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A MEDICAL MONITORING PROGRAM FOR THE MARINE HAZARDOUS CHEMICAL WORKER

VOL. I OF TASK III FINAL REPORT,
MARINE HAZARDOUS CHEMICAL WORKER

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Prepared for:

U.S. Department of Transportation
United States Coast Guard

Office of Research and Development
Washington, D.C. 20593

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Volume I of
Task III FINAL REPORT
Contract DTCG23-82-C-20027
SwRI Project 06-7223

Prepared for
U.S. Coast Guard
Commandant (G-FCP-22F/64)
2100 Second Street, S.W.
Washington, D.C. 20590

December 1985

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16. Abstract

This document is Volume I of a three-volume report which describes the development of a medical monitoring program for marine personnel who may be potentially exposed to hazardous chemicals during their work. The purpose of the program is to screen for adverse health effects of occupational exposures to noise and toxic chemical substances. A basic medical protocol for periodic screening examinations and a target organ protocol for examinations performed in response to acute overexposure to specific toxic substances are described. A recommended schedule for medical examinations is specified and guidelines for followups of abnormal laboratory results are provided. Auxiliary systems to support implementation and application of the medical monitoring system include: (1) A hazardous substance data system for nearly 700 marine hazardous substances, (2) A set of biochemical and medical data sheets for 179 of the more toxic marine hazardous substances, (3) Guidelines for biological monitoring of exposures to 26 marine hazardous substances for which methods are available, (4) Two methods for documentation of potential exposures to marine hazardous chemicals: one which is self-documented, and a second, which employs an indirect method based on cargo manifests and personnel records, (5) Guidelines for an industrial hygiene program to complement medical monitoring, and (6) A data management system to provide a record of data and to provide a means of rapid access to data files for specific information and for data summaries.

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The authors of this report wish to acknowledge the significant assistance and support provided to the study effort by a number of individuals and organizations. The medical monitoring program presented herein is the result of the joint efforts of a study panel described in more detail in Chapter I. The panel worked diligently and cooperatively as a team and were collectively responsible for the results of this study.

In addition to the study panel, acknowledgement is given to the contributions of others who provided significant support of the study effort. Our thanks are due Drs. M. L. Adess and J. R. Stockwell of the U. S. Coast Guard Environmental Health and Occupational Medicine section for providing the panel with timely access to information regarding the Coast Guard's developmental programs in occupational health and in medical data management and for trusting the panel with draft documentation long before it would have been otherwise available. The information and data provided by Drs. Adess and Stockwell have greatly berefited the program presented herein. Also due special recognition is Ms. A. W. Burney, who heads Maritime Health Information Services of Silverspring, MD. Ms. Burney was on staff at the U. S. Public Health service when PHS handled health matters for the U. S. merchant marine, and, through contacts maintained since that time, conducted an outstanding survey regarding merchant marine personnel in the U. S. inland waterways.

Others deserving thanks for contributions of time, advice, and information to the workings of the panel include: Mr. J. J. Cox and Mr. T. G. Lengyel of the American Institute of Merchant Shipping, Dr. Hunter Montgomery and Mr. B. G. Simpson of EXXON Corporation, Mr. R. R. Spencer of the Marine Engineering Benevolent Association, Mr. A. W. Musch of Texaco, Incorporated, and Col. R.T.E. de Treville of the U. S. Air Force. To all of these individuals and organizations, and to many others too numerous to mention here who provided help and support to the study team, we offer our sincere thanks and appreciation.

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I. INTRODUCTION

This report presents a medical monitoring program for marine workers who are exposed to hazardous chemical substances in performance of their normal work activities. It is the result of Task III of an investigation conducted by Southwest Research Institute for the United States Coast Guard entitled "A Study to Improve the Health and Safety of the Marine Hazardous Chemical Worker". The objective of that study has been to develop a comprehensive occupational safety and health program for marine hazardous chemical workers. To accomplish this, the study was divided into four tasks which each address a separate aspect of occupational safety and health program development:

Task I - Background Study and Scenario Definition
Task II - Environmental Monitoring and Instrumentation
Task III - Medical Monitoring Program
Task IV - Orientation and Trial Implementation

Tasks I and II have dealt with the background of work activities in the marine transportation industry which present a hazard of occupational exposures to toxic chemicals and the monitoring of the environment of those work activities, respectively. The results of Task I and Task II have been reported separately [1, 2] from this report. The medical monitoring program developed in Task III is reported herein. The fourth and final task will deal with pilot implementation of the results of the first three tasks and will be reported separately upon its completion.

The results of Task III have been documented in three volumes for convenience of presentation:

Volume I - A Medical Monitoring Program for the Marine Hazardous Chemical Worker
Volume II - A Marine Hazardous Substances Data System [3]
Volume III - Biochemical and Medical Information for Marine Hazardous Substances [4]

This volume, Volume I, describes the design of the medical monitoring program and includes a number of appe es that document important sub-elements of the medical monitoring design. Volumes II and III present data on marine hazardous substances and are designed to serve as stand-alone information sources for chemical and biomedical data.

I.1 Background

One of the important functions of the marine transport industry is the transportation of bulk liquid products in tankers and barges. These bulk liquid cargos include pure chemicals, gasoline, crude oil, and other common chemical and petrochemical products. More than 600 substances are regulated in marine transport by the United States Coast Guard under Title 46 of the Code of Federal Regulations.

The toxicity of bulk liquid cargos in the marine transportation industry ranges from substances with negligible toxicity, such as edible vegetable oils, to highly toxic substances, such as carcinogens. Many of the cargos are liquid organic solvents with appreciable vapor pressures, and, therefore, present a significant potential for respiratory hazard at ordinary temperatures. In addition to this respiratory hazard, some cargos present a significant potential for absorption through contact with skin or with mucous membranes.

Marine transport personnel who handle these bulk liquid cargos and U. S. Coast Guard personnel involved in regulation and inspection of marine transportation activities are potentially at risk to exposures to toxic substances in performance of their normal work ac. vities. This marine work environment has been described as a toxicologically hostile and potentially hazardous environment and the need exists to control and reduce exposures of marine workers to chemicals and to monitor their health status.

In the United States, the U. S. Coast Guard has responsibility for the safety and health of these marine personnel [5, 6]. Accordingly, the Coast Guard has in place a broad ; ogram of research efforts to identify, characterize, and assess the safety and health environment of the marine

hazardous chemical worker. The results of some of the more recent efforts [7, 8, 9, 10] have culminated in the safety and health program which is the subject of this report.

I.2 Objective and Approach

The objective of Task III was to design a medical monitoring program for the marine hazardous chemical worker which will detect adverse health effects associated with occupational exposures to toxic chemicals and noise. The scope of the design effort has been limited to matters concerning such occupational exposures. Therefore, the resulting design is not a comprehensive medical monitoring program but, rather, a program designed specifically to screen for adverse health effects of occupational exposures to toxic chemicals and noise.

The approach to the Task III design effort was to assemble a multidisciplined panel with expertise and training in occupational medicine, industrial hygiene, toxicology, biochemistry, epidemiology, and marine operations. The panel was given the responsibility of formulating the design of an appropriate medical monitoring program. The panel was supported by a project staff with the responsibility of covening the panel, scheduling panel workshop meetings, instructing the panel on objectives of the study, collecting and disseminating information to the panel, recording panel discussions and conclusions, and preparing reports. In addition, a group of scientific advisors was assembled to support the panel in technical issues. The makeup of the panel and advisors is presented in the following section.

I.3 Study Panel

The medical monitoring program developed in this study is the result of the joint efforts of a study panel assembled from the staff of Southwest Research Institute (SwRI) from the University of Texas School of Public Health (UTSPH), and from various facets of the marine industry including the National Maritime Union (NMU) and companies involved in marine shipping operations. In addition to the authors of this report, the principal study panel included the following individuals:

Individual and Organization	Area of Relevant Expertise
Mr. W. J. Astleford, SwRI	Marine Occupational Exposures
Dr. S. R. Cowles, Shell Oil Co.	Occupational Medicine and Oncology
Dr. H. G. Hamby, Texaco, Inc.	Marine Occupational Medicine
Mr. J. W. Hammond, UTSPH	Industrial Hygiene
Dr. H. L. Kaplan, SwRI	Toxicology
Dr. J. A. Schack, NMC	Marine Occupational Medicine
Dr. R. A. Wise, UTSPH	Occupational Medicine

The occupational physicians on the panel worked diligently and cooperatively to formulate a fundamental medical monitoring design. Dr. Cowles provided much of the initial drafting of the medical protocol and guidelines which were reviewed, discussed, revised, and sometimes significantly modified by the actions of the panel. Her willingness to document draft approaches and submit them to the open discussions and review of the panel expedited the process of determining panel consensus on the various subjects. Dr. Wise, formerly with EXXON Corporation, provided specific recommendations for the medical data forms and physician qualifications for the medical monitoring design presented herein. Drs. Schack and Hamby provided the panel with insights from union and industry perspectives and have helped mold the product of this study into a form which is more practical and usable.

Professor Jim Hammond, a Certified Industrial Hygienist who previously headed the industrial hygiene section at EXXON Corporation, provided the panel with an enormous knowledge of industrial chemicals and their effects on workers. He and his students and colleagues at the School of Public Health devoted a great deal of time and effort to preparation and review of industrial hygiene data for use in this study. In addition, Professor Hammond provided the initial ideas and drafting of guidelines for industrial hygiene which have been adopted in the marine occupational safety and health program reported herein.

Mr. Astleford, principal investigator for a number of recent studies of occupational exposures in the marine industry conducted for the Coast Guard, shared his knowledge of marine operations, work scenarios, and exposure

measurements with the study panel. This information has helped determine the types of marine personnel who should be included in the medical monitoring program. Dr. Kaplan, a toxicologist formerly with NASA concerned with exposure concentrations in confined spaces, provided the panel with assessment of the toxicological significance of measured exposure levels and developed guidelines for biological monitoring of occupational exposures which are presented in this report.

The panel was supported by a large number of scientific advisors in various areas of expertise. Many of these are mentioned in the acknowledgements section of this report and others, too numerous to mention, also provided support to the study team.

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II. STUDY DESIGN

II.1 Method of Approach

The marine medical monitoring program was developed in the following manner. Background information on existing relevant medical monitoring programs and relevant regulations were collected and reviewed by the panel. Additional data on bulk liquid cargos transported in the marine industry and on various marine worker populations were collected for review by the panel. Panel meetings were convened at intervals during the study period and specific aspects of the medical monitoring program were addressed at each panel meeting.

During intervening periods between panel meetings, the project staff at SwRI analyzed the results of the preceding meeting, collected additional information as necessary, and prepared reports and working papers to document the interim results. A bibliography of the more pertinent materials collected and reviewed during the course of the study is included in this report.

In this manner, the various elements of a marine medical monitoring program and important supporting information systems were developed. These activities included:

(1) Definition of a design population
(2) Selection and classification of marine toxic substances
(3) Development of a hazardous substances data system
(4) Development of biochemical and medical data
(5) Development of guidelines for industrial hygiene
(6) Development of guidelines for biological monitoring
(7) Development of medical protocol and guidelines
(8) Selection and definition of data forms
(9) Development of a conceptual data management system

II.2 Collection and Preparation of Background Information

To support the design of a medical monitoring program for marine hazardous chemical workers, a significant set of background information was collected for five topics:

Marine Hazardous Substances,
Design Population,
Work Scenarios,
Existing Medical Monitoring Programs, and
Seafarers Health Improvement Program (SHIP).

Some of these topics required a significant amount of data preparation. The pertinent data collection and preparation activities and the resulting information are discussed as follows.

II.2.1 Marine Hazardous Substances

Hazardous substances encountered in the marine work environment include hazardous cargos regulated under Subchapter D and Subchapter O (CFR 46 Parts 30-40 and 150-154, respectively) and non-cargo toxic substances encountered in maintenance and other routine operations aboard tankers and barges. A listing of all chemicals regulated as of 19 May 1983 in marine transportation under Subchapters D and O was obtained from the USCG Cargo and Hazards Branch [11] and this listing has served as the basis for defining the hazardous cargos of concern to the marine medical monitoring program. A listing of these substances is presented in Appendix A of this report. In addition to these hazardous cargo substances, non-cargo toxic substances encountered in the marine environment in maintenance and other routine operations also pose a potential for exposure. Pertinent non-cargo substances in the marine environment, as designated by the panel industrial hygienist, are also presented in the listing in Appendix A. The listing in Appendix A contains a total of 699 cargo and non-cargo hazardous substances which are considered by the study panel to comprise the marine hazardous substances for application to medical monitoring design.

A rationale was developed to rank the marine hazardous substances and to determine a set of toxicants to be covered in the medical monitoring program. For this purpose, the substances were separated into six priority classes:

Priority Class	Description of Class
1	Carcinogen Cargos
2	High Toxic Hazard Cargos (Noncarcinogens)
3	Toxic Hazard Cargos
4	Possible Toxic Hazard Cargos
5	Other Hazardous Cargos
6	Non-cargo Substances with Toxic Hazard

In general, the priority classes decrease in toxic hazard from Priority Class 1 to Priority Class 5. Priority Class 6 contains non-cargo substances, some of which are highly toxic. Relevant information on the health hazard of occupational exposures for Classes 1-3 substances has been documented by the American Conference of Governmental Industrial Hygienists (ACGIH) [12] and this information has been used to classify these cargo substances.

The substances designated Class 1 are bulk liquid cargos which are known or suspected carcinogens as documented by the ACGIH. The Class 1 designation indicates that these substances are considered by the Task III panel to exhibit the greatest potential for occupational health effects and warrant the greatest precautions for avoidance of exposures.

The substances designated Classes 2 and 3 include the remainder of all bulk liquid cargos regulated under Subchapters O and D for which a threshold limit value (TLV) has been assigned by the ACGIH. The differentiation between Classes 2 and 3 is based primarily on the hazard of toxic exposures via respiration. A respiratory hazard index was developed and used to rank the substances in this regard. This index is defined as the concentration at saturation (CS) in parts per million (ppm) divided by the current ACGIH time weighted average (TWA) threshold limit value in ppm where the concentration at saturation is the maximum concentration of a chemical

vapor in air at 20°C and one atmosphere pressure. The respiratory hazard index can be can be expressed as follows:

Respiratory Hazard Index = CS(ppm)/TWA(ppm).

All cargo substances with a respiratory hazard index (CS/TWA) of 10,000 or greater have been included in Priority Class 2, High Toxic Hazard. In addition, substances in Classes 3, 4 and 5 have been evaluated individually to determine if a rationale based on parameters other than respiratory hazard should be used to justify inclusion in Class 2. These other parameters are:

(1) Potential contribution to exposure by skin absorption
(2) Extreme toxicity without regard to vapor pressure
(3) NAS/NFPA classification [1]

For Class 4 substances, information on the health hazard of occupational exposures is not available from ACGIH; relevant data have been obtained from sources other than the ACGIH. Because the ACGIH has been considered by the Task III panel to be the most current and correct source of such information, the health hazard information available for Class 4 substances is considered to be of importance, but not of the same stature as ACGIH data on health hazards associated with occupational exposures.

For Class 5 substances, no data on health hazards associated with occupational exposures have been identified for inclusion in this report. These substances are known to present a safety hazard and thus are regulated in commerce under Subchapter O or Subchapter D. They may or may not exhibit an occupational health hazard.

Class 6 substances are not transported as bulk liquid cargos but are encountered in the marine environment in maintenance and other routine operations. The potential for exposures to these substances is generally less than for exposure to cargo substances, and thus they have been classed in the lowest priority classification. However, all substances designated as Class 6 do exhibit an occupational health hazard as documented by ACGIH [10].

To rank the marine hazardous substances and determine a set of toxicants to be covered in the medical monitoring program, the following chemical and health hazard information were collected and studied:

(1) Threshold limit values (TLV)

(2) Short term exposure limits (STEL)

(3) Immediately dangerous to life and health concentrations (IDLH)

(4) Odor threshold

(5) Concentration at saturation

(6) Carcinogenicity

(7) National Fire Protection Associates health hazard classification

(8) National Academy of Sciences health hazard rating

(9) Various other health hazard information

An attempt was made to collect data on the annual amount shipped in marine transportation. Shipment data were found to be inconsistent and somewhat incomplete therefore this parameter could not be used to rank the commodities transported in bulk in the marine mode.

Because of the size of this data set, a data system was developed to maintain and process the data compiled for the marine hazardous substances are documented in a separate volume entitled: "A Marine Hazardous Substances Data System" [1] which is Volume II of this final report. The purpose of Volume II is to provide a ready reference for threshold limits and other exposure related information for the marine hazardous substances. The data system is designed to provide an efficient method for obtaining specific subsets of data from the data bank of 699 substances with twenty-two separate types of information for each substance.

Applying the rationale for ranking the marine hazardous substances discussed previously and the chemical and health hazard data documented in Volume II, the marine hazardous substances were ranked into six

priority classes. The study panel has designated Class 1 - Carcinogen Cargos and Class 2 - High Toxic Hazard Cargos to comprise the minimum marine hazardous substances for application to medical monitoring design. These substances are listed in Tables 1 and 2, respectively.

Three columns of information are provided in Tables 1 and 2: the chemical name, the CHRIS Code used in the U. S. Coast Guard Chemical Response Information System as documented in Reference 13, and indication of the regulation of the cargo under 46 CFR Subchapter O. For information on the specific substances assigned to other priority classes and for detailed information on threshold limit values and other occupational health and exposure related topics for the 699 marine hazardous substances, the reader is referred to Volume II of this report [1].

The designation of Class 1 and Class 2 substances for application to marine medical monitoring is intended as a minimum requirement, not a limitation regarding substances important to medical monitoring. The operator of a medical monitoring program should consider inclusion of additional substances from other classes as deemed appropriate. Further, it should be recognized that the designation of substances important to a given medical monitoring program will need to be kept current. Additional chemicals are routinely submitted to the Coast Guard for evaluation and classification regarding marine commerce and new health data on chemicals previously classified can cause a need for change of the previous classification. These additional chemicals and new health data need to be considered as they become available. The data for the classification of marine hazardous substances presented in this report should be routinely reconsidered and reclassified as appropriate by any user applying these data to a medical monitoring program.

II.2.2 Design Population

The design population for the marine medical monitoring program documented in this study is comprised of workers with occupations which potentially expose them to cargo substances regulated in marine transport by the United States Coast Guard under Title 46 of the Code of Federal Regulations, Subchapter D and Subchapter O. Occupations specifically included are:

TABLE 1. CLASS 1 SUBSTANCES - CARCINOGEN CARGOS

22-JUL-85

CHEMICAL NAME	CHRIS CODE	CFR
ACRYLONITRILE	ACN	0
BENZENE	BNZ	0
BENZENE HYDROCARBON MIX (> OR = 10% BEN)	BHB	0
BENZENE HYDROCARBON MIX (WITH ACETYLENE)	BHA	0
BENZENE, TOLUENE, XYLENE MIXTURE	BTX	0
BUTADIENE (1,3 BUTADIENE)	BDI	0
BUTADIENE, BUTYLENE MIX WITH ACETYLENES	BBM	0
CARBON TETRACHLORIDE	CBT	0
CHLOROFORM	CRF	0
ETHYLENE DIBROMIDE	EDB	0
ETHYLENE OXIDE	EOX	0
ETHYLENE OXIDE, PROPYLENE OXIDE MIXTURE	EPM	0
FORMALDEHYDE SOLUTION	FMS	0
NITROPROPANE (1-, 2-, AND MIXTURES)	NPM	0
2-NITROPROPANE	NPP	0
NITROPROPANE (60%), NITROETHANE (40%)	NNM	0
O-TOLUIDINE	TLI	0
VINYL CHLORIDE	VCM	0

TOTAL OF 18 ITEM(S) IN TABLE

TABLE 2. CLASS 2 SUBSTANCES - HIGH TOXIC HAZARD CARGOS

22-JUL-85

CHEMICAL NAME	CHRIS CODE	CFR
ACETONE CYANOHYDRIN	ACY	0
ALLYL ALCOHOL	ALA	0
ALLYL CHLORIDE	ALC	0
AMMONIA, ANHYDROUS	AMA	0
ANILINE	ANL	0
BENZYL CHLORIDE	BCL	0
BUTYLAMINE (ALL ISOMERS)	BTY	0
N-BUTYLAMINE	BAM	0
SEC-BUTYLAMINE	BTL	0
TERT-BUTYLAMINE	BUA	0
CARBON DISULFIDE	CBB	0
CHLORINE	CLX	0
CHLOROSULFONIC ACID	CSA	0
CROTONALDEHYDE	CTA	0
2,2'-DICHLOROETHYL ETHER	DEE	0
DICHLOROMONOFLUOROMETHANE	DFM	0
1,3-DICHLOROPROPENE	DPU	0
DICHLOROPROPENE (1,1- 1,2- 1,3- AND MIX)	DPS	0
DICHLOROPROPENE, DICHLOROPROPANE MIXTURE)	DMX	0
DIISOPROPYLAMINE	DIA	0
DIMETHYLAMINE	DMA	0
DIMETHYLAMINE SOLUTION (45% OR LESS)	DMG	0
DIMETHYLAMINE SOLUTION (>45% AND <=55%)	DMY	0
DIMETHYLAMINE SOLUTION (55% AND <65%)	DMC	0
1,4-DIOXANE	DOX	0
DIPHENYLMETHANE DIISOCYANATE	DPM	0
EPICHLOROHYDRIN	EPC	0
ETHYLAMINE	EAM	0
ETHYLAMINE (40% OR LESS)	EAQ	0
ETHYLAMINE (72% OR LESS)	EAN	0
ETHYLENE DICHLORIDE	EDC	0
GLUTARALDEHYDE (50% OR LESS)	GTA	0
HYDROCHLORIC ACID	HCL	0
HYDROFLUORIC ACID	HFA	0
HYDROGEN CHLORIDE	HDC	0
HYDROGEN FLUORIDE	HFX	0
ISOPROPYLAMINE	IPP	0
ISOPROPYLAMINE (90% OR LESS)	IPQ	0
METHYLAMINE SOLUTION (42% OR LESS)	MSZ	0
METHYL BROMIDE	MTB	0
METHYL CHLORIDE	MTC	0
MOTOR FUEL ANTIKNOCK CMPDS (PB ALKYLS)	MFA	0
NITRIC ACID	NAC	0
NITRIC ACID (70% OR LESS)	NCD	0
NITROBENZENE	NTB	0
PHENOL	PHN	0
PHOSPHORUS, WHITE	PPW	0
PROPYLENE OXIDE	POX	0
STYRENE	STY	0
SULFUR DIOXIDE	SFD	0
1,1,2,2-TETRACHLOROETHANE	TEC	0
TOLUENE 2,4-DIISOCYANATE	TDI	0
TOLUENE DIISOCYANATE, DIPHENYLMET DIISOC	TDD	0
TRICHLOROETHYLENE	TCL	0
VINYL ACETATE	VAM	0
VINYLIDENECHLORIDE	VCI	0

TOTAL OF 56 ITEM(S) IN TABLE

(1) Workers on deep sea tankships which carry Subchapter D or O substances,

(2) Workers on barges in inland waters which carry Subchapter D or O substances, and

(3) U. S. Coast Guard personnel directly involved in regulation and inspection of marine transportation activities: marine inspectors, pollution prevention inspectors, and pollution response investigators.

Coast Guard Personnel. Of the three types of potentially exposed populations, the Coast Guard personnel are the best defined. In a report of a Coast Guard ad hoc working group on marine safety/environmental response personnel [14]. That report indicates that approximately 2250 military personnel are assigned to various offices involved in marine inspection, port safety, spill response, and strike team activities. Perhaps 80%, or 1800, of those personnel assigned are exposed to chemical/petroleum vapors and liquids during the course of their work, most of them fairly routinely.

Personnel distribution in the Coast Guard is:

Type of Unit	No. of Units	Military Personnel Assigned (CO, WO, enlisted)
MIO, MIDET	10	325
COTP, PSSTA, PSD	12	370
MSO, MSD	68	1450
Strike Teams	3	80
		2250

Tankership Personnel. Tankermen aboard deep sea tankers are the next best defined population of the three types. At present, tankers which carry bulk liquid cargos account for more than one-half of the vessels in the U. S.-flag fleet: 338 tankers out of a total of 571 privately owned vessels of 1000 gross tons or more [15]. Other types of vessels in the merchant vessel fleet include freighters, container vessels, combination passenger-cargo carriers, and bulk solid carriers. During the ten-year period 1973-1983, the total U. S.-flag fleet decreased from 616 to 571 vessels. However, the number of tankers increased during that same period from 239 to

288 vessels. This 20 percent increase reflects an increasing volume of marine commerce involving bulk liquid products.

A number of union organizations form a framework of collective bargaining between deep sea tankermen and management. These organizations fall into two categories: AFL-CIO organizations and independent or company organizations. The Seafaring Guide and Directory of Labor Management Affiliations [16] lists eleven major AFL-CIO affiliated unions and ten major independent or company unions.

The American Institute of Merchant shipping (AIMS) is the principal trade association of the companies which operate tankers in the U.S.-flag fleet. This trade association currently lists 29 member companies [17] who, collectively, employ the majority of the estimated 15 - 20,000 merchant tankermen on U. S.-flag ships. Implementation of a medical monitoring program for deep sea tankermen would ultimately involve some or all of the twenty-nine member companies of AIMS as well as the twenty-one union organizations.

Barge Tankermen. Barge tankermen are the least defined type of three types of exposed populations. No available information sources comprehensively describe the inland waterways portion of marine operations. To obtain a more complete set of information regarding barge tankermen who work on U. S. documented vessels transporting bulk liquids in the inland waterways of the United States, a survey was accomplished as part of the study reported herein. The results of that survey is documented in Appendix B of this report.

From Appendix B, the barge and towing industry in the U. S. consists of some 1,200 companies operating on a system of 25,543 miles of navigable inland and intracoastal waterways, serving 87 percent of major U. S. cities. The primary trade association of maritime companies and other marine related businesses along inland waterway trade routes is the American Waterways Operators, Inc. (AWO) located in Arlington, Virginia. The number of towing vessels and barges operated in 1982 for the transportation of freight [18] was:

Towboats and Tugs	- 4,890
Dry Cargo Barges and Scows	- 29,479
Tank Barges	- 4,909
Total	39,278

The traffic transported on inland waterways in 1982 was 571,005,177 net tons for 288,047,430,000 ton miles. Also in 1981-82, vessels of the types cited above carried 239,640 thousand net tons of petroleum and petroleum products and 42,372 thousand net tons of chemicals and fertilizers. Although the number of vessels operated over the past decade increased slightly, the net tonnage carried in 1982 was the lowest since 1971 and the ton miles traveled in 1982 was the lowest since 1977. The inland waterways workforce in 1984 was estimated as about 225,000, of which approximately 100,000 were considered to be "experienced" which, in this case, means they had practical experience and some training. A former MarAd official estimated that of this group, possibly 20,000 had acquired the tankerman endorsement.

Major transporters of hazardous substances, particularly Subchapter D and Subchapter O cargos which have been identified include: Agrico Chemical, Allied Chemical, American Commercial Barge Lines, Amoco Chemical (Division of Southern Towing), Dow Chemical, Dupont, Monsanto, Stauffer Chemical, Union Carbide, and Hooker Chemical. Also some 238 public terminals, 108 fleeting and harbor service firms, 49 independent tanker firms and approximately 1,260 private terminals were identified in the survey.

Some of the barge tankermen are associated with the same union organizations referred to for the deep sea tankermen. However, a large portion of the barge tankermen operate independently of any union organization. Implementation of a medical monitoring program for barge tankermen would ultimately involve a large number of independent chemical companies, marine terminals, fleeting and harbor service firms, and independent tankermen firms.

Summary. The design population of personnel potentially exposed may be summarized as follows:

Population Type	Population Estimate
Tankership personnel	15-20,000
Barge tankermen	approximately 20,000
U. S. Coast Guard personnel	1,800

The Coast guard population is well defined and, due to the military nature of the organization, poses the minimum organizational problems to implementation of a medical monitoring program. The deep sea tankermen are very unionized and are located in a limited number of companies and unions. The barge tankermen are a very diverse set of workers located in a large number of companies and independent organizations, and, due to the diverse and independent nature of the barge and towing industry, pose the greatest organizational problems to implementation of a medical monitoring program.

II.2.3 Work Scenarios

Work scenarios for various categories of the marine hazardous chemical worker were developed in Task I of this study [1]. A listing of the work scenarios for which exposure potential was evaluated in Task I is presented in Table 3. Barge cleaning operations are usually performed at shore facilities with shore-based personnel and do not usually involve barge tankermen. Matters related to occupational safety and health for some shore-based personnel are under the jurisdication of the Occupational Safety and Health Administration (OSHA).

The industrial hygiene program which will accompany the medical monitoring program in a comprehensive health and safety program must be designed to determine exposure levels for these work scenarios. Personnel involved in these work scenarios are potentially exposed to hazardous chemicals and should be enrolled in a medical monitoring program unless sufficient industrial hygiene measurements indicate that a hazard does not exist.

TABLE 3. WORK SCENARIOS

Tankership Personnel

I. Period Tank Gauging

- Open
- Restricted

II. Tank Topoff

- Open
- Restricted
- Short loading, shore stop

III. Tank Cleaning

- Washing
- Gas freeing
- Entry for manual cleaning
- Product line drainage (deck (piping)

IV. Miscellaneous Tank Entry

- Inspection of wall coating material
- Preloading inspection
- Equipment inspection and/or repair

V. Pumproom Activities

VI. Deck Day Work

- Sandblasting
- Spray painting
- Derusting/chipping
- Equipment maintenance

VII. Hose Hookup and Disconnect

- Manual
- Run-a-round changing

VIII. Engine Room

IX. Tank Ballasting Gauging

X. Product Discharge

- Periodic Gauging
- Stripping

TABLE 3. WORK SCENARIOS (cont'd.)

Barge Operations Personnel

I. Barge Loading

- Periodic Tank Gauging - Open
- Tank Topoff - Open
- Hose Hookup and Disconnect - Manual

II. Barge Cleaning

- Washing
- Gas Freeing
- Entry for Manual Cleaning

USCG Personnel

I. Marine Inspection Office (MIO) Personnel

- Barge inspection - topside
- Barge inspection - internals and void spaces
- Tanker inspection - biennial/LOC
- Tanker inspection - other than biennial

II. Captain of the Port - Pollution Prevention

III. Captain of the Port - Pollution Response

II.2.4 Existing Medical Monitoring Programs

Three existing medical monitoring programs were reviewed in detail for potential application to the current study: those of the USAF, USCG, and USEPA. The general outline of the scope and coverage of each of the programs was examined and the outstanding strong or weak points for each of the programs were determined. Each of these topics is discussed as follows:

USCG. The USCG occupational medical monitoring program (OMMP) is outlined in: The Coast Guard Medical Manual, COMDTINST M6000.1 [19]. It is similar to that of the Navy Sealift Command and is applicable to Coast Guard personnel classified as occupationally exposed. The designation of occupationally exposed for medical monitoring purposes applies to a work environment which at some times has exposures equal to or more than 50% of the most recent ACGIH (or equivalent) standards. In general, the program is well designed and served as a basis for the medical monitoring program designed in this study. The procedure involves looking up designated occupations or designated hazardous substances to identify specific exam types with detailed instructions as to exam content. A medical exam code is specified for specific designated occupations and for specific hazardous substances. It is designed to allow a corpsman to look up information. A unified, computerized data base for industrial hygiene and medical records to support the medical monitoring program is presently being implemented. Areas in which the OMMP design needs to be extended or expanded in the medical monitoring program being designed in this study include: (1) Some provision to record and address unusual exposure events, (2) Specification of acute or chronic exposures or history of exposures, and (3) Instructions regarding what to do when elevated levels or abnormal findings result from testing procedures.

USEPA. The EPA program is documented in a memorandum entitled: Occupational Medical Monitoring Program Guidelines [20]. It appears to be written as a legal document rather than a usable guideline. One good feature is the detail provided regarding laboratory quality control. The program includes a basic exam with add-ons for specific exposures including baseline exam, annual exam, and unscheduled exams for special situations. Specification of testing is general, without details and no standardized forms

for recording results of medical examinations are provided. The frequency of periodic examination is not designated. The occupational medical history is poor, particularly regarding specific chemical exposures. The individual is essentially asked to provide a listing of previous exposures. There is a need to establish baseline levels of exposures. Respiratory protection is addressed well and the respiratory protection form is quite good. In general, the EPA program is the least detailed of the three programs examined.

USAF. The USAF medical monitoring program has the label Standardized Occupational Health Program (SOHP) and is documented in AFOSCH Standard 161-17 [21]. It includes medical and industrial hygiene monitoring and record keeping activities to support the monitoring activities. Both military and civil service civilian personnel are included in the system, but not contractors. Environmental parameters include:

non-ionizing radiation
heat/cold
chemical agents
physical agents
biological exposures.

Forms include IH sampling data forms, chronological workplace data sheet and clinical occupational examination forms. The protocol is fairly comprehensive and includes reference to specific hazards such as radar, r.f. emitters, and laser hazards. Some strong points include a very positive approach, starting with a preplacement exam, IH data presented to the medical department at the time of periodic examination, and yearly IH surveys of the workplace. In general, workplace surveys are used to classify personnel as occupationally exposed or not; personnel classified as occupational exposed are monitored with SOHP. Some particularly good characteristics include use of unique identifier codes, the exposure form, the training and fit test form, the work history form, the past exam history form, and the workplace exposure form. Weak aspects of SOHP include no provision for follow-up of spills or excessively high exposures and no provision for extended workshift exposures.

