work wk, dieldrin shall not exceed the 8-hr TWA 0.25 mg/cu m, skin. **PEER REVIEWED** [29 CFR 1910.1000 (7/1/87)
2. Meets criteria for OSHA medical records rule. **PEER REVIEWED** [29 CFR 1910.20 (7/1/87)

NIOSH Recommendations:

1. NIOSH recommendation for environmental exposure limit: lowest reliably detectable level: 0.15 mg/cu m TWA by NIOSH-validated method; skin contact to be prevented.

Topic: DIELDRIN

PEER REVIEWED [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. V13(81) 263

Threshold Limit Values:

1. Time Weighted Avg (TWA) 0.25 mg/cu m, skin (1986) **QC REVIEWED** [American Conference of Governmental Industrial Hygienists. Threshold Limit Values for Chemical Substances and Physical Agents and Biological ExposureIndices for 1992-1993. Cincinnati, OH: ACGIH, 1992. 19
2. Excursion Limit Recommendation: Excursions in worker exposure levels may exceed three times the TLV-TWA for no more than a total of 30 min during a work day and under no circumstances should they exceed five times the TLV-TWA, provided that the TLV-TWA is not exceeded. **QC REVIEWED** [American Conference of Governmental Industrial Hygienists. Threshold Limit Values for Chemical Substances and Physical Agents and Biological ExposureIndices for 1992-1993. Cincinnati, OH: ACGIH, 1992. 5

Other Occupational Permissable Levels:

1. Other recommendations: USSR (1977), Bulgaria (1971), Hungary (1974) and Poland (1976) 0.01 mg/cu m; Romania (1975) 0.2 mg/cu m **PEER REVIEWED** [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH:American Conference of Governmental Industrial Hygienists, 1986. 196

Other Standards and Regulations

Water Standards:

1. Criterion to protect freshwater aquatic life is 0.0019 ug/l as a 24-hr avg; concn should not exceed 2.5 ug/l at anytime. Criterion to protect salt water aquatic life is 0.0019 ug/l as a 24 hr avg; concn should not exceed 0.71 ug/l at any time. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin p.B-12 (1980) EPA 440/5-80-019
2. Designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. **PEER REVIEWED** [40 CFR 116.4 (7/1/87)
3. Toxic pollutant designated pursuant to section 307(a)(1) of the Clean Water Act and is subject to effluent limitations. **PEER REVIEWED** [40 CFR 401.15 (7/1/87)

RCRA Requirements:

1. When dieldrin, as a commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate, becomes a waste, it must be managed according to federal and/or state hazardous waste regulations. Also defined as a hazardous waste is any container or inner liner used to hold this waste or any residue, contaminated soil, water, or other debris resulting from the cleanup of a spill, into water or on dry land, of this waste. Generators of small quantities of this waste may qualify for partial exclusion

from hazardous waste regulations (40 CFR 261.5 (e)). **PEER REVIEWED** [40 CFR 261.33 (7/1/87)

FIFRA Requirements:

1. This document revokes the tolerances for residues of th insecticide aldrin and its epoxidation product dieldrin, resulting from the application of aldrin; revokes the tolerances established specifically for residues of dieldrin; lists the action levels EPA is recommending to the Food and Drug Administration (FDA) to replace the revoked tolerances; and lists EPA recommendations to FDA and to the Food Safety and Inspection Service (FSIS) and the Agricultural Marketing Service (AMS) of the US Department of Agriculture (USDA) regarding existing action levels for commodities bearing residues for which tolerances had not been established. This rule was initiated by the EPA to remove pesticide tolerances for which related registered uses have been cancelled. **PEER REVIEWED** [51 FR 46662 (12/24/86)
2. Most uses cancelled. ... uses allowed: 1. subsurface ground insertion for termite control 2. dipping of non-food roots and tops 3. moth-proofing by manufacturing processes in a closed system. **PEER REVIEWED** [Environmental Protection Agency/OPTS. Suspended, Cancelled and Restricted Pesticides. 3rd Revision. Washington, D.C.: Environmental Protection Agency, January 1985. 4

FIFRA Requirements:

1. This document revokes the tolerances for residues of the insecticide aldrin and its epoxidation product dieldrin, resulting from the application of aldrin; revokes the tolerances established specifically for residues of dieldrin; lists the action levels EPA is recommending to the Food and Drug Administration (FDA) to replace the revoked tolerances; and lists EPA recommendations to FDA and to the Food Safety and Inspection Service (FSIS) and the Agricultural Marketing Service (AMS) of the US Department of Agriculture (USDA) regarding existing action levels for commodities bearing residues for which tolerances had not been established. This rule was initiated by the EPA to remove pesticide tolerances for which related registered uses have been cancelled. **PEER REVIEWED** [51 FR 46662 (12/24/86)

MONITORING AND ANALYSIS METHODS

Sampling Procedures:

1. A new, simple, and rapid procedure for determining chlorinated pesticide residues in milk /was discussed/. The entire acetonitrile extract from milk was passed through a 0.5 g activated charcoal chromatographic column. ... Chlorinated pesticides absorbed on the charcoal were eluted ... washed ... /and/ extracted. The extract was concentrated and measured by capture gas chromatography. Recoveries from 50 ml milk samples fortified with ... 0.05-0.5 mug dieldrin ranged from 86.9-103.2%. **PEER REVIEWED** [Adachi K et al; J Assoc Off Anal Chem 66 (6): 1315-18 (1983)

Topic: DIELDRIN

2. Analyte: dieldrin; matrix: air; procedure: filter collection, iso-octane extraction **PEER REVIEWED** [U.S. Department of Health, Education Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety Health. NIOSH Manual ofAnalytical Methods. 2nd ed. Volumes 1-7. Washington, DC: U.S. Government Printing Office, 1977-present.,p. V3 S283-1

Analytic Laboratory Methods:

1. ... Analysis of ... dieldrin in soils and sediments by gas chromatography /was performed/. ... 10 g of a soil or sediment sample were suspended ... filtered ... and washed. ... The fractions were concentrated and subjected to gas chromatography analysis. ... fraction 3 /contained/ dieldrin (recovery rate 86.1-94.7%) ... **PEER REVIEWED** [Mitsutake T et al; Zenkoku Kogaiken Kaishi 8 (2): 77-80 (1983)
2. 29.001-29.028: /DIELDRIN IN DAIRY PRODUCTS, FISH, NONFATTY FOODS, VEGETABLE OILS/ MEASURED BY GLC & IDENTIFIED BY COMBINATIONS OF GAS, THIN LAYER ... ... /CHROMATOGRAPHY/... **PEER REVIEWED** [Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 12/518
3. RESIDUES: ... IN SOIL, SEDIMENT, WATER, CORN GRAIN, CORN STALKS & SOYBEANS BY GC. WOODHAM, DW ET AL, J AGRIC FOOD CHEM, 20, 163-165, 1972. **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 204
4. Analyte: dieldrin; matrix: air; procedure: GC; range: 0.12-0.59 mg/cu m; precision: 0.086 **PEER REVIEWED** [U.S. Department of Health, Education Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety Health. NIOSH Manual ofAnalytical Methods. 2nd ed. Volumes 1-7. Washington, DC: U.S. Government Printing Office, 1977-present.,p. V3 S283-1
5. A rapid cost effective screening plan for chlorinated pesticides and volatile organic compounds at CERCLA sites was described. The plan was developed in region VIII of the Environmental Protection Agency (EPA) and is designed to meet project requirements for specially targeted compounds, such as dieldrin and toluene, identified in previous site work. The plan was developed for use by close support laboratories (CSLs) at CERCLA sites to help reduce the load on the EPA contract laboratory program (CLP). Organic constituents of samples are analyzed by using two portable HNu 301 gas chromatographs connected in series, the first being equipped with a photoionization detector and the second with a flame ionization or a Hall type electron capture detector sensitive to halogens. The samples were prepared by extraction with a hexane/acetone solvent (for chlorinated pesticides) and headspace injection or purging and trapping for the volatile organic

compounds. Selected representative data obtained by the CSPs and CLPs were tabulated. For example, in a soil sample, screening data obtained by the CSL indicated peaks corresponding to organochlorine pesticides in the 500 parts per billion to 10 parts per million range. The CLP found heptachlor dieldrin, 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene, an endrin ketone, 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane DDT, and chlordane at concentrations of 960 to 17000 mg/kg. /Data indicates/ that the CSL and analytical screening protocols can produce reliable analytical data on a short turnaround basis. Analytical services provided are relatively low cost, compared to commercial or CLPs, and address specific project requirements. **PEER REVIEWED** [Cheatham RA et al; Management of Uncontrolled Hazardous Waste Sites Dec 1-3: 386-92 (1986)

6. Method 8080: Organochlorine Pesticides and PCBs The sensitivity and reliability of Method 8080 usually depends on the level of interferences rather than on instrumental limitations. If interferences prevent detection of the analytes, Method 8080 may also be performed on samples that have undergone cleanup. Method 3620, Florisil Column Cleanup, by itself or followed by Method 3660, Sulfur Cleanup, may be used to eliminate interferences in the analysis. This method is used to determine the concentration of organochlorine pesticides and PCBs in solid waste. A representative sample is collected in a glass container equipped with a Teflon-lined cap. Due to the possibility of contamination, any contact with plastic must be avoided. Maximum sample holding time after extraction is 40 days. Detection is achieved by an electron capture detector (ECD) or a halogen-specific detector (HSD). Column 1 contains Supelcoport (100/120 mesh) coated with 1.5% SP-2250/1.95% SP-2401 packed in a 1.8-m by 4-mm I.D. glass column or equivalent. Colomn 2 contains Supelcoport (100/120 mesh) coated with 3% OV-1 in a 1.8-m by 4-mm I.D. glass column or equivalent. Under the prescribed conditions, dieldrin has a detection limit of 0.002 ug/l, an average recovery range of four measurements of 4.6-13.7 ug/l, and a limit for the standard deviation of 3.6 ug/l. **PEER REVIEWED** [USEPA; Test Methods for Evaluating Solid Waste SW-846 (1986)

Clinical Laboratory Methods:

1. RESIDUES: ... ANALYSIS IN HUMAN TISSUE BY COMBINED GAS CHROMATOGRAPHY-MASS SPECTROMETRY. BIROS, FJ & WALKER, AC, J AGRIC FOOD CHEM, 18, 425-439, 1970. ... **PEER REVIEWED** [Spencer, E. Y. Guide to the Chemicals Used in Crop Protection. 7th ed. Publication 1093. Research Institute, Agriculture Canada, Ottawa, Canada: Information Canada, 1982. 203

ADDITIONAL REFERENCES

Special Reports:

1. USEPA; Ambient Water Quality Criteria Doc: Aldrin/Dieldrin (1980) EPA 440/5-80-019
2. NIOSH; Special Occupational Hazard Review: Aldrin/Dieldrin

(1978) DHEW Pub. NIOSH 78-201
3. NTP TR No 021; Route: oral in feed; Species: rats and mice. NTIS No PB275666/AS. [NTP; Division of Toxicology Research and Testing; Management Status Report; 07/07/93; p.24
4. NTP TR No 022; Route: oral in feed; Species: rats. NTIS No PB275676/AS. [NTP; Division of Toxicology Research and Testing; Management Status Report; 07/22/92; p.23
5. NTP TR No 017; Route: oral in feed; Species: rats and mice. NTIS No PB274393/AS. /Photodieldrin/ [NTP; Division of Toxicology Research and Testing; Management Status Report; 07/22/92; p.26
6. USEPA/CAG; Carcinogenic Risk Assessment for Aldrin and Dieldrin (1985) EPA Contract No. 68-02-4131
7. DHHS/ATSDR; Toxicological Profile for Aldrin/Dieldrin (Draft) (11/87)
8. Dangerous Prop Ind Mater Rep (1): 9-16 (1986). Review dieldrin safety toxicol; Health hazard of dieldrin; Safety of dieldrin.
9. Woolley D et al; Neurotoxicology 6 (2): 165-92. A review with 87 refs on the mechanism of action and mamalian toxicity of the dieldrin/lindane type of insecticides.

MATERIAL SAFETY DATA SHEET

COATINGS AND RESINS GROUP

SECTION I - PRODUCT INFORMATION

MANUFACTURER'S NAME: PPG INDUSTRIES, INC.
PRODUCT CODE/IDENTITY: 97-D (041390M)
CUSTOMER PART#/NAME:
PRODUCT TRADE NAME: PITT-GUARD DIRECT TO RUST COMP. (A)
CHEMICAL FAMILY: POLYAMIDE

SHIPPING INFORMATION
US-DOT-SHIP.NAME/HAZ.CLASS: PAINT, FLAMMABLE LIQUID
UN NUMBER: UN1263

IN-PLANT HAZARD RATINGS
HEALTH= 2
FLAMMABILITY= 2
REACTIVITY= 0

0=MINIMAL 1=SLIGHT 2=MODERATE 3=SERIOUS 4=SEVERE
*=CONTAINS INGREDIENT(S) WHICH MAY CAUSE (LONG-TERM) HEALTH EFFECTS

PRODUCT SAFETY INFO: 760 KAPPA DRIVE
: PITTSBURGH, PA. [illegible]
: (412) 492-5555
PGM. PAINTS INFO. OR MSDS: 1-800-441-9090
AUTO REFINISH INFO. OR MSDS: 1-800-345-2580, IN OHIO (216) 671-0050
EMERGENCY MEDICAL INFO: (304) 843-1[illegible]
EMERGENCY SPILL INFO: (304) 843-1[illegible]
DATE OF MSDS PREPARATION: 6/04/90

THIS MATERIAL SAFETY DATA SHEET HAS BEEN PREPARED IN ACCORDANCE WITH THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200). THE SUPPLIER NOTIFICATION REQUIREMENTS OF SARA TITLE III, SECTION 313, AND OTHER APPLICABLE RIGHT-TO-KNOW REGULATIONS. ABBREVIATIONS AND OTHER DESIGNATIONS USED ON THIS MATERIAL SAFETY DATA SHEET INCLUDE THE FOLLOWING:

UI = UNKNOWN INFORMATION; N/A = NOT APPLICABLE; NOT ESTAB. = NOT ESTABLISHED; CERT. LTR. = CHEMICAL O.K. ON TSCA INVENTORY; CAS NO. NOT AVAILABLE

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

[FORMULA VALUES, NOT SALES SPECIFICATIONS]

BOILING RANGE: 114 - 184 DEG. C
SOLUBILITY IN WATER: <1 %
VAPOR PRESSURE: <15 mmHg
WT/GAL (LBS): 12-13 (U.S.)
VAPOR DENSITY: HEAVIER THAN AIR
pH: UI
% VOL/VOLUME: <25
% SOLID BY WEIGHT: 86-87
EVAP RATE(BuOAc=100): <15
SPECIFIC GRAVITY: 1.4 - 1.8
ODOR/APPEARANCE: VISCOUS LIQUID WITH AN ODOR CHARACTERISTIC OF THE SOLVENTS LISTED IN SECTION II.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

US-DOT CATEGORY: FLAMMABLE
FLASHPOINT: 83 DEG. F PMCC
FLAMMABLE LIMITS: LEL 1.3 UEL UI

EXTINGUISHING MEDIA:
USE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) CLASS B EXTINGUISHERS (CARBON DIOXIDE, DRY CHEMICAL, OR UNIVERSAL AQUEOUS FILM FORMING FOAM) DESIGNED TO EXTINGUISH NFPA CLASS IC FLAMMABLE LIQUID FIRES.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
KEEP CONTAINERS TIGHTLY CLOSED. ISOLATE FROM HEAT, ELECTRICAL EQUIPMENT, SPARKS, AND OPEN FLAMES. CLOSED CONTAINERS MAY EXPLODE WHEN EXPOSED TO EXTREME HEAT. DO NOT APPLY ON HOT SURFACES. TOXIC GASES MAY FORM WHEN PRODUCT IS CONTACTED BY FLAME OR HOT SURFACES.
SPECIAL FIRE FIGHTING PROCEDURES:
WATER SPRAY MAY BE INEFFECTIVE. WATER SPRAY MAY BE USED TO COOL CLOSED CONTAINERS TO PREVENT PRESSURE BUILD-UP AND POSSIBLE AUTOIGNITION OR EXPLOSION WHEN EXPOSED TO EXTREME HEAT. IF WATER IS USED, FOG NOZZLES ARE PREFERABLE. FIRE-FIGHTERS SHOULD WEAR SELF CONTAINED BREATHING APPARATUS.

SECTION V - REACTIVITY DATA

STABILITY: STABLE
HAZARDOUS POLYMERIZATION: NOT EXPECTED TO OCCUR
INCOMPATIBILITY (MATERIALS AND CONDITIONS TO AVOID):
AVOID CONTACT WITH STRONG ALKALIES, STRONG MINERAL ACIDS, OR STRONG OXIDIZING AGENTS
HAZARDOUS DECOMPOSITION PRODUCTS:
MAY PRODUCE HAZARDOUS DECOMPOSITION PRODUCTS WHEN HEATED. WELDING, BRAZING, OR FLAME-CUTTING ON SURFACES COATED WITH THIS PRODUCT MAY PRODUCE FUMES INCLUDING: Carbon Monoxide, Oxides of Nitrogen

SECTION VI - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:
PROVIDE MAXIMUM VENTILATION. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN AND EYE PROTECTION SHOULD BE PERMITTED IN THE AREA. REMOVE ALL SOURCES OF IGNITION. TAKE UP SPILLED MATERIAL WITH SAWDUST, VERMICULITE, OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR DISPOSAL.
WASTE DISPOSAL METHOD:
WASTE MATERIAL MUST BE DISPOSED OF IN ACCORDANCE WITH FEDERAL, STATE, PROVINCIAL, AND LOCAL ENVIRONMENTAL CONTROL REGULATIONS. EMPTY CONTAINERS SHOULD BE RECYCLED OR DISPOSED OF THROUGH AN APPROVED WASTE MANAGEMENT FACILITY.

SECTION VII - HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE FROM:

INGESTION:
-HARMFUL OR FATAL IF SWALLOWED.
EYE CONTACT:
-CAUSES SEVERE EYE IRRITATION.
SKIN CONTACT:
-MAY CAUSE MODERATE SKIN IRRITATION. -MAY BE ABSORBED THROUGH THE SKIN.
INHALATION:
-VAPOR AND SPRAY MIST HARMFUL IF INHALED. -VAPOR IRRITATES EYES, NOSE, AND THROAT. -REPEATED EXPOSURE TO HIGH VAPOR CONCENTRATIONS MAY CAUSE IRRITATION OF THE RESPIRATORY SYSTEM AND PERMANENT BRAIN AND NERVOUS SYSTEM DAMAGE. -INTENTIONAL MISUSE BY DELIBERATELY CONCENTRATING AND INHALING THE CONTENTS CAN BE HARMFUL OR FATAL.
CHRONIC OVEREXPOSURE:
AVOID LONG TERM AND REPEATED CONTACT. -THIS PRODUCT CONTAINS TITANIUM DIOXIDE. ANIMALS INHALING MASSIVE QUANTITIES OF TITANIUM DIOXIDE DUST IN A LONG-TERM STUDY DEVELOPED LUNG TUMORS. STUDIES WITH HUMANS INVOLVED IN MANUFACTURE OF THIS PIGMENT INDICATE NO INCREASED RISK OF CANCER FROM EXPOSURE. POTENTIAL FOR INHALATION OF TITANIUM DIOXIDE DUSTS FROM COATINGS IS VERY LIMITED. SINCE OVEREXPOSURES ARE NOT EXPECTED, THERE IS NO SIGNIFICANT HAZARD FOR MAN.
SIGNS AND SYMPTOMS OF OVEREXPOSURE:
-EYE WATERING, HEADACHES, NAUSEA, DIZZINESS, AND LOSS OF COORDINATION ARE INDICATIONS THAT SOLVENT LEVELS ARE TOO HIGH. -REDNESS, ITCHING, BURNING SENSATION AND VISUAL DISTURBANCES MAY INDICATE EXCESSIVE EYE CONTACT. -DRYNESS, ITCHING, CRACKING, BURNING, REDNESS, AND SWELLING ARE CONDITIONS ASSOCIATED WITH EXCESSIVE SKIN CONTACT.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:
NOT APPLICABLE

SECTION VIII - FIRST AID PROCEDURES

INGESTION:
IF SWALLOWED, DO NOT INDUCE VOMITING.
EYE CONTACT:
IN CASE OF EYE CONTACT, FLUSH EYES IMMEDIATELY WITH PLENTY OF WATER FOR AT LEAST 30 MINUTES.
SKIN CONTACT:
IN CASE OF SKIN CONTACT, REMOVE PROMPTLY BY WIPING. FOLLOWED BY WATERLESS HAND CLEANER AND SOAP AND WATER.
INHALATION:
IF AFFECTED BY INHALATION OF VAPOR OR SPRAY MIST, REMOVE TO FRESH AIR. APPLY ARTIFICIAL RESPIRATION AND OTHER SUPPORTIVE MEASURES AS REQUIRED.
OTHER:
IF ANY OF THE FOLLOWING OCCUR DURING OR FOLLOWING USE OF THIS PRODUCT, CONTACT A POISON CONTROL CENTER, EMERGENCY ROOM OR PHYSICIAN IMMEDIATELY. HAVE MATERIAL SAFETY DATA SHEET INFORMATION AVAILABLE. *INGESTION *EXCESSIVE EXPOSURE TO A CORROSIVE MATERIAL * PERSISTENT SKIN/EYE IRRITATION OR BREATHING DIFFICULTIES.