II.2.5 Seafarers Health Improvement Program

The Seafarers Health Improvement Program (SHIP) was established in 1978 under the auspices of the U. S. Public Health Service (PHS) as collaborative effort between PHS, other federal agencies and the maritime industry. A primary purpose of SHIP has been to stimulate communication, interaction, and dissemination of information among relevant parties interested in and responsible for various aspects of the health and safety of the American seafarer. PHS responsibility to provide medical care for seafarers was terminated by the Omnibus Budget Reconciliation Act of 1981 (P.L. 97-35, section 986). Since losing PHS as a sponsor in 1981, SHIP has continued as a non-governmental organization with meeting facilities and a limited amount of administrative support provided by the Maritime Administration (MarAd), Department of Transportation.

SHIP has resulted in physical examination standards which have been recommended to the shipping industry. Qualifications for U. S. merchant marine entry level physical examinations were developed and published as "Reference Guide Physical Examination Standards for Original Entry into the U. S. Merchant Marine." This reference guide has been promulgated to the industry through Coast Guard Navigation and Vessel Inspection Circular NVIC 3-83 [22].

A reference guide for physicians for retention or disqualification of seafarers has also been produced by SHIP entitled "Reference Guide for Physicians: Physical Examination for Retention of Seafarers in the U. S. Merchant Marine" [23]. This guide addresses the issue of disqualifying conditions for shipboard employment and specifies the resulting duty status as: 1) fit for duty, 2) not fit for duty, and 3) permanently not fit for duty. The guide was adopted by SHIP and forwarded to the Maritime Administration for voluntary application in the industry.

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III. THE MARINE MEDICAL MONITORING PROGRAM (MMMP)

III.1 Design Objective

The objective of Task III was to design a medical monitoring program for the marine hazardous chemical worker which will detect adverse health effects associated with their occupational exposures. With this objective in mind, the MMMP developed in Task III has been designed to screen individual workers for evidence of adverse health effects potentially associated with occupational exposures, to provide diagnostic support to occupational physicians performing such screening, and to identify trends in health effects that may be related to occupational exposures.

The focus of the MMMP design has been on health effects associated with occupational exposures. Accordingly, the MMMP is not intended to provide a guideline for a comprehensive medical monitoring program. Rather, it is designed to provide a method which will adequately screen for adverse health effects of occupational exposures to noise and toxic chemical substances in the marine industry. The methods described for the MMMP should be added to an existing occupational health care plan which has been designed to cover all necessary aspects of good health maintenance other than exposures to toxic chemicals and noise.

III.2 General Design

The general design of the MMMP is discussed in this section. The discussion provides an overview of the major elements and concepts on which the MMMP is based.

III.2.1 Designation of Personnel

The MMMP has been designed for application to personnel designated as "occupationally exposed for medical monitoring purposes". This designation can be based on potential for exposure or can result from known or measured esposure levels and applied categorically to all personnel of a specific job title or assignment. As discussed previously in Section II.2.1,

Class 1 and Class 2 marine hazardous substances have been designated the minimum set of substances of concern to medical monitoring regarding occupational exposures or potential for exposure. These substances will serve as the baseline for any specific marine medical monitoring program application. The operator of a specific medical monitoring program should also consider the designation of additional substances from other classes as deemed appropriate for the specific occupational setting.

For measured exposures to one or more of the designated hazardous substances, the exposure will be designated an occupational exposure for medical monitoring purposes if the concentration of the chemical(s) equals or exceeds 50% of the TLV-TWA for the chemical or mixture of chemicals for at least three days per calendar quarter. This criterion is in accordance with guidelines promulgated in the USCG Medical Manual, COMDTINST M6000.1, Change No. 27, dated June 28, 1984, which states that, unless otherwise specified, a person engaged in a designated occupation is considered occupationally exposed for medical monitoring purposes if the concentration in the work environment "is more than 50% of the time weighted average of the applicable workplace standard for at least three days per calendar quarter" [19]. Where data are not available to support or reject the criterion of three days per calendar quarter, application of this designation is based on the presumption that the individual workers do encounter comparable concentrations at least three days per calendar quarter.

Because it is impractical to measure exposure levels for all circumstances of occupational exposures, known potential for exposure is also used as a basis for designation of occupational exposures for medical monitoring purposes. A job scenario that involves the potential for exposure to toxic vapor concentrations and/or the potential for direct contact with the liquid phase of toxic substances with a known dermal absorption hazard can be categorically designated to involve occupational exposures for medical monitoring purposes. This designation can then be applied to all personnel who are assigned to the specific job, and moreover, to all personnel of a specific job title or job assignment.

All persons engaged in an occupation that has been categorically designated as occupationally exposed for medical monitoring purposes should be enrolled in the medical monitoring program.

III.2.2 Basic Medical Examination

A basic medical examination has been developed to screen for adverse health effects of occupational exposures to noise and toxic chemicals. It is designed to be performed periodically on all persons designated as occupationally exposed for medical monitoring purposes. As a minimum, it should be performed: 1) at pre-employment or pre-placement in an occupation which has been categorically designated as occupationally exposed for medical monitoring purposes, 2) periodically during employment, and 3) at termination of employment. Medical protocol and guidelines for the basic medical examination are presented and discussed in Section III.3.

III.2.3 Target Organ Specific Medical Examination

Special, episodic examinations performed as a result of an actual or suspected acute overexposure to a specific toxic chemical or mixture of toxic chemicals should emphasize the major target organs. For this purpose, specific examination protocol guidelines have been developed for each of the following target organ systems:

(1) Cardiovascular system and heart
(2) Central and peripheral nervous system
(3) Eyes
(4) Hematopoietic system
(5) Kidneys and urinary tract
(6) Liver and gastro-intestinal system
(7) Lower respiratory tract
(8) Upper respiratory tract
(9) Skin

Medical examination protocols and guidelines for the target organ specific examination are presented and discussed in Section III.3 for the above listed organ systems. Each protocol is labeled with the Current Medical Information and Terminology (CMIT) classification which has been adopted by the American Medical Association [24]. The CMIT provides a standardized numbering scheme for the naming and description of diseases for reference in clinical recording and reporting, and applications in the computerization of medical information. The CMIT classification is as follows:

CMIT Classification	Organ System
00	Body as a whole, including Psyche
01	Integumentary System (skin)
02	Musculoskeletal System
03	Respiratory System
04	Cardiovascular System
05	Hemic and Lymphatic Systems
06	Digestive System
07	Urogenital System
08	Endocrine System
09	Nervous System
10	Organs of Special Sense

III.2.4 Frequency and Content of Medical Examinations

A recommended schedule of medical examinations for marine workers designated as occupationally exposed for medical monitoring purposes is presented in Table 4. There are four types of exams:

(1) Pre-employment or pre-placement,
(2) Periodic during employment,
(3) Termination of employment, and
(4) Episodic.

TABLE 4. RECOMMENDED FREQUENCY AND CONTENT OF MEDICAL EXAMINATIONS

Examination Type	Examination Content
Pre-employment or Placement	Basic protocol plus emphasis on pre-existing conditions which could be exacerbated by toxic chemical exposures
Periodic at Specified Intervals During Employment	Basic protocol plus emphasis of target organ systems for known or suspected exposures.
Termination of Employment	Basic protocol plus emphasis of target organ systems for known or suspected exposures. Medical status summated. Counseling with recommendations for future medical exams.
Episodic in response to acute overexposure or specific request	Target organ specific protocol

For the pre-employment or pre-placement medical examination, particular attention must be given to evaluation of conditions which could be exacerbated by toxic chemical exposures. These include, in addition to the basic protocol, evaluation of:

(1) Chronic allergic conditions,

(2) Anemia or other chronic blood dyscrasia,

(3) Chronic or recurring cardiac arrhythmias,

(4) Chronic liver disease (chronic active hepatitis, cirrhosis),

(5) Chronic lung disease (asthma, chronic bronchitis, emphysema),

(6) Chronic neurologic condition (multiple sclerosis, myasthenia gravis, peripheral neuropathy),

(7) Chronic renal disease,

(8) Chronic or recurrent skin conditions, and

(9) History of malignant disease.

For the periodic medical examination, the frequency of examination is dependent on risk of exposure:

Standard Frequency: Every Three Years - A complete medical examination covering all aspects of the basic medical examination protocol will be required at least every three years for all marine workers designated as occupationally exposed for medical monitoring purposes. In addition, a partial medical examination should be accomplished annually which includes, as a minimum:

(1) Height and Weight,
(2) Blood pressure and pulse,
(3) Medical and exposure history update,
(4) Audiogram, if indicated by exposure.

Since the partial examination does not involve a complete physical examination it need not be performed by a physician; however, the results of the partial medical examination must be reviewed by a physician or medical officers.

Special Frequency: Annual Basic Examination - Marine workers subject to the following special circumstances will require the complete medical examination covering all aspects of the basic medical examination protocol at least annually:

(1) Personnel classified as high risk due to high potential for exposure to Class 1 or Class 2 chemical substances or to additional chemicals in other classes as designated at the discretion of the marine operator's medical and safety officers. This requires both of the following conditions to be met:

    (a) High potential for exposure in routine job assignment. and

    (b) Known or suspected involvement with designated chemical substances.

(2) Personnel with special need of annual examinations as designated by physician's recommendation.

management. In addition, it is recommended that physicians supporting the program have the following specific qualifications in occupational medicine:

(1) Preferable qualifications: boards in occupational medicine plus experience in primary care specialty;

(2) Acceptable qualifications: boards in internal medicine, family practice, or other primary care specialty plus experience in occupational medicine.

If a physician without one of the listed qualifications must be utilized due to special, temporary circumstances, the examining physician should have a number of easily accessible consultants to whom patients can be referred for examination, diagnosis, and treatment, reserving the routine cases for himself.

III.2.6 Medical Support Information

For each individual scheduled for medical examination, a package of medical support information will be provided to the physician as a diagnostic aid. If possible, this package should be provided to the physician prior to the medical examination, so the physician may familiarize himself with the history and prior health status of the individual to be examined. The package will contain:

(1) Medical history,

(2) Occupational history,

(3) Exposure history, including:

  (a) Record of potential exposures--toxic substances the individual has potentially contacted in work activities,

  (b) Record of any personal dosimetry on file for the individual,

  (c) Record of unusual exposure episodes, including concentration or dosimetry data, if available.

III.2.7 Auxiliary Support Systems

A number of resources have been developed to support the administration of a marine medical monitoring program and to provide direct support to the examining physician. Each of these is briefly described here and is discussed in more detail in Section III.4.

(1) A hazardous substance data system which provides easy access to detailed data for 699 hazardous substances encountered in the marine industry.

(2) A set of biochemical and medical data sheets for 179 of the more toxic hazardous substances listed in item (1) above which will serve as a desk reference for such items as target organ systems and the more important acute and chronic effects of exposure.

(3) Guidelines for an industrial hygiene program to provide information on measured concentrations and personal exposures in the work place.

(4) Guidelines for biological monitoring of exposures to toxic substances in the work place with specific information for 26 toxic substances for which methods are available.

(5) Two methods for development of potential exposure information on marine hazardous chemical workers: one which is self-documented, and a second, which employs an indirect method based on cargoes loaded and personnel records.

(6) A method for using sentinel health effects for the surveillance of work place diseases.

(7) A data management system to provide a record of the data generated by medical monitoring and to provide a means of rapid access to data files for specific information and for data summaries.

III.3 Medical Monitoring Protocol and Guidelines

The medical monitoring protocol for the basic medical examination and for the target organ specific medical monitoring program are presented in this section. In addition, recommended guidelines for the follow-up of abnormal laboratory results are presented separately. A glossary of the medical abbreviations used in this report is provided on page 62.

III.3.1 Basic Medical Examination Protocol

The basic medical examination for persons designated as occupationally exposed for medical monitoring purposes will include the core examination protocol presented in Table 5. The core examination should be extended to cover the elements in Table 6 for special circumstances of age or exposure history.

III.3.2 Target Organ Specific Medical Examination Protocols

Protocols for a target organ specific medical examination are presented in Table 7. A separate protocol is presented for each of ten major target organ systems. The protocols are applicable to a special episodic medical examination performed as a result of an actual or suspected acute overexposure to a specific toxic chemical or mixture of chemicals. Each protocol provides a general guide for the medical examination and follow-up requirements for the major target organ systems associated with acute overexposure to a given toxic chemical or mixture of chemicals.

TABLE 5. CORE PROTOCOL FOR THE BASIC MEDICAL EXAMINATION

As a minimum, the basic medical examination for marine workers designated as occupationally exposed for medical monitoring purposes should include the following elements:

1. Medical and social history including smoking, drug and alcohol use, reproductive and family history.

2. Occupational history including exposures.

3. Height and weight.

4. Vital signs (temperature, pulse, respirations, blood pressure).

5. Physical examination with particular attention to skin and mucous membranes, lungs, neurologic system, heart, liver and abdomen, kidneys, eyes (including fundoscopic exam, without dilation), and musculoskeletal system.

6. Air conduction audiometry at frequencies from 500-6,000 Hz.

7. Screening spirometry (FEV1, FVC, FEF25-75).

8. Chest X-ray (PA and LAT) at preplacement and termination only, unless indicated by specific exposure.

9. CBC with differential, Hct, Hgb.

10. Urinalysis with dipstick (pH, glucose, protein, ketones) plus microscopic evaluation.

11. Serum chemistry screening for liver and kidney profiles (BUN, creatinine, glucose, cholesterol, uric acid, triglycerides, calcium, SGOT, SGPT, LDH, alkaline phosphatase, bilirubin, or standard SMAC-12).

TABLE 6. ADDITIONAL PROTOCOL FOR THE BASIC MEDICAL EXAMINATION FOR SPECIAL CIRCUMSTANCES OF AGE OR EXPOSURE HISTORY

For special circumstances of age or exposure history, the core examination should be extended to also include the following elements:

1.	For age 35 and over:	EKG at pre-placement and every three years thereafter.
2.	For regular exposures	(30 or more days a year) to the following substances, specific additional tests are indicated:
	(a) Asbestos	Annual respiratory symptom history, pulmonary function testing, and chest X-ray; B-reader interpretation of the X-ray results every five years.
	(b) Benzene	CBC with differential and indices every six months.
	(c) Acrylonitrile	Annual chest X-ray and, if 35 years or older, annual stool hemocult.
	(d) Ethylene Oxide	Annual reproductive history.
	(e) Inorganic lead	Blood lead and zinc protoporphyrin every six months.
	(f) Vinyl chloride	Expanded history of liver disease, transfusions. GGT annually until age 45, then every six months as long as there is exposure to vinyl chloride. (GGT often positive after ETOH ingestion; if GGT abnormal, retest after 72 hours abstention from ETOH.)
3.	For a history of exposures which include:	
	(a) Acute overexposure to a specific toxic substance, or	
	(b) Regular exposures	(30 or more days a year) to Class 1 or Class 2 substances on the priority list of marine hazardous substances,

the relevant target systems should be emphasized as part of the basic exam, but not necessarily to the extent in the protocol for special examinations performed in response to specific, acute overexposures.

TABLE 7. TARGET ORGAN SYSTEM MEDICAL EXAMINATION PROTOCOLS

The following protocols are recommended, as a guide, to emphasize the major target organ system or systems associated with acute overexposures to a given toxic chemical or mixture of chemicals. In addition to the protocols indicated here, each examination should include vital signs (T, P, R, BP) and a careful history of exposure. In all cases, clinical judgement must prevail. If the clinical course is unsatifactory, refer to a specialist for consultation.

Target Organ System	Proposed Medical Exam Protocol
Cardiovascular System and Heart (CMIT Classification 04)	EKG, BP, attention to rate and rhythm of heart, presence of extra sounds, murmurs, snaps or thrills, cardiac size. Evaluate cyanosis, pallor, state of consciousness, hx syncope, cough, examine lungs for rales, signs of congestion. Chest X-ray if clinically indicated. Follow-up 24 hours, also three to six months after acute episode.
Central and Peripheral Nervous System (CMIT Classification 09)	Evaluate state of consciousness, pupils (size and equality), skin color, cranial nerves, adequacy of airway and respiratory function, sensory and motor function, strength, reflexes, vibratory sense, Romberg and Babinski tests. Psychometric testing, nerve conduction studies, etc., if clinically indicated. Follow-up 24 hours and as clinically indicated, six months - one year, for signs chronic sequelae.
Eyes (CMIT Classification 10)	Specific attention to symptoms including tearing, redness, itching, photophobia, pain, etc. Visual acuity testing, fluorescein staining of cornea for tissue damage if indicated, fundoscopic, extraocular movements, response to light and accommodation, pupil size. Slit lamp or visual field examination if indicated. Follow-up in 24 hours.

TABLE 7. TARGET ORGAN SYSTEM MEDICAL EXAMINATION PROTOCOLS (cont'd.)

Target Organ System	Proposed Medical Exam Protocol
Hematopoietic System (Blood and Lymph) (CMIT Classification 05)	Evaluate symptoms, malaise, pallor, faintness. Examine for lymphadenopathy, pallor, petechiae, size of liver and spleen. Obtain CBC with platelet count, reticulocyte count, serum iron and TIBC, serum bilirubin, and urine urobilinogen. Bone marrow examination if symptoms or findings severe. Follow-up one week, one month, six months, and one year.
Kidneys and Urinary Tract (CMIT Classification 07)	Attention to symptoms of urgency, frequency, dysuria, incomplete emptying of bladder, increased nocturia, edema, total output volumes. Check BP, obtain urinalysis with microscopic, BUN, creatinine. Clearance tests such as creatinine clearance; IVP; cystoscopy if clinically indicated. Follow-up 24 hours or as clinically indicated. Repeat U/A, BUN, creatinine in six months.
Liver and Gastrointestinal (CMIT Classification 06)	Abdominal examination for liver size, consistency, and tenderness, intestinal palpation, masses, jaundice, pain, hx: colic, nausea, vomiting, anorexia, fever, bowel function. Liver battery including SGOT, SGPT, alkaline phosphatase, LDH, total bilirubin, GGT. Evaluate possibility of nonexposure related causes of liver disease (e.g., ETOH, and hepatitis). Follow-up 24-48 hours, two weeks, three to six months, longer if studies remain abnormal.
Lower Respiratory Tract (CMIT Classification 03)	Examine for wheezes, rales, rhonchi, increased rate of respiration, cyanosis, other evidence of respiratory distress. Attention to symptoms such as cough, tightness, chest pain. Chest x-ray, spirometry if indicated. Hospitalization for observation if symptoms severe or if agent known to produce delayed pulmonary edema.

TABLE 7. TARGET ORGAN SYSTEM MEDICAL EXAMINATION PROTOCOLS (cont'd.)

Target Organ System	Proposed Medical Exam Protocol
Lower Respiratory Tract (cont'd.)	Follow-up in 24 hours if severe, one week, and three to six months.
Upper Respiratory Tract (Nose, Throat, Trachea) (CMIT Classification 03)	Examination of nose, throat, trachea for irritation, redness swelling. Attention to symptoms such as cough, pain, increased nasal discharge or bleeding. Evaluate for inadequate airway due to edema of affected tissues. Follow-up 24 hours.
Skin (CMIT Classification 01)	Examine skin for temperature, appearance, erythema, edema, rashes, indurations, bruising, abrasions, contusions, petechiae, hemorrhage, increased cracking, keratinization, decreased or increased pigmentation, carotenemia, etc. For halogenated hydrocarton exposures examine for evidence of chloracne. Blood and urine testing if clinically indicated (i.e., phenol exposures, etc.). Follow-up 24 hours - one year as indicated by course.
Bones and Musculoskeletal System (CMIT Classification 02)	No particular protocol indicated. Specific exposure will determine evaluation.
Ears (CMIT Classification 10)	Specific exposure will determine evaluation.
Reproductive System (CMIT Classification 07)	Specific exposure will determine evaluation.

III.3.3 Recommended Guidelines for Follow-up of Abnormal Laboratory Results

Recommended guidelines for follow-up of abnormal laboratory results are presented in Table 8 for CBC, U/A, serum chemistries, and liver function tests. Four categories of individuals have been identified for follow-up of abnormal laboratory results:

(1) Asymptomatic individual with normal exam on routine periodic, with no known overexposures;

(2) Asymptomatic individual with history of exposure to toxin known to affect organ system;

(3) Symptomatic individual;

(4) Pre-employment examinee.

Recommended procedures for follow-up of each of these categories are presented in Table 9.

TABLE B. GENERAL GUIDELINES FOR FOLLOW-UP OF ABNORMAL LABORATORY RESULTS

Abnormalities on CBC:

(1) If severe or abnormalities are multiple and not readily explained, immediate follow-up indicated (severe = WBC $\leq$ 3,000 or $\geq$ 16,000; differential markedly abnormal: Hgb $\leq$ 10; Hct $\leq$ 30; platelets < 100,000).

(2) If less severe, repeat in 1-3 months, depending on work.

(3) In any case, clinical judgement must prevail.

Abnormalities of U/A:

(1) More than trace glucose - immediate follow-up.

(2) More than trace protein - if dilute urine, consider immediate follow-up; if concentrated specimen and no more than 1+ or so, consider repeat in next 2-4 months depending on work schedule.

(3) RBC's in urine - if > 6-8 HPF, consider immediate follow-up.

(4) Other abnormalities of urine - use clinical judgement.

Abnormalities in serum chemistries:

(1) Clinical judgement with view toward what consequences might be if examinee sent to sea;

(2) BUN >30 - consider immediate follow-up.

(3) Creatinine > 2.0 - immediate follow-up (especially if both elevate).

(4) Glucose abnormality - consider immediate follow-up if $\geq$ 120 mg/dl (if known that subject has been fasting).

Liver function elevations:

(1) Consider immediate follow-up if three or more liver function tests elevated (elevated = 10% > normal high range).

(2) If two or fewer tests are elevated, careful clinical review needed - if nonthreatening reason for elevations found, consider repeat follow-up in three months and allow to work if no contradictions. If rising values in three months, immediate follow-up should be considered.

TABLE 9. RECOMMENDED PROCEDURES FOR FOLLOW-UP OF ABNORMAL LABORATORY RESULTS

Category 1 - Asymptomatic Individual, Normal Exam, No Known Overexposures

(1) Confirm abnormal results with repeat tests.

(2) Careful clinical evaluation and consideration of immediate follow-up prior to return to work.

Category 2 - Asymptomatic Individual, Normal Exam, History of Exposure

(1) Confirm abnormal results with repeat tests.

(2) Give particular attention to target organs; consider application of target organ specific protocol.

(3) Consider industrial hygiene consultation.

(4) Careful clinical evaluation and consideration of immediate follow-up prior to return to work.

Category 3 - Symptomatic Individual with Abnormal Lab Test(s)

(1) Confirm abnormal results with repeat tests.

(2) Follow-up symptoms.

(3) Seek additional medical information.

(4) Consider industrial hygiene consultation if history of potential exposures or known overexposures to toxin known to affect target organ system associated with symptoms or abnormal lab test.

(5) Careful clinical evaluation and follow-up prior to return to work.

Category 4 - Pre-employment or Pre-placement Examinee with Abnormal Lab Test

(1) Stress evaluation of pre-existing conditions which could be exacerbated by toxic chemical exposures.

(2) Repeat abnormal test(s) to confirm results.

(3) If abnormal test is confirmed, focus on target organ system(s).

(4) Seek additional medical information.

(5) Defer disposition until clinical status is resolved.

III.3.4 Reference Materials for Physicians

Because the focus of the marine medical monitoring program is health effects associated with occupational exposures to toxic chemicals, the occupational physicians performing medical examinations should have available adequate reference materials on toxic substances found in the marine environment. The following reference materials are recommended:

(1) Occupational Diseases: A guide to Their Recommendation, published by NIOSH [25].

(2) 1984 Emergency Response Guidebook, published by the U.S. Department of Transportation [26].

(3) Hazardous Materials Injuries: Handbook for Pre-Hospital Care, published by Bradford Communications Corporation [27].

(4) Biochemical and Medical Information for Marine Hazardous Substances, prepared by SwRI for the U.S. Coast Guard [4].

(5) NIOSH/OSHA Pocket Guide to Chemical Hazards, published by the National Institute for Occupational Safety and Healty [28].

(6) Chemical Data Guide for Bulk Shipment by Water, published by the U.S. Coast Guard [13].

(7) A Marine Hazardous Substance Data System, prepared by SwRI for the U.S. Coast Guard [3].

III.4 MMMP Auxiliary Support Systems

As mentioned in Section II.1 a number of auxiliary systems which are available to provide support to the medical monitoring program are briefly discussed in this section. Each of these systems has been documented more thoroughly in separate volumes of this report, in appendices to this report, or in referenced materials.

III.4.1 Hazardous Substances Data System (HSDS)

A data system has been developed to maintain and process a large set of data on 699 marine hazardous substances. The data system,

labeled HSDS, has been programmed to provide access to 22 types of information maintained for each substance. The types of information contained in the HSDS are listed in Table 10. The HSDS is programmed to provide accesss to any subset of the characteristics data which the user requires and list out this information for any specified subset of substances. As an example, the following information could be requested: TLV-TWA, STEL, and IDLH for all substances regulated under Subchapter O.

The HSDS has been designed so that the data can easily be updated as new information becomes available. The program can handle as many as 800 substances as it is currently configured, and it can easily be reconfigured to handle as many as may be desired. Output from the HSDS is labeled with the date of the listing on each page of output so that the status of the data associated with specific revisions is clearly indicated.

The HSDS, including listings of the data currently contained, is documented in Volume II [3] of this report. That document is intended to provide a stand-alone ready reference of health and safety related information on marine hazardous substances. A copy of the document or listings of output from the HSDS should be available to medical and safety offices which oversee the health and safety of marine hazardous chemical workers.

III.4.2 Biochemical and Medical Information

A set of biochemical and medical information for 179 hazardous substances found in the marine environment is presented in Volume III [4] of this report. The hazardous substances include certain toxic substances encountered in marine maintenance activities and certain bulk liquid cargos which are known to present a toxic hazard in the workplace. The bulk liquid cargo substances for which data are presented are those substances regulated under Title 46 of the Code of Federal Regulations, Subchapter D and/or Subchapter O, that the American Conference of Governmental Industrial Hygienists (ACGIH) has assigned a threshold limit value for occupational exposures. As such, they are a subset of the hazardous substances covered by the HSDS and documented in Volume II [3].

TABLE 10. LISTING OF THE TYPES OF INFORMATION MAINTAINED FOR MARINE HAZARDOUS SUBSTANCES IN THE HSDS

1. Chemical name of the hazardous substance
2. Chemical Hazards Response Information System (CHRIS) Code
3. Indication of 46CFR Subchapter which regulates substance (O or D)
4. Potential contribution to overall exposure by the cutaneous route (skin)
5. Time Weighted Average Threshold Limit Value (TLV-TWA)
6. Short Term Exposure Limit (STEL)
7. Immediately Dangerous to Life or Health (IDLH) Concentration
8. Odor Threshold
9. Concentration at Saturation (vapor pressure)
10. Respiratory Hazard Index
11. Toxicity Priority Class Code
12. Carcinogenicity Reference per ACGIH
13. NFPA Health Hazard Classification and NAS Health Hazard Rating
14. Secondary Product (if any)
15. Chemical Abstracts Service (CAS) Registry Number
16. DOT Emergency Response Guide Number
17. Availability of Biochemical and Medical Data Sheet (in Vol. III)
18. Availability of NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards
19. Availability of Biological Monitoring Methods (in Appendix D)
20. Availability of Qualitative Detector Tube
21. Availability of quantitative Detector Tube
22. Availability of Threshold Limit Value Detector Tube

For each substance, selected biochemical and medical information are presented on a one page data sheet. The format of the data sheet is presented in Table 11. As can be observed from the table, the types of information include occupational exposure limits and classification regarding carcinogenicity, A_1 or A_2, as defined by the ACGIH. A_1 substances are substances associated with industrial processes that are recognized to have carcinogenic or cocarcinogenic potential; A_2 substances are industrial substances that are suspected of carcinogenic potential for man. Other important biochemical and medical characteristics associated with exposures to a substance are also provided in the data sheet:

(1) Route of entry or exposure,

(2) Target organs and/or organ related symptoms,

(3) Acute and chronic effects of exposure,

(4) Biological fate and/or metabolites resulting from exposure,

(5) Medical monitoring and/or specific laboratory tests which should be considered.

(6) Synergism or antagonism associated with exposures,

(7) Carcinogenicity and mutagenicity.

The purpose of Volume III is to provide to medical personnel reference for certain biochemical and medical information which are not readily available from other sources. The material safety data sheets (MSDS) that accompany the transport of hazardous substances do not cover the data provided in the Volume III data sheets. Other available sources which do contain some or most of the data provided here are much more detailed and, therefore, more cumbersome than the one page format in Volume III. The Volume III data sheets should be available to medical personnel who oversee the health of marine hazardous chemical workers.

TABLE 11. FORMAT FOR BIOCHEMICAL AND MEDICAL INFORMATION

AGENT(CAS#): DOT EMERGENCY RESPONSE GUIDE: #

SYNONYMS:

ACGIH EXPOSURE LIMITS: TWA PPM: MG/M^3: A_1 or A_2:

ROUTE OF ENTRY/EXPOSURE:

TARGET ORGAN OR SYMPTOM:

EFFECTS OF EXPOSURE:

acute, accidental:

chronic:

BIOL. FATE/METABOLITES:

MEDICAL MONITORING;
(Laboratory)

SYNERGISM OR ANTAGONISM:

CARCINOGENCITY:	Yes	No	Comments
human:			
animal:			

MUTAGENICITY:
human:
mammal:
Microbe:

PERSONAL PROTECTIVE EQUIPMENT:

REFERENCES:
NIOSH Occupational Diseases (1977)
ACGIH TLV Booklet (1983-84)
ACGIH Documentation of TLVs (1981/82)
DOT P 5800.3 (1984)

III.4.3 Industrial Hygiene

The occupational safety and health program designed in this study for the marine hazardous worker involves not only medical monitoring of adverse health effects in the worker populations which may be due to occupational exposures but also an active industrial hygiene program to provide preventive measures to avoid adverse chemical exposures. Guidelines for such an industrial hygiene program for workers exposed to hazardous chemicals in the marine transportation industry are provided in Appendix C of this report.

The industrial hygiene program is designed to prevent adverse chemical expsoures and to avoid other safety problems by training workers to utilize appropriate safety equipment and to follow designated safe work practices. The program accomplishes this by providing audits of compliance with safety protocols, by monitoring levels of toxic chemicals in the workplace, and by design of environmental controls and work practices. In Appendix C, discussion of the program is divided into five major topics:

(1) Recognition and evaluation of exposure hazards,
(2) Control of exposures,
(3) Training program,
(4) Audit surveys to evalulate exposure control, and
(5) Personnel and laboratory support.

The information resulting from a properly designed industrial hygiene program has a number of uses. Among these are determination of compliance with standards and regulations, determination of potential workplace health problems so as to allow preventive measures to be introduced, and determination of worker-specific information such as personal exposure concentrations.

Certain types of information resulting from industrial hygiene serve as important inputs to the medical monitoring program. These include:

(1) Results of IH surveys which indicate workplace conditions and exposure concentrations for specific employees or for specific work scenarios,

(2) Records of entry into confined spaces with identification of specific employees and description of the conditions during entry and concentrations of chemical substances measured.

(3) Reports of incidents or accidents involving known or suspected overexposures with identification of specific employees and exposure conditions.

The medical monitoring program is designed to receive these inputs from a complementary industrial hygiene program. It is particularly important that industrial hygiene information on specific individuals be routinely placed in the medical file for that individual. This information should include: personal exposure concentration, results of biological sampling, records of entry into confined spaces, and records of incidents of known or suspected overexposure.

III.4.4 Biological Monitoring

To evaluate internal dose, monitoring of the concentration of substances in biological media (urine, and exhaled air) and the concentration of biotransformation products (metabolites) in these biological media should be considered as one element of a marine occupational safety and health program. The main objectives of such biological monitoring are to insure that the current or past exposure of workers is safe and to detect potential excessive exposure before the occurrence of clinically detectable adverse health effects. Because these biological parameters are more directly related to the potential for adverse health effects than any environmental measurement, they may offer a better estimate of risk.

To augment environmental monitoring, biological monitoring of exposed or potentially exposed workers should be considered for the following exposure circumstances:

1. In response to known or supected acute overexposure to a specific mixture or single substance during an unplanned, unexpected incident or accident;

2. To determine whether or not protective gear worn in extremely hazardous environments adequately protects the worker from absorption of excessive internal dose through respiratory or dermal routes during activities in response to an accident, or during routine, extremely hazardous operations;

3. To augment routine environmental measurements during industrial hygiene audits of marine operations involving extremely toxic substances such as carcinogens in work scenarious with high potential exposure hazard.

When operating in the marine environment on a vessel or marine terminal, the use of invasive biological sampling methods such as venipuncture is not recommended for routine operations. Non-invasive methods which require minimal training of both worker and staff and which offer no inherent risk to the worker are more appropriate for the marine environment. The primary non-invasive sampling media are urine and exhaled air.

Guidelines for biological monitoring are presented in Appendix D. The number of marine hazardous substances for which biological monitoring methods are available is somewhat limited: 26 substances of which seven are Class 1 or Class 2 substances. The availability of pertinent data is rapidly changing and it is expected that the number of substances with biological monitoring methods will significantly increase over the next few years.

Industrial hygiene should consider biological monitoring of extremely hazardous substances (Class 1 and Class 2 substances) to augment environmental monitoring.

III.4.5 Potential Exposures

It is not practical to obtain personal exposure measurements for all work activities which involve potential for exposure to marine hazardous substances. However, there is a real need for information which relates to exposures, particularly exposures to Class 1 or Class 2 marine hazardous substances. To address this issue, two methods have been developed in this study to collect potential exposures information for marine hazardous chemical workers. The first is a self-maintained record of potential exposures which is applicable to Coast Guard personnel. The second is an

indirect method for estimating potential exposures which is applicable to tankship personnel. Though the indirect method was developed specifically for application to tankship personnel, the concept is applicable to barge operations, depending only on the availability of records, as will be discussed.