SECTION IX - PROTECTION INFORMATION

PERSONAL PROTECTIVE EQUIPMENT FOR:

EYE PROTECTION:
WEAR CHEMICAL-TYPE SPLASH GOGGLES OR FULL FACE SHIELD.
SKIN PROTECTION:
WEAR PROTECTIVE CLOTHING, INCLUDING IMPERMEABLE APRON AND GLOVES CONSTRUCTED OF: POLYVINYL ALCOHOL, NEOPRENE RUBBER, NITRILE RUBBER/BUTYL RUBBER OR LATEX RUBBER
RESPIRATORY PROTECTION:
OVEREXPOSURE TO VAPORS MAY BE PREVENTED BY ENSURING VENTILATION CONTROLS VAPOR EXHAUST OR FRESH AIR ENTRY. NIOSH/MSHA-APPROVED (TC-23C-) PAINT SPRAY OR AIR SUPPLIED (TC-19C-) RESPIRATORS MAY ALSO REDUCE EXPOSURE. READ RESPIRATOR MANUFACTURER'S INSTRUCTIONS AND LITERATURE CAREFULLY TO DETERMINE THE TYPE OF AIRBORNE CONTAMINANTS AGAINST WHICH THE RESPIRATOR IS EFFECTIVE AND HOW IT IS TO BE PROPERLY FITTED.
OTHER EQUIPMENT:
CLEAN OR DISCARD CONTAMINATED CLOTHING AND SHOES
VENTILATION REQUIREMENTS:
PROVIDE GENERAL DILUTION OR LOCAL EXHAUST VENTILATION IN VOLUME AND PATTERN TO KEEP THE CONCENTRATION OF [illegible]GREDIENTS LISTED IN SECTION II BELOW THE LOWEST SUGGESTED EXPOSURE LIMITS, THE LEL IN SECTION IV BELOW THE STATED LIMIT, AND TO REMOVE DECOMPOSITION PRODUCTS DURING WELDING OR FLAME CUTTING ON SURFACES COATED WITH THIS PRODUCT.

SECTION X - SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:
DO NOT STORE ABOVE 120 DEGREES F. STORE LARGE QUANTITIES IN BUILDINGS DESIGNED AND PROTECTED FOR STORAGE OF NFPA CLASS IC FLAMMABLE LIQUIDS.
OTHER PRECAUTIONS:
IF THIS MATERIAL IS PART OF A MULTIPLE COMPONENT COATING SYSTEM, READ THE MATERIAL SAFETY DATA SHEET(S) FOR THE OTHER COMPONENT OR COMPONENTS BEFORE BLENDING AS THE RESULTING MIXTURE MAY HAVE THE HAZARDS OF ALL OF ITS PARTS. CONTAINERS SHOULD BE GROUNDED WHEN POURING. AVOID FREE FALL OF LIQUIDS IN EXCESS OF A FEW INCHES.

9097/D/////////G04

97-D
97-147
97-148
97-145

CONTINUATION OF MANUFACTURER'S CODE: 97-D DATE OF PREP: 6/04/90 PAGE 2

SECTION II - INGREDIENTS AND REGULATORY INFORMATION

INGREDIENTS	CAS NUMBER	MAX % WEIGHT	...SARA TITLE III & CERCLA CLASSIFICATIONS.... NS (102)	EHS (302)	TC* (313)	RQ (LBS)	TPQ (LBS)	SARA 311/312 AC	CH	FL	PR	RE
CLAY	NOT ESTAB.	50-55	N	N	N	N/A	N/A	N	N	N	N	N
TITANIUM DIOXIDE #	13463-67-7	10-15	N	N	N	N/A	N/A	N	Y	N	N	N
METHYL ISOBUTYL KETONE	108-10-1	10-15	Y	N	Y	5000	N/A	Y	N	Y	N	N
NORMAL BUTYL ALCOHOL	71-36-3	1- 2	Y	N	Y	5000	N/A	Y	N	Y	N	N
FILM FORMERS, RESINS, AND ADDITIVES	NOT ESTAB.	25-30	N	N	N	N/A	N/A	Y	N	N	N	N

*** OCCUPATIONAL EXPOSURE LIMITS HAVE BEEN ESTABLISHED FOR THE FOLLOWING MATERIALS ***

INGREDIENTS	.....ACGIH..... TLV-TWA	TLV-STEL	.....OSHA..... PEL-TWA	PEL-STEL	.....PPG-IPEL..... IPEL-TWA	IPEL-STEL
TITANIUM DIOXIDE #	10 mg/m3	NOT ESTAB	15 mg/m3	NOT ESTAB	10 mg/m3	NOT ESTAB
METHYL ISOBUTYL KETONE	50 ppm	75 ppm	100 ppm	NOT ESTAB	50 ppm	75 ppm
NORMAL BUTYL ALCOHOL	50 ppm-S	TWA CEILING	100 ppm	NOT ESTAB	50 ppm	TWA CEILING

*** SARA 311/312 CATEGORIES FOR THIS PRODUCT ***
ACUTE=Y CHRONIC=Y FLAM=Y PRESS=N REAC=N

*** PRODUCT STATUS RELATIVE TO THE US EPA TOXIC SUBSTANCES CONTROL ACT ***
ALL CHEMICAL SUBSTANCES IN THIS PRODUCT COMPLY WITH ALL APPLICABLE RULES OR ORDERS UNDER THE ENVIRONMENTAL PROTECTION AGENCY'S TOXIC SUBSTANCES CONTROL ACT.

*** FOOTNOTES FOR SECTION II ***
CARCINOGENIC ACCORDING TO CRITERIA ESTABLISHED BY: *=NTP **=IARC @=OSHA #=OTHER
ORAL= LD50 ORAL (RAT), (g/kg) DERM= LD50 DERMAL (RABBIT), (g/kg) INHL= LC50 INHALATION (RAT), (Mg/L)
* INGREDIENTS IN THE TC COLUMN ARE SUBJECT TO THE REPORTING REQUIREMENTS OF SARA TITLE III. SEE 40 CFR PART 372.

MATERIAL SAFETY DATA SHEET

COATINGS AND RESINS GROUP

SECTION I - PRODUCT INFORMATION

MANUFACTURER'S NAME: PPG INDUSTRIES, INC.
PRODUCT CODE/IDENTITY: 97-98 (911190E)
CUSTOMER PART#/NAME:
PRODUCT TRADE NAME: AQUAPON CLEAR - COMP. B
CHEMICAL FAMILY: EPOXY

SHIPPING INFORMATION
US-DOT-SHIP.NAME\HAZ CLASS: PAINT, FLAMMABLE LIQUID
UN NUMBER: UN1263

IN-PLANT HAZARD RATINGS
HEALTH= 3*
FLAMMABILITY= 3
REACTIVITY= 0

0=MINIMAL 1=SLIGHT 2=MODERATE 3=SERIOUS 4=SEVERE
*=CONTAINS INGREDIENT(S) WHICH MAY CAUSE * CHRONIC (LONG-TERM) HEALTH EFFECTS

PRODUCT SAFETY INFO: 3800 KAPPA DRIVE
PITTSBURGH, PA 15238
(412) 492-5555
PGH. PAINTS INFO. OR MSDS: 1-800-441-9695
AUTO REFINISH INFO. OR MSDS: 1-800-345-2580, IN ON (216) 671-0050
EMERGENCY MEDICAL INFO: (304) 843-1300
EMERGENCY SPILL INFO: (304) 843-1300
DATE OF MSDS PREPARATION: 6/05/90

THIS MATERIAL SAFETY DATA SHEET HAS BEEN PREPARED IN ACCORDANCE WITH THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200), THE SUPPLIER NOTIFICATION REQUIREMENTS OF SARA TITLE III, SECTION 313, AND OTHER APPLICABLE RIGHT-TO-KNOW REGULATIONS. ABBREVIATIONS AND OTHER DESIGNATIONS USED ON THIS MATERIAL SAFETY DATA SHEET INCLUDE THE FOLLOWING:

U/I = UNKNOWN INFORMATION; N/A = NOT APPLICABLE; NOT ESTAB. = NOT ESTABLISHED; CERT. LTR. = CHEMICAL O.K. ON TSCA INVENTORY; CAS NO. NOT AVAILABLE

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

(FORMULA VALUES, NOT SALES SPECIFICATIONS)

BOILING RANGE: 110 - 153 DEG. C
VAPOR PRESSURE: 8.3mmHg
VAPOR DENSITY: HEAVIER THAN AIR
% VOL/VOLUME: 58.00
EVAP RATE(BuOAc=100): 89
SOLUBILITY IN WATER: 18.0%
WT/GAL (LBS): 8.42 (U.S.)
pH: U/I
% SOLID BY WEIGHT: 47.85
SPECIFIC GRAVITY: 1.01
ODOR/APPEARANCE: VISCOUS LIQUID WITH AN ODOR CHARACTERISTIC OF THE SOLVENTS LISTED IN SECTION II.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

US-DOT CATEGORY: FLAMMABLE
FLASHPOINT: 87 DEG. F PMCC
FLAMMABLE LIMITS: LEL 1.3 UEL U/I

EXTINGUISHING MEDIA:
USE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) CLASS B EXTINGUISHERS (CARBON DIOXIDE, DRY CHEMICAL OR UNIVERSAL AQUEOUS FILM FORMING FOAM) DESIGNED TO EXTINGUISH NFPA CLASS IB FLAMMABLE LIQUID FIRES.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
KEEP CONTAINERS TIGHTLY CLOSED. ISOLATE FROM HEAT, ELECTRICAL EQUIPMENT, SPARKS, AND OPEN FLAMES. CLOSED CONTAINERS MAY EXPLODE WHEN EXPOSED TO EXTREME HEAT. DO NOT APPLY ON HOT SURFACES. TOXIC GASES MAY FORM WHEN PRODUCT IS CONTACTED BY FLAME OR HOT SURFACES.
SPECIAL FIRE FIGHTING PROCEDURES:
WATER SPRAY MAY BE INEFFECTIVE. WATER SPRAY MAY BE USED TO COOL CLOSED CONTAINERS TO PREVENT PRESSURE BUILD-UP AND POSSIBLE AUTOIGNITION OR EXPLOSION WHEN EXPOSED TO EXTREME HEAT. IF WATER IS USED, FOG NOZZLES ARE PREFERABLE. FIRE-FIGHTERS SHOULD WEAR SELF CONTAINED BREATHING APPARATUS.

SECTION V - REACTIVITY DATA

STABILITY: STABLE
HAZARDOUS POLYMERIZATION: NOT EXPECTED TO OCCUR
INCOMPATIBILITY (MATERIALS AND CONDITIONS TO AVOID):
AVOID CONTACT WITH STRONG ALKALIES, STRONG MINERAL ACIDS, OR STRONG OXIDIZING AGENTS.
HAZARDOUS DECOMPOSITION PRODUCTS:
MAY PRODUCE HAZARDOUS DECOMPOSITION PRODUCTS WHEN HEATED. WELDING, BRAZING, OR FLAME-CUTTING ON SURFACES COATED WITH THIS PRODUCT MAY PRODUCE FUMES INCLUDING: Carbon Monoxide,

SECTION VI - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:
PROVIDE MAXIMUM VENTILATION. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN AND EYE PROTECTION SHOULD BE PERMITTED IN THE AREA. REMOVE ALL SOURCES OF IGNITION. TAKE UP SPILLED MATERIAL WITH SAWDUST, VERMICULITE, OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR DISPOSAL.
WASTE DISPOSAL METHOD:
WASTE MATERIAL MUST BE DISPOSED OF IN ACCORDANCE WITH FEDERAL, STATE, PROVINCIAL, AND LOCAL ENVIRONMENTAL CONTROL REGULATIONS. EMPTY CONTAINERS SHOULD BE RECYCLED OR DISPOSED OF THROUGH AN APPROVED WASTE MANAGEMENT FACILITY.

SECTION VII - HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE FROM:

INGESTION:
-HARMFUL OR FATAL IF SWALLOWED.
EYE CONTACT:
-CAUSES SEVERE EYE IRRITATION.
SKIN CONTACT:
-MAY CAUSE MODERATE SKIN IRRITATION. -MAY BE ABSORBED THROUGH THE SKIN -PROLONGED OR REPEATED CONTACT MAY CAUSE AN ALLERGIC SKIN REACTION.
INHALATION:
-VAPOR AND SPRAY MIST HARMFUL IF INHALED. -VAPOR IRRITATES EYES, NOSE, AND THROAT -REPEATED EXPOSURE TO HIGH VAPOR CONCENTRATIONS MAY CAUSE IRRITATION OF THE RESPIRATORY SYSTEM AND PERMANENT BRAIN AND NERVOUS SYSTEM DAMAGE -INTENTIONAL MISUSE BY DELIBERATELY CONCENTRATING AND INHALING THE CONTENTS CAN BE HARMFUL OR FATAL.
CHRONIC OVEREXPOSURE:
AVOID LONG TERM AND REPEATED CONTACT. -THIS PRODUCT CONTAINS AN ETHYLENE SERIES GLYCOL ETHER AND/OR ACETATE WHICH HAS BEEN SHOWN TO CAUSE ADVERSE EFFECTS ON THE KIDNEYS, LIVER, BLOOD AND/OR BLOOD-FORMING TISSUE. THERE IS NO CONCLUSIVE EVIDENCE OF THESE EFFECTS IN HUMANS.
SIGNS AND SYMPTOMS OF OVEREXPOSURE:
-EYE WATERING, HEADACHES, NAUSEA, DIZZINESS, AND LOSS OF COORDINATION ARE INDICATIONS THAT SOLVENT LEVELS ARE TOO HIGH. -REDNESS, ITCHING, BURNING SENSATION AND VISUAL DISTURBANCES MAY INDICATE EXCESSIVE EYE CONTACT. -DRYNESS, ITCHING, CRACKING, BURNING, REDNESS, AND SWELLING ARE CONDITIONS ASSOCIATED WITH EXCESSIVE SKIN CONTACT.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:
NOT APPLICABLE

SECTION VIII - FIRST AID PROCEDURES

INGESTION:
IF SWALLOWED, DO NOT INDUCE VOMITING.
EYE CONTACT:
IN CASE OF EYE CONTACT, FLUSH EYES IMMEDIATELY WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.
SKIN CONTACT:
IN CASE OF SKIN CONTACT, REMOVE PROMPTLY BY WIPING. FOLLOWED BY WATERLESS HAND CLEANER AND SOAP AND WATER.
INHALATION:
IF AFFECTED BY INHALATION OF VAPOR OR SPRAY MIST, REMOVE TO FRESH AIR. APPLY ARTIFICIAL RESPIRATION AND OTHER SUPPORTIVE MEASURES AS REQUIRED.
OTHER:
IF ANY OF THE FOLLOWING OCCUR DURING OR FOLLOWING USE OF THIS PRODUCT CONTACT A POISON CONTROL CENTER, EMERGENCY ROOM OR PHYSICIAN IMMEDIATELY. HAVE MATERIAL SAFETY DATA SHEET INFORMATION AVAILABLE. *INGESTION *EXCESSIVE EXPOSURE TO A CORROSIVE MATERIAL * PERSISTENT SKIN/EYE IRRITATION OR BREATHING DIFFICULTIES.

SECTION IX - PROTECTION INFORMATION

PERSONAL PROTECTIVE EQUIPMENT FOR:

EYE PROTECTION:
WEAR CHEMICAL-TYPE SPLASH GOGGLES OR FULL FACE SHIELD.
SKIN PROTECTION:
WEAR PROTECTIVE CLOTHING, INCLUDING IMPERMEABLE APRON AND GLOVES CONSTRUCTED OF: POLYVINYL ALCOHOL, NEOPRENE RUBBER, NITRILE RUBBER/BUTYL RUBBER OR LATEX RUBBER
RESPIRATORY PROTECTION:
OVEREXPOSURE TO VAPORS MAY BE PREVENTED BY ENSURING VENTILATION CONTROLS VAPOR EXHAUST OR FRESH AIR ENTRY. NIOSH/MSHA-APPROVED (TC-23C-) PAINT SPRAY OR AIR SUPPLIED (TC-19C-) RESPIRATORS MAY ALSO REDUCE EXPOSURE. READ RESPIRATOR MANUFACTURER'S INSTRUCTIONS AND LITERATURE CAREFULLY TO DETERMINE THE TYPE OF AIRBORNE CONTAMINANTS AGAINST WHICH THE RESPIRATOR IS EFFECTIVE AND HOW IT IS TO BE PROPERLY FITTED.
OTHER EQUIPMENT:
CLEAN OR DISCARD CONTAMINATED CLOTHING AND SHOES
VENTILATION REQUIREMENTS:
PROVIDE GENERAL DILUTION OR LOCAL EXHAUST VENTILATION IN VOLUME AND PATTERN TO KEEP THE CONCENTRATION OF INGREDIENTS LISTED IN SECTION II BELOW THE LOWEST SUGGESTED EXPOSURE LIMITS, THE LEL IN SECTION IV BELOW THE STATED LIMIT, AND TO REMOVE DECOMPOSITION PRODUCTS DURING WELDING OR FLAME CUTTING ON SURFACES COATED WITH THIS PRODUCT.

SECTION X - SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:
DO NOT STORE ABOVE 120 DEGREES F. STORE LARGE QUANTITIES IN BUILDINGS DESIGNED AND PROTECTED FOR STORAGE OF NFPA CLASS IB FLAMMABLE LIQUIDS.
OTHER PRECAUTIONS:
IF THIS MATERIAL IS PART OF A MULTIPLE COMPONENT COATING SYSTEM, READ THE MATERIAL SAFETY DATA SHEET(S) FOR THE OTHER COMPONENT OR COMPONENTS BEFORE BLENDING AS THE RESULTING MIXTURE MAY HAVE THE HAZARDS OF ALL OF ITS PARTS. CONTAINERS SHOULD BE GROUNDED WHEN POURING. AVOID FREE FALL OF LIQUIDS IN EXCESS OF A FEW INCHES.

9097/98/////605

CONTINUATION OF MANUFACTURER'S CODE: 97-98 DATE OF PREP: 6/05/90 PAGE 2

SECTION II - INGREDIENTS AND REGULATORY INFORMATION

INGREDIENTS	CAS NUMBER	% WEIGHT	...SARA TITLE III & CERCLA CLASSIFICATIONS.... HS (102)	EHS (302)	TC* (313)	RQ (LBS)	TPQ (LBS)	SARA 311/312 AC	CH	FL	PR	RE
1-METHOXY-2-PROPANOL	107-98-2	10-15	N	N	N	N/A	N/A	Y	N	Y	N	N
XYLENE	1330-20-7	25-30	Y	N	Y	1000	N/A	Y	N	Y	N	N
ETHYLENE GLYCOL MONOPROPYL ETHER	2807-30-9	5-10	N	N	Y	N/A	N/A	Y	Y	Y	N	N
TOLUENE	108-88-3	5-10	Y	N	Y	1000	N/A	Y	N	Y	N	N
FILM FORMERS, RESINS, AND ADDITIVES	NOT ESTAB.	45-50	N	N	N	N/A	N/A	Y	N	N	N	N

*** THE FOLLOWING INGREDIENTS ARE REPORTABLE AS SARA SECTION 313 CHEMICAL CATEGORIES ***

GLYCOL ETHERS	NOT ESTAB.	5-10

*** OCCUPATIONAL EXPOSURE LIMITS HAVE BEEN ESTABLISHED FOR THE FOLLOWING MATERIALS ***

INGREDIENTS	.....ACGIH..... TLV-TWA	TLV-STEL	.....OSHA..... PEL-TWA	PEL-STEL	.....PPG-IPEL..... IPEL-TWA	IPEL-STEL
1-METHOXY-2-PROPANOL	100 ppm	150 ppm	NOT ESTAB	NOT ESTAB	100 ppm	150 ppm
XYLENE	100 ppm	150 ppm	100 ppm	NOT ESTAB	100 ppm	150 ppm
TOLUENE	100 ppm	150 ppm	200 ppm	300 ppm	100 ppm	150 ppm

*** SARA 311/312 CATEGORIES FOR THIS PRODUCT ***
ACUTE=Y CHRONIC=Y FLAM=Y PRESS=N REAC=N

*** PRODUCT STATUS RELATIVE TO THE US EPA TOXIC SUBSTANCES CONTROL ACT ***
ALL CHEMICAL SUBSTANCES IN THIS PRODUCT COMPLY WITH ALL APPLICABLE RULES OR ORDERS UNDER THE ENVIRONMENTAL PROTECTION AGENCY'S TOXIC SUBSTANCES CONTROL ACT.