The indirect method has the advantage over the self-maintained record in that it is based on verifiable records. However, use of a self-maintained potential exposure log should be considered as an alternative which may have applicability in the marine industry. The decision to apply one or the other of these methods to collect potential exposure information on employees must be made by the medical and safety office of a given company.

Self-Maintained Record. Methods for a self-maintained record of potential exposures applicable to Coast Guard personnel are described in Appendix E of this report. The method is designed for field personnel of the USCG performing marine inspection, pollution response, and pollution prevention activities who routinely encounter a potential for exposures to hazardous chemical during normal work activities. For each job activity involving potential exposure to Class 1 or Class 2 substances or other designated chemicals, a set of information will be self-recorded using a specially designed form. This information will include:

(1) Date and time of job activity,

(2) Location of the job activity,

(3) Description of the operations going on during the potential exposure,

(4) Job activity of the individual worker recording the information,

(5) Identification of the chemical substance,

(6) Duration of the potential exposure activity, and

(7) Protective equipment utilized, if any.

The self-maintained log of potential exposures will be collected at intervals and reviewed by supervisory staff for completeness and accuracy. A data file will be established for each individual and the

potential exposures information will be processed at intervals to produce a summary file. From the data in the summary file for each individual, a listing will be compiled for inclusion in the medical file for the individual. The listing would include:

(1) Employee identification (name and identification number)
(2) Title
(3) Period covered
(4) Potential exposure (substance, frequency, total duration)

Indirect Method. An indirect method for estimating exposures of tanker vessel personnel to bulk liquid cargos is described in Appendix F of this report. The approach is to design an information system which uses existing records as input that produces potential exposure information on individuals as output.

Two types of records are used for estimating potential exposures: 1) records of personnel assigned to a vessel and 2) records of cargo loaded. For each vessel, a roster is maintained which documents a listing of all personnel assigned to the vessel. The roster identifies each person by name and title. The title provides information as to the rank of the individual as well as the type of work to which the individual is assigned. Whenever there is a change of personnel assigned to the vessel, the roster is updated so that a current and correct roster is maintained. Copies of the roster are maintained aboard the vessel at all times and a copy is forwarded to the office of the shipping company whenever there is a change in the ship's personnel.

Each time a vessel loads or discharges cargo, a set of information is duly entered into the ship's record. Included in this record are the types and quantities of cargos transferred. For each port or terminal visited by the vessel, a report is prepared which documents the types of quantities for all such cargo transfers. A copy of the port or terminal activities report is maintained aboard the vessel and is regularly forwarded to the shipping company offices for processing and maintenance in the company's record files. Information on the record of cargos loaded and the

roster of ship's personnel will be input to a data management system (DMS). For each individual designated as occupationally exposed for medical monitoring purposes, a file will be established and data for all go loadings of Class 1 and Class 2 substances and/or other designated chemicals will be added to that file, sequentially, by date of loading.

At specified intervals, the records for each individual will be reduced to a single entry for each different cargo type. The summary data will include the frequency (number of separate loadings of the cargo type) and the total quantity (tonnage) involved. The time period covered in the summarized data will also be retained in the summary file for the individual.

From the data in the summary file for each individual, a listing will be compiled for inclusion in the medical file for the individual. The listing will include:

(1) Worker identification (Name and Identification No.)
(2) Title
(3) Period covered
(4) Cargos loaded (substance, frequency, total tonnage)

It should be noted that this method depends solely on information which already exists and requires no additional data collection. Existing records would be input to a data management system and machine processed to produce the desired output. Though it would require a good deal of machine processing, the method should not require a monumental effort to implement. It should be feasible for implementation in any industry where personnel records can be used to determine the assignment of a given tankerman to a specific tanker vessel on a given day, and where cargo activity records are available which can be used to identify the cargos loaded on each tanker vessel on a given day.

The method presented in Appendix F was specifically developed for application to tanker vessel operations. The basic method is applicable to barge operations where personnel assignment records are available that can be used to determine the assignment of a given tankerman to a specific barge

on a given day and where cargo activity records are available to identify the cargos loaded on the barge, by date of loading. Given the availability of these records, the method described in Appendix F could be modified to compile summary potential exposure data for barge tankermen.

III.4.6 Sentinel Health Events (Occupational)

The U.S. Coast Guard has incorporated the use of sentinel health events in the overall health surviellance scheme of its Occupational Medical Monitoring program (OMMP).

A Sentinel Health Event (SHE) is a preventable disease, disability, or untimely death whose occurence serves as a warning signal that the quality of preventive and/or therapeutic medical care may need to be improved. A SHE (Occupational) is a disease, disability, or untimely death which is occupationally related and whose occurence may: 1) provide the impetus for epidemiologic or industrial hygiene studies; or 2) serve as a warning signal that materials substitution, engineering control, personal protection, or medical care may be required.

A descriptive article on SHE(O) published by NIOSH in the American Journal of Public Health [29] presented a basic list of 50 sentinel events. The Coast Guard has expanded this basic list of 50 sentinel events to a total of 108 sentinel events for surveillance of occupational diseases of Coast Guard personnel [30]. The expanded SHE(O) has been implemented in the Coast guard's compu erized occupational health surveillance information system known as Coast Guard Occupational Health Information System (CGOHMIS).

The American Medical Association's Current Medical Information and Terminology (CMIT) [24] has been used by the Coast Guard in identification description, clinical recording, and reporting of occupational disease conditions and their method of diagnosis. Each SHE(O) in the expanded Coast Guard system has a characteristic CMIT definition and a unique identification number for computer application. By computerizing appropriate portions of the CMIT definition for each sentinel event, a fast and reliable check can be made

to see if a pattern of abnormal health exists which would not otherwise be apparent without an evaluation of the full medical record.

Application of the SHE(O) surveillance does not provide adequate information for the occupational physician to make a decision on presumptive association between a computer generated sentinel health event report, and an actual occupational disease process in an individual. Rather, the report generated by this approach provides a first level screen which, due to extreme sensitivity, will have false positives. Nevertheless, the occupational physician can use this type of report to determine which employees' full records warrant a more thorough analysis.

Because the data management system conceptually designed to support the marine medical monitoring program incorporates the Coast Guard's CGOHMIS system, the SHE(O) method will be available for surveillance of occupational diseases in the MMMP.

III.4.7 Data Management System

A conceptual design for a data management system (DMS) to provide a record of the data generated by the marine occupational safety and health program (MOSHP), including medical monitoring and industrial hygiene, and to provide a means of rapid access to data files for specific information for data summaries is described in Appendix G of this report. The approach is based on use of microcomputers to interface with the CGOHMIS [31] database management system currently being implemented by the U.S. Coast Guard Office of Health Services. The CGOHMIS is itself an adaptation of the Flow II Gemini system developed by Flow General, Inc., and is operated by the Coast Guard through a time sharing arrangement. The capabilities of CGOHMIS will be extended for two separate applications: one for U.S. Coast Guard operations and a second one for application to the marine industry.

It must be noted that the Coast Guard has developed the CGOHMIS database management system for internal Coast Guard use only. The system is not available to the general maritime industry through the Coast Guard and there are no plans to make it available. If an industry group wants

to utilize the modified CGOHMIS system via a microcomputer interface, it would be necessary that a time sharing arrangement be made with Flow General, Inc. or a licensed operator of the Flow II Gemini database management system. The software developed for the MOSHP DMS and the modified CGOHMIS software could then be available to any industry group through such a time sharing arrangement.

Input data for the DMS will be collected by use of the 15 data forms listed in Table 12. A copy of each of these data forms is presented in Appendix G. DMS Data Forms 1-9 are standard data forms currently used by the USCG Office of Health Services as input for the Coast Guard Occupational Health Management Information System (CGOHMIS). DMS Data Forms 10-15 have been specially designed to provide input for the MOSHP DMS.

Implementation of the MOSHP by an industrial user group would require evaluation of the applicability of the information on DMS Forms 1-15 for the specific user and preparation of a set of user-specific data forms. It is anticipated that the user specific data forms would identify the user group on each of the forms with minimal revisions to the data format so as not to require revision of the user-friendly data entry mode of the MOSHP DMS.

Output from the DMS will provide information to support the administration of the medical monitoriong and industrial hygiene programs and will produce medical support information for the physicans performing medical examinations. The CGOHMIS, on which the DMS is based, produces a medical report which covers medical and occupational history. Specifically covered in the medical report are personal health history, work history, physiological results, audiometry results, electrocardiogram results, and laboratory results. Data are presented for the most recent examination and for each of the three preceding examinations so that outstanding changes or trends may be observed. In addition, an evaluation report is prepared which provides a summary of results outside reference ranges. These medical and work history reports will be included in the MOSHP medical support information provided to the occupational physicians.

TABLE 12. DMS DATA FORMS

DMS Form No.	Standard Form No.	Description
1	SF 93	Report of Medical History
2	SF 507	Clinical Record: Continuation of SF93 for OMMP
3	CG 5197	Occupational History
4	SF 88	Report of Medical Examination
5	SF 507	Clinical Record: Continuation of SF 88 for OMMP
6	SF 507	Clinical Record: Report on OMMP Periodic Examination
7	DD 2215	Reference Audiogram (Baseline Exam)
8	DD 2216	Hearing Conservation Data (Follow-up Exams)
9	CGHQ 5386	Industrial Hygiene Workplace Monitoring Form
10	--	Potential Exposure Log (for individual workers)
11	--	Record of Cargos Loaded
12	--	Record of Ship's Personnel
13	--	Incident Report Form
14	--	Confined space Entry Permit
15	--	Request for Industrial Hygiene Data

At present CGOHMIS does not cover exposure history. The DMS will be developed to process data from DMS Forms 9-14 listed in Table 12 to produce an exposure history which includes potential exposures, confined space entries, and unusual exposure epis des. Any personal dosimetry on file for the individual will also be included. This exposure history information will also be included in the MOSHP medical support information provided to the occupational physicians.

If the physician should desire additional information from the industrial hygiene files, DMS Form 15 listed in Table 12 will be used to request industrial hygiene data from the files for a specific marine hazardous substance or substances and a given work scenario. An industrial hygiene report will then be prepared from the data on file and forwarded to the physician.

III.5 Applications

A flow chart which depicts the sequence of events in the MMMP is presented in Appendix H. The flow chart begins with establishment of an occupational safety and health medical monitoring staff and proceeds through

the scheduling and performance of medical examinations to the informing of the employee of examination results.

The MMMP is designed to be applied by any organization employing marine hazardous chemical workers. Implementation will require specific application of the various facets of the program as appropriate for the given organization: U.S. Coast Guard, shipping company, barge and towing company, or marine union. In general, the major activities will involve:

(1) Commitment by the organization to improvement of marine hazardous chemical worker safety and health,

(2) Establishment of a medical monitoring program staff,

(3) Establishment of an industrial hygiene program to complement medical monitoring,

(4) Determination of the marine hazardous substances which must be considered in medical monitoring,

(5) Designation of the worker populations who are occupationally exposed and must be enrolled in medical monitoring,

(6) Establishment of a specific medical monitoring plan including scheduling of examinations and specification of examination protocol and guidelines,

(7) Selection of occupational physician support to perform medical examinations,

(8) Provision of instructions and support materials to occupational physicians including hazardous substances data, biochemical and medical information of examination protocol and guidelines, medical support information, and specification of standard forms for collection of medical information (DMS Forms 1-8),

(9) Establishment of procedures to collect potential exposures information on all personnel enrolled in the medical monitoring program with use of DMS Form 10 or with DMS Forms 11 and 12,

(10) Establishment of a data management system to store and process medical and industrial hygiene records and to schedule medical examinations,

(11) Schedule medical examinations and inform personnel; specify requirements for fasting and abstention from alcohol for blood and urine tests,

(12) Prepare medical support information for physicians including medical and work history records and exposure history including potential exposures, confined space entries, unusual exposure episodes, and any personal dosimetry on file,

(13) Occupational physicians conduct medical examinations per MMMP protocol and guidelines with use of DMS standard forms,

(14) Respond to physician request for industrial hygiene data (DMS Form 15) as required,

(15) Receive medical data from physicians on DMS standard forms,

(16) Decide employee disposition and inform employee of results,

(17) Input pertinent information into DMS,

(18) Revise procedures as required,

(19) Continue scheduling and performance of medical examinations.

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IV. CONCLUSIONS

1. A medical monitoring program is needed to assist in improving the health and safety of the marine hazardous chemical worker.

2. The medical monitoring program for the marine hazardous chemical worker must provide a method which will adequately screen for adverse health effects of occupational exposures to noise and toxic chemical substances.

3. A complementary industrial hygiene program that provides preventive measures to avoid adverse occupational exposures is essential to marine safety and health; medical monitoring, alone, is insufficient.

4. To augment environmental monitoring, biological monitoring of exposed or potentially exposed workers is applicable in a limited number of exposure circumstances and should be included in a comprehensive industrial hygiene program.

5. Information on exposures and potential exposures, made available to the physician performing a medical examination, is essential in diagnosing health effects potentially related to occupational exposures.

6. There is need for a systematic record of potential exposures for marine personnel who routinely encounter potential for exposure to toxic chemical substances.

7. There is need for centralized medical records to support the medical care of merchant mariners. At present, there is none, and this circumstance impedes the provision of adequate medical care.

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V. RECOMMENDATIONS

1. Class 1 and Class 2 marine hazardous substances are the minimum set of substances important to medical monitoring and should serve as a baseline for any specific marine medical monitoring application.

2. The operator of a specific marine medical monitoring program should also consider the inclusion of additional substances from other classes in the set of substances important to medical monitoring, as deemed appropriate for the specific operational setting.

3. Exposure or potential for exposure to Class 1, Class 2, and/or other designated marine hazardous substances should be used as a basis for enrollment of personnel in a marine medical monitoring program.

4. Measured exposures to designated marine hazardous substances should be considered an occupational exposure for medical monitoring purposes if the concentration of the toxic substance(s) equals or exceeds 50% of the TLV-TWA of the substance or mixture of substances.

5. On the basis of exposure or potential for exposure, certain job titles, work assignments, or work scenarios should be categorically designated as occupationally exposed for medical monitoring purposes. All personnel engaged in such activities should be enrolled in a medical monitoring program.

6. Because a safe level of exposure to carcinogenic substances cannot be defined, the objective should be to reduce exposures to the lowest possible level for Class 1 marine hazardous substances.

7. Marine workers should be made aware that Class 1 marine hazardous substances can cause cancer and that the effect of exposure to these substances may not occur until many years after exposure.

8. For all personnel enrolled in the marine medical monitoring program, a potential exposures log should be maintained to record potential exposures to Class 1 and Class 2 marine hazardous substances and the log should be included in the medical record file of the individual.

9. Medical support data should be prepared and provided to occupational physicians prior to the medical examination which includes record of potential exposures, unusual exposure episodes, and personal dosimetry on file.

10. An industrial hygiene workup should be available to the physician, on request, which provides a summary of data on file for measured concentrations of a given marine hazardous substance in specified work scenarios.

11. Biological monitoring methods should be developed for all Class 1 substances.

12. CGOHMIS should be upgraded to include a potential exposure log in the medical record file.

13. CGOHMIS should be upgraded to allow occupational physicans to request an industrial hygiene workup for specific marine hazardous substances and specific work scenarios.

14. Because additional chemicals are continually being added to those regulated in marine commerce and new health data on chemicals previously classified can result in a need for change of previous classification, the HSDS should be expanded and maintained with current information as it becomes available.

15. Biochemical and medical data sheets should be developed for additional marine hazardous substances as data become available.

16. HSDS output and biochemical and medical data sheets should be made available to all occupational physicians who perform medical examinations on marine hazardous chemical workers.

17. Because a centralized medical records system for merchant mariners is needed which the Coast guard is not in a position to directly provide, the Coast Guard should use every opportunity to actively encourage and support the provision of some form of central medical record file for seamen, perhaps through existing marine organizations or associations.

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GLOSSARY OF MEDICAL ABBREVIATIONS

Medical Abbreviation	Description
BP	Blood pressure
B-reader	Person qualified to interpret radiographs for asbestosis, silicosis, and other lung disorders
BUN	Blood, urea, nitrogen analysis
CBC	Complete blood count
EKG	Electrocardiogram
ETOH	Ethyl alcohol
FEF 25-75	Forced Expiratory Flow; the rate of flow from the point of 25% to the point of 75% of the expired volume
FEV-1	Forced Expiratory Volume - the volume of air expired in one second
FVC	Forced Vital Capacity - the largest volume of forcibly expired air following a maximum inspiration
GGT	Gamma glutamyl transferase
Hct	Hematocrit
Hgb	Hemoglobin
HPF	High power field microscopic examination
hx	history of
IVP	Intravenous pyelogram
LAT	Lateral view
LDH	Lactate dehydrogenase
P	Pulse
PA	Posterior - anterior view
pH	Degree of acidity or alkalinity as indicated by a measure of the hydrogen ion concentration
R	Respiration rate
RBC	Red blood count

GLOSSARY OF MEDICAL ABBREVIATIONS (cont'd.)

SGOT	Serum glutamic - oxaloacetic transaminase
SGPT	Serum glutamic - pyruvic transaminase
SMAC-12	Blood chemistry profile for 12 specific parameters
T	Temperature
TIBC	Total iron binding capacity
U/A	Urinalysis
WBC	White blood count

REFERENCES

1. Bass, R. L., Task I Status Report, Attachment 1, Monthly Progress Report No. 9, Study to Improve the Health and Safety of the Marine Hazardous Chemical Worker, USCG Contract OTCG23-82-C-20027, May 1983.

2. Morrow, T. B., Buckingham, J. C., and Magott, R. J., Development of an Environmental Monitoring Program, Task II Final Report, SwRI Project 06-7223, USDOT Contract OTCG23-82-C-20027, June 1985.

3. Prevost, R. J. and Bowles, P. K., A Marine Hazardous Substances Data System. Volume II, Task III Final Report, SwRI Project 06-7223, USDOT Contract OTCG23-82-C-20027, July 1985.

4. Prevost, R. J. and Hammond, J. W., Biochemical and Medical Information for Marine Hazardous Substances, Volume III, Task III Final Report, SwRI Project 06-7223, USDOT Contract OTCG23-82-C-20027, July 1985.

5. Memorandum of Understanding: Authority to Prescribe and Enforce Standards or Regulations Affecting Occupational Safety and Health of Seamen Aboard Vessels Inspected and Certificated by the United States Coast Guard. U. S. Department of Transportation: Coast Guard, U. S. Department of Labor: Occupational Safety and Health Administration, Federal Register, Vol. 48, No. 53, March 1983.

6. 46 United States Code (USC) 3305, 3306; 46 USC 6101(a); 46 USC 7101, 7301(b), 7306, and 7313(c)(3); 46 USC 10104; 46 USC 10902; 46 USC 11101(a), and 46 USC 11301.

7. National Research Council Committee on Maritime Hazardous Materials, Principals of Toxicological Interactions with Multiple Chemical Exposures, Final Report, USDOT Document CG-M-3-81, December 1980.

8. Astleford, W. J., Morrow, T. B., Magott, R. J., Prevost, R. J., Kaplan, H. L., Bass, R. L., and Buckingham, J. C., Investigation of the Hazards Posed by Chemical Vapors Released in Marine Operations - Phase II, Final Report, SwRI Project 06-5686, USDOT Document CG-D-10-83, April 1983.

9. Astleford, W. J., Buckingham, J. C., Kaplan, H. L., Magott, R. J., and Riegel, J. P., A Crew Exposure Study - Phase II, Volume II - At Sea, Final Report, SwRI Project 06-6177, USDOT Contract OTCG23-80-C-20015, March 1985.

10. Kaplan, H. L., Astleford, W. J., Prevost, R. J., and Bass, R. L., Development and Application of a Method for Toxicological Assessment of Occupational Exposures to Chemicals in Marine Operations, Addendum to Final Report, SwRI Project 06-5686, USDOT Contract DOT-CG-904571-A, June 1985.

11. Listing of All Chemicals Regulated in the CFR, U. S. Coast Guard, Cargo and Hazards Branch, 19 May 1983.

12. TLVs, Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment with Intended Changes for 1983-84, The American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1984.

13. Chemical Data Guide for Bulk Shipment by Water, United States Coast Guard Document CIM 16616.6, 1982.

14. Morrissette, M. M., Doolan, K., Fust, C., Paskewich, J. and Adess, M. L., Report of the Marine Safety/Environmental Response Personnel Occupational Health Ad Hoc Working Group, U. S. Coast Guard, 1 September 1982.

15. Vessel Inventory Report, U. S. Department of Transportation, Maritime Administration, Office of Trade Studies and Statistics, Washington, D.C., 1983.

16. Seafaring Guide and Directory of Labor Management Affiliations, U. S. Department of Transportation, Maritime Administration, December 1982.

17. All About AIMS, The American Institute of Merchant Shipping, Washington, D.C., 1983.

18. Inland Waterborne Commerce Statistics 1981-82, American Waterways Operators, Inc., Arlington, Virginia.

19. U. S. Coast Guard Medical Manual, Chapter 12, Occupational Medical Monitoring Program, COMDTINST M6000.1, Change No. 27, June 1984.

20. Occupational Medical Monitoring Program Guidelines, United States Environmental Protection Agency, July 1982.

21. Occupational Health Standardized Occupational Health Program, U. S. Air Force, AFOSH Standard 161-17, June 1982.

22. Voluntary Qualification for U. S. Merchant Marine Entry Ratings, U. S. Coast Guard Navigation and Vessel Inspection Circular No. 3-83, April 1983.

23. Reference Guide for Physicians: Physical Examination for Retention of Seafarers in the U. S. Merchant Marine, Seafarers Health Improvement Program/U. S. Maritime Administration, Washington, D.C., 1984.

24. Current Medical Information and Terminology, Fifth Edition, American Medical Association, Finkel, A. J., editor, Chicago, Illinois, 1981.

25. Occupational Diseases: A Guide to their Recognition, U. S. Department of Health and Human Services, National Institute for Occupational Safety and Health, June 1977.

26. 1984 Emergency Response Guidebook, U. S. Department of Transportation, Document No. DOT P5800.3, 1984.

27. Stutz, D. R., Ricks, R. C. and Olsen, M. F., Hazardous Materials Injuries: A Handbook for Pre-Hospital Care, Bradford Communications Corporation, Greenbelt, Maryland, 1982.

28. NIOSH/OSHA Pocket Guide to Chemical Hazards, U. S. Department of Health and Human Services, National Institute for Occupational Safety and Health, Publication No. 78-210, August 1980.

29. Rutstein, D. D., et al., Sentinel Health Events (Occupational): A Basis for Physician Recognition and Public Health Surveillance, American Journal of Public Health, Volume 73, No. 9, September 1983.

30. Stockwell, J. R., Adess, M. L., Titlow, T. B. and Zaharias, G. R., Computer Assisted Occupational Health Surveillance in the U. S. Coast Guard, American Journal of Occupational Medicine, in press.

31. Detailed Design: U. S. Coast Guard Occupational Health Management Information System - Phase III, JRB Associates, McLean, Virginia, January 1985.

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BIBLIOGRAPHY

1. Allievi, A., Chemical Carriers: Sophisticated Ships, Proceedings of the Marine Safety Council, pp. 233-236, October-November, 1983.

2. Austin, W. B. and Phillips, C. F., Development and Implementation of a Health Surveillance System, American Industrial Hygiene Association Journal, pp. 638-642, September, 1983.

3. Ballantyne, B., Evaluation of Hazards from Mixtures of Chemicals in the Occupational Environment, Journal of Occupational Medicine, Vol. 27, No. 2, pp. 85-94, February, 1985.

4. Baram, M. S., Public Health and the Law: Charting the Future Course for Corporate Management of Health Risks, American Journal of Public Health, Vol. 74, No. 10, pp. 1163-1166, October, 1984.

5. Bartoletti, M., Elements of a Comprehensive Health Program, Hazardous Material Spills Conference, 1982, pp. 456-461.

6. Beck, D. D., Pugh, W. M. and Ramsey-Klee, D. M., Specifications for a Navy Occupational Health Information Monitoring System: II. A Functional Overview, Report No. 82-6, Naval Health Research Center, San Diego, California, 1983.

7. Belk, H. D., Sussman, N. and Bonney, T. B., The Alcoa Health Information System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 815-818, October, 1982.

8. Blackman, K., Could This Line of Work be Hazardous to Your Health?, Proceedings of the Marine safety Council, Vol. 40, No. 9, pp. 224-232, October-November, 1983.

9. Bonnett, J. C. and Pell, S., DuPont's Health Surveillance Systems, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 819-823, October, 1982.

10. Brower, J.F. and Viall, D., Symposium Leads to Hazard Communication Standards Possibilities, ASTM Standardization News, pp. 18-19, July, 1985.

11. Carel, R. S. and Lesnem, G., Evaluation of the Cost-Effectiveness of an Automated Multiphasic Health Testing System, Preventive Medicine, Vol. 9, pp. 689-697, 1980

12. Charap, M. H., The Periodic Health Examination: Genesis of a Myth, Annals of Internal Medicine, Vol. 95, No. 6, pp. 733-735, December, 1981.

13. Cole, P. and Morrison, A. S., Basic Issues in Population Screening for Cancer, Journal of the National Cancer Institute, Vol. 64, No. 5, pp. 1263-1272, May, 1980.

14. Collen, M. F., Feldman, R., Siegelaub, A. B. and Crawford, D., Dollar Cost for Positive Test for Automated Multiphasic Screening, New England Journal of Medicine, Vol. 283, No. 9, pp. 459-463, August, 1970.

15. Cook, R., Business Outlook: Database Market Shifts to Low End, High Technology, December, 1984.

16. Cooper, L. P., OSHA Medical and Workplace Surveillance Requirements and NIOSH Recommendations: For Employees Exposed to Toxic Substances and Other Work Hazards, NASA Contract Report 3690, Occupational Health Office, National Aeronautics and Space Administration, 1983.

17. Cowles, S. R., Medical Effects of Combined Industrial Exposures, Journal of Occupational Medicine, Vol. 21, No. 6, pp. 413-416, June, 1979.

18. Dales, L. G., Friedman, G. D. and Collen, M. F., Evaluating Periodic Multiphasic Health Checkups: A Controlled Trial, Journal of Chronic Disorders, Vol. 32, No. 5, pp. 385-404, 1979.

19. Delzell, E. and Monson, R. R., Mortality Among Rubber Workers: VI. Men with Potential Exposure to Acrylonitrile, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 767-769, October, 1982.

20. Desjardins, R. B., Employee-Related Environmental Information Systems, American Industrial Hygiene Association Journal, Vol. 44, No. 6, pp. 395-401, June, 1983.

21. Douglas, J., Toward Better Methods of Risk Assessment, EPRI Journal, pp. 23-28, March, 1982.

22. Elmer, C. and Coleman, D. L., Monsanto's Medical and Environmental Health Information (MEHI) System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 788-790, October, 1982.

23. Finucane, R. D., General Foods Medical Environmental Health Systems (MEHS), Journal of Occupational Medicine, Vol. 24, No. 10, pp. 794-798, October, 1982.

24. First, M. W., Engineering Control of Occupational Health Hazards, American Industrial Hygiene Association Journal, Vol. 44, No. 9, pp. 621-626, September, 1983.

25. Freundt, K. J., Mixed Exposure to Chemical Hazards, Occupational Health and Safety, pp. 11-13, 39-42, August, 1982.

26. Garrett, R. W., Environmental Tracking at Eli Lilly and Company, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 836-839, October, 1982.

27. Goldman, R. H. and Peters, J. M., The Occupational and Environmental Health History, Journal of the American Medical Association, Vol. 246, No. 24, pp. 2831-2836, December, 1981.

28. Guffey, S. E., An Easier Calculation System for Ventilation Design, American Industrial Hygiene Association Journal, Vol. 44, No. 9, pp. 627-630, September, 1983.

29. Hagstrom, R. M., Dougherty, W. E., English, N. B., Lochhead, T. J. and Schriver, R. C., SmithKline Environmental Health Surveillance System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 799-803, October, 1982.

30. Heinzelman, L., Medical Emergency at Sea, Marine Engineering Log, pp. 97-99, November, 1983.

31. Hillman, D. W., A Computerized Occupational Health and Environmental Surveillance System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 785-787, October, 1982.

32. Hillman, G., ECHOES: IBM's Environmental Chemical and Occupational Evaluation System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 827-835, October, 1982.

33. Hinds, R. and Duvall, M. N., Coupling with OSHA's Hazard Communication Standard, Occupational Safety and Health Reporter, Vol. 13, No. 47, pp. 1280-1285, April 26, 1984.

34. Howe, H. F., Organization and Operation of an Occupational Health Program, Journal of Occupational Medicine, Vol. 17, No. 6, pp. 361-400, June, 1975.

35. Howe, H. F., Organization and Operation of an Occupational Health Program, Journal of Occupational Medicine, Vol. 17, No. 8, pp. 528-540, August, 1975.

36. Joiner, R. J., Occupational health and Environmental Information Systems: Basic Considerations, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 863-866, October, 1982.

37. Joyner, R. E. and Pack, P. H., The Shell Oil Company's Health Surveillance System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 812-814, October, 1982.

38. Judd, S. H., Occupational Health Information System (OHIS), Journal of Occupational Medicine, Vol. 24, No. 10, pp. 806-808, October, 1982.

39. Karrh, B. W. et al., Scope of Occupational Health Programs and Occupational Medical Practice, Journal of Occupational Medicine, Vol. 21, No. 7, pp. 497-499, July, 1979.

40. Kerr, P. S., Recording Occupational Health Data for Future Analysis, Journal of Occupational Medicine, Vol. 20, No. 3, pp. 197-203, March, 1978.

41. Kimberly-Clark Health Management Program Aimed at Prevention, Occupational Health and Safety, pp. 25-27, November-December, 1977.

42. Kuritz, S. J., The Ford Motor Company Environmental Health Surveillance System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 844-847, October, 1982.

43. Kurt, T. L., Pre-Placement Health Screening Needs Problem-Oriented Approach, Occupational Health and Safety, p. 23, May, 1985.

44. Marine Safety Council, Merchant Marine Personnel Statistics, Proceedings of the Marine Safety Council, pp. 89-93, April-May, 1983.

45. LaDou, J., Sherwood, J. N. and Hughes, L., Multiphasic Health Testing, Journal of Occupational Medicine, Vol. 17, No. 8, pp. 495-501, August, 1975.

46. LeBlanc, J. V., A Computerized Health and Environmental Surveillance System (CHESS), Journal of Occupational Medicine, Vol. 24, No. 10, pp. 804-805, October, 1982.

47. Magerlein, J. M., Yager, C. A. and Cernik, J. J., Occupational Health Surveillance System (OHSS) at The Upjohn Company, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 809-811, October, 1982.

48. Mettler, F. A., Optimization of Mobile Multiphasic Health Testing, Journal of Occupational Medicine, Vol. 22, No. 3, pp. 180-182, March, 1980.

49. Mettler, F. A., The Role of Mobile Health Testing Programs, Occupational Health and Safety, pp. 44-48, September, 1982.

50. Morrissette, M. D., Hazard Evaluation of Chemicals for Bulk Marine Shipment, Journal of Hazardous Materials, Vol. 3, pp. 33-48, 1979.

51. Ott, M. G., Linking Industrial Hygiene and Health Records, Journal of Occupational Medicine, Vol. 19, No. 6, pp. 388-390, June, 1977.

52. Phillips, W. R. and Thompson, D. J., Multi-Test Screening and the Chances of Being Normal, The Journal of Family Practice, Vol. 11, No. 7, pp. 1095-1098, 1980.

53. Rappaport, S. M., Selvin, S., Spear, R. C. and Keil, C., Air Sampling in the Assessment of Continuous Exposure to Acutely-Toxic Chemicals: Part I - Strategy, American Industrial Hygiene Journal, Vol. 42, No. 11, pp. 831-838, November, 1981.

54. Robinson, H. and Wood, L. W., The New York Telephone Company Medical Information System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 840-843, October, 1982.

55. Rossi, D. A., Cox, J. D. and Seger, M. J., Computerization of Medical and Exposure Records in the Semiconductor Industry, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 859-862, October, 1982.

56. Ryan, C., Breysse, P. N., White, N. and Corn, M., Critical Review of International Standards for Respiratory Protective Equipment - I. Respiratory Protective Equipment for Particulate-Laden Atmospheres, American Industrial Hygiene Journal, Vo. 44, No. 10, pp. 756-761, October, 1983.

57. Scavone, J. G., Latshaw, R. F. and Rohrer, G. V., Use of Lumbar Spine Films, Journal of the American Medical Association, Vol. 246, No. 10, pp. 1105-1108, September, 1981.

58. Scherr, L., Maynard, E. P. et al., Periodic Health Examination: A Guide for Designing Individualized Preventive Health Care in the Asymptomatic Patient, Annals of Internal Medicine, Vol. 95, No. 6, pp. 729-732, December, 1981.

59. Schulte, P. A. and Ringen, K., Notification of Workers at High Risk: An Emerging Public Health Problem, American Journal of Public Health, Vol. 74, No. 5, pp. 485-491, May, 1984.

60. Shindell, S. and Goldberg, H. M., Surveillance Systems: What to Include and Why, Occupational Health and Safety, pp. 34-39 56, July, 1981.

61. Smith, F. R., Gutierrez, R. R. and McDonagh, T. J., Exxon's Health Information System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 824-826, October, 1982.

62. Snyder, P. J., Bell, Z. G. and Samelson, R. J., The Computerization of Industrial Hygiene Records, American Industrial Hygiene Association Journal, pp. 709-720, August, 1979.

63. Soto, R. J., Kalan, D. A., Crisostomo, B., Falbo, L. L., Groh, W. J., Smith, L. W. and Stewart, R. D., Data Base Management System for Tracking Occupational Health, American Industrial Hygiene Journal, Vol. 44, No. 6, pp. 389-394, June, 1983.

64. Stallard, C. W., The SOHIO Health Information System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 853-858, October, 1982.

65. Sugano, D. S., Worker Tracking--A Complex but Essential Element in Health Surveillance Systems, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 783-784, October, 1982.

66. Tamburro, C. H. and Greenberg, R., Effectiveness of Federally Required Medical Laboratory Screening in the Detection of Chemical Liver Injury, Environmental Health Perspectives, Vol. 41, pp. 117-122, October, 1981.

67. Thorner, R. M., Whither Multiphasic Screening, New England Journal of Medicine, Vol. 280, No. 19, pp. 1037-1042, May, 1969.

68. Those Costly Annual Physicals, Consumer Reports, pp. 601-606, October, 1981.

69. Torkelson, T. R., Redirection of Industrial Health, American Industrial Hygiene Journal, Vol. 44, No. 11, pp. 781-787, November, 1983.

70. Trell, E., Dahlberg, N., Larsson, C., Krantz, J., Lazer, A. and Petersson, B., Interactive Computer System for Monitoring Multiphasic Health Screening, Computer Programs in Biomedicine, Vol. 12, pp. 262-270, 1980.

71. Urner, C. J., Occupational Medicine at Sea: The Seafarer as a Patient, Journal of Occupational Medicine, Vol. 24, No. 11, pp. 917-922, November, 1982.

72. Verminski, E. R., Protopapas, C. and Loca, L. M., A Functionally Oriented Computer System for Industrial Hygiene Exposure Data, American Industrial Hygiene Association Journal, pp. 437-444, June, 1981.

73. Walter, D. F., Control Data Corporation's Occupational Health and Safety System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 848-852, October, 1982.

74. Whyte, A. A., Occupational Health Information Systems, Occupational Health and Safety, pp. 14-19 36, August, 1982.

75. Wolkonsky, P., Computerized Recordkeeping in an Occupational Health System: The Amoco System, Journal of Occupational Medicine, Vol. 24, No. 10, pp. 791-793, October, 1983.

76. Wright, C. C., Cost Containment Through Health Promotion Programs, Journal of Occupational Medicine, Vol. 24, No. 12, pp. 965-968, December, 1982.

77. Zenz, C., Reproductive Risks in the Workplace, National Safety News, pp. 38-46, September, 1984.

78. Ziporyn, L., Computer-Assisted Medical Decision-Making: Interest Growing, Journal of the American Medical Association, Vol. 248, No. 8, pp. 913-918, August, 1982.

APPENDIX A

Marine Hazardous Substances

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MARINE HAZARDOUS SUBSTANCES

This appendix contains a listing of marine hazardous substances for consideration in medical monitoring design. The listing is alphabetical, by chemical name, and contains three types of substances:

(1) Bulk liquid cargo substances regulated under 46CFR Subchapter O,
(2) Bulk liquid cargo substances regulated under 46CFR Subchapter D, and
(3) Non-cargo toxic substances encountered in the marine environment.

Three columns of information are provided in the listing: the chemical name, the CHRIS Code used in the U. S. Coast Guard Chemical Hazards Response Information System, and indication of the CFR designation of O for cargo substances regulated under 46CFR Subchapter O, and D for cargo substances regulated under 46CFR Subchapter D. Non-cargo substances are indicated by blanks in both the CHRIS Code column and the CFR column.

20-DEC-85

CHEMICAL NAME	CHRIS CODE	CFR
ACETALDEHYDE	AAD	0
ACETIC ACID	AAC	0
ACETIC ANHYDRIDE	ACA	0
ACETONE	ACT	0
ACETONE CYANOHYDRIN	ACY	0
ACETONITRILE	ATN	0
ACETOPHENONE	ACP	0
ACETYL TRIBUTYL CITRATE		0
ACRYLAMIDE (50% OR LESS)	AAM	0
ACRYLIC ACID	ACR	0
ACRYLONITRILE	ACN	0
ADIPONITRILE	ADN	0
ALCOHOLS (MIXED)		0
ALKENYL SUCCINIC ACID		0
ALKENYLSUCCINIC ANHYDRIDE		0
ALKYLBENZENESULFONIC ACIDS	ABS	0
N-ALKYL PHTHALATES		0
ALKYL SUCCINNATE FORMALDEHYDE HYDROXY AM		0
ALLYL ALCOHOL	ALA	0
ALLYL CHLORIDE	ALC	0
2-(2-AMINOETHOXY)ETHANOL	AEX	0
AMINOETHYLETHANOLAMINE	AEE	0
N-AMINOETHYLPIPERAZINE	AEP	0
AMMONIA, ANHYDROUS	AMA	0
AMMONIUM HYDROXIDE, 28 PERCENT AQ.	AMH	0
N-AMYL ACETATE	AML	0
N-AMYL ALCOHOL	AAN	0
AMYLENE		0
N-AMYL METHYL KETONE	AMK	0
AMYL TALLATE		0
ANILINE	ANL	0
ASBESTOS--AMOSITE		
ASBESTOS--CHRYSOTILE		
ASBESTOS--CROCIDOLITE		
ASBESTOS--OTHER		
ASPHALT	ASP	0
ASPHALT BLENDING STOCKS: ROOFERS FLUX	ARF	0
ASPHALT BLENDING STOCKS: STRAIGHT RUN RE	ASR	0
BEHENYL ALCOHOL		0
BENZENE	BNZ	0
BENZENE HYDROCARBON MIX (> OR = 10% BEN)	BHB	0
BENZENE HYDROCARBON MIX (WITH ACETYLENE)	BHA	0
BENZENESULFONYL CHLORIDE	BSC	0
BENZENE, TOLUENE, XYLENE MIXTURE	BTX	0
BENZYL ALCOHOL	BAL	0
BENZYL CHLORIDE	BCL	0
BERYLLIUM		
BICYCLIC TERPENEL POLYAMINE AMIDE SALT		0
BISPHENOL A DIGLYCIDYL ETHER	BDE	0
BUTADIENE (1,3 BUTADIENE)	BDI	0
BUTADIENE, BUTYLENE MIX WITH ACETYLENES	BBM	0

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CHEMICAL NAME	CHRIS CODE	CFR
BUTANE	BUT	O
N-BUTYL ACETATE	BCN	D
SEC-BUTYL ACETATE	BTA	D
ISO-BUTYL ACRYLATE	BAI	O
BUTYL ACRYLATE (INH) (ISO, N, AND MIXES)	BAR	O
N-BUTYL ACRYLATE	BTC	O
N-BUTYL ALCOHOL	BAN	D
SEC-BUTYL ALCOHOL	BAS	D
TERT-BUTYL ALCOHOL	BAT	D
BUTYLAMINE (ALL ISOMERS)	BTY	O
N-BUTYLAMINE	BAM	O
SEC-BUTYLAMINE	BTL	O
TERT-BUTYLAMINE	BUA	O
BUTYLBENZYL PHTHALATE	BPH	D
BUTYLENE	BTN	O
BUTYLENE GLYCOL		D
1,2-BUTYLENE OXIDE	BTO	O
BUTYLENE POLYGLYCOL		D
N-BUTYL ETHER	BTE	O
BUTYL HEPTYL KETONE		D
ISO-BUTYL METHACRYLATE	BMI	O
N-BUTYL METHACRYLATE	BMN	O
BUTYL METHYL KETONE		D
BUTYL STEARATE		D
BUTYL TOLUENE (P-TERT)		D
ISO-BUTYRALDEHYDE	BAD	O
BUTYRALDEHYDE (ISO, N, AND MIXTURES)	BAE	O
N-BUTYRALDEHYDE	BTR	O
GAMMA-BUTYROLACTONE	BLA	D
CADMIUM		
CALCIUM ALKYLPHENATE		D
CALCIUM ALKYL SALICYLATE	CAK	D
CALCIUM AMINO NONYL PHENOLATE		D
CALCIUM CARBOXYLATE		D
CAMPHOR	CPO	O
CAMPHOR (OIL)	CPO	O
CAPROLACTAM (SOLUTION)	CLS	D
CARBOLIC OIL (PHENOL)	CBO	O
CARBON BLACK BASE		D
CARBON DISULFIDE	CBB	O
CARBON MONOXIDE		
CARBON TETRACHLORIDE	CBT	O
CAUSTIC POTASH SOLUTION	CPS	O
CAUSTIC SODA SOLUTION	CSS	O
CETYL ALCOHOL		D
CETYL-EICOSYL METHACRYLATE	CEM	O
CETYL STEARYL ALCOHOL		D
CHEMICAL WASTES (CHLORHCARBONS & CAUST)	CWC	O
CHLORINE	CLX	O
CHLOROACETIC ACID SOLUTION (80% OR LESS)	CHM	O
CHLOROBENZENE	CRB	O

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CHEMICAL NAME	CHRIS CODE	CFR
CHLOROFORM	CRF	0
CHLOROHYDRINS (CRUDE)	CHD	0
CHLOROPRENE	CRP	0
2-CHLOROPROPIONIC ACID	CLA	0
3-CHLOROPROPIONIC ACID	CLP	0
2- AND 3-CHLOROPROPIONIC ACID MIXTURE	CPM	0
CHLOROSULFONIC ACID	CSA	0
CHLOROTOLUENE (O, M, P, AND MIXTURES)	CHI	0
M-CHLOROTOLUENE	CTM	0
O-CHLOROTOLUENE	CTO	0
P-CHLOROTOLUENE	CRN	0
CHROMIUM (VI)		
CLEANING SPIRIT (UNLEADED)		D
CREOSOTE	CCW	0
M-CRESOL	CRL	0
O-CRESOL	CSL	0
P-CRESOL	CSO	0
CRESOLS	CRS	0
CRESYLATE SPENT CAUSTIC	CSC	0
CROTONALDEHYDE	CTA	0
CUMENE	CUM	D
CYCLOHEXANE	CHX	D
CYCLOHEXANOL	CHN	D
CYCLOHEXANONE	CCH	0
CYCLOHEXYLAMINE	CHA	0
CYCLOPENTADIENE POLYMERS		D
P-CYMENE	CMP	D
N-DECALDEHYDE	DAL	D
DECANE	DCC	D
1-DECENE	DCE	D
DECYL ACRYLATE (ISO, N, AND MIXTURES)	DAT	0
N-DECYL ACRYLATE	DAR	0
N-DECYL ALCOHOL	DAN	D
N-DECYLBENZENE	DBZ	D
DETERGENT ALKYLATE		D
DIACETONE ALCOHOL	DAA	D
DIAMMONIUM SALT OF ZINC EDTA (SOLUTION)	DSZ	0
DI-N-BUTYLAMINE	DBA	0
DIBUTYL CARBINOL		D
DIBUTYL PHTHALATE	DPA	D
M-DICHLOROBENZENE	DBM	0
O-DICHLOROBENZENE	DBO	0
P-DICHLOROBENZENE	DBP	0
DICHLORODIFLUOROMETHANE	DCF	0
1,1-DICHLOROETHANE	DCH	0
2,2'-DICHLOROETHYL ETHER	DEE	0
DICHLOROISOPROPYL ETHER	DCI	0
DICHLOROMETHANE (METHYLENE CHLORIDE)	DCM	0
DICHLOROMONOFLUOROMETHANE	DFM	0
2,4-DICHLOROPHENOL	DCP	0
1,1-DICHLOROPROPANE	DPB	0

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CHEMICAL NAME	CHRIS CODE	CFR
1,2-DICHLOROPROPANE	DPP	D
1,3-DICHLOROPROPANE	DPC	D
1,3 DICHLOROPROPENE	DPU	D
DICHLOROPROPENE (1,1- 1,2- 1,3- AND MIX)	DPS	D
DICHLOROPROPENE, DICHLOROPROPANE MIXTURE)	DMX	D
2,2-DICHLOROPROPIONIC ACID	DCN	D
DICHLOROTETRAFLUOROETHANE	DTE	D
DICYCLOPENTADIENE	DPT	D
DIETHANOLAMINE	DEA	D
DIETHYLAMINE	DEN	D
DIETHYLBENZENE	DEB	D
DIETHYLENE GLYCOL	DEG	D
DIETHYLENE GLYCOL DIETHYL ETHER		D
DIETHYLENEGLYCOL MONOBUTYL ETHER ACETATE	DEM	D
DIETHYLENE GLYCOL MONOBUTYL ETHER	DME	D
DIETHYLENEGLYCOL MONOETHYL ETHER	DGE	D
DIETHYLENE GLYCOL MONOETHYL ETHER ACETAT		D
DIETHYLENEGLYCOL MONOMETHYL ETHER	DGM	D
DIETHYLENE GLYCOL MONOMETHYL ETHER ACET		D
DIETHYLENE GLYCOL MONOPHENYL ETHER		D
DIETHYLENETRIAMINE	DET	D
DIETHYLETHANOLAMINE	DAE	D
DI-(2-ETHYLHEXYL)PHOSPHORIC ACID	DEP	D
DI(ETHYLHEXYL)PHTHALATE		D
DIETHYL PHTHALATE	DPH	D
DIETHYL SULFATE	DSU	D
DIHEPTYL PHTHALATE	DHP	D
DIHEXYL PHTHALATE		D
DIISOBUTYLAMINE	DBU	D
DIISOBUTYL CARBINOL	DBC	D
DIISOBUTYLENE	DBL	D
DIISOBUTYL KETONE	DIK	D
DIISOBUTYL PHTHALATE	DIT	D
DIISODECYL PHTHALATE	DID	D
DIISONONYL PHTHALATE	DIN	D
DIISOOCTYL PHTHALATE	DIO	D
DIISOPROPANOLAMINE	DIP	D
DIISOPROPYLAMINE	DIA	D
DIISOPROPYL BENZENE		D
DIMETHYLACETAMIDE	DAC	D
DIMETHYLAMINE	DMA	D
DIMETHYLAMINE SOLUTION (45% OR LESS)	DMG	D
DIMETHYLAMINE SOLUTION (>45% AND <=55%)	DMY	D
DIMETHYLAMINE SOLUTION (55% AND <65%)	DMC	D
DIMETHYL AMMONIUM-2,4-DICHLOROPHENOXYACE	DDA	D
N,N-DIMETHYLCYCLOHEXYLAMINE	DXN	D
DIMETHYLETHANOLAMINE	DMB	D
DIMETHYLFORMAMIDE	DMF	D
DIMETHYL PHTHALATE	DTL	D
2,2-DIMETHYLPROPANE-1,3-DIOL		D
DINONYL PHTHALATE		D

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CHEMICAL NAME	CHRIS CODE	CFR
DI(OCTYLPHENYL)AMINE		D
DIOCTYL PHTHALATE	DOP	D
1,4-DIOXANE	DOX	O
DIPENTENE	DPN	D
DIPHENYL	DIL	D
DIPHENYL DIPHENYL OXIDE	DDO	D
DIPHENYL ETHER	DPE	D
DIPHENYLMETHANE DIISOCYANATE	DPM	O
DI-N-PROPYLAMINE	DNA	O
DIPROPYLENE GLYCOL	DPG	D
DIPROPYLENE GLYCOL MONOMETHYL ETHER		D
DISTILLATES FLASHED FEED STOCKS	DFF	D
DISTILLATES STRAIGHT RUN	DSR	D
DIUNDECYL PHTHALATE	DUP	D
DODECANE		D
DODECANOL	DDN	D
DODECENE	DDC	D
1-DODECENE	DDC	D
DODECYLBENZENE	DDB	D
DODECYL DIPHENYL OXIDE DISULFONATE SOLN	DOS	O
DODECYLMETHACRYLATE	DDM	O
DODECYL PENTADECYL METHACRYLATE	DDP	O
DODECYL PHENOL		D
EPICHLOROHYDRIN	EPC	O
ETHOXYLATED LINEAR ALCOHOLS, C11-C15		D
ETHANE	ETH	O
2-ETHOXYETHANOL	EGE	D
2-ETHOXYETHYL ACETATE		D
ETHOXYLATED DODECANOL	EOD	D
ETHOXYLATED PENTADECANOL	EOP	D
ETHOXYLATED TETRADECANOL	EOT	D
ETHOXYLATED TRIDECANOL	ETD	D
ETHOXYLATED UNDECANOL		D
ETHOXY TRIGLYCOL	ETG	D
ETHYL ACETATE	ETA	D
ETHYL ACRYLATE	EAC	O
ETHYL ALCOHOL	EAL	D
ETHYLAMINE	EAM	O
ETHYLAMINE (40% OR LESS)	EAO	O
ETHYLAMINE (72% OR LESS)	EAN	O
ETHYL AMYL KETONE		D
ETHYLBENZENE	ETB	D
ETHYL BUTANOL	EBT	D
N-ETHYL-N-BUTYLAMINE	EBA	O
ETHYL CHLORIDE	ECL	O
ETHYL CYCLOHEXANE	ECY	D
N-ETHYL CYCLOHEXYLAMINE	ECC	O
ETHYLENE	ETL	O
ETHYLENE CARBONATE		D
ETHYLENE CHLOROHYDRIN	ECH	O
ETHYLENE CYANOHYDRIN	ETC	O

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CHEMICAL NAME	CHRIS CODE	CFR
ETHYLENEDIAMINE	EDA	O
ETHYLENE DIBROMIDE	EDB	O
ETHYLENE DICHLORIDE	EDC	O
ETHYLENE GLYCOL	EGL	D
ETHYLENE GLYCOL DIACETATE	EGY	D
ETHYLENE GLYCOL METHYL BUTYL ETHER		D
ETHYLENE GLYCOL MONOBUTYL ETHER	EGM	D
ETHYLENE GLYCOL MONOBUTYL ETHER ACETATE	EMA	D
ETHYLENE GLYCOL MONOETHYL ETHER ACETATE	EGA	D
ETHYLENE GLYCOL MONOISOPROPYL ETHER		D
ETHYLENE GLYCOL MONOMETHYL ETHER	EME	D
ETHYLENE GLYCOL MONOMETHYL ETHER ACETATE		D
ETHYLENE GLYCOL PHENYL ETHER		D
ETHYLENE OXIDE	EOX	O
ETHYLENE OXIDE, PROPYLENE OXIDE MIXTURE	EPM	O
ETHYLENE - PROPYLENE COPOLYMERS		D
ETHYL ETHER	EET	O
ETHYLHEXALDEHYDE	EHA	D
ETHYLHEXANOIC ACID (ETHYL HEXOIC ACID)		D
2-ETHYL HEXANOL	EHX	D
2-ETHYLHEXYL ACRYLATE	EAI	O
2-ETHYL HEXYLAMINE	EHM	O
ETHYL HEXYL PHTHALATE		D
ETHYLHEXYL TALLATE	EHT	D
ETHYLIDENE NORBORNENE	ENB	O
ETHYL METHACRYLATE	ETM	O
2-ETHYL-3-PROPYLACROLEIN	EPA	O
ETHYL TOLUENE	ETE	D
FATTY ACID AMIDES		D
FERRIC CHLORIDE SOLUTIONS	FCS	O
FLUORIDES		
FORMALDEHYDE SOLUTION	FMS	O
FORMAMIDE	FAM	D
FORMIC ACID	FMA	O
FURFURAL	FFA	O
FURFURYL ALCOHOL	FAL	D
GAS OIL CRACKED	GOC	D
GASOLINE AUTOMOTIVE (4.23G PB/GAL)	GAT	D
GASOLINE AVIATION (4.86G PB/GAL)	GAV	D
GASOLINE BLENDING STOCKS: ALKYLATES	GAK	D
GASOLINE BLENDING STOCKS: REFORMATES	GRF	D
GASOLINE CASINGHEAD	GCS	D
GASOLINE POLYMER	GPL	D
GASOLINE STRAIGHT RUN	GSR	D
GLUTARALDEHYDE (50% OR LESS)	GTA	O
GLYCERINE	GCR	D
GLYCERYL TRIACETATE		D
GLYCIDYL ESTER OF TERTIARY CARBOXYLIC AC		D
GLYCIDYL ESTER OF VERSATIC ACID		D
GLYCOLS, RESINS, AND SOLVENTS MIXTURE		D
GLYCOL TRIACETATE		D

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CHEMICAL NAME	CHRIS CODE	CFR
GLYOXAL, 40% SOLUTION	GOS	D
GREASE		D
HEPTADECANE		D
HEPTANE	HPT	D
HEPTANOIC ACID	HEP	D
HEPTANOL	HTN	D
1-HEPTENE	HTE	D
HERBICIDE (C15-H22-NO2-CL)		D
HEXAETHYLENE GLYCOL		D
HEXAMETHYLENEDIAMINE	HMD	O
HEXAMETHYLENEDIAMINE SOLUTION	HMC	O
HEXAMETHYLENE GLYCOL		D
HEXAMETHYLENEIMINE	HMI	O
HEXANE	HXA	D
HEXANOL	HXN	D
1-HEXENE	HXE	D
HEXYL ACETATE		D
HEXYLENE GLYCOL	HXG	D
HOG GREASE		D
HYDROCHLORIC ACID	HCL	O
HYDROCHLORIC ACID, SPENT (15% OR LESS)	HCS	O
HYDROFLUORIC ACID	HFA	O
HYDROGEN CHLORIDE	HDC	O
HYDROGEN FLUORIDE	HFX	O
HYDROGEN SULFIDE		
2-HYDROXYETHYL ACRYLATE	HAI	O
INDUSTRIAL WASTES (METHYL MERCAPTAN, ETC)	INW	O
ISOAMYL ACETATE	IAT	D
ISOBUTYL ACETATE	IBA	D
ISOBUTYL ALCOHOL	IAL	D
ISOBUTYLAMINE	IAM	O
ISODECALDEHYDE	IDA	D
ISODECYL ACRYLATE	IAI	O
ISODECYL ALCOHOL	ISA	D
ISOHEXANE	IHA	D
ISOOCTALDEHYDE	IOC	D
ISOPHORONE	IPH	D
ISOPHORONE DIAMINE	IPI	O
ISOPHORONE DIISOCYANATE	IPD	O
ISOPRENE	IPR	O
ISOPROPYL ACETATE	IAC	D
ISOPROPYL ALCOHOL	IPA	D
ISOPROPYLAMINE	IPP	O
ISOPROPYLAMINE (90% OR LESS)	IPO	O
ISOPROPYL ETHER	IPE	O
ISOVALERALDEHYDE	IVA	O
JET FUEL: JP-1 (KEROSENE)	JPO	D
JET FUEL: JP-3	JPT	D
JET FUEL: JP-4	JPF	D
JET FUEL: JP-5 (KEROSENE, HEAVY)	JPV	D
KEROSENE	KRS	D

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CHEMICAL NAME	CHRIS CODE	CFR
LACTIC ACID	LTA	D
LARD		D
LATEX, LIQUID SYNTHETIC	LLS	D
LEAD DUST		
LEAD FUMES		
LIQUIFIED NATURAL GAS (OR LPG)	LNG	O
MAGNESIUM NONYL PHENOL SULFIDE		D
MAGNESIUM SULFONATE		D
MALEIC ANHYDRIDE	MLA	O
MALEIC ANHYDRIDE COPOLYMER		D
MANGANESE (FUME)		
2-MERCAPTOBENZOTHIAZOLE (SOLUTIONS)	MBT	D
MERCURY		
MESITYL OXIDE	MSO	O
METHACRYLIC ACID	MAD	O
METHANE	MTH	O
METHOXYTRIGLYCOL	MTG	D
METHYL ACETATE	MTT	D
METHYL ACETOACETATE		D
METHYL ACETYLENE, PROPADIENE MIXTURE	MAP	O
METHYLACRYLATE	MAM	O
METHYL ALCOHOL	MAL	D
METHYLAMINE SOLUTION (42% OR LESS)	MSZ	O
METHYL AMYL ACETATE	MAC	D
METHYL AMYL ALCOHOL(METHYLISOBUTYL CARB.	MAA	D
METHYL BROMIDE	MTB	O
METHYL BUTANOL (ISOAMYL ALCOHOL)		D
METHYL-T-BUTYL ETHER	MBE	D
METHYL CHLORIDE	MTC	O
2-METHYL-6-ETHYL ANILINE	MEN	O
METHYL ETHYL KETONE (2-BUTANONE)	MEK	D
2-METHYL-5-ETHYLPYRIDINE	MEP	O
METHYL FORMAL	MTF	D
METHYL FORMATE	MFM	O
METHYL HEPTYL KETONE (ETHYL AMYL HEPTANO	MHK	D
2-METHYL-2-HYDROXY-3-BUTYNE	MHB	O
METHYL ISOBUTYL CARBINOL	MIC	D
MEHTYL ISOBUTYL KETONE (HEXONE)	MIK	D
METHYL METHACRYLATE	MMM	O
METHYL NAPHTHALENE	MNA	D
2-METHYL PENTENE	MPN	D
2-METHYLPYRIDINE	MPR	O
1-METHYLPYRROLIDONE	MPY	D
ALPHA-METHYLSTYRENE	MSR	O
MINERAL SPIRITS	MNS	D
MONOCHLORODIFLUOROMETHANE	MCF	O
MONOCHLOROTETRAFLUOROETHANE	MTE	O
MONOCHLOROTRIFLUOROMETHANE	MCM	O
MONOETHANOLAMINE (ETHANOLAMINE)	MEA	O
MONOISOPROPANOLAMINE	MPA	O
MORPHOLINE	MPL	O

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CHEMICAL NAME	CHRIS CODE	CFR
MOTOR FUEL ANTIKNOCK CMPDS (PB ALKYLS)	MFA	O
NAPHTHA: AROMATIC (10% OR LESS BENZENE)		D
NAPHTHA: COAL TAR	NCT	O
NAPHTHA: CRACKING FRACTION		D
NAPHTHA: HEAVY		D
NAPHTHALENE	NTM	O
NAPHTHA: PARAFFINIC		D
NAPHTHA: PETROLEUM		D
NAPHTHA: SOLVENT	NSV	D
NAPHTHA: STODDARD SOLVENT	NSS	D
NAPHTHA: VM & P (75% NAPHTHA)	NVM	D
NAPHTHENIC ACID	NTI	D
NICKEL		
NITRIC ACID	NAC	O
NITRIC ACID (70% OR LESS)	NCD	O
NITROBENZENE	NTB	O
NITROGEN, LIQUIFIED	NXX	O
NITROGEN OXIDES		
2-NITROPHENOL	NTP	O
1-NITROPROPANE	NPN	O
NITROPROPANE (1-, 2-, AND MIXTURES)	NPM	O
2-NITROPROPANE	NPP	O
NITROPROPANE (60%), NITROETHANE (40%)	NNM	O
O-NITROTOLUENE	NIE	O
NITROTOLUENE (O, P, AND MIXTURES)	NIT	O
P-NITROTOLUENE	NTT	O
NONANE	NAN	D
NONANOIC ACID		D
NONANOIC-TRIDECANOIC ACID MIXTURE		D
NONENE	NON	D
1-NONENE	NNE	D
NONYL ALCOHOL		D
NONYL PHENOL	NNP	D
NONYL PHENOL (ETHOXYLATED)		D
NONYL PHENOL SULFIDE (30% OR LESS)		D
OCTADECENE		D
OCTADECENEAMIDE (OLEAMIDE)		D
OCTANE	OAN	D
OCTENE		D
OCTYL ACETATE		D
ISO-OCTYL ALCOHOL		D
N-OCTYL ALCOHOL		D
OCTYL EPOXYTALLATE	OET	D
OCTYL PHTHALATE		D
OIL, CLARIFIED	OCF	D
OIL: CRUDE (SOUR)	OIL	D
OIL: DIESEL	ODS	D
OIL, EDIBLE: BEECHNUT		D
OIL, EDIBLE: CASTOR	OCA	D
OIL, EDIBLE: COCOA BUTTER		D
OIL, EDIBLE: COCONUT	OCC	D

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CHEMICAL NAME	CHRIS CODE	CFR
OIL, EDIBLE: COCONUT OIL, ESTERIFIED		D
OIL, EDIBLE: COCONUT OIL, FATTY ACID		D
OIL, EDIBLE: COCONUT OIL, METHYL ESTER		D
OIL, EDIBLE: COD LIVER		D
OIL, EDIBLE: CORN		D
OIL, EDIBLE: COTTONSEED	OCS	D
OIL, EDIBLE: COTTON SEED FATTY ACID		D
OIL, EDIBLE: FISH	OFS	D
OIL, EDIBLE: GRAPESEED		D
OIL, EDIBLE: GROUNDNUT		D
OIL, EDIBLE: HAZELNUT		D
OIL, EDIBLE: LARD	OLD	D
OIL, EDIBLE: MAIZE		D
OIL, EDIBLE: MUSTARD SEED		D
OIL, EDIBLE: NUTMEG BUTTER		D
OIL, EDIBLE: OLIVE	OOL	D
OIL, EDIBLE: PALM	OPM	D
OIL, EDIBLE: PEANUT	OPN	D
OIL, EDIBLE: POPPY		D
OIL, EDIBLE: RAISIN SEED		D
OIL, EDIBLE: RAPESEED		D
OIL, EDIBLE: RICE BRAN		D
OIL, EDIBLE: SAFFLOWER	OSF	D
OIL, EDIBLE: SALAD		D
OIL, EDIBLE: SESAME		D
OIL, EDIBLE: SOYA BEAN	OSB	D
OIL, EDIBLE: SOYBEAN (EPOXIDIZED)		D
OIL, EDIBLE: SUNFLOWER SEED		D
OIL, EDIBLE: TUCUM	OTC	D
OIL, EDIBLE: VEGETABLE	OVG	D
OIL, EDIBLE: WALNUT		D
OIL, FUEL: NO. 1 (KEROSENE)	OON	D
OIL, FUEL: NO. 1-D	OOD	D
OIL, FUEL: NO. 2	OTW	D
OIL, FUEL: NO. 2-D	OTD	D
OIL, FUEL: NO. 4	OFR	D
OIL, FUEL: NO. 5	OFV	D
OIL, FUEL: NO. 6	OSX	D
OIL, MISC: ABSORPTION	OAS	D
OIL, MISC: ALIPHATIC		D
OIL, MISC: ANIMAL		D
OIL, MISC: AROMATIC (5% OR LESS BENZENE)		D
OIL, MISC: AVIATION F2300		D
OIL, MISC: CASHEW NUT SHELL	OCN	D
OIL, MISC: COAL		D
OIL, MISC: COAL TAR	OCT	D
OIL, MISC: CROTON	OCR	D
OIL, MISC: GAS, LOW POUR		D
OIL, MISC: GAS, LOW SULFUR		D
OIL, MISC: HEARTCUT DISTILLATE		D
OIL, MISC: LANOLIN		D

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CHEMICAL NAME	CHRIS CODE	CFR
OIL, MISC: LINSEED	OLS	D
OIL, MISC: LUBRICATING	OLB	D
OIL, MISC: MINERAL	OMN	D
OIL, MISC: MINERAL SEAL	OMS	D
OIL, MISC: MOTOR	OMT	D
OIL, MISC: NEATSFOOT	ONF	D
OIL, MISC: OITICIA		D
OIL, MISC: PENETRATING	OPT	D
OIL, MISC: PERILLA		D
OIL, MISC: PILCHARD		D
OIL, MISC: PINE		D
OIL, MISC: RANGE	ORG	D
OIL, MISC: RESIDUAL		D
OIL, MISC: RESIN	ORS	D
OIL, MISC: RESINOUS PETROLEUM		D
OIL, MISC: ROAD	ORD	D
OIL, MISC: ROSIN	ORN	D
OIL, MISC: SEAL		D
OIL, MISC: SOAPSTOCK		D
OIL, MISC: SPERM	OSP	D
OIL, MISC: SPINDLE	OSD	D
OIL, MISC: SPRAY	OSY	D
OIL, MISC: TALL	OTL	D
OIL, MISC: TALL, FATTY ACID		D
OIL, MISC: TANNER'S	OTN	D
OIL, MISC: TRANSFORMER	OTF	D
OIL, MISC: TUNG		D
OIL, MISC: TURBINE	OTB	D
OIL, MISC: WHALE		D
OIL, MISC: WHITE (MINERAL)		D
OIL, MISC: WOOD		D
OLEIC ACID	OLA	D
OLEUM	OLM	O
OLEYL ALCOHOL (OCTADECANOL)		D
ORGANIC AMINE 70		D
OZONE		
PAINT PIGMENTS (DRY)		
PARALDEHYDE	PDH	O
PENTACHLOROETHANE	PCE	O
PENTADECANOL	PDC	D
1,3-PENTADIENE	PDI	O
PENTAETHYLENE GLYCOL		D
N-PENTANE	PTA	D
1-PENTENE	PTE	D
PERCHLOROETHYLENE(TETRACHLOROETHYLENE)	PER	O
PETROLATUM	PTL	D
PHENOL	PHN	O
PHOSPHORIC ACID	PAC	O
PHOSPHORIZED BICYCLIC TERPENE		D
PHOSPHORUS, WHITE	PPW	O
PHTHALATE PLASTICIZERS		D