*** FOOTNOTES FOR SECTION II ***
ORAL= LD50 ORAL (RAT), (g/kg) DERM= LD50 DERMAL (RABBIT), (g/kg) INHL= LC50 INHALATION (RAT), (Mg/L)
* INGREDIENTS IN THE TC COLUMN ARE SUBJECT TO THE REPORTING REQUIREMENTS OF SARA TITLE III. SEE 40 CFR PART 372.

MATERIAL SAFETY DATA SHEET

COATINGS AND RESINS GROUP

SECTION I - PRODUCT INFORMATION

MANUFACTURER'S NAME: PPG INDUSTRIES, INC.
PRODUCT CODE/IDENTITY: 97-149 (010990E)
CUSTOMER PART#/NAME:
PRODUCT TRADE NAME: PITT GUARD COMP. B
CHEMICAL FAMILY: EPOXY

SHIPPING INFORMATION
US-DOT-SHIP.NAME-HAZ.CLASS: PAINT, FLAMMABLE LIQUID
UN NUMBER: UN1263

IN-PLANT HAZARD RATINGS
HEALTH= 3*
FLAMMABILITY= 3
REACTIVITY= 0

0=MINIMAL 1=SLIGHT 2=MODERATE 3=SERIOUS 4=SEVERE
*=CONTAINS INGREDIENT(S) WHICH MAY CAUSE (LONG-TERM) HEALTH EFFECTS

PRODUCT SAFETY INFO: 250 KAPPA DRIVE
: PITTSBURGH, PA. 15238
: (412) 492-5555
PGH. PAINTS INFO. OR MSDS: 1-800-441-9696
AUTO REFINISH INFO. OR MSDS: 1-800-245-2590, IN OH.(216) 671-0050
EMERGENCY MEDICAL INFO: (304) 843-1300
EMERGENCY SPILL INFO: (304) 843-1300
DATE OF MSDS PREPARATION: 6/05/90

THIS MATERIAL SAFETY DATA SHEET HAS BEEN PREPARED IN ACCORDANCE WITH THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200), THE SUPPLIER NOTIFICATION REQUIREMENTS OF SARA TITLE III, SECTION 313, AND OTHER APPLICABLE RIGHT-TO-KNOW REGULATIONS. ABBREVIATIONS AND OTHER DESIGNATIONS USED ON THIS MATERIAL SAFETY DATA SHEET INCLUDE THE FOLLOWING:

U/I = UNKNOWN INFORMATION; N/A = NOT APPLICABLE; NOT ESTAB. = NOT ESTABLISHED; CERT. LTR. = CHEMICAL O.K. ON TSCA INVENTORY; CAS NO. NOT AVAILABLE

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

(FORMULA VALUES, NOT SALES SPECIFICATIONS)

BOILING RANGE: 136 - 202 DEG. C SOLUBILITY IN WATER: 0.1%
VAPOR PRESSURE: 14.1mmHg WT/GAL (LBS): 11.83 (U.S.)
VAPOR DENSITY: HEAVIER THAN AIR pH: U/I
% VOL/VOLUME: 8.60 % SOLID BY WEIGHT: 83.93
EVAP RATE(BuOAc=100): 11 SPECIFIC GRAVITY: 1.39
ODOR/APPEARANCE: VISCOUS LIQUID WITH AN ODOR CHARACTERISTIC OF THE SOLVENTS LISTED IN SECTION II.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

US-DOT CATEGORY: FLAMMABLE
FLASHPOINT: 85 DEG. F PMCC
FLAMMABLE LIMITS: LEL 3.4 UEL U/I

EXTINGUISHING MEDIA:
USE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) CLASS B EXTINGUISHERS (CARBON DIOXIDE, DRY CHEMICAL, OR UNIVERSAL AQUEOUS FILM FORMING FOAM) DESIGNED TO EXTINGUISH NFPA CLASS IC FLAMMABLE LIQUID FIRES.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
KEEP CONTAINERS TIGHTLY CLOSED. ISOLATE FROM HEAT, ELECTRICAL EQUIPMENT, SPARKS, AND OPEN FLAMES. CLOSED CONTAINERS MAY EXPLODE WHEN EXPOSED TO EXTREME HEAT. DO NOT APPLY ON HOT SURFACES. TOXIC GASES MAY FORM WHEN PRODUCT IS CONTACTED BY FLAME OR HOT SURFACES.
SPECIAL FIRE FIGHTING PROCEDURES:
WATER SPRAY MAY BE INEFFECTIVE. WATER SPRAY MAY BE USED TO COOL CLOSED CONTAINERS TO PREVENT PRESSURE BUILD-UP AND POSSIBLE AUTOIGNITION OR EXPLOSION WHEN EXPOSED TO EXTREME HEAT. IF WATER IS USED, FOG NOZZLES ARE PREFERABLE. FIRE-FIGHTERS SHOULD WEAR SELF CONTAINED BREATHING APPARATUS.

SECTION V - REACTIVITY DATA

STABILITY: STABLE
HAZARDOUS POLYMERIZATION: NOT EXPECTED TO OCCUR
INCOMPATIBILITY (MATERIALS AND CONDITIONS TO AVOID):
AVOID CONTACT WITH STRONG ALKALIES, STRONG MINERAL ACIDS, OR STRONG OXIDIZING AGENTS
HAZARDOUS DECOMPOSITION PRODUCTS:
MAY PRODUCE HAZARDOUS DECOMPOSITION PRODUCTS WHEN HEATED WELDING, BRAZING, OR FLAME-CUTTING ON SURFACES COATED WITH THIS PRODUCT MAY PRODUCE FUMES INCLUDING Carbon Monoxide.

SECTION VI - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:
PROVIDE MAXIMUM VENTILATION. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN AND EYE PROTECTION SHOULD BE PERMITTED IN THE AREA. REMOVE ALL SOURCES OF IGNITION. TAKE UP SPILLED MATERIAL WITH SAWDUST, VERMICULITE, OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR DISPOSAL.
WASTE DISPOSAL METHOD:
WASTE MATERIAL MUST BE DISPOSED OF IN ACCORDANCE WITH FEDERAL, STATE, PROVINCIAL AND LOCAL ENVIRONMENTAL CONTROL REGULATIONS. EMPTY CONTAINERS SHOULD BE RECYCLED OR DISPOSED OF THROUGH AN APPROVED WASTE MANAGEMENT FACILITY.

SECTION VII - HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE FROM:

INGESTION:
-HARMFUL OR FATAL IF SWALLOWED.
EYE CONTACT:
-CAUSES EYE IRRITATION.
SKIN CONTACT:
-MAY CAUSE SLIGHT SKIN IRRITATION. -MAY BE ABSORBED THROUGH THE SKIN. -PROLONGED OR REPEATED CONTACT MAY CAUSE AN ALLERGIC SKIN REACTION.
INHALATION:
-VAPOR AND SPRAY MIST MAY BE HARMFUL IF INHALED. -SANDING AND GRINDING DUSTS MAY BE HARMFUL IF INHALED. -VAPOR IRRITATES EYES, NOSE, AND THROAT. -REPEATED EXPOSURE TO HIGH VAPOR CONCENTRATIONS MAY CAUSE IRRITATION OF THE RESPIRATORY SYSTEM AND PERMANENT BRAIN AND NERVOUS SYSTEM DAMAGE. -INTENTIONAL MISUSE BY DELIBERATELY CONCENTRATING AND INHALING THE CONTENTS CAN BE HARMFUL OR FATAL.
CHRONIC OVEREXPOSURE:
AVOID LONG TERM AND REPEATED CONTACT. -THIS PRODUCT CONTAINS A FORM OF CRYSTALLINE SILICA WHICH IARC ASSOCIATES WITH AN INCREASED RISK OF CANCER IN LABORATORY ANIMALS. LONG-TERM EXPOSURES TO CRYSTALLINE SILICA MAY ALSO LEAD TO A DISABLING INJURY KNOWN AS SILICOSIS. THESE EFFECTS ARE ASSOCIATED WITH BREATHING EXCESSIVE AMOUNTS OF SILICA DUST. APPLICATION OF THIS PRODUCT IS NOT EXPECTED TO GENERATE EXCESSIVE AMOUNTS OF RESPIRABLE SILICA, SO THE POTENTIAL HAZARD FOR HUMANS IS LIMITED. -THIS PRODUCT CONTAINS NITROETHANE. STUDIES WITH LABORATORY ANIMALS HAVE SHOWN THAT INGESTION OR INHALATION OF HIGH LEVELS OF NITROETHANE CAUSES KIDNEY AND LIVER DAMAGE AND CENTRAL NERVOUS SYSTEM EFFECTS.
SIGNS AND SYMPTOMS OF OVEREXPOSURE:
-EYE WATERING, HEADACHES, NAUSEA, DIZZINESS, AND LOSS OF COORDINATION ARE INDICATIONS THAT SOLVENT LEVELS ARE TOO HIGH. -REDNESS, ITCHING, BURNING SENSATION AND VISUAL DISTURBANCES MAY INDICATE EXCESSIVE EYE CONTACT. -DRYNESS, ITCHING, CRACKING, BURNING, REDNESS, AND SWELLING ARE CONDITIONS ASSOCIATED WITH EXCESSIVE SKIN CONTACT.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:
NOT APPLICABLE

SECTION VIII - FIRST AID PROCEDURES

INGESTION:

IF SWALLOWED, DO NOT INDUCE VOMITING.
EYE CONTACT:
IN CASE OF EYE CONTACT, FLUSH EYES IMMEDIATELY WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.
SKIN CONTACT:
IN CASE OF SKIN CONTACT, FLUSH IMMEDIATELY WITH PLENTY OF WATER FOLLOWED BY WASHING WITH SOAP AND WATER.
INHALATION:
IF AFFECTED BY INHALATION OF VAPOR OR SPRAY MIST, REMOVE TO FRESH AIR. APPLY ARTIFICIAL RESPIRATION AND OTHER SUPPORTIVE MEASURES AS REQUIRED.
OTHER:
IF ANY OF THE FOLLOWING OCCUR DURING OR FOLLOWING USE OF THIS PRODUCT, CONTACT A POISON CONTROL CENTER, EMERGENCY ROOM OR PHYSICIAN IMMEDIATELY. HAVE MATERIAL SAFETY DATA SHEET INFORMATION AVAILABLE. *INGESTION *EXCESSIVE EXPOSURE TO A CORROSIVE MATERIAL * PERSISTENT SKIN/EYE IRRITATION OR BREATHING DIFFICULTIES.