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CHEMICAL NAME	CHRIS CODE	CFR
PHTHALIC ANHYDRIDE	PAN	O
PINENE		D
POLYALKENYL SUCCINIC ANHYDRIDE AMINE		D
POLYAMINE, AMIDE MIXTURE		D
POLYBUTENE	PLB	D
POLYETHYLENE GLYCOL		D
POLYETHYLENE POLYAMINES	PEB	O
POLYISOBUTYLENE		D
POLYMERIZED ESTER		D
POLYMETHYLENE POLYPHENYL ISOCYANATE	PPI	O
POLYPROPYLENE	PLP	D
POLYPROPYLENE GLYCOL	PGC	D
POLYPROPYLENE GLYCOL METHYL ETHER	PGM	D
POLYSTYRENE DIALKYL MALEATE		D
POLYVINYLBENZYLTRIMETHYL AMMONIUM CHLORI	PVB	O
PROPANE	PRP	O
N-PROPANOLAMINE	PLA	O
PROPIONALDEHYDE	PAD	O
PROPIONIC ACID	PNA	O
PROPIONIC ANHYDRIDE	PAH	O
PROPIONITRILE	PCN	O
N-PROPYL ACETATE	PAT	D
N-PROPYL ALCOHOL	PAL	D
N-PROPYLAMINE	PRA	O
PROPYL BENZENE		D
PROPYLENE	PPL	O
PROPYLENE BUTYLENE POLYMER	PBP	D
PROPYLENE GLYCOL	PPG	D
PROPYLENE GLYCOL METHYL ETHER	PME	D
PROPYLENE OXIDE	POX	O
PROPYLENE POLYMER		D
PROPYLENE TETRAMER	PTT	D
PROPYLENE TRIMER		D
PSEUDOCUMENE (1,2,4-TRIMETHYLBENZENE)		D
PYRIDINE	PRD	O
RUM		D
SAND		
SILICA		
SILICON TETRACHLORIDE	STC	O
SODIUM ACETATE, GLYCOL, WATER SOLUTIONS		D
SODIUM BOROHYDRIDE (13%)	SBI	O
SODIUM BOROHYDRIDE (<=15%), NAOH/SOLUT	SBX	O
SODIUM CHLORATE (50% OR LESS)	SDD	O
SODIUM DICHROMATE SOLUTION (<=69%)(CRVI)	SDL	O
SODIUM HYDROSULFIDE SOLUTION (<=45%)	SHR	O
SODIUM HYPOCHLORITE SOLUTION (<=15%)	SHP	O
SODIUM 2-MERCAPTOBENZOTHIAZOL SOLUTION	SMB	O
SODIUM SULFONATE		D
STEARIC ACID	SRA	D
STEARYL ALCOHOL (OCTADECANOL)		D
STYRENE	STY	O

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CHEMICAL NAME	CHRIS CODE	CFR
SULFOLANE	SFL	D
SULFUR	SXX	O
SULFUR DIOXIDE	SFD	O
SULFURIC ACID	SFA	O
SULFURIC ACID, SPENT	SAC	O
TALLOW	TLO	D
TALLOW FATTY ALCOHOL	TFA	D
TALLOW NITRILE		D
1,1,2,2-TETRACHLOROETHANE	TEC	O
TETRADECANOL	TTN	D
1-TETRADECENE	TTD	D
TETRADECYLBENZENE	TDB	D
TETRAETHYLENE GLYCOL	TTG	D
TETRAETHYLENEPENTAMINE	TTP	O
TETRAHYDROFURAN	THF	O
TETRAHYDRONAPHTHALENE	THN	D
TETRAPROPYL BENZENE		D
TITANIUM		
TOLUENE	TOL	D
TOLUENEDIAMINE	TDA	O
TOLUENE 2,4-DIISOCYANATE	TDI	O
TOLUENE DIISOCYANATE, DIPHENYLMET DIISOC	TDD	O
O-TOLUIDINE	TLI	O
TRIARYLPHOSPHATE		D
1,2,4-TRICHLOROBENZENE	TCB	O
1,1,2-TRICHLOROETHANE	TCM	O
TRICHLOROETHYLENE	TCL	O
1,2,3-TRICHLOROPROPANE	TCN	O
TRICRESYL PHOSPHATE (<1% O-ISOMER)	TCP	D
TRICRESYL PHOSPHATE (>1% ORTHO)	TCO	O
TRIDECANE		D
TRIDECANOIC ACID		D
TRIDECANOL	TDN	D
1-TRIDECENE	TDC	D
TRIDECYL BENZENE		D
TRIETHANOLAMINE	TEA	O
TRIETHYLAMINE	TEN	O
TRIETHYLBENZENE	TEB	D
TRIETHYLENE GLYCOL	TEG	D
TRIETHYLENE GLYCOL DIETHYL BUTYRATE		D
TRIETHYLENE GLYCOL MONOMETHYL ETHER		D
TRIETHYLENETETRAMINE	TET	O
TRIETHYL PHOSPHATE		D
TRIISOOCTYL TRIMELLITATE		D
TRIISOPROPANOLAMINE	TIP	O
2,2,4-TRIMETHYL PENTANEDIOL-1,3-DIISOBUT		D
TRIMETHYLACETIC ACID	TAA	O
TRIMETHYL BENZENE		D
TRIMETHYL HEXAMETHYLENE DIAMINE(224,244)	THA	O
TRIMETHYL HEXAMETHYLENE DIISOCYANATE	THI	O
2,2,4-TRIMETHYL-3-PENTANOL-1-ISOBUTYRATE		D

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CHEMICAL NAME	CHRIS CODE	CFR
TRIMETHYL PHOSPHITE	TPP	O
TRIPROPYLENE		D
TRIPROPYLENE GLYCOL	TGC	D
TRIPROPYLENE GLYCOL MONOMETHYL ETHER		D
TRIXYLONYL PHOSPHATE		D
TURPENTINE	TPT	D
TURPENTINE SUBSTITUTE (WHITE SPIRIT)		D
UNDECANOL	UND	D
1-UNDECENE	UDC	D
N-UNDECYLBENZENE	UDB	D
UREA, AMMONIUM NITRATE SOLN (> 2% NH3)	UAS	O
N-VALERALDEHYDE	VAL	O
VANADIUM		
VINYL ACETATE	VAM	O
VINYL ACETATE, FUMARATE COPOLYMER		D
VINYL CHLORIDE	VCM	O
VINYL ETHYL ETHER	VEE	O
VINYLIDENECHLORIDE	VCI	O
VINYL NEODECANATE	VND	O
VINYLTOLUENE	VNT	O
WAX: CANDELILLA		D
WAX: CARNAUBA	WCA	D
WAX: PARAFFIN	WPF	D
WAX: PETROLEUM		D
WELDING FUMES		
WHITE SPIRIT		D
WHITE SPIRIT, LOW AROMATIC		D
WINE		D
WOOL GREASE		D
M-XYLENE	XLM	D
O-XYLENE	XLO	D
P-XYLENE	XLP	D
XYLENE PARASOL		D
XYLENOL	XYL	O
ZINC		
ZINC DIALKYLDITHIOPHOSPHATE	ZDP	D

TOTAL OF 699 ITEM(S) IN TABLE

* CHLORODIFLUOROMETHANE -- SEE MONOCHLORODIFLUOROMETHANE
* ETHYL HEXOIC ACID -- SEE ETHYLHEXANOIC ACID
* ETHYLENE GLYCOL MONOETHYL ETHER -- SEE 2-ETHOXYETHANOL
* GLYCOL DIACITATE -- SEE ETHYLENE GLYCOL DIACITATE
* METHYL AMYL KETONE -- SEE N-AMYL METHYL KETONE

APPENDIX B

Merchant Vessel Personnel Involved in the Barging of Bulk Liquid Hazardous Substances on the U. S. Inland Waterways System

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MERCHANT VESSEL PERSONNEL INVOLVED IN THE BARGING OF BULK LIQUID HAZARDOUS SUBSTANCES ON THE U. S. INLAND WATERWAYS SYSTEM

The purpose of this paper is to impart information about merchant vessel personnel, particularly tankermen, who work on U. S. documented vessels transporting hazardous bulk liquids on the inland waterways of the United States. Factors present in the maritime workplace which impact on the occupational health and safety of this group of workers, are focused upon and described. To facilitate the understanding of the specific work milieu, a "broad brush" general description of the U. S. maritime industry and some information about the inland waterways commerce are provided. The term "inland waterways" refers to major rivers in the continental United States, including the Gulf Intracoastal Waterway. Unless otherwise identified, vessels are tugs, tow-boats and barges which ply these waters. Seafarers or seamen are individuals who hold merchant mariner documents issued by the U. S. Coast Guard. In general, merchant vessel personnel must possess this document in order to be employed on U. S. merchant vessels over 100 gross tons. There are exceptions to this requirement which are listed in Title 46 of the U.S. Code, Section 8701.

The first section of the paper is an overview of the maritime industry and the elements of which it is composed. Included in this section are: (1) definitions of terms used, (2) delineation of federal regulatory agencies involved, (3) identification of management and labor organizations, (4) descriptions of prevalent work practices and procedures, and, (5) a general description of the present economic condition of the maritime industry. The second section is a description of the inland waterways industry. It is composed of information and statistics about the inland waterway fleet--its commerce, workforce, vessels, amount and kinds of hazardous materials transported, licensing and endorsement procedures, medical services and health benefits for seafarers. This second part concludes with a grouping of relevant exhibits. The third section focuses on the tankermen of the inland waterway fleet. Information is included about courses and tests required of those seeking endorsement as tankermen, endorsement procedures as they relate to hazardous cargos, and proposed new regulations. The fourth and

final section contains a discussion about health care for merchant vessel personnel, including tankermen.

Information was obtained and corroborated through telephone interviews and reference materials documented in the text. References are listed at the end of the paper; individuals contacted are identified in Exhibit 9. Statistics cited about commerce on the inland waterways were obtained almost exclusively from a publication (Inland Waterborne...1981-82,) of the American Waterways Operators, Inc., a leading maritime inland waterways trade association, and a statistical document serial (Waterborne Commerce...1982), published annually by the U. S. Corps of Engineers. The most recent year for which final statistics were available was usually 1982. The Corps of Engineers compiled its 1982 data from reports of movements completed in 1981 and reported to the Corps between 1 March 1981, and 28 February 1982. When pertinent, and where possible, data for previous years were cited to indicate trends.

Overview

The maritime industry is an enigma to most people. Its impact on our lives is rarely of concern and when considered, it is often thought of in general, romantic terms. Nevertheless, the bulk of the trade between countries all over the world is carried by ship, boat or barge. Each country sets its own rules and regulations regarding registry of vessels and conduct of maritime business within its national waters. Matters of international concern are discussed and acted upon by the International Maritime Organization (IMO), an agency of the United Nations.

The U. S. maritime industry and its elements are usually described very generally. For example, the same word (e.g., ship, boat) is defined differently by the people or organizations making reference to it. As with most industries, the maritime industry is loosely divided into a variety of segments for the conduct of business, maintenance of working relationships, and the dissemination of information. Differentiation of the maritime industry into portions is almost always based on some combination of fleet vessel type(s), cargo-carried, and trade routes. One result of this approach,

which is frequently used, is a separation into parts commonly referred to as deepsea, inland waterways, Great Lakes, offshore, and fishing.

In a way, "deepsea" and "offshore" are the approximate counterparts of "coast-wise and foreign" and "mineral and oil." Since the latter two phrases are not as vague, it was suggested that these labels be used instead (J. Bobb, personal communication, June 1985). However, ambiguities remain. For example, using this general classification, ocean-going tankers can be classified some of the time as being in the mineral and oil part of the industry and at other times as being part of the coast-wise and foreign portion, depending upon the way the vessel is registered (J. Bobb, personal communication, June 1985). Similar ambiguities are prevalent when merchant vessel personnel are discussed. As a result, personnel who work aboard vessels transporting hazardous bulk liquids are frequently referred to as "tankermen," whereas, the Coast Guard (CG), which regulates these matters, classifies as tankermen only those seafarers who have acquired the tankerman endorsement on their merchant mariners document (MMD). However, seafarers who hold a valid license as master, mate, or engineer are permitted to serve as tankermen without having their MMD so endorsed.

As a general rule, each section of the industry is regulated by different federal agencies and commissions, work practices vary from one section to another, each has different trade association and management organizations, and each section often relates to a very different complement of companies due to the part of the maritime trade in which the company is engaged. The Congress, the Coast Guard, and the AFL-CIO affiliated unions are about the only exceptions to this general principle. The AFL-CIO affiliated unions have little or no presence in the mineral and oil portion of the industry. They are, however, well represented, and play an active role in each of the other parts of the industry, including fishing. To an outside observer, each sector seems to be a rather tight society. There are many groups and subgroups that tend to talk or not talk and work together or not, according to well-established maritime protocol and long institutional memory about ancient favors or "beefs" (complaints or disagreements). In the past, there has been little cross-fertilization and interaction between the various parts of the maritime industry. There have been few known efforts to form coalitions which

cut across the full spectrum of the industry to define and solve common problems such as the impact of hazardous substance exposure on the maritime workforce. Two exceptions to this general trend are the U. S. Coast Guard (CG) and the Seafarers' Health Improvement Program (SHIP).

As part of its regulatory and enforcement responsibilities, the Coast Guard has been one instrument for cross-fertilization and dissemination of information to various parts of the maritime industry. The CG has been especially effective with respect to setting standards regarding the seaworthiness of vessels, describing prudent ship operation and identifying the rudiments of safety practices for merchant vessel personnel. Another example is SHIP, which was established in 1978 under the auspices of the U. S. Public Health Service (PHS). At its inception, this forum was a collaborative effort between PHS, other federal agencies and the maritime industry. A primary purpose of SHIP was to stimulate communication, interaction and dissemination of information among relevant parties interested in and responsible for various aspects of the health and safety of the American seafarer. PHS responsibility to provide medical care for seafarers was terminated by the Omnibus Budget Reconciliation Act of 1981 (P.L. 97-35, section 986, no pagination). Since losing PHS as a sponsor in 1981, SHIP has continued as a non-governmental organization with meeting facilities and a limited amount of administrative support provided to the group by the Maritime Administration (MarAd), Department of Transportation (A. Friedberg, personal communication, June 1985).

Accurate, reliable and up-to-date data about the maritime labor force is extremely sparse and difficult to acquire. No federal agency, including the Coast Guard, maintains a file of active duty mariners serving in the inland waterways. The CG records the fact when licenses, endorsements and other documents are issued, but it has no system to update the files (J. Pendegraft, personal communication, March 1985). The Office of Maritime Labor and Training (OMLT), in the Maritime Administration collects and compiles various types of information in small data sets, including the number of members in AFL-CIO affiliated unions (F. Love, personal communication, February 1985). The report of the number of each union's members is compiled from information received by MarAd from telephone requests made to the unions (L. Bartholow,

personal communication, January 1985). Although the Public Health Service provided medical care to seafarers from 1798 to 1981, its records were never useful for demographic analysis because they were filed by patient name and facility. The PHS records of individuals were rarely consolidated or aggragated by beneficiary group for epidemiological study. Seldom were an individual's previous records obtained from other PHS facilities except to solve difficult diagnostic or treatment problems (Source--the writer, based on professional experience while employed in the PHS Bureau which administered the hospitals and clinics). Federal agencies, trade associations and businesses such as the Marine Index Bureau (MIB) usually base their estimates on a combination of individual experiences, tabulations and analyses of specific phenomena self-reported to them, and information extrapolated from data collected for other purposes by themselves or another organization (MIB, memorandum to "All MIB Member Companies,"--regarding services available and how to report to MIB, no date but believed to be circa 1978, p. 1). As a result, all known sources of statistics about merchant vessel personnel are probably too incomplete to be relied upon for anything more than general impressions. It is possible that, because of the subsidy programs administered by MarAd, more is known about personnel and related labor practices in the coast-wise and foreign portion of the industry than any other.

Maritime unions are of two types, AFL-CIO affiliated and independent or "company." The latter type unions are almost exclusively associated with the large oil companies, and their members work in the mineral and oil sector of the industry. AFL-CIO affiliated unions and their related labor practices are better known than the independent unions. This is probably due to the high proportion of their members employed aboard many of the subsidized vessels and vessels under contract to the federal government. Total AFL-CIO affiliated union membership nationwide was estimated as 64,308 as of December 31, 1984 (E. Love, personal communication, June 1985). See Exhibit 8, pp. 1-3 for a listing of seafarer AFL-CIO affiliated and independent unions extrapolated from Seafaring Guide and Directory of Labor Management Affiliations (U. S. Department of Transportation [DOT], Maritime Administration [MarAd], 1982, pp. 1, 2, 4, 51, and 52).

The U. S. maritime industry has been in general decline for many years. Each part is changed by its own set of circumstances, so the degree, speed and timing of deterioration varies. All parts of the industry complain about some aspect of foreign competition, high labor costs, newly imposed user fees or threats thereof, and for the past two or three years, about the high cost of health care services. Companies with inland waterway trade routes also compete with railroads and trucks for the business of import-export cargos as well as terminal-to-terminal and port-to-port trade.

Inland Waterways

Information regarding commerce in this portion of the industry is included so that general projections can be made about the approximate number of workers who may potentially be exposed to bulk liquid hazardous substances in the course of their work. The vessel types most commonly used to transport these substances on the inland waterways are tugs, tow-boats and barges.

The primary trade association of maritime companies and other marine related businesses along inland waterway trade routes is the American Waterways Operators, Inc. (AWO) located in Arlington, Virginia. Much of the work of the AWO is done through task forces, committees and conferences composed of AWO members. Efforts are directed toward issues of concern and interest to AWO members and the groups are formed or dissolved as need dictates (AWO, Annual Report 1983-1984, no publication date, p. 6). The AWO is concerned about vessel personnel, and one of its committees is the Safety, Health, and Training Committee, chaired by Howard Case of Southern Towing Company (AWO, Annual Report 1983-1984, no publication date, p. 11). AWO staff support for this committee is provided by John Duke, AWO Vice President, Southern Region (AWO, Annual Report 1983-1984, pp. 21 and 23). In addition, as a public service, AWO issues a report each year entitled Inland Waterborne Commerce Statistics. The introduction to the report summarizes its contents (Inland Waterborne...1981-82, no page number). Pertinent excerpts include:

> "The barge and towing industry...consists of some 1,200 companies operating on a system of 25,543 miles of navigable inland and intracoastal waterways, serving 87 percent of major

U. S. cities. It operates a fleet of 4,890 towboats and tugboats with a combined horsepower of 7.6 million, powering a fleet of 34,388 barges with a capacity of 49.9 million tons."

" ...in 1982, the last year for which final figures are available, barges carried more than 617.8 million tons of freight, or about 64.6 percent of the close to one billion tons of total domestic waterborne traffic."

" ...over 60 percent of the products transported by barge are energy-related, i.e., 38.8 percent consist of petroleum and petroleum products and 22.5 percent consist of coal and lignite."

"In addition to energy products, the industry moves grain and grain products (9.5 percent); chemicals (6.9 percent); sand, gravel and stone (7.4 percent); and, in substantial quantities, more than 100 kinds of bulk materials, including iron and steel products, lime, fertilizer, logs, marine shells, etc."

Also per Inland Waterborne Commerce Statistics 1981-82, as of May 1982, the number of towing vessels and barges of the U. S. operated for the transportation of freight were:

Towboats and Tugs	-	4,890
Dry Cargo Barges and Scows	-	29,479
Tank Barges	-	4,909
Total		39,278

(AWO, no date of publication, p. 5, also included as Exhibit 2.)

The traffic transported on inland waterways in 1982 was 571,005,177 net tons of 2,000 pounds for 288,047,430,000 ton miles (AWO, ibid, p. 11; included as Exhibit 4). Also in 1981-82, vessels of the types cited above carried 239,640 thousand net tons of petroleum and petroleum products and 42,372 thousand net tons of chemicals and fertilizers (AWO, ibid, p. 8, included as Exhibit 5). A scan of data in Exhibits 1-6 listed below shows that although

the number of vessels operated over the past decade increased slightly, the net tonnage carried in 1982 was the lowest since 1971 and the ton miles traveled in 1982 was the lowest since 1977.

The inland waterways workforce in 1984 was estimated as about 225,000, of which approximately 100,000 were considered to be "experienced" which, in this case, means they had practical experience and some training. A former MarAd official estimated that of this group, possibly 20,000 had acquired the tankerman endorsement. Tours of duty on the inland waterways vary between 30-60 days. However, most are about 30 days long and involve multiple voyages of 2-10 days. Pay for seafarers in this part of the industry is based on a 12-hour day. Work is performed in 6-hour shifts around the clock (i.e., 6 hours on, 6 hours off, then 6 hours on again). The crew size on most barge tow-boats was estimated as between 11-15, with the usual maritime split of one-third officers and two-thirds unlicensed personnel. Workers who manage the barges are members of the tow-boat crew (E. Love, personal communication, February 1985).

Cargos are loaded on barges and unloaded at the terminal or they may be handled intermittently by a fleeting service. The number of barges a tow boat maneuvers varies and depends upon the vessel's power, the cargo, the load and the waterway route (J. Simpson, personal communication, February 1985). For the past two or three years, unemployment has been high--estimated by some as almost half of the inland waterways workforce. Jobs are down because the numbers and amounts of cargo shipments are down (E. Love, personal communication, February 1985).

Some of the major transporters of hazardous substances, particularly Subchapter D and Subchapter O cargos, were identified through personal communications (D. Owen and J. Simpson, personal communications, February, March, and June 1985). Page number in parenthesis after company name refers to page number in Inland River Guide [1984] on which more detailed information can be found about the company). Companies identified included: Agrico Chemical, p. 22; Allied Chemical, p. 26; American Commercial Barge Lines (currently in court trying to fight a hostile takeover by CSX), p. 28; Amoco Chemical--Division of Southern Towing, listed as Amoco Oil, pp. 29 and 30;

BASF Wyandotte, p. 34; Dow Chemical, p. 74; Dupont, p. 77; Monsanto, p. 128; Stauffer Chemical, p. 161; Union Carbide, p. 170; and Hooker Chemical (listed as terminal only), p. 271 (Owen, 1984, pp. 22, 26, 28, 29-30, 34, 74, 77, 128, 161, 170, and 271). The Inland River Guide, 1984, also lists 238 public terminals, 108 fleeting and harbor service firms, 49 independent tanker firms and approxiamtely 1,260 private terminals (Owen, 1984, pp. 185-262, 297-348, 349-355, and 263-293 respectively).

Although commerce along the inland waterways has not declined as much as in some other portions of the industry, in the past few years, business has been poor. Since about 1983, unemployment has been high, labor-management disagreements have been more evident, there has been increased labor strife as well as a greater number of bankruptcies and forced mergers. Persons close to this part of the industry are concerned about more dire consequences in the next few years (J. Simpson and also E. Love in separate personal communications, February, March and April 1985).

For further elaboration on information in this section, please refer to:

EXHIBIT 1 - A Map of the United States on Which the Major Inland Waterways are Illustrated (AWO, Inland Waterborne...1981-82, centerfold)

EXHIBIT 2 - Number of Towing Vessels and Barges by Type of Vessel and Waterways (AWO, ibid, p. 5)

EXHIBIT 3 - Number of Towing Vessels and Barges for Years 1977-1982, By Type of Vessel (AWO, ibid, p. 6)

EXHIBIT 4 - Traffic Transported on Inland Waterways of the United States (AWO, ibid, p. 11)

EXHIBIT 5 - Domestic Barge Traffic by Broad Product Classification (AWO, ibid, p. 8)

EXHIBIT 6 - Principal Commodities Transported on the Inland Waterways 1980, 1981 and 1982 (AWO, ibid, pp. 13-14).

EXHIBIT 7 - Domestic Barge Traffic by Selected Commodity Codes 1982 (U. S. Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1982, Part 5 - National Summaries, 1984, p. 30)

(Exhibits 1-6 were photocopied from Inland Waterborne Commerce Statistics 1981-1982, Exhibit 7 was extrapolated from Table 10, Waterborne Commerce of the United States, Calendar Year 1982, Part 5 - National Summaries, 1984, p. 30).

Tankermen

Extensive and detailed information about the knowledge required and responsibilities of the tankerman was found in the U. S. Coast Guard document CG-174, A Manual for the Safe Handling of Flammable and Combustible Liquids and Other Hazardous Products (U. S. Department of Transportation [DOT], Coast Guard [CG], 1976). This document was provided to the author by a Coast Guard official who made other significant contributions to this paper by providing background information, additional documents, and sharing some of his knowledge about the milieu in which tankermen work (J. Pendegraft, personal communications, March 1985).

The tankerman endorsement has existed for many years, exactly how long seems to have been lost in history. The CG official who provided the writer with much of this information recalls seeing reference to the endorsement in a 1955 CG manual (J. Pendegraft, personal communication, March 1985). To acquire the endorsement, seafarers must qualify to take the examination and pass the test. Qualifications are based on:

(1) Practical experience
(2) Training
(3) Examination
(4) Physical standards

(CG-174, A Manual..., 1976, page 1-2).

Requirements for tankerman are cited in the Code of Federal Regulations (CFR, Shipping, 46 Parts 1 to 40, subsection 12.20-1, 3 and 5, 1984, pp. 159-160). A valid license as master, mate, pilot, or engineer permits the holder to serve in this capacity without a separate certificate as tankerman. Seafarers holding other classifications of merchant mariner documents must be qualified for certification by the CG. Qualified applicants are issued a merchant mariners document endorsed with the rating of tankerman and the grade or grades of liquid cargo the holder is qualified to handle.

It was estimated that over half of the seafarers who get the tankerman endorsement do so through practical experience alone by working their way up through the ranks. The others take an approved tankerman course at one of several maritime schools (J. Pendegraft, personal communication, March 1985). In addition to learning how to handle products safely, an important part of many courses is the development of fire-fighting knowledge and skills (J. Pendegraft, personal communication, March 1985). Moreover, the CG is in the process of reevaluating the need for additional requirements in several areas, including physical qualifications (Federal Register, "Certification of Seamen," February 4, 1985, pp. 4875-4877).

The current regulations require:

> "(a) ...shall present a certificate of a medical officer of the United States Public Health Service or other reputable physician, attesting that his eyesight, hearing and physical condition are such that he can perform the duties required of a tankerman. (b) The medical examination is the same as for an original license as engineer, except that the applicant will be given a color vision test required for a licensed deck officer as set forth in section 10.02-5 of this subchapter," (CFR, Shipping, 46 Parts 1-40, 1984, p. 160). Occupational safety and health regulation enforcement aboard vessels is the responsibility of the CG by virtue of a memorandum of understanding between CG and the Occupational Safety and Health Administration (OSHA), signed in

1983 (Federal Register, "Authority to Prescribe...," March 17, 1983, pp. 11365-11366).

It is unknown how many tankerman endorsements are currently held by working seafarers or those actively seeking employment as tankermen. There are also no records of the grade or grades of cargo that holders of endorsements are qualified to handle, nor the number of documents which become invalid due to death, retirement, or disability of tankerman endorsement holders (J. Pendegraft, personal communication, March 1985). CG information reported to MarAd, indicates that between 1980-1983, 7,775 tankerman endorsements were issued:

2,412 - 1980
1,924 - 1981
2,082 - 1982
1,357 - 1983
7,775

(E. Love, personal communication, February 1985).

Tankerman endorsements are issued for cargos classified as A, B, C, D, and E, LFG (liquefied flammable gas) and LPG (liquefied petroleum gas) based on the flammability or combustibility of the product. The more hazardous products are classified as A. CG definitions for the different classifications and grades are:

FLAMMABLE LIQUIDS - Are those liquids which give off flammable vapors (as determined by flashpoint from an open-cup tester) at or below a temperature of 80 degrees F. Within this class there are three grades, which based on Reid vapor pressure.

Grade A - Flammable liquids are those having a Reid vapor pressure of 14 pounds per square inch (psi) or more. Some examples are casing head

or natural gasoline, very light napthas and butane blend (a solution of petroleum gas in gasoline).

Grade B - Flammable liquids are those having a Reid vapor pressure of more than 8½ psi but less than 14 psi. Most commercial gasolines are Grade B liquids.

Grade C - Flammable liquids are those having a Reid vapor pressure of 8½ psi or less, such as most crude oils, creosote, benzol, toluol, alcohol, aviation gasoline Grade 115/145, JP-4 jet fuel, some cut-back asphalts (asphalt thinned with volatile oil).

COMBUSTIBLE LIQUIDS - Are those which give off flammable vapors only above 80 degrees F (as determined from an open-cup tester). Within this class, there are two grades, Grades D and E, based on flash point:

Grade D - Combustible liquids are those having a flash point above 80 degrees F, but below 150 degrees F, such as kerosene, JP-5 jet fuel, light oils, distillates and a few heavy crude oils.

Grade E - Combustible liquis are those having a flash point of 150 degrees F or above, such as heavy fuel oils, Bunker C, road oil, lubricating oil, asphalt, coal tar and fish, animal or vegetable oil.

(CG-174, "A Manual...," 1976, pp. 1-5 and 1-6).

An endorsement is valid for the lifetime of the document of the individual (J. Pendegraft, personal communication, March 1985). At the present time, endorsements for specific Subchapter D or Subchapter O cargoes are not placed on a tankerman's MMD. However, this is subject to change. New regulations were proposed and published December 18, 1980. The industry and the CG have been discussing them ever since (Federal Register, "Tankerman Requirements...," December 18, 1980, pp. 83290-83299). It is not known if the new rules will ever become law, and if so when. Nevertheless, as frequently happens, the proposed rules have made an impact. A good example of this influence is demonstrated by the fact that, in the interim, most of the tankerman courses have been redesigned to meet the more rigorous criteria (J. Pendegraft, personal communication, March 1985).

The proposed regulations are scheduled to provide for tankerman endorsement classifications and set standards for handling dangerous liquids and liquefied gases as defined by the Inter-Governmental Maritime Organization (IMO). Currently, those companies or terminals which handle Subchapter D and Subchapter O products write a letter to the nearest CG Captain of the Port requesting CG recognition of "person-in-charge" on the vessel or in the terminal responsible for handling Subchapter O or Subchapter D cargos. If the request is granted, this letter is posted on the vessel or in the terminal and the designated person is responsible for the handling of the products. He (or she) must also direct the work of all the other personnel in the terminal or on the vessel with respect to maintenance during transport, loading and unloading (J. Pendegraft, personal communication, March 1985). The same CG official estimated that river tankermen most frequently hold D and E endorsements and more seafarers with tankerman endorsements work on the inland waterways than work on ocean-going vessels engaged in trade to foreign ports.

Health Care

Maritime tradition, "Jones Act" case law and maritime labor contracts are replete with statements and rulings holding the vessel owner/operator of U. S. documented vessels responsible for provision of medical care to officers and crew and compensation for illnesses and injuries sustained in "the service of the vessel." Accordingly, personnel aboard vessels are not eligible for

worker's compensation. The Coast Guard enforces standards and regulations affecting the occupational safety and health of seafarers aboard vessels in U. S. waters, including the inland waterways (Federal Register, "Authority to...," March 11, 1983, pp. 11365-11366). The U. S. Public Health Service (PHS) was established in 1798 to care for "sick and disabled seaman." Any seafarer whose work aboard a U. S. documented vessel involved its operation, defined as "navigation, preservation and care," and who had the requisite "sea time," was eligible for health care services in any of the PHS facilities (PHS, Bureau of Medical Services, "Health care...," 1980, p. 1). That entitlement was terminated September 30, 1981, by the Omnibus Reconciliation Act of 1981, P.L. 97-35, signed August 13, 1981. When the PHS facility system was closed in 1981, it was comprised of 9 hospitals and 27 clinics (Source--the writer, based on professional experience while employed in the PHS Bureau which administered the hospital and clinic system).

Even while seafarers were entitled to medical care through PHS hospitals and clinics, most unions had their own clinics and health plans through which their members (and in some instances, dependents) could receive care. Primary funding for the union plans was and is derived from a negotiated employer contribution to the joint company-union trust fund and is computed on a man-per-day basis. The preemployment examination usually required of unlicensed seafarers prior to each coast-wise and foreign voyage rarely is required of personnel working on inland waterways because those individuals (officers and unlicensed) tend to work for the same company on one to three year contracts. However, irrespective of the part of the industry in which they work, any seafarer (licensed-unlicensed, union-nonunion) may be required by the company and/or the union to undergo annual or biannual physical examinations (E. Love, personal communication, January 1985).

The health and safety of tankermen and all other seafarers is impaced by conditions of the maritime workplace. The same small group of people must operate the vessel 24 hours a day, seven days a week. There are no "fresh troops" available as in most land-based industries that operate on an eight-hour-a-day schedule and a five-day workweek. Added stress results from the vast technological changes that have increased the size and complexity of vessels. There has been no corresponding increase in the size of crews.

Crews, in fact, have been reduced in number of personnel required. Ocean-going vessels average crews of 25-30; inland waterway vessels average crews of 11-15. Also, hazards abound in necessary, recurring functions when loading and unloading combustible, flammable, and/or toxic substances and when maintaining sophisticated equipment under adverse weather conditions. The crew's duties require skilled use of complicated apparatus while standing on unsteady platforms. The lighting is often poor, and the work area wet and slippery. High noise levels and intense heat are normal components of work in certain areas such as the engine room or the galley. Officers and crew must adapt to vast extremes in temperature.

Seafarers are required to work seven days a week. They receive overtime pay for all work over 40 hours. Workday patterns vary. Coast-wise and foreign industry officers and crew work two four-hour watches (shifts) during every 24-hour period. They have eight hours off between each watch. On inland waterway vessels, personnel work six hours on duty and six hours off (E. Love, personal communication, February 1985). The nature of the working conditions demands cooperative, competent performance on the part of each crew member. Preservation of life and safety takes precedence over individual rights and privileges.

Once "signed on," crews are, of necessity, subject to much stricter compliance with the demands of officers for the aforementioned reasons. Debate and questioning of authority is not permitted. Serious charges can be lodged against seafarers who do not follow orders. This sometimes leads to "bottled-up" emotions and physical reactions such as heightened blood pressure levels, migraine headaches, heart malfunctions, gastro-intestinal problems and other anxiety-related illnesses.

Mariners, including those who work on the inland waterways, are more at risk of infection, on-the-job accidents and exposure to hazardous and toxic substances than land-based workers. Their workplace is constantly on the move. Unlike most workers whose jobs are in one community, mariners receive care from a variety of sources, usually in many different locations. Although a mariner may have a regular source of care in their home port, there is little chance of obtaining continuous care from the same provider when

working. This factor can also interfere with the detection of subtle physiological changes such as those caused by repeated exposure to small doses of toxic substances over an extended period of time.