SECTION IX - PROTECTION INFORMATION

PERSONAL PROTECTIVE EQUIPMENT FOR:

EYE PROTECTION:
WEAR CHEMICAL-TYPE SPLASH GOGGLES OR FULL FACE SHIELD.
SKIN PROTECTION:
WEAR IMPERMEABLE PROTECTIVE CLOTHING CONSTRUCTED OF NITRILE, NEOPRENE OR LATEX RUBBER SUFFICIENT TO COVER THE ENTIRE BODY.
RESPIRATORY PROTECTION:
OVEREXPOSURE TO VAPORS MAY BE PREVENTED BY ENSURING VENTILATION CONTROL, VAPOR EXHAUST OR FRESH AIR ENTRY. NIOSH/MSHA-APPROVED (TC-23C-) PAINT SPRAY OR AIR SUPPLIED (TC-19C-) RESPIRATORS MAY ALSO REDUCE EXPOSURE. READ RESPIRATOR MANUFACTURER'S INSTRUCTIONS AND LITERATURE CAREFULLY TO DETERMINE THE TYPE OF AIRBORNE CONTAMINANTS AGAINST WHICH THE RESPIRATOR IS EFFECTIVE AND HOW IT IS TO BE PROPERLY FITTED.
OTHER EQUIPMENT:
CLEAN OR DISCARD CONTAMINATED CLOTHING AND SHOES.
VENTILATION REQUIREMENTS:
PROVIDE GENERAL DILUTION OR LOCAL EXHAUST VENTILATION IN VOLUME AND PATTERN TO KEEP THE CONCENTRATION OF INGREDIENTS LISTED IN SECTION II BELOW THE LOWER SUGGESTED EXPOSURE LIMITS, THE LEL IN SECTION IV BELOW THE STATED LIMIT, AND REMOVE DECOMPOSITION PRODUCTS DURING WELDING OR FLAME CUTTING ON SURFACES COATED WITH THIS PRODUCT.

SECTION X - SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:
DO NOT STORE ABOVE 120 DEGREES F. STORE LARGE QUANTITIES IN BUILDINGS DESIGNED AND PROTECTED FOR STORAGE OF NFPA CLASS IC FLAMMABLE LIQUIDS.
OTHER PRECAUTIONS:
IF THIS MATERIAL IS PART OF A MULTIPLE COMPONENT COATING SYSTEM, READ THE MATERIAL SAFETY DATA SHEET(S) FOR THE OTHER COMPONENT OR COMPONENTS BEFORE BLENDING AS THE RESULTING MIXTURE MAY HAVE THE HAZARDS OF ALL OF ITS PARTS. CONTAINERS SHOULD BE GROUNDED WHEN POURING. AVOID FREE FALL OF LIQUIDS IN EXCESS OF A FEW INCHES.

9097/149////605

CONTINUATION OF MANUFACTURER'S CODE: 97-[illegible]9 DATE OF PREP: 6/05/90 PAGE 2

SECTION II - INGREDIENTS AND REGULATORY INFORMATION

INGREDIENTS	CAS NUMBER	% WEIGHT	...SARA TITLE III & CERCLA CLASSIFICATIONS.... NS (102)	EHS (302)	TC* (313)	RQ (LBS)	TPQ (LBS)	SARA 311/312 AC	CH	FL	PR	RE
SILICA, CRYSTALLINE QUARTZ	7631-86-9	30-35	N	N	N	N/A	N/A	N	Y	N	N	N
NITROETHANE	79-24-3	2- 5	N	N	N	N/A	N/A	Y	Y	Y	N	N
FILM FORMERS, RESINS, AND ADDITIVES	NOT ESTAB.	65-70	N	N	N	N/A	N/A	Y	N	N	N	N
*** THE FOLLOWING HAZARDOUS MATERIALS ARE COMPONENTS OF ONE OR MORE OF THE ABOVE INGREDIENTS ***												
QUARTZ**	14808-60-7	30-35	N	N	N	N/A	N/A	N	Y	N	N	N

*** OCCUPATIONAL EXPOSURE LIMITS HAVE BEEN ESTABLISHED FOR THE FOLLOWING MATERIALS ***

INGREDIENTS	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA PEL-STEL	PPG-IPEL IPEL-TWA	PPG-IPEL IPEL-STEL
SILICA, CRYSTALLINE QUARTZ	10 mg/m3	NOT ESTAB	6 mg/m3	NOT ESTAB	5 mg/m3	NOT ESTAB
NITROETHANE	100 ppm	NOT ESTAB	100 ppm	NOT ESTAB	100 ppm	NOT ESTAB
QUARTZ**	0.1 mg/m3	NOT ESTAB	0.1 mg/m3	NOT ESTAB	0.1 mg/m3	NOT ESTAB

*** SARA 311/312 CATEGORIES FOR THIS PRODUCT ***
ACUTE=Y CHRONIC=Y FLAM=Y PRESS=N REAC=N

*** PRODUCT STATUS RELATIVE TO THE US EPA TOXIC SUBSTANCES CONTROL ACT ***
ALL CHEMICAL SUBSTANCES IN THIS PRODUCT COMPLY WITH ALL APPLICABLE RULES OR ORDERS UNDER THE ENVIRONMENTAL PROTECTION AGENCY'S TOXIC SUBSTANCES CONTROL ACT.

*** FOOTNOTES FOR SECTION II ***
CARCINOGENIC ACCORDING TO CRITERIA ESTABLISHED BY: *=NTP **=IARC @=OSHA #=OTHER
ORAL= LD50 ORAL (RAT), (g/kg) DERM= LD50 DERMAL (RABBIT), (g/kg) INHL= LC50 INHALATION (RAT), (Mg/L)
* INGREDIENTS IN THE TC COLUMN ARE SUBJECT TO THE REPORTING REQUIREMENTS OF SARA TITLE III. SEE 40 CFR PART 372.

MATERIAL SAFETY DATA SHEET

COATINGS AND RESINS DIVISION

SECTION I - PRODUCT INFORMATION

MANUFACTURER'S NAME: PPG INDUSTRIES, INC.
PRODUCT CODE/IDENTITY: 97-A (041390M)
CUSTOMER PART#/NAME:
PRODUCT TRADE NAME: AQUAPON 'A' COMPONENTS
CHEMICAL FAMILY: POLYAMIDE

SHIPPING INFORMATION
US-DOT-SHIPPING NAME/HAZ CLASS: PAINT, FLAMMABLE LIQUID
UN NUMBER: UN1263

IN-PLANT HAZARD RATINGS
HEALTH= 3*
FLAMMABILITY= 3
REACTIVITY= 0

0=MINIMAL 1=SLIGHT 2=MODERATE 3=SERIOUS 4=SEVERE
*=CONTAINS INGREDIENT(S) WHICH MAY CAUSE (LONG-TERM) HEALTH EFFECTS

PRODUCT SAFETY INFO: 3938 KAPPA DRIVE
PITTSBURGH, PA. 15205
(412) 492-5555
PGH. PAINTS INFO. OR MSDS: 1-800-441-9090
AUTO REFINISH INFO. OR MSDS: 1-800-248-2580, IN OH.(216) 671-0050
EMERGENCY MEDICAL INFO: (304) 843-1300
EMERGENCY SPILL INFO: (304) 843-1300
DATE OF MSDS PREPARATION: 6/04/90

THIS MATERIAL SAFETY DATA SHEET HAS BEEN PREPARED IN ACCORDANCE WITH THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200), THE SUPPLIER NOTIFICATION REQUIREMENTS OF SARA TITLE III, SECTION 313, AND OTHER APPLICABLE RIGHT-TO-KNOW REGULATIONS. ABBREVIATIONS AND OTHER DESIGNATIONS USED ON THIS MATERIAL SAFETY DATA SHEET INCLUDE THE FOLLOWING:

U/I = UNKNOWN INFORMATION; N/A = NOT APPLICABLE; NOT ESTAB. = NOT ESTABLISHED; CERT. LTR. = CHEMICAL O.K. ON TSCA INVENTORY; CAS NO. NOT AVAILABLE

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

[FORMULA VALUES, NOT SALES SPECIFICATIONS]

BOILING RANGE: 82 - 210 DEG. C SOLUBILITY IN WATER: <34 %
VAPOR PRESSURE: <18 mm/Hg WT/GAL (LBS): 9.13 (U.S.)
VAPOR DENSITY: HEAVIER THAN AIR pH: U/I
% VOL/VOLUME: <71 % SOLID BY WEIGHT: 32-66
EVAP RATE(BuOAc=100): <15 SPECIFIC GRAVITY: 1.1 - 1.6
ODOR/APPEARANCE: VISCOUS LIQUID WITH AN ODOR CHARACTERISTIC OF THE SOLVENTS LISTED IN SECTION II.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

US-DOT CATEGORY: FLAMMABLE
FLASHPOINT: 69 DEG. F PMCC
FLAMMABLE LIMITS: LEL 1.4 UEL U/I

EXTINGUISHING MEDIA:
USE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) CLASS B EXTINGUISHERS (CARBON DIOXIDE, DRY CHEMICAL, OR UNIVERSAL AQUEOUS FILM FORMING FOAM) DESIGNED TO EXTINGUISH NFPA CLASS B FLAMMABLE LIQUID FIRES.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
KEEP CONTAINERS TIGHTLY CLOSED. ISOLATE FROM HEAT, ELECTRICAL EQUIPMENT, SPARKS, AND OPEN FLAMES. CLOSED CONTAINERS MAY EXPLODE WHEN EXPOSED TO EXTREME HEAT. DO NOT APPLY ON HOT SURFACES. TOXIC GASES MAY FORM WHEN PRODUCT IS CONTACTED BY FLAME OR HOT SURFACES.
SPECIAL FIRE FIGHTING PROCEDURES:
WATER SPRAY MAY BE INEFFECTIVE. WATER SPRAY MAY BE USED TO COOL CLOSED CONTAINERS TO PREVENT PRESSURE BUILD-UP AND POSSIBLE AUTOIGNITION OR EXPLOSION WHEN EXPOSED TO EXTREME HEAT. IF WATER IS USED, FOG NOZZLES ARE PREFERABLE. FIRE-FIGHTERS SHOULD WEAR SELF CONTAINED BREATHING APPARATUS.