In addition to regular sources of health care, seafarers who become ill or injured on the vessel are taken to the nearest port for medical care if the ailment cannot be handled on the vessel. As a result, parts of any seafarers medical history may be lodged in a myriad of hospitals and doctor's offices scattered among various ports and the surrounding area. Notations regarding the particular illness or injury and associated events are recorded in the ship's log of the specific voyage on which they occur. Rarely, if ever, is there consolidation of any type, so records remain isolated and incomplete.

Although not to the same degree as for seafarers, the health care delivery system is fragmented for most Americans and many groups are confronted with problems of access and continuity of care as well as the prudent utilization of health care services. Nationwide, rapidly escalating costs for health care have made the rise in health care costs consistently steeper than the rise in the Consumer Price Index. The most current statistics on these indicators are contained in a report the Department of Health and Human Services is required to send to Congress and the President each year on the health status of the American people. An excerpt from the "Highlights" section of this report states:

> "In 1983, health care expenditures in the United States totaled $355.4 billion, an average of $1,459 per person, and comprised 10.8 percent of the gross national product. Between 1982 and 1983, the medical care component of the Consumer Price Index (CPI) increased nearly three times the overall inflation rate (8.7 percent versus 3.2 percent). During this period the hospital room component of the CPI increased by 11.3 percent, a smaller increase than between 1981 and 1982 (15.7 percent). Hospital care expenditures continued to claim the largest share of the health care dollar, accounting for 41 percent of health care expenditures in 1983..." (DHHS, National Center for Health Statistics, Health United States 1984, p. 3).

For a number of years, the Economic Policy Division of the Chamber of Commerce of the United States has conducted an annual survey of employee benefits offered by a cross section of American companies (Chamber of Commerce of the United States, Employee Benefits 1983, 1984, p. 4). The February 1985 issue of Coalition Report published by the U. S. Chamber of Commerce's Clearinghouse on Business Coalitions for Business Action reported on the Chamber's most recent survey which found that:

> "American employers paid more than $100 billion for private and public health insurance in 1983. It was estimated that approximately $82 billion or 75 percent of this money was spent for private health insurance and about $18.5 billion or 31 percent was spent for Medicare," (Clearinghouse on Business Coalitions for Health Action, "U. S. Chamber's Benefits Survey," Coalition Report, February 1985, p. 1).

Maritime employers are at a greater disadvantage than owner/managers in most other industries. They are located in widely separated ports all over the country and the world. Their workers are rarely in the same locale as the main office of the company. Communication of the needs and desires of either management or labor is difficult. Maritime law, work practices and tradition peculiar to the industry are superimposed and are an intricate part of all negotiations on health matters. For example, merchant vessel personnel have an unequivocal right to a trial by jury for personal injuries suffered in the course of their employment (46 USC 688, placed into law as an amendment to the Merchant Marine Act of 1920, which is better known as "the Jones Act." Committee Print, 98th Congress, 1st Session, "The Merchant Marine Act, 1936...," p. 172. This document is a compilation of laws of interest to the Merchant Marine and Fisheries Committee, U. S. House of Representatives). Since maritime workers are rarely eligible for workers compensation, a greater financial responsibility accrues to the employer. This situation is aggravated by the current lack of a cohesive plan for the delivery of health services, knowledge about what services are being used and how much of the company or unions' resources are being subsumed by this required employee benefit. The maritime industry has not yet become involved in the growing revolution taking place in the health care field.

Concern about escalating costs has motivated many land-based employers to become involved in developing cost-effective health delivery plans. They have developed coalitions to determine employees' health care needs, patterns of utilization, and costs to productivity resulting from time lost due to accident or illness. Through business coalitions and other means, many managers have increased their knowledge and understanding about the value and cost-effectiveness of including preventive health care, health education and rehabilitative services in employee benefit plans. Those whose workers are exposed to dangerous conditions are especially alert to the financial disaster that can result from lack of attention to health and safety matters in the workplace. Enhanced public awareness of the dangers of toxic or flammable materials has also provided added impetus to this concern about occupational health and safety. Alternative plans which change traditional patterns of health care delivery have proven to be effective in the improvement of health care cost and utilization trends. Some of these techniques can be adapted and applied effectively in the maritime workplace.

REFERENCES

American Waterways Operators, Inc., Annual Report, 1983-84 (no publication date), Arlington, VA, pp. 6, 11, 21, and 23.

American Waterways Operators, Inc., Inland Waterborne Commerce Statistics 1981-82 (no publication date), Arlington, VA, pp. centerfold, 5, 6, 8, 11, 13 and 14.

Chamber of Commerce of the United States, Employee Benefits 1983 (1984), Survey Research Section, Research Center, Economic Policy Division, Washington, D.C., p. 4.

Clearinghouse on Business Coalitions for Health Action, "U. S. Chamber's Benefits Survey", Coalition Report (February 1985), pp. 1, 4.

Coast Guard, "Approved Course Listing - December 1984," Unpublished work document, computer printout made available by staff of CG Merchant Vessel Personnel Office.

Coast Guard, A Manual for the Safe Handling of Flammable and Combustible Liquids and Other Hazardous Products, CG-174 (September 1, 1976), Washington, D.C., U. S. Government Printing Office, pp. 1-5 and 1-6.

Code of Federal Regulations, "Shipping" (1984), 46 Parts 1-40, Washington, D.C., Government Printing Office, p. 160.

Committee Print, 98th Congress, 1st Session, The Merchant Marine Act, 1936, The Shipping Act, 1916, and Related Acts (as amended through the 97th Congress) (January 6, 1983), Serial No. 98-8, printed for the use of the Merchant Marine and Fisheries Committee, House of Representatives, p. 172.

Corps of Engineers, Waterborne Commerce of the United States Calendar Year 1982, Part 5 - National Summaries (WRSC-WCUS-82-5) (1982), Waterborne Commerce Statistics Center, New Orleans, LA, p. 30.

Department of Health and Human Services, Bureau of Medical Services, Health Care for Seafarers: A Guide to Care and Services by the Public Health Service, DHHS Publication Number (HSA) 80-2016 (1980), Public Health Service, Washington, D.C., U. S. Government Printing Office, p. 1.

Department of Health and Human Services, National Center for Health Statistics, Health, United States, 1984, DHHS Publication Number PHS 85-1232 (December 1984), Public Health Service, Washington, D.C., U. S. Government Printing Office, p. 3.

Federal Register, "Authority to Prescribe and Enforce Standards of Regulations Affecting Occupational Safety and Health of Seamen Aboard Vessels Inspected and Certificated by the United States Coast Guard, Memorandum of Understanding," Volume 48, Number 53, March 17, 1983, pp. 11365-11366.

Federal Register, "Certification of Seaman," Volume 50, Number 23 (February 4, 1985), pp. 4875-4877. Advance notice of proposed rulemaking.

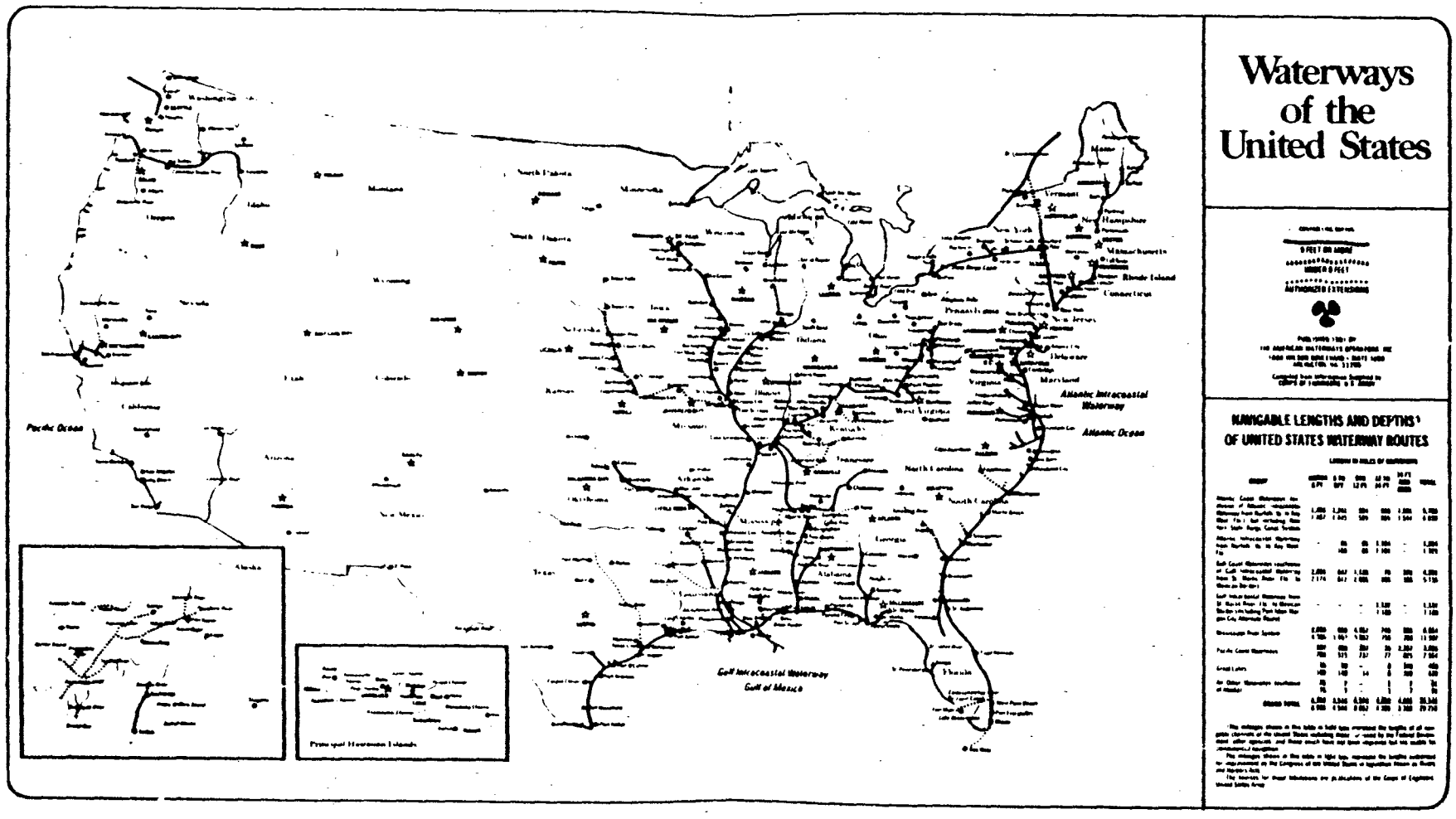
Federal Register, Tankerman Requirements/Qualifications of Persons in Charge of Oil Transfer Operations," Volume 45, Number 245 (December 18, 1980), pp. 83290-83299. Proposed rules, same subject, same issue, pp. 83268-83269.

Marine Index Bureau, Inc., Memorandum to "All MIB Member Companies" (no date, but believed to be circa 1978), New York, NY, p. 1.

Maritime Administration, Seafaring Guide and Directory of Labor Management Affiliations (1982), Washington, D.C., pp. 1, 2, 4, 51, and 52.

Owen, Dan (Ed.), Inland River Guide 1984 Edition (1984), The Waterways Journal, Inc., St. Louis, MO, pp. 22, 26, 28, 29-30, 34, 74, 77, 128, 161, 170, 271, as well as 185-262, 297-348, 349-355 and 263-293.

Public Law 97-35, Omnibus Budget Reconciliation Act of 1981 (August 13, 1981), Section 986, no pagination.



Source: Inland Waterborne Commerce Statistics 1981-82, Centerfold
American Waterways Operators, Inc., Arlington, VA

Exhibit 1

NUMBER OF TOWING VESSELS AND BARGES OF THE UNITED STATES OPERATED FOR THE TRANSPORTATION OF FREIGHT AS OF MAY 1, 1982

Types of Vessels	Mississippi River System and the Gulf Intracoastal Waterway	Atlantic, Gulf and Pacific Coasts	Great Lakes System	Total
SELF-PROPELLED				
Towboats and Tugs				
Number of Vessels	3,161	1,589	140	4,890
Horsepower	4,989,480	2,468,191	143,620	7,601,291
NON-SELF-PROPELLED				
Dry Cargo Barges and Scows				
Number of Vessels	24,331	4,892	256	29,479
Cargo Capacity (net tons)	32,590,978	5,018,969	421,129	38,031,076
Tank Barges				
Number of Vessels	4,183	698	28	4,909
Cargo Capacity (net tons)	8,557,207	3,290,445	54,719	11,902,371
Total Non-Self Propelled				
Number of Vessels	28,514	5,590	284	34,388
Cargo Capacity (net tons)	41,148,185	8,309,414	475,848	49,933,447

Source: U.S. Army Corps of Engineers

Reference: Inland Waterborne Commerce Statistics 1981-82, p.5
American Waterways Operators, Inc.; Arlington, VA.

Exhibit 2

NUMBER OF TOWING VESSELS AND BARGES OF THE UNITED STATES OPERATED FOR THE TRANSPORTATION OF FREIGHT FOR THE YEARS 1977-1982

Types of Vessels	1977	1978	1979	1980	1981-82
SELF-PROPELLED					
Towboats and Tugs					
Number of Vessels	4,379	4,380	4,492	4,693	4,890
Horsepower	6,161,348	6,390,438	6,646,141	7,146,576	7,601,291
NON-SELF-PROPELLED					
Dry Cargo Barges and Scows					
Number of Vessels	24,937	24,037	25,420	27,426	29,479
Cargo Capacity (net tons)	29,454,921	29,338,851	32,093,068	34,486,851	38,031,076
Tank Barges					
Number of Vessels	3,770	3,946	4,000	4,166	4,909
Cargo Capacity (net tons)	9,519,840	9,467,565	10,334,677	10,388,265	11,902,371
Total Non-Self-Propelled					
Number of Vessels	28,707	27,983	29,420	31,592	34,388
Cargo Capacity (net tons)	38,974,761	39,306,416	42,427,745	44,875,116	49,933,447

Source: U.S. Army Corps of Engineers

Reference: Inland Waterborne Commerce Statistics 1981-82, p.6
American Waterways Operators, Arlington, VA.

Exhibit 3

Exhibit 4

TRAFFIC TRANSPORTED ON INLAND WATERWAYS OF UNITED STATES
(Exclusive of Great Lakes)

Year	Net Tons Of 2,000 Pounds[1]	Ton-Miles
1940	183,417,791	22,411,961,000
:	:	:
1965	472,480,483	152,812,240,000
1966	489,066,210	164,528,798,000
1967	500,912,733	174,582,978,000
1968	520,904,639	179,336,707,000
1969	548,481,358	187,666,323,000
1970	553,598,222	204,084,966,000
1971	560,470,417	210,003,291,000
1972	597,255,337	229,754,230,000
1973	596,459,513	232,307,988,000
1974	599,219,554	247,430,888,000
1975	582,211,482	243,038,688,000
1976	607,703,665	267,216,[illegible]1,000
1977	612,149,130	277,58[illegible],000
1978	624,015,527	290,38[illegible]21,000
1979	628,082,832	302,90[illegible],779,000
1980	629,162,723	310,845,090,000
1981	613,818,593	312,258,571,000
1982	571,055,177	288,047,430,000

[1] Known duplications resulting from reporting of identical shipments over two or more waterways have been eliminated except that the figures for 1965 and subsequent years represent originated traffic.

Source: Inland Waterborne Commerce Statistics 1981-82, p. 11
American Waterways Operators, Inc.; Arlington, VA.

DOMESTIC BARGE TRAFFIC[1]
1970-1982
(Thousands of net tons)

Year	Grains	Coal	Petroleum and Products	Sand, Gravel and Stone	Chemicals and Fertilizers	Total All Commodities
1970	27,052	122,859	215,865	71,067	43,471	562,156
1971	28,324	113,963	232,641	79,460	46,496	581,314
1972	36,320	123,846	251,004	76,918	51,327	623,063
1973	35,984	120,711	256,584	78,705	49,846	625,146
1974	39,785	122,582	245,151	73,738	51,570	622,319
1975	44,434	130,683	244,000	65,851	46,612	610,039
1976	54,747	132,578	264,436	59,163	48,628	637,641
1977	52,324	133,992	270,942	58,793	54,182	640,163
1978	58,730	120,825	281,474	69,350	53,002	662,197
1979	58,991	135,953	280,473	67,670	56,316	656,648
1980	52,140	141,702	262,000	59,252	56,429	667,222
1981	56,781	151,151	255,938	47,923	53,021	658,210
1982	58,977	139,134	239,640	45,775	42,372	617,781

[1] Includes not only inland waterways traffic, but also coastwise shipments by barge. Thus annual tonnages will be somewhat higher than those reported for individual waterways.

Source. Inland Waterborne Commerce Statistics 1981-82, p.8
American Waterways Operators, Inc.; Arlington, VA.

Exhibit 5

Exhibit 6

PRINCIPAL COMMODITIES TRANSPORTED ON THE INLAND WATERWAYS OF THE UNITED STATES (EXCLUSIVE OF THE GREAT LAKES) IN NET TONS OF 2,000 POUNDS—CALENDAR YEARS 1980, 1981 AND 1982

Commodity	1980	1981	1982
Grain and grain products	51,466,545	56,233,780	58,492,791
Soybeans	16,117,949	15,377,286	19,807,951
Fresh fish and shellfish	1,182,905	2,321,762	2,135,151
Menhaden	123,332	411,689	233,117
Marine shells, unmanufactured	9,241,183	8,029,683	8,230,510
Iron ore and concentrates	4,479,286	3,531,288	888,651
Aluminum ore and concentrates	483,841	310,294	217,207
Manganese ores and concentrates	510,122	856,502	182,979
Nonferrous ore concentrates, n.e.c.	720,312	549,277	379,823
Coal and lignite	138,513,379	147,513,423	136,244,775
Crude petroleum	47,606,856	39,383,749	37,583,032
Limestone	4,175,761	3,653,501	4,196,213
Sand, gravel and crushed rock	56,146,815	45,867,295	43,048,838
Clay and structural clay products	1,323,853	1,062,276	872,662
Sulphur, dry and liquid	4,796,450	4,575,197	2,866,822
Nonmetallic minerals, n.e.c.	4,852,328	4,093,389	4,764,301
Sugar	817,058	965,601	845,284
Molasses	415,836	435,794	517,803
Vegetable oils, margarine, shortening	1,570,339	1,253,516	1,127,863
Tallow, animal oils and fats	488,837	363,854	325,185
Animal feeds	4,243,540	4,063,354	4,547,210
Logs	705,666	411,579	280,107
Rafted logs	16,735,458	13,191,812	12,820,804
Pulpwood, log	1,431,776	1,475,777	1,070,950
Lumber and wood products, exc. furniture	3,264,706	2,848,923	1,878,841
Pulp	946,891	872,817	783,178
Paper and paper products	1,813,200	1,777,500	1,479,950
Sodium hydroxide	3,391,667	2,703,186	2,514,891
Crude tar, oil, gas products	1,363,495	1,381,469	1,149,837
Alcohols	2,384,883	2,291,087	2,332,891
Benzene and toluene	3,438,349	3,213,551	2,845,483
Sulphuric acid	2,223,203	2,059,379	1,543,178
Basic chemicals and products, n.e.c.	17,373,927	17,229,851	14,170,285
Fertilizer and fertilizer materials	9,240,973	8,250,781	7,403,791
Gasoline	35,437,397	33,780,837	32,072,289
Jet fuel	4,588,997	4,864,894	4,772,286
Kerosene	1,837,914	1,230,331	1,302,939
Distillate fuel oil	38,283,044	34,749,147	30,809,324
Residual fuel oil	81,023,439	82,329,906	70,159,042
Lubricating oils and greases	2,368,556	2,101,925	2,151,158
Naphtha, petroleum solvents	4,598,952	3,489,196	2,825,839
Asphalt tar and pitches	3,407,528	3,354,849	4,060,496
Coke, petroleum coke	3,929,544	4,146,643	3,724,581
Liquefied gases	987,918	1,188,535	1,109,389
Other petroleum and coal products	2,901,851	2,204,981	2,091,941
Building cement	5,787,841	4,568,938	4,859,371
Lime	1,128,344	1,286,041	1,370,448
Slag	774,987	420,975	664,292
Iron and steel products (w/ferroalloys)	8,971,898	7,539,868	4,857,981
Iron and steel scrap	2,891,839	2,291,532	1,884,825
Waste and scrap, n.e.c.	15,564,979	18,983,173	22,125,370
Water	2,900,770	3,134,981	1,847,870
Other commodities	5,285,814	5,109,063	5,274,792
GRAND TOTAL	629,162,723	613,918,593	571,055,177

Source: Inland Waterborne Commerce Statistics 1981-82, pp. 13-14
American Waterways Operators, Inc.; Arlington, VA.

Exhibit 7

* DOMESTIC BARGE TRAFFIC - SELECTED COMMODITIES
Calendar Year 1982
(IN TONS OF 2,000 POUNDS)

CODE	PRODUCTS	BARGE TRAFFIC	PERCENT BARGE TO TOTAL TRAFFIC	TOTAL DOMESTIC TRAFFIC
	CHEMICALS AND ALLIED PRODUCTS			
2810	Sodium Hydroxide	3,321,797	87.2	3,809,758
2811	Crude Tar, Oil, Gas Products	1,190,050	89.0	1,336,654
2812	Dyes, Pigment, Tanning Mats	1,203	33.7	3,575
2813	Alcohols	2,440,353	75.0	3,253,960
2816	Radioactive Materials, Wastes			344
2817	Benzene and Toluene	2,965,785	88.3	3,360,281
2818	Sulphuric Acic	1,609,570	99.9	1,609,630
2819	Basic Chemicals and Prod, Nec	14,958,019	79.6	18,800,619
2821	Plastic Materials	97,018	72.7	133,400
2822	Synthetic Rubber	82.414	98.3	83,839
2823	Synthetic (Man Made) Fibers			1,663
2831	Drugs	1		14,513
2841	Soap	746	.7	100,547
2851	Paints	1,384	6.4	21,706
2861	Gum and Wood Chemicals	220,079	92.6	237,649
2871	Nitrogenous Chem Fertilizers	3,370,341	98.3	3,427,749
2872	Potassic Chem Fertilizers	1,088,208	98.6	1,103,294
2873	Phosphatic Chem Fertilizers	285,261	99.7	286,250
2876	Insecticides, Disinfectants	2,015	19.1	10,566
2879	Fertilizer and Materials, Nec	3,453,014	99.4	3,474,457
2891	Miscellaneous Chemical Prod	365,384	60.9	600,110
	CATEGORY TOTAL	35,452,642		41,670,364
	PETROLEUM AND COAL PRODUCTS			
2911	Gasoline	54,349,769	72.4	75,047,346
2912	Jet Fuel	8,145,816	62.3	13,078,178
2913	Kerosene	1,546,424	69.3	2,231,674
2914	Distillate Fuel Oil	40,618,274	65.5	62,055,773
2915	Residual Fuel Oil	80,996,198	71.5	113,301,897
2916	Lubricating Oils and Greases	2,215,415	45.3	4,889,269
2917	Naontha, Petroleum Solvents	3,653,381	71.4	5,118,513
2918	Asphalt, Tar, and Pitches	6,379,710	91.7	6,957,556
2920	Coke, Petroleum Coke	3,774,248	98.1	3,845,575
2921	Liquefied Gases	1,376,568	98.8	1,393,114
2951	Asphalt Building Materials	3,824	41.7	9,161
2991	Petroleum and Coal Prod, Nec	2,504,039	87.4	2,866,314
	CATEGORY TOTAL	205,563,666		290,794,370

* Extrapolated from Table 10, "Domestic Barge Traffic - Commodity By Type of Traffic." Waterborne Commerce of the United States, Calendar Year 1982, Part 5, National Summaries, page 30. WRSC-WCUS-82-5. Department of the Army, Corps of Engineers, Water Resources Support Center. Fort Belvoir, VA 22060. July 1984.

MARITIME LABOR/MANAGEMENT AFFILIATION INFORMATION

AFL-CIO AFFILIATED SEAFARING UNIONS:

MMP	International Organization of Masters, Mates and Pilots	10,000
MEBA 1	National Marine Engineers' Beneficial Association District 1	9,881
MEBA 2	Marine Engineers' Beneficial Association - Associated Maritime Officers (Sometimes referred to as MEBA2-AMO)	2,750
MEBA 3	Radio Officers Union (ROU-NMEBA3)	459
ARA	American Radio Association-MMP (Merged with MMP circa 1981)	450
MSO	Marine Staff Officers Associations -SIUNA	90
SOA	Staff Officers Association of America	104
MFU	Marine Fireman's Union	1,672
NMU	National Maritime Union	20,000
SIU	Seafarers International Union of North America (SIUNA is used less frequently than SIU)	15,902
	Deepsea - 10,714	
	Great Lakes - 869	
	Inland Waterways - 4,319	
SUP	Sailors' Union of the Pacific	3,000
		64,308

Source: Office of Maritime Labor and Training, Maritime Administration, U.S. Department of Transportation. Information as of December 31, 1984. (L. Bartholow, personal communication, January 1985.)

INDEPENDENT TANKERMEN'S UNIONS: (Not affiliated with AFL-CIO, usually referred to as "company" unions)

- o American Tanker Officers' Association
- o Atlantic Maritime Officers Association
  Atlantic Maritime Employees Union
- o Exxon Radio Officers' Association
  Exxon Seamen's Association
- o Getty Tanker Officers' Association
  Getty Tankermen's Association
- o Gulf Trading and Transportation Company
  (Deck and Engine Officers Only)
- o Mobile Tanker Officers' Association
  Oil, Chemical and Atomic workers, Local 8-9011
- o Sabine Independent Seagoing Officers Association
  Sabine Independent Seamen's Association
- o Sun Marine Licensed Officers Association
  Sun Marine Employees' Association
- o Tanker Management Inc. Seagoing Officers Association
  Tanker Management Inc., Seagoing Seamen's Association
- o Texaco Tanker Officers' Association
  Texaco Radio Officers' Association

Source: Seafaring Guide and Directory of Labor Management Affiliations. Office of Maritime Labor and Training, Maritime Administration, U.S. Department of Transportation, December 1982, pp 51-52.

LONGSHORE UNIONS:

ILA International Longshoremen's Association (AFL-CIO)

ILWU International Longshoremen's and Warehousemen's Union

Source: Seafaring Guide and Directory of Labor Management Affiliations. Office of Maritime Labor and Training, Maritime Administration, U.S. Department of Transportation, December 1982, pp 51-52.

NEGOTIATING BODIES AND ASSOCIATIONS:

- AMA - American Maritime Committee

  Negotiates with MMP, MEBA2/AMO, ARA, ROU, SIU

- MSC - Maritime Service Committee

  Negotiates with MMP, MEBA, ROU, SOA, NMU

- TSC - Tanker Service Committee

  Negotiates with MMP, MEBA, ARA, ROU, NMU

- PMA - Pacific Maritime Association

  Negotiates with ILWU, MSO, SUP, MCS, MFU

Source: Seafaring Guide and Directory of Labor Management Affiliations. Office of Maritime Labor and Training, Maritime Administration, Department of Transportation, December 1982, pp 1-2.

Exhibit 9

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APPENDIX C

Guidelines for Industrial Hygiene

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GUIDELINES FOR INDUSTRIAL HYGIENE

Background

One of the important functions of the marine transport industry is the transportation of bulk liquid products in tankers and barges. These bulk liquid cargos include pure chemicals, gasoline, crude oil, and other common chemical and petrochemical products. More than 600 substances are regulated in marine transport by the United States Coast Guard under Title 46 of the Code of Federal Regulations.

The toxicity of bulk liquid cargos ranges from substances with negligible toxicity, such as edible vegetable oils, to highly toxic substances, such as carcinogens. Many of the cargos are liquid organic solvents which tend to have significant vapor pressures, and therefore significant potential for respiratory hazard at ordinary temperatures. Others present a significant potential for absorption of liquid or vapors through contact with the skin or with mucous membranes.

Marine transport personnel who handle these bulk liquid cargos and U. S. Coast Guard personnel involved in regulation and inspection of marine transportation activities are potentially at risk to exposures to toxic substances in performance of their normal work activities. This work environment is a toxicologically hostile and potentially hazardous environment, therefore, the need to control exposures of marine workers to chemicals and to monitor their health status is obvious. This paper outlines such an industrial hygiene program for the marine hazardous chemical worker. Industrial hygiene is one element of a marine occupational safety and health program comprised of three major elements: industrial hygiene, medical monitoring and data base management. Industrial hygiene provides an active set of preventive measures to avoid adverse chemical exposures and other safety problems. Medical monitoring provides a "safety net" to monitor for adverse health effects in the worker populations. Data base management provides a record of data generated and provides a means of rapid access to data files for specific information and for data summaries.

Scope of Industrial Hygiene

The American Industrial Hygiene Association defines industrial hygiene as "that science and art devoted to the recognition, evaluation and control of

the environmental factors and stresses, arising in and from the workplace, which may cause sickness, impaired health and well being, or significant discomfort and inefficiency among workers or among citizens of the community." The objective of industrial hygiene is to prevent occupational diseases which could result in disability or death and to maintain the health and well-being, both mental and physical, of the individual in his or her work environment.

Effective control of occupational diseases is dependent on recognition of the causative agent or agents. The essential element in this recognition is the ability to isolate and to measure the etiological agent in the work environment. Accordingly, the industrial hygienist needs airborne contamination data over a period of time to determine if a health hazard exists. For many substances, biological specimens from the workers can be used as an indicator of exposure in conjunction with air samples.

Proper sampling technique, calibration of equipment, and accurate laboratory analyses of industrial hygiene samples, including biological samples, permit proper evaluation of exposures from both the environment and work practices. The concerted efforts of the industrial hygienist, the physician, and the laboratory chemist assures the best means of evaluating potential exposures to hazardous work conditions. Quantitative data collected and properly documented provide valuable records for the future. Also, these laboratory data can be indicative of compliance with standards and regulations.

A properly designed industrial hygiene program will provide:

(1) Uniform early recognition of health threats such as elevated concentrations or prolonged exposures to permit preventive measures to be applied, and

(2) Evaluation of those substances that are potentially capable of causing discomfort, stress, and inefficiency where there may not be any clinical symptoms of occupational disease.

Major Elements of a Marine Industrial Hygiene Program

This paper presents guidelines for development of an industrial hygiene program for workers exposed to hazardous chemicals in the marine transporation industry. The program is designed to prevent adverse chemical exposures and to avoid other safety problems by training workers to utilize appropriate safety equipment and to follow designated safe work practices. The industrial

hygiene program accomplishes this by providing audits of compliance with safety protocols, by monitoring levels of toxic chemicals in the workplace, and by design of environmental controls and work practices. For convenience of discussion, these activities have been divided into five major topics:

(1) Recognition and evaluation of exposure hazards,

(2) Control of exposures,

(3) Training program,

(4) Audit surveys to evaluate exposure control, and

(5) Personnel and laboratory support.

Recognition. An industrial hygiene program will provide recognition of the hazard types and evaluation of all work activities with potential for hazardous exposures. It will categorize work scenarios, chemicals, and number of workers so that priorities can be established for high risk situations having the largest number of man hours with potential exposures. This effort will require evaluation of exposure levels, work practices and procedures by proper use of calibrated instruments and sampling devices.

Control. The second major component is control of exposures through routine application of safe work practices and other control measures during all potentially hazardous operations. Control measures will involve implementation of engineering controls to reduce or eliminate exposures, routine application of a hazard communication system to inform workers of the potential hazards to health and safety, and development and application of work scenario and chemical specific safe work practices. The compliance of workers to safe work practices is a key part of industrial hygiene. It involves routine implementation of environmental monitoring to assess work-place concentrations in confined spaces, routine application of procedures and controls such as engineering and administrative controls, and the use of protective equipment. To be effective, these procedures and controls must be followed regularly by the marine workers.

Training. The third major component is the training of workers in safe work procedures and use of personal protective equipment. The training should be very specific to actual work situations. Testing and frequent retraining must be an integral part of this activity.

Audit Survey. The fourth element is an audit function of the industrial hygienist to monitor occupational exposure levels of toxic chemicals in various work practices, to monitor compliance with established regulations,

procedures, and controls, to assess the status of training, and to ensure that proper records are being maintained. These audits must be performed by trained personnel. Because of the need for cost effectiveness, the audits should focus on the high risk situations: the most toxic chemicals, the most dangerous work conditions and durations of potential exposures, and the largest numbers of employees. These audits can be regularly scheduled events or can be made in response to an accident or episode known or suspected to present a serious health or safety problem.

Support. Implementation of a marine industrial hygiene program will be accomplished under direction of an industrial hygiene staff and organization responsible to upper management for occupational safety and health. In addition to in-house management and staff, audit survey teams will be required to perform audit surveys at all hazardous work locations. Arrangements for adequate and appropriately located laboratory support will also be required for analysis of environmental and biological samples.

Summary. A summary of the topics included in a comprehensive industrial hygiene program appropriate for workers exposed to hazardous chemicals in the marine transportation industry is presented in Table 1. In certain components of the industry, such as barge operations in inland waterways, it may be more difficult to implement all aspects of the comprehensive program.

Inputs to Medical Monitoring

The information resulting from a properly designed industrial hygiene program has a number of uses. Among these are determination of compliance with standards and regulations, determination of potential workplace health problems so as to allow preventive measures to be introduced, and determination of worker-specific information such as personal exposure concentrations.

Certain types of information resulting from an industrial hygiene program can serve as important inputs to medical monitoring and health surveillance programs for those workers potentially exposed to hazardous chemicals. These include:

(1) Results of IH audit surveys reporting workplace concentrations observed and measured for specific chemical substances or mixtures of chemical substances with record of:

(a) Worksite location and description,

(b) Work scenario description,

(c) Workplace conditions, protective equipment used, engineering controls employed,

(d) Identification of employees performing specific work activities,

(e) Identification of specific employee for all personal exposure sampling or biological sampling,

(f) Description of the hazardous materials observed and/or measured,

(g) Specification of the samples obtained and the results of laboratory analysis.

A standard form for recording such information currently in use by the U.S. Coast Guard, Number CG-5386(4-85), is presented in Attachment A.

(2) Record of entry into confined spaces not intended for continuous employee occupancy including:

(a) Workplace location,

(b) Description of the confined space,

(c) Description of the work activities,

(d) Description of the hazards expected in the confined space,

(e) Concentrations of chemical substances measured in the confined space including oxygen level, combustible gas concentration, and concentration of toxic substances,

(f) Identification of the employees entering the confined space,

(g) Description of the conditions during entry including protective equipment, ventilation, monitoring, and duration of stay in confined space.

The use of a confined space entry permit such as that presented in Attachment B would provide the necessary information.

(3) Reports of incidents or accidents involving known or suspected overexposures of personnel, with record of:

(a) Description of incident or accident,

(b) Worksite location and description,

(c) Work scenario description,

(d) Workplace conditions, protective equipment used, engineering controls employed,

(e) Description of the hazardous materials observed and/or measured,

(f) Identification of the specific individuals with known or suspected exposures,

(g) Sampling and analysis data for all measurements including area concentrations, personal exposure sampling, and/or biological sampling.

An example incident report form for collection of the required information is presented in Attachment C.

TABLE 1

GUIDELINES FOR AN INDUSTRIAL HYGIENE PROGRAM FOR WORKERS EXPOSED TO HAZARDOUS CHEMICALS IN THE MARINE TRANSPORTATION INDUSTRY

Recognition and Evaluation of Exposure Hazards

Recognition

(1) Toxic Substances
(2) Work Scenarios
(3) Workplace Locations with Exposure Potential
(4) Routes of Potential Exposure
(5) Numbers of Workers Potentially Exposed

Evaluation

(1) Exposure Levels and Lengths of Exposure
(2) Equipment Requirements and Availability

    (a) Protective gear
    (b) Environmental instruments

(3) Work Practices, Procedures, and Control Measures in Use
(4) Records

Control of Exposures

Engineering Controls
Administrative Controls

(1) Hazard Communication

    (a) Workplace labeling
    (b) Employee information and training
    (c) Work authorization permits

(2) Safe Work Practices

    (a) Work scenario specific

        (i) Confined spaces

            - Entry permit
            - Environmental monitoring requirements

        (ii) Ullage Gauging
        (iii) Other

Control of Exposures - Cont'd.

(b) Chemical specific practices

(i) Carcinogens (class 1)
(ii) High toxic hazards (class 2)

(3) Reporting

(a) IH audit reports

(i) Descriptive report
(ii) Concentrations and/or personal exposures measured
(iii) Data for individual medical records

(b) Confined space entry records

(i) Concentrations and/or personal exposures measured
(ii) Personnel entering confined space

(c) Incident reports

(i) Descriptive report
(ii) Hazardous materials observed and/or measured
(iii) Personnel involved
(iv) Concentrations and/or personal exposures measured

Personnel Protection

(1) Protective Equipment

(a) Respiratory
(b) Dermal

(2) Instrumentation: Concentration Levels

(a) Oxygen levels
(b) Flammability levels
(c) Detector tubes - toxic levels
(d) Maintenance and calibration requirements

Training Program

Hazard Education

(1) Noise
(2) Chemical Agents

(a) Modes of exposure

(i) Inhalation
(ii) Skin and mucous surfaces
(iii) Ingestion

Training Program - Cont'd.

(b) Toxic effects

(i) Acute effects - high level exposure
(ii) Chronic effects - low level exposure
(iii) Genetic effects - carcinogenic
- mutagenic
- teratogenic

(3) Radiation

(a) Ionizing
(b) Non-ionizing

(4) Confined Space Hazards

(a) Oxygen levels
(b) Flammability levels
(c) Toxic levels

Hazard Communication

(1) MSDS
(2) Emergency Response Guidebook
(3) Confined Space Entry Permit
(4) Cargo Information Cards

Protective Equipment

(1) Noise
(2) Dermal
(3) Respiratory

(a) Fit testing

(4) Radiation

Detection Equipment

(1) Instruments

(a) Oxygen and flammability levels
(b) Calibration

(2) Detector Tubes

(a) Toxic levels
(b) Limitations

Training Program - Cont'd.

Work Practices

(1) Confined Space Entry
(2) Ullage Gauging
(3) Other

Audit Surveys to Evaluate Exposure Control

Purpose of Audit Surveys
Action Levels

(1) Occupational Exposures

(a) Greater than ½ TLV
(b) Medical surveillance required

(2) Potential Hazard

(a) Greater than TLV - Remedial action required if toxicological assessment confirms existance of hazard

Survey Schedules

(1) Initial Survey

(a) Schedule all work stations
(b) Prioritize

(i) Severity of hazard
(ii) Number of workers

(2) Follow-Up Surveys

(a) TLV exceeded on initial survey

(i) Immediate remedial action if toxicological assessment confirms existance of hazard
(ii) Immediate follow-up survey if remedial action has been taken

(b) Greater than ½ TLV noted

(i) Follow-up survey on regularly scheduled basis - Annually or Biannually

(c) Less than ½ TLV

(i) No schedule for follow-up
(ii) Follow-up only if additional information indicates need

Audit Surveys to Evaluate Exposure Control - Cont'd

Observations

(1) Compliance with Established Procedures
(2) Records

    (a) Training
    (b) Hazards communication
    (c) Confined space entry records
    (d) Incident reports

Measurements

(1) Noise Levels
(2) Concentrations in Confined Spaces
(3) Personal Exposure Monitoring
(4) Biological Monitoring

Evaluation and Reporting

(1) Measurements and Observations
(2) Action Levels Observed
(3) Follow-Up Requirements

Personnel and Laboratory Support

I H Staff Organization
Audit Survey Team

(1) In-House Teams
(2) Consultant Teams
(3) Certified Industrial Hygienists

Laboratory Support

(1) Capabilities
(2) Locations

ATTACHMENT A

U.S. COAST GUARD INDUSTRIAL HYGIENE WORKPLACE MONITORING FORM

RNO Report # _____

UNITED STATES COAST GUARD
INDUSTRIAL HYGIENE WORKPLACE MONITORING REPORT

File(s) (check one or more):
☐ IHSD (Fill out blocks 1, 2, 3, 4) ☐ HMIN (Fill out block 5) ☐ HMIS (Fill out block 6)

FAC 1. Worksite Description — Facility Sampled:

WLOC Worksite (Bldg., Shop, etc.) _____

OPS Description of Work Operation _____

_____

WOC Workplace Conditions _____

PRO Protective Equipment: _____

ENG Eng. Controls: _____

_____

2. Hazardous Materials In Use

PNO Product # _____ Product Class _____

NM Product Name _____

CL

3. Sampling and Analysis Data

a. Sampling Data

		Atmospheric Conditions		
		DB Temp (° F)	R. H. (%)	Wind
SNO	Sample #			
ST	Sample Type (P, A or B)			
SLOC	Sample Location			
MED	Collection Medium (T;F;I)			
DT	Sample Data (mo-da-yr)			
	Sample Instrument			
	Calibration Date			
	Sample Rate (ℓ/min)			
TIME	Sample Time (min)			
	Sample Volume (ℓ)			

Analysis Requested	CAS #	NAME	CAS #	NAME
CAS, A	1	1	5	5
CAS, A	2	2	6	6
CAS, A	3	3	7	7
CAS, A	4	4	8	8

Sampled by _____ Title _____

b. Analysis Data:

Analytical Method (CAM) SCP # if NIOSH Method):		
R1, R5 Analytical Results (mg/M3) R2, R6 (f/cc) (%) R3, R7 R4, R8	1. 2. 3. 4.	5. 6. 7. 8.

Date Sample Received	Date Results Reported	Lab Report #

Analyzed By _____ Laboratory _____

COM Comments: _____

UNITED STATES COAST GUARD
INDUSTRIAL HYGIENE WORKPLACE MONITORING REPORT

RNO Report # _____

4. Employee Exposure Sampling Data

EMP SSN RATE ESNO FREQ — Name: Last, First, MI	SSN*		Job Title, Rate	Sample #	Est. Exp Time (hr/...
		( )			
		( )			
		( )			
		( )			
		( )			
		( )			

*Note: Insert an "x" after the SSN to indicate a personal sample.

5. Hazardous Materials Inventory

PNO NM CL FSN MFG ATLO — Product No.	Product Name	Product Class	Fed. Stock No.	Manufacturer	Material Location

6. Hazardous Materials Information

Data Source (check one)
- ☐ CG-HMIS
- ☐ DOD-HMIS
- ☐ MFG.-MSDS (OSHA FORM 20)
- ☐ OTHER (Explain) _____

PNO Product No.
SORCE
NM Product Name
CL Product Class
FSN Fed. Stock No.
FED FED Spec
ING Major Chem. Ingredients (%)
AMT
HAZ Hazard
PRO Protective Measures

ATTACHMENT B

EXAMPLE CONFINED SPACE ENTRY PERMIT

CONFINED SPACE ENTRY PERMIT

PERMIT NO. 00001

FOR ENTRY INTO: CARGO TANKS, BALLAST TANKS, COFFERDAMS, DOUBLE BOTTOMS, FUEL OIL TANKS, WATER TANKS, LUBE OIL TANKS, AND OTHER NORMALLY CLOSED SPACES NOT INTENDED FOR CONTINUOUS EMPLOYEE OCCUPANCY.

VESSEL -

DATE -

TIME OF PERMIT -

EXPIRATION TIME (MAX. 24 HRS.) -

CONFINED SPACE TO BE ENTERED -

DESCRIPTION OF WORK TO BE PERFORMED -

HAZARDS EXPECTED -

---TOXIC MATERIALS

---FLAMMABLE MATERIALS

---CORROSIVE MATERIALS

---RESIDUAL LIQUIDS

---OXYGEN DEFICIENCY

---OTHERS (SPECIFY)

ALL QUESTIONS MUST BE ANSWERED	YES	NO	N/A
1. HAVE VALVES ON PIPING TO THE SPACE BEING WORKED BEEN BLANKED OR CLOSED AND LASHED TO PREVENT ACCIDENTAL OPENING?			
2. HAVE APPROPRIATE SIGNS BEEN POSTED OR TAGS ATTACHED TO THE APPROPRIATE VALVES?			
3. HAS THE SPACE BEEN VENTILATED?			
4. HAS THE SPACE ATMOSPHERE BEEN GAS TESTED AND FOUND SAFE FOR ENTRY AND SAFE FOR WORK TO BE DONE?			
5. HAS FORCED VENTILATION BEEN PROVIDED FOR USE DURING THE JOB?			
6. HAS THE WORKER BEEN FITTED WITH A SAFETY HARNESS OR SAFETY LINE?			
7. DOES THE WORKER HAVE THE PROPER TOOLS FOR THE JOB?			
8. HAS A MAN BEEN ASSIGNED TO WATCH THE WORKER AND HAS HE BEEN TOLD WHAT HE SHOULD DO IF THE WORKER GETS INTO TROUBLE?			
9. IS THE PROPER RESCUE AND PERSONAL PROTECTION EQUIPMENT AVAILABLE AT THE TANK TOP?			
10. HAS ADEQUATE ILLUMINATION BEEN PROVIDED?			
11. HAVE THE MEN INVOLVED IN THIS JOB BEEN INFORMED OF THE HAZARDS THAT MAY BE ENCOUNTERED?			
12. HAVE THE MEN INVOLVED IN THIS JOB BEEN GIVEN INSTRUCTIONS REGARDING THE SAFE AND EFFICIENT METHOD OF DOING THE WORK?			
13. HAVE THE MEN INVOLVED IN THIS JOB BEEN TRAINED AND TESTED ON THE USE OF ANY NECESSARY PROTECTIVE EQUIPMENT?			
14.			

RESULTS OF GAS TESTING

CHEMICALS PREVIOUSLY IN THE SPACE	ACGIH TLV-TWA (PPM)	ACGIH TLV-STEL (PPM)	IDLH (PPM)	USCG SUBCHAPTER (O OR D)
1.				
2.				
3.				
4.				
5.				
6.				
7.				

OXYGEN CONCENTRATION --------% MEASUREMENT METHOD ----------

MEASUREMENT LOCATION ----------

COMBUSTIBLE GAS TEST --------%LEL MEASUREMENT METHOD ----------

MEASUREMENT LOCATION ----------

CALIBRATION GAS ----------

TOXIC CONCENTRATIONS MEASURED:

CHEMICAL MEASURED	CONCENTRATION (PPM)	MEASUREMENT LOCATION	MEASUREMENT METHOD
1.			
2.			
3.			
4.			
5.			
6.			
7.			

CONDITIONS FOR VALIDITY OF PERMIT

REQUIRED PERIODIC OR CONTINUOUS MONITORING -

VENTILATION REQUIREMENT -

PROTECTIVE EQUIPMENT

--HARD HAT --CHEMICAL GOGGLES --HEARING PROTECTION --GLOVES

--CHEMICAL RESISTANT CLOTHING --BREATHING APPARATUS

--SAFETY HARNESS --SAFETY LINE --GAS TESTER

--FIRE EXTINGUISHER --FLASHLIGHT --OTHER (SPECIFY)

SPECIAL INSTRUCTIONS -

I HAVE INSPECTED EACH REQUIREMENT ON THIS PERMIT AND STATE THAT THIS WORK CAN BE DONE SAFELY AND IN COMPLIANCE WITH THE RULES OF THE U.S. COAST GUARD (46 CFR PARTS 30-40 AND 150-154), COMPANY POLICY, AND THOSE OF ANY APPLICABLE LOCAL AUTHORITY.

SIGNATURE OF THE OFFICER IN CHARGE OF THIS WORK:

I HAVE READ THE ABOVE PERMIT SIGNED BY THE OFFICER IN CHARGE. (BY SIGNING THIS FORM THE WORKER INDICATES THAT HE HAS READ AND UNDERSTANDS THE ABOVE PERMIT AND WILL ABIDE BY ITS CONDITIONS)

SIGNATURE OF WORKER --- TIME IN- TIME OUT-	SIGNATURE OF WORKER --- TIME IN- TIME OUT-
-SIGNATURE OF WORKER --- TIME IN- TIME OUT-	-SIGNATURE OF WORKER --- TIME IN- TIME OUT-
-SIGNATURE OF WORKER --- TIME IN- TIME OUT-	-SIGNATURE OF WORKER --- TIME IN- TIME OUT-

LOG OF PERIODIC OR CONTINUOUS MONITORING

VESSEL _____ DATE _____

ENTRY PERMIT NUMBER _____

CONFINED SPACE TO BE ENTERED -

TIME	CHEMICAL MEASURED	CONCENTRATION (PPM)	MEASUREMENT LOCATION	MEASUREMENT METHOD	INITIA

OFFICER IN CHARGE _____

NAMES OF PERSONS WHOSE INITIALS APPEAR ON THIS FORM

_____

_____

ATTACHMENT C

INCIDENT REPORT FORM

INCIDENT REPORT FORM

Date of Incident or Accident:
Location of Incident or Accident:

Description of Incident or Accident

Personal injuries:
Exposures to toxic chemicals:
Exposures to physical agents:
Damage to equipment or facilities:
Descriptive comments:

Workplace Conditions

Work scenario description:
Protective equipment used:
Engineering controls employed:

Hazardous materials observed/measured

Chemical substances			
Concentrations Measured*			

Individuals with Known or Suspected Exposures*

Name	Title	SSN	Estimated Duration of Exposures

*Attach completed copy of Form CG-5386 for documentation of sampling and analysis data.

APPENDIX D

Guidelines for Biological Monitoring

Prepared by:

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April 1985

GUIDELINES FOR BIOLOGICAL MONITORING

Definition

Biological monitoring of exposure to industrial chemicals involves the evaluation of the internal exposure of the organism to a chemical agent (i.e., the internal dose) by a biological method. The term internal exposure or internal dose may mean the amount of the chemical recently absorbed, the amount already stored in the organism (body burden) or the amount of the active chemical species bound to the sites of action. Three types of measurements are usually selected to evaluate the internal dose:

1. The concentration of the substance in biological media (blood, urine, expired air, saliva, etc.);
2. The concentration of its biotransformation products (metabolites) in biological media;
3. The determination of non-adverse biological changes that result from reaction of the organism to exposure.

Historical Background

Elkins (1954) is considered to be among the first to advocate the adoption of biological monitoring as an essential element of an industrial hygiene program. His work pioneered correlations between exposure concentrations of industrial chemicals and their concentrations in body fluids. Later, Elkins proposed the establishment of biological threshold limit values for chemicals in biological specimens, comparable to the threshold limit values for substances in the industrial atmosphere (Elkins, 1967). More recently, the American Conference of Governmental Industrial Hygienists (ACGIH) has proposed the use of biological exposure indices as warning levels of biological response to chemicals or the metabolic products of chemicals in tissues, fluids, or exhaled air of exposed workers (ACGIH, 1984).

Purpose

Biological monitoring is one element of a total environmental program for control of industrial chemical exposure, which also includes employee medical monitoring, environmental controls, and the monitoring of

contaminants in workroom air. The main objective of biological monitoring of exposure is either to insure that the current or past exposure of workers is "safe" or to detect potentially excessive exposure before the occurrence of detectable adverse health effects. It is essentially a preventive medical activity.

Advantages of Biological Monitoring

The greatest advantage of biological monitoring is the fact that the biological parameter of exposure is more directly related to the adverse health effects that one attempts to prevent than any environmental measurement. Therefore, it may offer a better estimate of the risk than ambient monitoring.

Biological monitoring takes into consideration absorption by routes other than the lungs. Many industrial chemicals can enter the organism by absorption through the skin or the gastrointestinal tract. For these substances, measurement of atmospheric concentrations may not provide an accurate indication of the exposure dose.

Many physico-chemical and biological factors (particle size distribution, work load, ventilatory parameters) may affect the relationship between the airborne concentrations of chemicals and the amounts absorbed by the lungs. For example, a physical load of 100 Watts doubles or triples the respiratory uptake of trichloroethylene by comparison with the uptake at rest. The daily uptake of xylene by volunteers exposed to the same time-weighed average concentration varies with the environmental conditions (constant or peak exposures) and the work load.

Other variables may affect the relationship between airborne concentration of a chemical and the amount of chemical that enters an organism by any route. These include personal hygiene habits, smoking, individual variations in the absorption rates of chemicals and sex differences in absorption rates.

Non-occupational background exposures may be expressed in the biological level. The organism integrates the total external (environmental and industrial) exposure to one internal load.

Factors and Limitations of Biological Monitoring

Rational biological monitoring is only possible when sufficient biochemical information has been gathered on the mechanism of action and/or the fate (absorption, biotransformation, distribution, excretion) of xenobiotics to which workers may be exposed. Furthermore, even when this information is adequate to suggest a potentially useful biological parameter, other prerequisites must be met before applying its use for the routine monitoring of workers exposed to the chemical. These include the determination of an acceptable level of the parameter, the variability in the biological parameter, and potential modifications of the biological parameter by environmental and biological factors (other chemicals, drugs, diet, diseases, sex).

For many industrial chemicals, a biological parameter can be suggested for monitoring exposure, but a meaningful biological threshold limit cannot yet be defined. Ideally, the permissible value of a biological parameter should be defined on the basis of the relationship between the changes in the biological parameter and the occurrence of health-relevant biological effects in groups of exposed workers. This relationship is frequently unknown.

Factors to be considered in biological monitoring include the inherent complications associated with specimen sampling, transporting and storage of biological specimens, and reliable and accurate laboratory analyses. Samples should be collected at the end of the shift in which potential exposures occur, and, in general, no later than 24 hours after exposure.

Summary Guidelines

To evaluate internal dose, monitoring of the concentration of substances in biological media (blood, urine, and exhaled air) and the concentration of biotransformation products (metabolites) in these biological media should be considered as one element of a marine occupational safety and health program. The main objectives of such biological monitoring are to insure that the current or past exposure of workers is safe and to detect potential excessive exposure before the occurrence of clinically detectable adverse health effects. Because these

biological parameters are more directly related to the potential for adverse health effects than any environmental measurement, they may offer a better estimate of risk.

To augment environmental monitoring, biological monitoring of exposed or potentially exposed workers should be considered for the following exposure circumstances:

1. In response to known or suspected acute overexposure to a specific mixture or single substance during an unplanned, unexpected incident or accident;
2. To determine whether or not protective gear worn in extremely hazardous environments adequately protects the worker from absorption of excessive internal dose through respiratory or dermal routes during activities in response to an accident, or during routine, extremely hazardous operations;
3. To augment routine environmental measurements during industrial hygiene audits of marine operations involving extremely toxic substances such as carcinogens in work scenarios with high potential exposure hazard.

When operating in the marine environment on a vessel or marine terminal, the use of invasive biological sampling methods such as venipuncture is not recommended for routine operations. Non-invasive methods which require minimal training of both worker and staff and which offer no inherent risk to the individual worker are more appropriate for the marine environment. The primary non-invasive sampling media are urine and end exhaled air.

The requirements to support biological monitoring are quite strenuous. Included are:

1. Training of personnel to collect, prepare, store, and transmit samples to analytical laboratories,
2. Supplies for sample collection, preparation and storage of samples until transmittal to an analytical laboratory,
3. Collection of samples within a specified time limit from time of exposure,
4. Preparation of samples for storage and their storage under appropriate temperature conditions until transmittal to an analytical laboratory,

5. Transmittal of samples to an analytical laboratory under appropriate temperature conditions within a specified time limit to minimize degradation of the sample.

The costs associated with provision of these requirements may be impractical for application to one or more of the exposure circumstances discussed previously.

The number of chemical substances for which biological monitoring methods have been developed is limited by the availability of appropriate epidemiological and toxicological data. The marine hazardous substances and associated biological media and metabolites for which biological monitoring methods have been developed to detect excessive internal dose are listed in the following section. Table 1 presents data for bulk liquid cargo substances. Table 2 presents data for hazardous substances encountered in maintainance operations. The availability of pertinent data is rapidly changing due to the results of work currently underway in the U.S. and in Europe. As sufficient data become available for additional hazardous marine substances, it is expected that the list will be expanded.

REFERENCES

1. ACGIH, Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices with Intended Changes for 1984-85, American Conference of Governmental Industrial Hygienists, Cincinnati, 1984.

2. Baselt, R. C., Biological Monitoring Methods for Industrial Chemicals, Biomedical Publications, Davis, California, 1980.

3. Elkins, H. B., Analyses of Biological Materials as Indices of Exposure to Organic Solvents, Arch. Ind. Hyg. Occ. Med., Vol. 9, pp. 212-222, 1954.

4. Elkins, H. B., Excretory and Biological Threshold Limits, Am. Ind. Hyg. Asso. J., Vol. 28, pp. 305-314, 1967.

5. Lauwerys, R. R., Industrial Chemical Exposure: Guidelines for Biological Monitoring, Biological Publications, Davis, California, 1983.

TABLE 1

BULK LIQUID CARGO SUBSTANCES

Chemical Substance	Biological Medium	Biological Parameter	Level Indicative of Potentially Excessive Exposure	Timing	Reference
acetone	urine	acetone	20 mg/g creatinine		5
acrylonitrile	urine	thiocyanate	20 mg/L		2
aniline	urine	p-aminophenol	10 mg/g creatinine		5
benzene	urine	phenol	45 mg/g creatinine		5
cumene	urine	dimethylphenyl-carbinol	10 mg/h	last 2 hr of exposure	5
cyclohexane	urine	cyclohexanol	3.2 mg/g creatinine		5
	breath	cyclohexane	220 ppm	during exposure	5
dichloromethane	breath	dichloromethane	35 ppm		5
dimethylformamide	urine	n-methylformamide	40 mg/g creatinine		5
	breath	dimethylformamide	1 ppm	during exposure	5
ethyl benzene	urine	mandelic acid	2 g/L	end of shift	1
		mandelic acid	1.5 g/g creatinine	end of workweek	1
furfural	urine	furoic acid	200 mg/g creatinine		5
n-hexane	urine	2-hexanol	0.2 mg/g creatinine		5
methane	urine	methanol	7 mg/g creatinine		5
methyl ethyl ketone	urine	methyl ethyl ketone	2.6 mg/g creatinine		5
nitrobenzene	urine	p-nitrophenol	5 mg/g creatinine		5
phenol	urine	phenol	300 mg/g creatinine		5
styrene	urine	mandelic acid	1.0 g/L	end of shift	1
			0.8 g/g creatinine		1
	urine	phenylglyoxylic acid	250 mg/L	end of shift	1
			240 mg/g creatinine		1
	breath	styrene	18 ppm	during shift	1
toluene	urine	hippuric acid	2.5 g/g creatinine	end of shift	1
	breath	toluene	20 ppm	during shift	1
trichloroethylene	urine	trichloracetic acid	100 mg/L	end of workweek	1
	breath	trichloroethylene	0.5 ppm	end of workweek	1
xylene	urine	methylhippuric acid	1.5 g/g creatinine	end of shift	1
			2 mg/min	last 4 hr of shift	1

TABLE 2

HAZARDOUS SUBSTANCES ENCOUNTERED IN MAINTENANCE OPERATIONS

Chemical Substance	Biological Medium	Biological Parameter	Level Indicative of Potentially Excessive Exposure	Timing	Reference
cadmium	urine	cadmium	10 µg/g creatinine		5
carbon monoxide	breath	CO	40 ppm	end of shift	1
chromium	urine	chromium	30 µg/g creatinine		5
fluoride	urine	fluoride	7 mg/g creatinine	postshift	5
lead	urine	lead	150 µg/g creatinine		5
	urine	δ-aminolevulinic acid	10 mg/g creatinine		5
	urine	coproporphrin	250 µg/g creatinine		5
mercury	urine	mercury	50 µg/g creatinine		5
nickel	urine	nickel	70 µg/g creatinine		5

APPENDIX E

A Self-Maintained Record of Potential Exposures

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May 1985

A SELF-MAINTAINED RECORD OF POTENTIAL EXPOSURES

Background

Field personnel of the USCG performing marine inspection, pollution response, and pollution prevention activities routinely encounter a potential for exposures to hazardous chemicals during normal work activities. Some of the bulk liquid cargo substances encountered in these activities are known to be highly toxic, and 18 of the regulated cargo substances are known or suspected carcinogens. This work environment is recognized to be potentially hazardous and warrants medical monitoring of the exposed personnel.

To complement such medical monitoring, there is a need for a systematic record of exposure information for field personnel who routinely encounter potential exposures. At present, no routine record is maintained for recording of exposures or exposure potential for these personnel. This paper outlines a method for using a self-maintained log to systematically produce information on potential exposure for individuals. Such a record of potential exposures, made available to the examining physician at the periodic medical examination, would provide a significant aid in diagnosing health effects potentially related to occupational exposures.

Method

Data Collection. For each job activity involving potential exposure to known toxic substances, a set of information will be self-recorded by the individual using a specially designed form. This information will include:

(1) Date and time of job activity,
(2) Location of the job activity,
(3) Description of the operations going on during the potential exposure,

(4) Job activity of the individual worker recording the information,
(5) Identification of the chemical substance,
(6) Duration of the potential exposure activity, and
(7) Protective equipment utilized, if any.

An example form is shown in Figure 1.

Training Requirements

To support proper use of a self-maintained log of potential exposures, personnel will require training regarding job activities with potential for exposures to toxic chemical substances and information on the toxic chemical substances to be aware of in the work environment. Field personnel should be provided a listing of toxic chemical substances considered important for purposes of the potential exposures log. This listing should include all Class 1 (Carcinogens) and Class 2 (High Toxic Hazard) substances and additional substances from other classes as defined by the Medical Monitoring Program. An appropriate listing will need to be prepared by the responsible medical or safety office.

Review. The self-maintained log of potential exposures will be collected at intervals and reviewed by supervisory staff for completeness and accuracy. Only work activities with potential for exposures should be included and, only then, for activities which involve substances which present a high toxic hazard. The supervisor will review with the employee any changes in data collection procedures which may be needed. A record copy of the potential exposures log will then be filed at the unit. At intervals, a copy of each potential exposure log on file at the unit will be forwarded for input to a data management system.

Data Processing. The following information from the potential exposure log will be input for data processing: Name, title, and identification number, date and time of potential exposure activity, chemical substance identification, and duration of potential exposure

Potential Exposure Log

Name and Title: _____

Employee Identification Number: _____

Date and Time	Facility - shipyard, terminal, vessel or barge	Operation at this Facility	Chemical Substance or Trade Name	Employee Activity	Duration (hrs)	Protective Equipment Worn	Other Comments

FIGURE 1. EXAMPLE POTENTIAL EXPOSURE LOG

activity. For each individual, a data file containing these data will be established. Additional entries will be made to the individual's data file as subsequent potential exposure logs are processed.

The input data will be checked for redundancy, so that data for the same date and time are not entered more than once. At intervals, the data contained in an individual's file for a specified time period will be processed to produce one entry for each chemical substance. That entry will include frequency (number of separate potential exposure episodes) and total duration (summary of the separate durations). The time period covered in the summarized data will also be retained in the summary file for the individual.

Output: From the data in the summary file for each individual, a listing can be compiled for inclusion in the medical file for the individual. The listing would include:

(1) Employee identification (name and identification number)
(2) Title
(3) Period covered
(4) Potential exposures:

Substance	Frequency	Duration (hrs)
_____	_____	_____
_____	_____	_____
_____	_____	_____

Discussion

Use of a self-maintained potential exposure log must be restricted to personnel who are properly trained and motivated. Improper use of the log could generate misinformation regarding the potential exposures of a given individual. If the individual is lax in maintaining the record, the log will indicate fewer episodes of potential exposure than is true.

There is also the obvious potential of the log being abused by an individual who seeks to create evidence for later litigious use.

The data generated by this method are labeled "potential" exposures because there is no specific measurement of exposures, but rather information as to the presence of a given toxic chemical substance during an activity known to involve a potential for exposure. Clearly, the data do not indicate known exposures. Accordingly, output for inclusion in the individual's medical file must clearly indicate that the substances listed are those for which the individual has had potential for exposure, and in no way describe known exposures.

APPENDIX F

An Indirect method for Estimating Potential Exposures to Tanker Vessel Cargos

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May 1985

AN INDIRECT METHOD FOR ESTIMATING POTENTIAL EXPOSURES TO TANKER VESSEL CARGOS

Background

Studies conducted aboard tanker vessels to measure occupational exposures have shown that workers can encounter significant levels of exposures to toxic chemicals during routine work activities such as cargo loading or tank cleaning operations. The documented concentrations of chemicals and durations of exposures indicate a potentially hazardous work environment warranting medical monitoring of exposed personnel.

To complement medical monitoring, there is a need for a systematic record of exposure information for individual workers. At present, no routine record is maintained for the purpose of recording exposures or exposure potential for individuals. Personnel records are maintained regarding job title, work assignment, and location assignment such as a given vessel for a given period of time. Records are also maintained regarding cargos loaded and unloaded. These and other records for specific personnel and specific cargos are maintained for purposes of ship safety, organization of work activities, payment of correct wages, and to record the cargos received and delivered in the process of meeting contracted requirements.

This paper outlines a method for linking existing personnel and cargo records to systematically produce information on potential exposures for individual workers. Such a record of potential exposures, made available to the examining physician at the periodic physical examination, would provide a significant aid in diagnosing health effects potentially related to occupational exposures.

Approach

The approach to design of an information system which would use existing records as input and provide potential exposure information for specific individuals as output is based on records for each vessel in a company's fleet. Records of activities of each vessel are maintained at shipping company offices to record the personnel assigned to the vessel, the movements of the vessel from port to port, and the cargos handled.

Records of personnel assignments and records of cargo activities aboard such vessels will be used to correlate cargos with worker history. This correlation will be used to determine potential worker exposure. This potential is dependent on only two parameters: 1) having a work assignment which routinely brings the worker into potential contact with cargos or cargo vapors, and 2) the loading of specific cargos aboard the vessel to which an individual is assigned. Personnel will generally fall into one of two categories: 1) deck crew and officers directly involved in cargo transfer, tank cleaning/tank entry activities, or other cargo related activities, and 2) others who do not routinely work with cargos such as workers in the ship's galley or the engine room.

The approach will be to establish a chronological listing of cargos loaded and to compile a listing of such cargos, by date, for each worker aboard the vessel who is assigned to cargo transfer, tank cleaning/tank entry activities, or to other activities determined by the company safety office to involve potential for exposures to cargos or cargo vapors.

Input Requirements

Two types of records will be used for estimating potential exposures: 1) records of personnel assigned to a vessel and 2) records of cargo loaded.

Personnel Records. For each vessel, a roster is maintained which documents a listing of all personnel assigned to the vessel. The roster identifies each person by name and title. The title provides information as to the rank of the individual as well as the type of work to which the individual is assigned. Whenever there is a change of personnel assigned to the vessel, the roster is updated so that a current and correct roster is maintained. Copies of the roster are maintained aboard the vessel at all times and a copy is forwarded to the office of the shipping company whenever there is a change in the ship's personnel.

Cargo Records. Each time a vessel loads or discharges cargo, a set of information is duly entered into the ship's record. Included in this record are the types and quantities of cargos transferred. For each port or terminal visited by the vessel, a report is prepared which documents the types and quantities for all such cargo transfers. A copy of the port or terminal activities report is maintained aboard the vessel and is regularly forwarded

to the shipping company offices for processing and maintenance in the company's record files.