SECTION V - REACTIVITY DATA

STABILITY: STABLE
HAZARDOUS POLYMERIZATION: NOT EXPECTED TO OCCUR
INCOMPATIBILITY (MATERIALS AND CONDITIONS TO AVOID):
AVOID CONTACT WITH STRONG ALKALIES, STRONG MINERAL ACIDS, OR STRONG OXIDIZING AGENTS.
HAZARDOUS DECOMPOSITION PRODUCTS:
MAY PRODUCE HAZARDOUS DECOMPOSITION PRODUCTS WHEN HEATED. WELDING, BRAZING, OR FLAME-CUTTING ON SURFACES COATED WITH THIS PRODUCT MAY PRODUCE FUMES INCLUDING: Carbon Monoxide, Oxides of Nitrogen

SECTION VI - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:
PROVIDE MAXIMUM VENTILATION. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN AND EYE PROTECTION SHOULD BE PERMITTED IN THE AREA. REMOVE ALL SOURCES OF IGNITION. TAKE UP SPILLED MATERIAL WITH SAWDUST, VERMICULITE, OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR DISPOSAL.
WASTE DISPOSAL METHOD:
WASTE MATERIAL MUST BE DISPOSED OF IN ACCORDANCE WITH FEDERAL, STATE, PROVINCIAL, AND LOCAL ENVIRONMENTAL CONTROL REGULATIONS. EMPTY CONTAINERS SHOULD BE RECYCLED OR DISPOSED OF THROUGH AN APPROVED WASTE MANAGEMENT FACILITY.

SECTION VII - HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE FROM:

INGESTION:
-HARMFUL OR FATAL IF SWALLOWED.
EYE CONTACT:
-CAUSES SEVERE EYE IRRITATION.
SKIN CONTACT:
-MAY CAUSE MODERATE SKIN IRRITATION. -MAY BE ABSORBED THROUGH THE SKIN.
INHALATION:
-VAPOR AND SPRAY MIST HARMFUL IF INHALED. -VAPOR IRRITATES EYES, NOSE, AND THROAT. -REPEATED EXPOSURE TO HIGH VAPOR CONCENTRATIONS MAY CAUSE IRRITATION OF THE RESPIRATORY SYSTEM AND PERMANENT BRAIN AND NERVOUS SYSTEM DAMAGE. -INTENTIONAL MISUSE BY DELIBERATELY CONCENTRATING AND INHALING THE CONTENTS CAN BE HARMFUL OR FATAL.
CHRONIC OVEREXPOSURE:
AVOID LONG TERM AND REPEATED CONTACT. -THIS PRODUCT CONTAINS TITANIUM DIOXIDE. ANIMALS INHALING MASSIVE QUANTITIES OF TITANIUM DIOXIDE DUST IN A LONG-TERM STUDY DEVELOPED LUNG TUMORS. STUDIES WITH HUMANS INVOLVED IN MANUFACTURE OF THIS PIGMENT INDICATE NO INCREASED RISK OF CANCER FROM EXPOSURE. POTENTIAL FOR INHALATION OF TITANIUM DIOXIDE DUSTS FROM COATINGS IS VERY LIMITED. SINCE OVEREXPOSURES ARE NOT EXPECTED, THERE IS NO SIGNIFICANT HAZARD FOR MAN. -THIS PRODUCT CONTAINS AN ETHYLENE SERIES GLYCOL ETHER AND/OR ACETATE WHICH HAS BEEN SHOWN TO CAUSE ADVERSE EFFECTS ON THE KIDNEYS, LIVER, BLOOD AND/OR BLOOD-FORMING TISSUE. THERE IS NO CONCLUSIVE EVIDENCE OF THESE EFFECTS IN HUMANS.
SIGNS AND SYMPTOMS OF OVEREXPOSURE:
-EYE WATERING, HEADACHES, NAUSEA, DIZZINESS, AND LOSS OF COORDINATION ARE INDICATIONS THAT SOLVENT LEVELS ARE TOO HIGH. -REDNESS, ITCHING, BURNING SENSATION AND VISUAL DISTURBANCES MAY INDICATE EXCESSIVE EYE CONTACT. -DRYNESS, ITCHING, CRACKING, BURNING, REDNESS, AND SWELLING ARE CONDITIONS ASSOCIATED WITH EXCESSIVE SKIN CONTACT.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:
NOT APPLICABLE

SECTION VIII - FIRST AID PROCEDURES

INGESTION:
IF SWALLOWED, DO NOT INDUCE VOMITING.
EYE CONTACT:
IN CASE OF EYE CONTACT, FLUSH EYES IMMEDIATELY WITH PLENTY OF WATER FOR AT LEAST 30 MINUTES.
SKIN CONTACT:
IN CASE OF SKIN CONTACT, REMOVE PROMPTLY BY WIPING, FOLLOWED BY WATERLESS HAND CLEANER AND SOAP AND WATER.
INHALATION:
IF AFFECTED BY INHALATION OF VAPOR OR SPRAY MIST, REMOVE TO FRESH AIR. APPLY ARTIFICIAL RESPIRATION AND OTHER SUPPORTIVE MEASURES AS REQUIRED.
OTHER:
IF ANY OF THE FOLLOWING OCCUR DURING OR FOLLOWING USE OF THIS PRODUCT, CONTACT A POISON CONTROL CENTER, EMERGENCY ROOM OR PHYSICIAN IMMEDIATELY. HAVE MATERIAL SAFETY DATA SHEET INFORMATION AVAILABLE. *INGESTION *EXCESSIVE EXPOSURE TO A CORROSIVE MATERIAL * PERSISTENT SKIN/EYE IRRITATION OR BREATHING DIFFICULTIES.

SECTION IX - PROTECTION INFORMATION

PERSONAL PROTECTIVE EQUIPMENT FOR:

EYE PROTECTION:
WEAR CHEMICAL-TYPE SPLASH GOGGLES OR FULL FACE SHIELD.
SKIN PROTECTION:
WEAR PROTECTIVE CLOTHING, INCLUDING IMPERMEABLE APRON AND GLOVES CONSTRUCTED OF: NITRILE RUBBER, NEOPRENE RUBBER OR POLYVINYL ALCOHOL
RESPIRATORY PROTECTION:
OVEREXPOSURE TO VAPORS MAY BE PREVENTED BY ENSURING VENTILATION CONTROL VAPOR EXHAUST OR FRESH AIR ENTRY. NIOSH/MSHA-APPROVED (TC-23C-) PAINT SPRAY AIR SUPPLIED (TC-19C-) RESPIRATORS MAY ALSO REDUCE EXPOSURE. READ RESPIRATOR MANUFACTURER'S INSTRUCTIONS AND LITERATURE CAREFULLY TO DETERMINE THE TYPE AIRBORNE CONTAMINANTS AGAINST WHICH THE RESPIRATOR IS EFFECTIVE AND HOW IT TO BE PROPERLY FITTED.
OTHER EQUIPMENT:
CLEAN OR DISCARD CONTAMINATED CLOTHING AND SHOES.
VENTILATION REQUIREMENTS:
PROVIDE GENERAL DILUTION OR LOCAL EXHAUST VENTILATION IN VOLUME AND PATTERN KEEP THE CONCENTRATION OF INGREDIENTS LISTED IN SECTION II BELOW THE LOWEST SUGGESTED EXPOSURE LIMITS, THE LEL IN SECTION IV BELOW THE STATED LIMIT, AND REMOVE DECOMPOSITION PRODUCTS DURING WELDING OR FLAME CUTTING ON SURFACES COATED WITH THIS PRODUCT.

SECTION X - SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:
DO NOT STORE ABOVE 120 DEGREES F. STORE LARGE QUANTITIES IN BUILDINGS DESIGNED AND PROTECTED FOR STORAGE OF NFPA CLASS IB FLAMMABLE LIQUIDS.
OTHER PRECAUTIONS:
IF THIS MATERIAL IS PART OF A MULTIPLE COMPONENT COATING SYSTEM, READ THE MATERIAL SAFETY DATA SHEET(S) FOR THE OTHER COMPONENT OR COMPONENTS BEFORE BLENDING AS THE RESULTING MIXTURE MAY HAVE THE HAZARDS OF ALL OF ITS PARTS. CONTAINERS SHOULD BE GROUNDED WHEN POURING. AVOID FREE FALL OF LIQUID IN EXCESS OF A FEW INCHES.

9097IA/////904

97-A	
97-1	97-9
97-2	97-10
97-3	97-11
97-4	97-12
97-5	97-13
97-6	97-51
97-7	97-56
97-8	97-57

CONTINUATION OF MANUFACTURER'S CODE: 97-A DATE OF PREP: 6/04/90 PAGE 2

SECTION II - INGREDIENTS AND REGULATORY [illegible]

INGREDIENTS	CAS NUMBER	MAX % WEIGHT	...SARA TITLE III & CERCLA CLASSIFICATIONS.... HS (102)	CHS (302)	TC* (313)	RQ (LBS)	TPQ (LBS)	SARA 311/312 AC	CH	FL	PR	RE
ALUMINUM SILICATE	1327-36-2	25-30	N	N	[illegible]	N/A	N/A	Y	N	N	N	N
MAGNESIUM SILICATE	14807-96-6	5-10	N	[illegible]	N	N/A	N/A	N	N	N	N	N
PIGMENTS	NOT ESTAB.	2- 5	N	[illegible]	[illegible]	N/A	N/A	N	N	N	N	N
ISOPROPYL ALCOHOL, ANHYDROUS	67-63-0	10-15	N	[illegible]	Y	N/A	N/A	Y	N	Y	N	N
ETHYLENE GLYCOL MONOPROPYL ETHER	2807-30-9	10-15	N	[illegible]	[illegible]	N/A	N/A	Y	Y	Y	N	N
XYLENE	1330-20-7	30-35	Y	[illegible]	Y	1000	N/A	Y	N	Y	N	N
TOLUENE	108-88-3	10-15	Y	[illegible]	Y	1000	N/A	Y	N	Y	N	N
FILM FORMERS, RESINS, AND ADDITIVES	NOT ESTAB.	70-75	N	N	[illegible]	N/A	N/A	N	Y	N	N	N

*** THE FOLLOWING INGREDIENTS ARE REPORTABLE AS SARA SECTION 313 CHEMICAL CATEGORIES ***

GLYCOL ETHERS	NOT ESTAB.	10-15

*** OCCUPATIONAL EXPOSURE LIMITS HAVE BEEN ESTABLISHED FOR THE FOLLOWING MATERIALS ***

INGREDIENTS	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA PEL-STEL	PPG-IPEL IPEL-TWA	PPG-IPEL IPEL-STEL
ISOPROPYL ALCOHOL, ANHYDROUS	400 ppm	500 ppm	400 ppm	NOT ESTAB	400 ppm	500 ppm
XYLENE	100 ppm	150 ppm	100 ppm	NOT ESTAB	100 ppm	150 ppm
TOLUENE	100 ppm	150 ppm	200 ppm	300 ppm	100 ppm	150 ppm

*** SARA 311/312 CATEGORIES FOR THIS PRODUCT ***
ACUTE=Y CHRONIC=Y FLAM=Y PRESS=N REAC=N

*** PRODUCT STATUS RELATIVE TO THE US EPA TOXIC SUBSTANCES CONTROL ACT ***
ALL CHEMICAL SUBSTANCES IN THIS PRODUCT COMPLY WITH ALL APPLICABLE RULES OR ORDERS UNDER THE ENVIRONMENTAL PROTECTION AGENCY'S TOXIC SUBSTANCES CONTROL ACT.

*** FOOTNOTES FOR SECTION II ***
ORAL= LD50 ORAL (RAT), (g/kg) DERM= LD50 DERMAL (RABBIT), (g/kg) INHL= LC50 INHALATION (RAT), (Mg/L)
* INGREDIENTS IN THE TC COLUMN ARE SUBJECT TO THE REPORTING REQUIREMENTS OF SARA TITLE III. SEE 40 CFR PART 372.

Appendix A
Task Specific Site Safety Plan
Removal Action Oversight
Des Moines TCE Site, OU4
Des Moines, Iowa

Written by Robin Wankum (Author) Date: 4/11/94

Reviewed by Craig Willis (Project Manager) Date: 4/11/94

Approved by _____ (BVWS DHS) Date: _____

Expiration Date: _____

The following appendix is health and safety information specific to the tasks described within. This appendix is an extension of the HASP and as such must be used in conjunction with that document.

Appendix A
Removal Action Oversight
Table of Contents

1.0 Removal Action Oversight Activities

BVWS has been requested by the USEPA Region VII to provide oversight for the removal action activities currently ongoing at the Des Moines TCE Site, OU4. These removal activities include removing the dust from the five buildings noted to contain pesticide contamination, the removal of the Aldrin tank building annex, and the removal of the Aldrin tank. BVWS will observe these activities, take photographs, and record field notes. The BVWS field representative will be Robin Wankum.

2.0 Hazard Assessment

HEPA-vac Buildings 1 through 5: Potential hazards include inhalation of dust containing pesticides, overhead hazard associated with the hoists being used to vacuum the ceilings and walls, hand, finger, and foot injury from crushing or entanglement in ropes and cables, and slips, trips, and falls over debris within the buildings.

Aldrin Tank Building Annex Removal: Potential hazard due to contact with excavation equipment and slips, trips, and falls over the debris.

3.0 Chemical Hazards

The chemicals of concern are believed to be homogeneous at the site in both concentrations and location. The personnel performing the tasks covered under this Appendix have the potential to be exposed to all of the chemicals noted in Attachment 3.

4.0 Personnel Qualifications

No modifications to HASP necessary.

5.0 Personal Protective Equipment

It is anticipated that PPE upgrade and downgrade potential will be dependent upon the monitoring levels detected during the activities. Level C PPE will be implemented for most of these oversight activities unless levels are pre-approved by the BVWS DHS. The following PPE is anticipated for these activities:

- Full-face APR with cartridges.
- Hooded Saranex.
- Boot Covers.
- Steel-toed Boots.
- Hard hat (when overhead hazard exists).
- Nitrile gloves.

6.0 Monitoring Program

Monitoring will be conducted by the personnel conducting the removal action activities. BVWS personnel will take action based on the levels detected by the monitoring personnel in conjunction with the action levels specified in Attachment 3.

No additional modifications to HASP necessary.

7.0 Site Control

No modifications to HASP necessary.

8.0 Safety and Emergency Procedures

The nearest phone is located in the office trailer outside of Building 4 (Figure 2-1). Decontamination procedures will be conducted in the specific areas as indicated by the personnel conductingthe removal action. No additional modifications to HASP necessary.

9.0 Emergency Action Plan

No modification to the HASP necessary.

10.0 Team Member Responsibilities

No modification to HASP necessary.

11.0 Certification

By my signature, I certify that:

- I have read,
- I understand, and
- I will abide by the Task Specific Safety Plan for the Des Moines TCE Site, OU4.

Printed Name	Signature	Date	Affiliation

Appendix B
Task Specific Site Safety Plan
Removal Action Oversight
Des Moines TCE Site, OU4
Des Moines, Iowa

Written by Robin Wanburn (Author) Date: 5-19-94

Reviewed by Craig Wilkie (Project Manager) Date: 5/19/94

Approved by [signature] (BVWS DHS) Date: 19 MAY 94

Expiration Date: DEC 31 94

The following appendix is health and safety information specific to the tasks described within. This appendix is an extension of the HASP and as such must be used in conjunction with that document.

Appendix B
Removal Action Oversight
Table of Contents

1.0 Removal Action Oversight Activities

BVWS has been requested by the USEPA Region VII to provide oversight for the removal action activities currently ongoing at the Des Moines TCE Site, OU4. These removal activities include removing the dust from the five buildings noted to contain pesticide contamination, encapsulating all exposed surface with epoxy paint, and setting up the washline assembly for rinsing the pesticide residue off the products. BVWS will observe these activities, take photographs, and record field notes. The BVWS field representative will be Robin Wankum.

2.0 Hazard Assessment

HEPA-vac Buildings 1 through 5: Potential hazards include inhalation of dust containing pesticides, overhead hazard associated with the hoists being used to vacuum the ceilings and walls, hand, finger, and foot injury from crushing or entanglement in ropes and cables, and slips, trips, and falls over debris within the buildings.

Encapsulate Exposed Surfaces: Potential hazards from the epoxy paint may include inhalation or dermal contact with the solvents. Product Description sheets for the epoxy paints have been included in Attachment 5.

3.0 Chemical Hazards

The chemicals of concern are believed to be homogeneous at the site in both concentrations and location. The personnel performing the tasks covered under this Appendix have the potential to be exposed to all of the chemicals noted in Attachment 2. Additional chemicals of concern associated with the encapsulation activities have been included within the Materials Safety Data Sheets within in Attachment 5.

4.0 Personnel Qualifications

No modifications to HASP necessary. PRP personnel will serve as the SSC. BVWS's role is as an overseer. BVWS therefore will participate in the PRP's safety briefings and adhere to the provisions of their plan if it does not conflict with BVWS's HASP.

5.0 Personal Protective Equipment

Level C PPE will be implemented for most of these oversight activities unless levels are pre-approved by the BVWS DHS. The following PPE is anticipated for these activities:

- Full-face APR with organic vapor/ acid gas/HEPA filter cartridges (cartridges to be replaced after each use).
- Hooded Saranex.
- Boot Covers.
- Steel-toed Boots.
- Hard hat (when overhead hazard exists).
- Nitrile gloves (double layer of 4 mils).

6.0 Monitoring Program

Monitoring will be conducted by the personnel conducting the removal action activities. BVWS personnel will take action based on the levels detected by the monitoring personnel in conjunction with the action levels specified in Attachment 3. If BVWS personnel determine that the PRP monitoring program is not protective of themselves, they will initiate independent monitoring. During the encapsulation activities, BVWS personnel will either monitor the explosive limitations of the buildings or observe the activities from outside of the buildings, unless explosive monitoring is conducted by the PRPs. The BVWS personnel will log all monitoring results given to them or taken by them. Any level of dust above 2 mg/m^3 will require evacuation of the site. No additional modifications to HASP necessary.

7.0 Site Control

Site control is the responsibility of the PRP, BVWS personnel will adhere to the provisions of the PRP's SSP if it does not conflict with BVWS's HASP.

8.0 Safety and Emergency Procedures

BVWS personnel will maintain periodic contact with PRP personnel working at the site. The nearest phone is located in the office trailer outside of Building 4 (Figure 2-1). Decontamination procedures will be conducted in the specific areas as indicated by the personnel conducting the removal action. No additional modifications to HASP necessary.

9.0 Emergency Action Plan

No modification to the HASP necessary.

10.0 Team Member Responsibilities

BVWS will serve as an overseer of the operations. Site safety is the responsibility of the PRP. BVWS personnel will adhere to the provisions in the PRP's SSP if it does not conflict with BVWS's plan.

11.0 Certification

By my signature, I certify that:

- I have read,
- I understand, and
- I will abide by the Task Specific Safety Plan for the Des Moines TCE Site, OU4.

Printed Name	Signature	Date	Affiliation
Robin Wankum	Robin Wankum	5/23/94	BVWS