The Indirect Method for Estimating Potential Exposures

The method employed to calculate potential exposures is discussed in the following steps:

1. Port or Terminal Activity. Receipt of a port or terminal activities report at a company's office will initiate action. For any cargo loading activities reported in the form, a listing of the specific cargos and quantities loaded will be prepared on a separate, specially designed form. The date on which each loading activity occurred will also be recorded. An example form for recording these data is shown in Figure 1.

2. Personnel Roster. For each date on which cargos were loaded aboard a given vessel, a copy of the ship s roster of personnel in effect for that date will be used to specify the personnel potentially exposed.

3. Personnel Titles and Cargos of Interest. The shipping company's medical and safety offices will define the set of personnel considered to be potentially exposed to cargos or cargo vapors in their routine work activities. As a minimum, titles associated with deck crew and officers directly involved with cargo transfer activities, tank cleaning/tank entry activities, or other cargo related activities should be included. Titles of other members of the ship's personnel may be included, at the discretion of the shipping company's medical and safety offices.

The types of cargo that need to be recorded for potential exposures will be listed by the shipping company's medical and safety offices. These cargo types should include all Class 1 (Carcinogens) and Class 2 (High Toxic Hazard) substances as defined by the Medical Monitoring Program. Other cargo types could be included at the discretion of the shipping company's medical and safety offices.

4. Data Entry and Reduction. Information on the record of cargos loaded and the roster of ship's personnel will be input to a data management system (DMS). A file of all personnel titles and cargos of interest will be maintained in the DMS for data selection purposes.

The input data will first be reduced to consider only personnel titles and cargos of interest. For each individual bearing a title of

Date:

Vessel Identification:

Terminal Identification:

Loading No.	Type of Cargo Loaded	Quantity Loaded (Tons)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Figure 1. Example Form for Record of Cargos Loaded

interest, a file will be established and data for all cargo loadings for cargos of interest will be added to that file, sequentially, by date of loading.

The record for each individual will then be reduced to a single entry for each different cargo type. That entry will include the frequency (number of separate loadings of the cargo type) and the total quantity (tonnage) involved. The time period covered in the summarized data will also be retained in the summary file for the individual.

5. Output. From the data in the summary file for each individual, a listing can be compiled for inclusion in the medical file for the individual. The listing would include:

(1) Worker identification (Name and Identification No.)

(2) Title

(3) Period covered

(4) Cargos loaded:

Substance	Frequency	Tonnage
____	____	____
____	____	____
____	____	____

Discussion

The method described herein is labeled "indirect" because it makes use of vessel specific information rather than individual specific information. That a given type of cargo was loaded during a given individual's assignment aboard a tanker vessel does not indicate a known exposure of the individual to the substance. However, the assignment of the individual to the vessel at the time of the cargo loading does constitute an exposure potential, depending on the job assignment of the individual during the loading or during any subsequent handling of the cargo or involvement with the cargo tank or tanks, hoses, or other equipment which come in contact with the cargo while it is carried aboard the vessel.

Accordingly, output which is prepared for inclusion in the individual's medical file must clearly indicate that the substances listed are those for which the individual has had potential for exposure, and in no way describe known exposures.

APPENDIX G

Data Management System Conceptual Design

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DATA MANAGEMENT SYSTEM CONCEPTUAL DESIGN

Introduction

A marine occupational safety and health program (MOSHP) has been developed to improve health and safety conditions of the marine hazardous chemical worker. This comprehensive safety and health program is comprised of three major elements:

(1) An industrial hygiene program to provide an active set of measures to avoid adverse chemical exposures,

(2) A medical monitoring program to provide a safety net to monitor for adverse health effects in the worker populations, and

(3) A data management system (DMS) to provide a record of the data generated from both of these aforementioned programs and to provide a means of rapid access to data files for specific data sets and for data summaries.

This paper presents a conceptual design for the MOSHP DMS.

Input Data

Input data for the DMS will be collected by use of the 15 data forms listed in Table I. A copy of each of these data forms is presented in Attachment A. DMS Data Forms 1-9 are standard data forms currently used by the USCG office of Health Services as input for the Coast Guard Occupational Health Management Information System (CGOHMIS). DMS Data Forms 10-15 have been specially designed to provide input for the MOSHP DMS.

Implementation of the MOSHP by an industrial user group would require evaluation of the applicability of the information on DMS Forms 1-15 for the specific user and preparation of a set of user-specific data forms. It is anticipated that the user specific data forms would identify the user group or

TABLE I. DMS DATA FORMS

DMS Form No.	Standard Form No.	Description
1	SF 93	Report of Medical History
2	SF 507	Clinical Record: Continuation of SF 93 for OMMP
3	CG 5197	Occupational History
4	SF 88	Report of Medical Examination
5	SF 507	Clinical Record: Continuation of SF 88 for OMMP
6	SF 507	Clinical Record: Report on OMMP Periodic Examination
7	DD 2215	Reference Audiogram (Baseline Exam)
8	DD 2216	Hearing Conservation Data (Follow-up Exams)
9	CGHQ 5386	Industrial Hygiene Workplace Monitoring form
10	--	Potential Exposure Log (for individual workers)
11	--	Record of Cargos Loaded
12	--	Record of Ship's Personnel
13	--	Incident Report Form
14	--	Confined Space Entry Permit
15	--	Request for Industrial Hygiene Data

each of the forms with minimal revisions to the data format so as not to require revision of the user-friendly data entry mode of the MOSHP DMS.

Approach

The approach is based on use of microcomputers to interface with the CGOHMIS database management system currently being implemented by the U. S. Coast Guard Office of Health Services. The CGOHMIS is itself an adaptation of the Flow II Gemini system developed by Flow General, Inc., and is operated by the Coast Guard through a time sharing arrangement. The capabilities of CGOHMIS will be extended for two separate applications: one for U. S. Coast Guard operations and a second one for application to the marine industry.

All programming will be accomplished on IBM PC microcomputers. The programming will be considered developmental, not operational, and no changes will be made to CGOHMIS software during this developmental work. The existing CGOHMIS will be accessed through a direct time sharing arrangement with Flow General, Inc. An IBM PC will be used to access CGOHMIS, enter data, and execute CGOHMIS reports. In addition, the microcomputer will be programmed to create augmentation files, data entry, edit, and execute reports on

augmentation files, merge CGOHMIS data with augmentation files, process CGOHMIS and augmentation data, and execute reports on merged data.

Conceptual Design

The OMS conceptual design is discussed in four separate parts:

(1) Baseline OMS,
(2) Level 1 Modification - Coast Guard Application,
(3) Level 2 Modification - Industry Application, and
(4) Further Conceptual Development.

Baseline OMS: The baseline OMS is the CGOHMIS database management system operated by the USCG. CGOHMIS is currently structured to handle data obtained from OMS data forms 1-9, as defined in Table I. Data may be retrieved from CGOHMIS in the form of medical records and reports using Flow II Gemini reporting capabilities. Output reports and report formats currently available through CGOHMIS are depicted and discussed in Reference 1. The major components of the CGOHMIS database are illustrated in Figure 1.

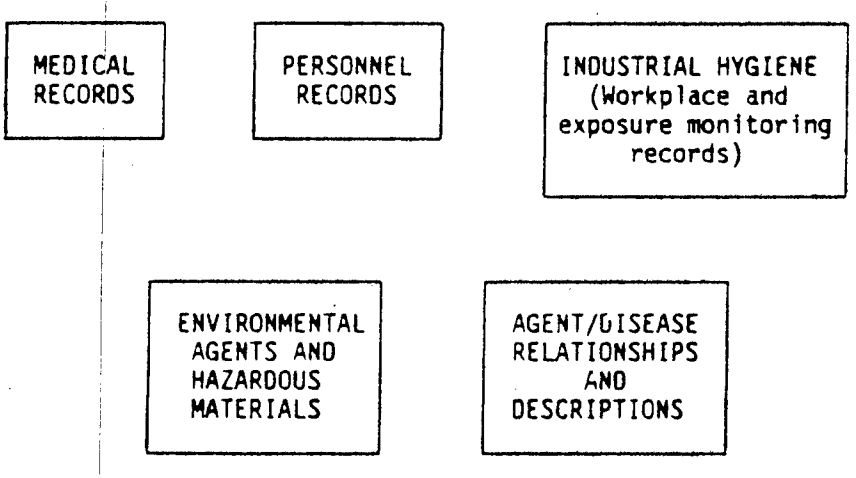


FIGURE 1. CGOHMIS DATABASE COMPONENTS

Level 1 Modification - Coast Guard Application: The Level 1 Modification for the Coast Guard Application will augment the baseline OMS with potential exposure information obtained from Data Form 10. Logic for processing data extracted from OMS Form 10 and description of the output format is provided in Reference 2. The Level 1 Modification will allow data entry, editing, and execution of reports based on Data Form 10 information, and the merging of these data with the Baseline OMS data during reporting.

Level 2 Modification - Industry Application: The Level 2 Modification for the Industry Application will augment the Level 1 Modification with information extracted from Data Forms 11-15.

Data Form	Description
11	Record of Cargos Loaded
12	Record of Ship's Personnel
13	Incident Report Form
14	Confined Space Entry Permit
15	Request for Industrial Hygiene Data

Logic for processing data from Data Forms 11 and 12 and description of the output format are provided in Reference 3. For Data Forms 13 and 14, the following information will be extracted and formatted for reporting:

Data Form 13:

(1) Description of incident or accident,
(2) Worksite location and description,
(3) Work scenario description,
(4) Workplace conditions, protective equipment used, engineering controls employed,
(5) Description of the hazardous materials observed and/or measured,

Data Form 13 (continued):

(6) Identification of the specific individuals with known or suspected exposures, and
(7) Sampling and analysis data for all measurements, including area concentrations, personal exposure sampling, and/or biological sampling.

Data Form 14:

(1) Workplace location,
(2) Description of the confined space,
(3) Description of the work activities,
(4) Description of the hazards expected in the confined space,
(5) Concentrations of chemical substances measured in the confined space including oxygen level, combustible gas concentration, and concentration of toxic substances,
(6) Identification of the employees entering the confined space, and
(7) Description of the conditions during entry including protective equipment, ventilation, monitoring, and duration of stay in confined space.

Report formats for Data Forms 13 and 14 will include output prepared for inclusion in the medical record file of each individual identified in the data. The data for inclusion in the individual's medical record file will include as much data as are available regarding:

(1) Identification of the chemical substance(s)
(2) Concentration of each chemical substance
(3) Duration of exposure(s)

For Data Form 15, the following information will be extracted and formatted for reporting:

Data Form 15:

(1) Requestor identification
(2) Patient identification
(3) Reason for request
(4) Information on known or suspected exposures
(5) Information requested

Information in the data file for Data Form 10 will be searched for the information requested for specific chemical substance/job scenario combinations and reported in a format suitable for provision to a requesting physician.

The Level 2 Modification will allow data entry, editing, and execution of reports based on Data Forms 10-15 information, and the merging of these data with the Baseline DMS data during reporting.

Further Conceptual Development

In addition to the Level 1 and Level 2 Modifications to the Baseline DMS, a number of further enhancements will be conceptualized, but not implemented in either hardware or software. These will include, but not be limited to, consideration of:

(1) Remote access to database by a physician
(2) Records on "smart card"
(3) Indexing of risk factors
(4) Trend analysis
(5) Stand-alone, microcomputer-based DMS

Specific concepts for extending the modified DMS to include these capabilities will be discussed in the DMS final documentation.

Implementation

The Baseline DMS, CGOHMIS, (or a copy of it) will be used in its implemented form. No modifications will be made to CGOHMIS. Figure 2 depicts data flow in the Baseline DMS.

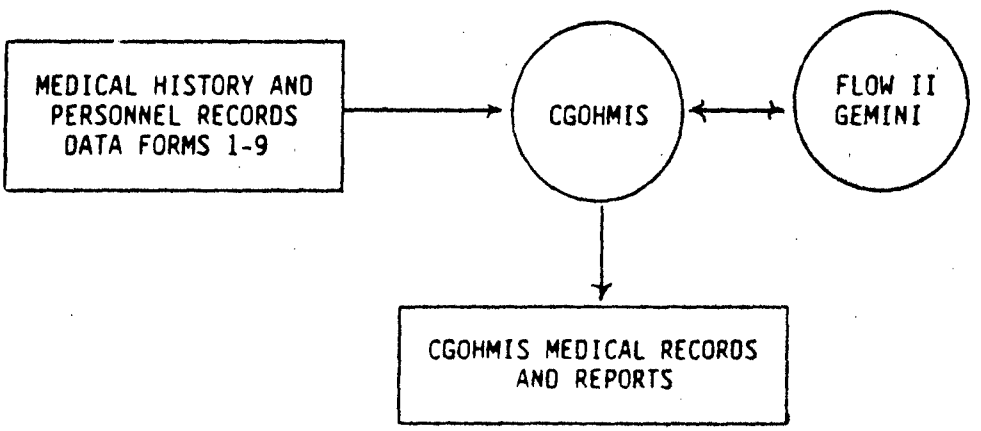


FIGURE 2. BASELINE DMS

In order to establish a Baseline DMS capability, the following tasks will be accomplished:

1. Develop familiarity with CGOHMIS

    a. CGOHMIS/FLOW II Gemini database structure and specific content
    b. Remote data access for entry and reporting

2. Determine microcomputer interface capabilities

    a. IBM PC interface requirements and capabilities
    b. C3 computer interface possibilities and considerations

The level 1 Modification will be implemented using an IBM PC/XT computer interfaced with CGOHMIS as shown in Figure 3.

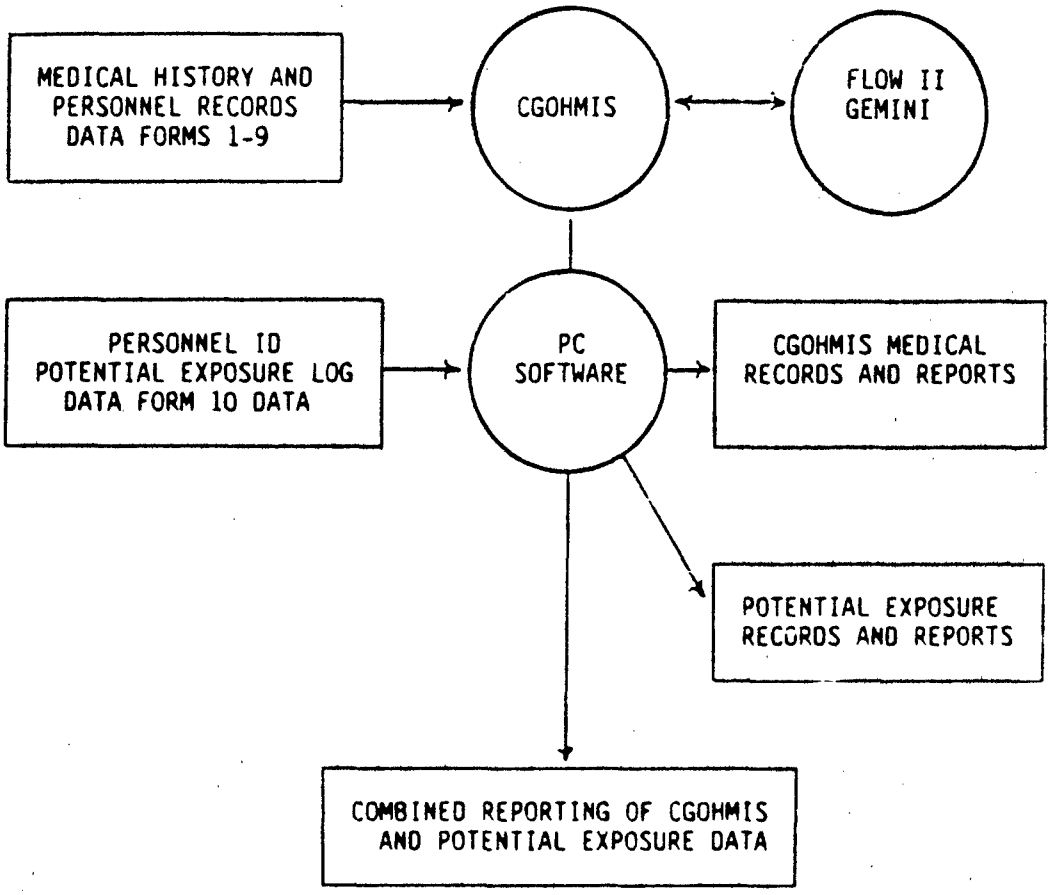


FIGURE 3. LEVEL 1 MODIFICATION DATA FLOW

The IBM will be equipped to (1) interface to CGOHMIS for data entry (if required) and retrieval using a modem for standard telephone line communications, and (2) with a database management system (DBMS) to support local data handling. Using the PC, standard reports can be retrieved from CGOHMIS, Form 10 data can be collected and reported, CGOHMIS data records can be retrieved and loaded to the PC's DBMS, and reports combining CGOHMIS data with Form 10 data can be produced.

Implementation of the Level 1 capability requires the following tasks:

1. PC capability for processing Form 10, Potential Exposure Log

    a. DBMS description of Form 9 and Form 10 data records
    b. Data entry screens and edits for Forms 9 and 10
    c. Report definitions for outputs

2. PC capability for merging Form 10 data with existing CGOHMIS data

    a. DBMS description of CGOHMIS data to be imported from CGOHMIS to the PC's DBMS
    b. Report definitions for outputs

3. Retrieval of masked (no personnel identifiers) CGOHMIS data, Data Forms 1-8

4. Data entry and processing of trial implementation data for the Coast Guard

    a. Form 9
    b. Form 10
    c. Reports of Form 9 and Form 10 data merged with data from CGOHMIS

The Level 2 Modification will use the same hardware/software configuration as for Level 1. As illustrated in Figure 4, remote data entry to CGOHMIS for Data Forms 1-9 will be implemented as well as PC data collection from Data Forms 10-15. Reports will be produced, and as for Level 1, data from CGOHMIS can be retrieved and merged with locally resident data for reporting.

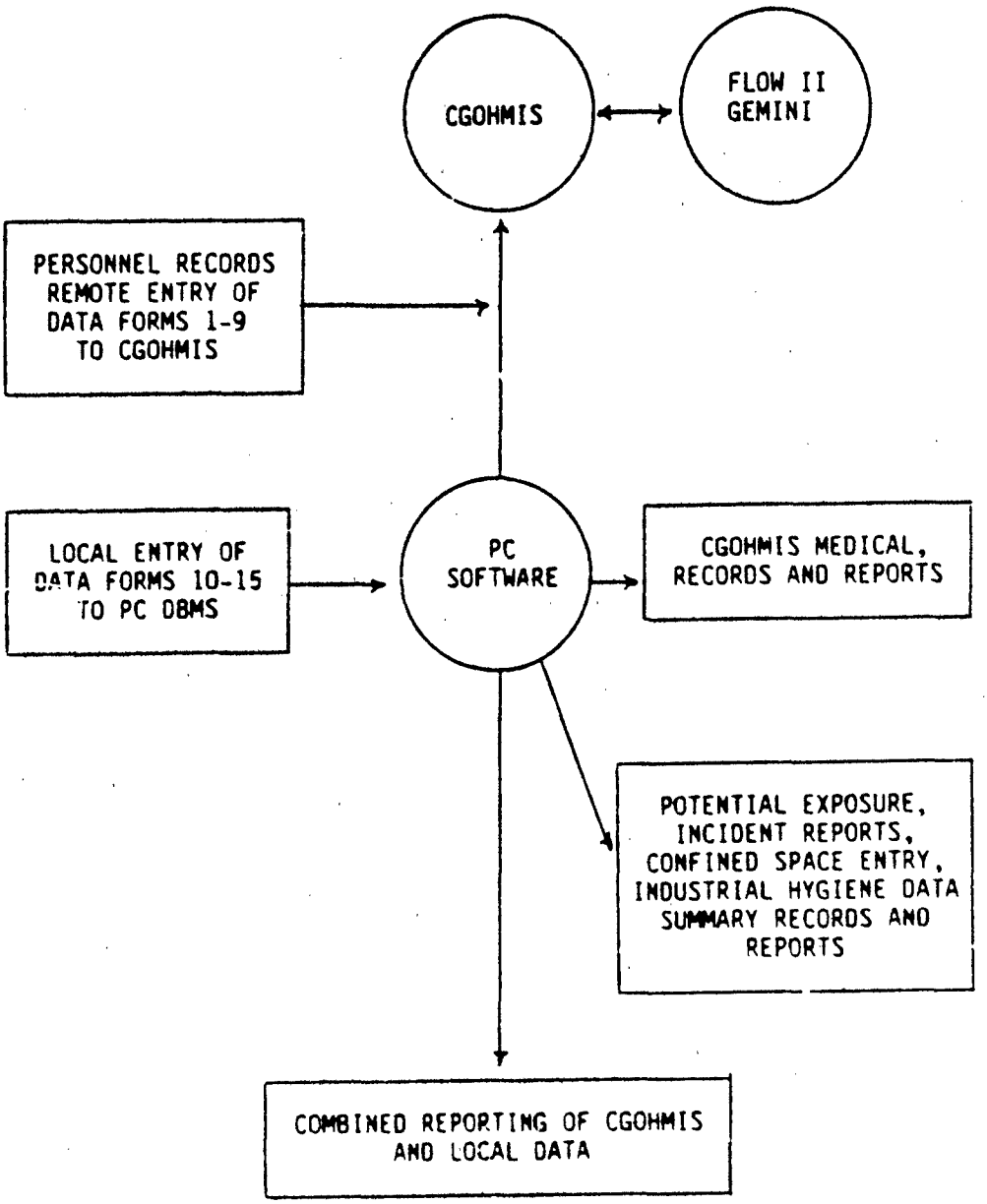


FIGURE 4. LEVEL 2 MODIFICATION DATA FLOW

Implementation of the Level 2 capability requires the following tasks:

1. Forms 1-9 data collection for industry and input to CGOHMIS via terminal emulation.

2. Development of local OMS data collection capabilities for Data Forms 10-15.

3. Development reporting capability for Form 9-Form 15 data merged with CGOHMIS data.

4. Input and processing of sample data for industry trial implementation.

5. Develop program for scheduling of medical examinations.

Software and Hardware Support Requirements

To support the developmental OMS design, the following commercially available software, hardware, and supplies will be required:

Software

Database Management System - PC/FOCUS

Hardware

IBM XT with:

- DOS 2.1
- 256K RAM
- Monochrome Monitor
- Monochrome Display/Printer Port Card
- Serial Port Card
- AST SIXPAC multifunction card w/384K

Computer Accessories Corp. Model P2 Power Director
Hayes Smart modem 1200 w/Smartcom II
Printer - Okidata Microline 84, 200 CPS, w/forms tractor
IOMEGA 20Mbyte Bernoulli Box
Supplies: Cartridges for IOMEGA, Printer Ribbons, Floppy Disks

REFERENCES

1. Detailed Design: U. S. Coast Guard Occupational Health Management Information System - Phase III, JRB Associates, McLean, Virginia, January 31, 1985.

2. A Self-Maintained Record of Potential Exposures, Appendix D of this report.

3. An Indirect Method for Estimating Potential Exposures to Tanker Vessel Cargos, Appendix E of this report.

ATTACHMENT A

DMS DATA FORMS

An example of each of the 15 data forms listed in Table I is presented in this attachment.

DMS Data Form 1

SF 93 - Report of Medical History

STANDARD FORM 93
REV OCTOBER 1974
GSA FPMR 101-11.8

APPROVED
OFFICE OF MANAGEMENT AND BUDGET No. 29-R0191

REPORT OF MEDICAL HISTORY

(THIS INFORMATION IS FOR OFFICIAL AND MEDICALLY-CONFIDENTIAL USE ONLY AND WILL NOT BE RELEASED TO UNAUTHORIZED PERSONS)

1. LAST NAME—FIRST NAME—MIDDLE NAME		2. SOCIAL SECURITY OR IDENTIFICATION NO.
3. HOME ADDRESS (No. street or RFD, city or town, State, and ZIP CODE)		4. POSITION (title, grade, component)
5. PURPOSE OF EXAMINATION	6. DATE OF EXAMINATION	7. EXAMINING FACILITY OR EXAMINER, AND ADDRESS (Include ZIP Code)

8. STATEMENT OF EXAMINEE'S PRESENT HEALTH AND MEDICATIONS CURRENTLY USED (Follow by description of past history, if complaint exists)

9. HAVE YOU EVER (Please check each item)

YES	NO	(Check each item)
		Lived with anyone who had tuberculosis
		Coughed up blood
		Bled excessively after injury or tooth extraction
		Attempted suicide
		Been a sleepwalker

10. DO YOU (Please check each item)

YES	NO	(Check each item)
		Wear glasses or contact lenses
		Have vision in both eyes
		Wear a hearing aid
		Stutter or stammer habitually
		Wear a brace or back support

11. HAVE YOU EVER HAD OR HAVE YOU NOW (Please check at left of each item)

YES	NO	DON'T KNOW	(Check each item)	YES	NO	DON'T KNOW	(Check each item)	YES	NO	DON'T KNOW	(Check each item)
			Scarlet fever, erysipelas				Cramps in your legs				"Trick" or locked knee
			Rheumatic fever				Frequent indigestion				Foot trouble
			Swollen or painful joints				Stomach, liver, or intestinal trouble				Neuritis
			Frequent or severe headache				Gall bladder trouble or gallstones				Paralysis (include infantile)
			Dizziness or fainting spells				Jaundice or hepatitis				Epilepsy or fits
			Eye trouble				Adverse reaction to serum, drug or medicine				Car, train, sea or air sickness
			Ear, nose, or throat trouble								Frequent trouble sleeping
			Hearing loss				Broken bones				Depression or excessive worry
			Chronic or frequent colds				Tumor, growth, cyst, cancer				Loss of memory or amnesia
			Severe tooth or gum trouble				Rupture/hernia				Nervous trouble of any sort
			Sinusitis				Piles or rectal disease				Periods of unconsciousness
			Hay Fever				Frequent or painful urination				
			Head injury				Bed wetting since age 12				
			Skin diseases				Kidney stone or blood in urine				
			Thyroid trouble				Sugar or albumin in urine				
			Tuberculosis				VD—Syphilis, gonorrhea, etc.				
			Asthma				Recent gain or loss of weight				
			Shortness of breath				Arthritis, Rheumatism, or Bursitis				
			Pain or pressure in chest				Bone, joint or other deformity				
			Chronic cough				Lameness				
			Palpitation or pounding heart				Loss of finger or toe	12. FEMALES ONLY: HAVE YOU EVER			
			Heart trouble				Painful or "trick" shoulder or elbow				Been treated for a female disorder
			High or low blood pressure				Recurrent back pain				Had a change in menstrual pattern

13. WHAT IS YOUR USUAL OCCUPATION?

14. ARE YOU (Check one)
☐ Right handed ☐ Left handed

93-102

YES	NO	CHECK EACH ITEM YES OR NO. EVERY ITEM CHECKED YES MUST BE FULLY EXPLAINED IN BLANK SPACE ON RIGHT
		15. Have you been refused employment or been unable to hold a job or stay in school because of: A. Sensitivity to chemicals, dust, sunlight, etc.
		B. Inability to perform certain motions.
		C. Inability to assume certain positions.
		D. Other medical reasons (If yes, give reasons.)
		16. Have you ever been treated for a mental condition? (If yes, specify when, where, and give details).
		17. Have you ever been denied life insurance? (If yes, state reason and give details.)
		18. Have you had, or have you been advised to have, any operations? (If yes, describe and give age at which occurred.)
		19. Have you ever been a patient in any type of hospital? (If yes, specify when, where, why, and name of doctor and complete address of hospital.)
		20. Have you ever had any illness or injury other than those already noted? (If yes, specify when, where, and give details.)
		21. Have you consulted or been treated by clinics, physicians, healers, or other practitioners within the past 5 years for other than minor illnesses? (If yes, give complete address of doctor, hospital, clinic, and details.)
		22. Have you ever been rejected for military service because of physical, mental, or other reasons? (If yes, give date and reason for rejection.)
		23. Have you ever been discharged from military service because of physical, mental, or other reasons? (If yes, give date, reason, and type of discharge: whether honorable, other than honorable, for unfitness or unsuitability.)
		24. Have you ever received, is there pending, or have you applied for pension or compensation for existing disability? (If yes, specify what kind, granted by whom, and what amount, when, why.)

I certify that I have reviewed the foregoing information supplied by me and that it is true and complete to the best of my knowledge.
I authorize any of the doctors, hospitals, or clinics mentioned above to furnish the Government a complete transcript of my medical record for purposes of processing my application for this employment or service.

TYPED OR PRINTED NAME OF EXAMINEE	SIGNATURE

NOTE: HAND TO THE DOCTOR OR NURSE. OR IF MAILED MARK ENVELOPE "TO BE OPENED BY MEDICAL OFFICER ONLY."

25. Physician's summary and elaboration of all pertinent data (Physician shall comment on all positive answers in Items 9 through 24. Physician may develop by interview any additional medical history he deems important, and record any significant findings here.)

TYPED OR PRINTED NAME OF PHYSICIAN OR EXAMINER	DATE	SIGNATURE	NUMBER OF ATTACHED SHEETS

REVERSE OF STANDARD FORM 93

OMS Data Form 2

SF 507 - Clinical Record: Continuation of SF 93 for OMMP

Standard Form 507

CLINICAL RECORD

Report on _____
or
Continuation of S. F. 93 for OMMP
(Strike out one line) *(Specify type of examination or data)*

(Sign and date)

Note: Each question in the Occupational, Family, and Personal Health Histories does not have to be answered again IF you have already completed these sections of the Occupational Health History on a previous exam **AND IF** the answers to the questions have not changed.

I. Occupational History

Answer each of the following questions by making an "X" in either the YES or NO box to the left of each question.

1 ☐ Initial this box if there have been no changes in this part of your work history since your last exam and go on to the Family History section

	YES	NO	
2	☐	☐	Have you had any work related illness or injury?
3	☐	☐	Have you had to wear any protective clothing or equipment during your work?
4	☐	☐	Have you experienced difficulty wearing your protective clothing or equipment?
5	☐	☐	Have you been limited in your work for health reasons?
6	☐	☐	Have you received compensation for a work related illness or injury?
7	☐	☐	Have you left a job because of health reasons?
8	☐	☐	Have you had a work related experience which you believe may have affected your health or the health of fellow workers?

II. Family History

Mark an "X" in either the YES or NO box to the left of any of the following conditions or diseases anyone of your blood relatives (mother, father, brother, sister, grandparents, aunt, uncle, children) has ever had.

9 ☐ Initial this box if there have been no changes in your family history since your last exam and go on to the Personal History section

	YES	NO	
10	☐	☐	Anemia, blood disease, or bleeding tendency
11	☐	☐	Asthma, hayfever, or allergies
12	☐	☐	Birth defect
13	☐	☐	Cancer or tumor
14	☐	☐	Diabetes (sugar disease)
15	☐	☐	Eye trouble
16	☐	☐	Epilepsy, fits, or convulsions
17	☐	☐	Hearing trouble or impairment
18	☐	☐	Heart trouble, high blood pressure, or stroke
19	☐	☐	Kidney trouble
20	☐	☐	Lung trouble
21	☐	☐	Some other disease or condition which runs in your family

If so, please list _____

III. Personal History

Answer each of the following questions by making an "X" in either the YES or NO box to the left of each question.

23 ☐ Initial this box if there have been no changes in your personal history since your last exam.

	YES	NO	
24	☐	☐	Are you allergic or have you had a bad reaction to any drug, medication, chemical, or other substance? (Examples: blood, bee sting, dust, penicillin)
			Have you ever been told by a medical person that you had something wrong with your:
25	☐	☐	X ray
26	☐	☐	Heart tracing
27	☐	☐	Breathing test
28	☐	☐	Blood test
29	☐	☐	TB skin test
30	☐	☐	Other, please indicate: _____
			Have you ever been advised by a medical person to take medicine for:
32	☐	☐	Diabetes
33	☐	☐	High blood pressure
34	☐	☐	Epilepsy
35	☐	☐	Tuberculosis
36	☐	☐	Heart trouble
37	☐	☐	Is your spouse/are you now pregnant?
38	☐	☐	Have you, your spouse ever tried to have children but have been unable to?
			If yes, how many years? ___
			Did any pregnancy result in a
40	☐	☐	Miscarriage? If so, how many? ___
42	☐	☐	Still birth? If so, how many? ___
44	☐	☐	Premature birth? If so, how many. ___
46	☐	☐	Abnormal birth? If so, how many? ___
48	☐	☐	Do you smoke cigarettes?
49	☐	☐	If NO: Did you ever smoke cigarettes?
			What year did you stop? ___
			How many years had you smoked? ___
			How many packs a day? ___
			If YES
			How many years have you smoked? ___
			How many packs a day? ___
55	☐	☐	Do you smoke cigars or a pipe?
56	☐	☐	If NO: Did you ever smoke cigars or a pipe?
			What year did you stop? ___
			How many years had you smoked? ___
			How many cigars or pouches a week? ___
			If YES:
			How many years have you smoked? ___
			How many cigars or pouches a week? ___
			How much alcohol do you usually drink?
62	☐	☐	Liquor, ounces per week ___
63	☐	☐	Beer, bottles per week ___
64	☐	☐	Wine, glasses per week ___

_____
Signature of Medical Officer

_____
Date

(Continue on reverse side)

PATIENT'S IDENTIFICATION *(For typed or written entries give: Name—last, first, middle, grade; date, hospital or medical facility)*

REGISTER NO.	WARD NO.

REPORT ON _____ **or CONTINUATION OF** _____

Standard Form 507
GENERAL SERVICES ADMINISTRATION AND
INTERAGENCY COMMITTEE ON MEDICAL RECORDS
FFMR 101-11.4 6-6
OCTOBER 1978 507-108

U.S. Government Printing Office: 1979—261-647/6001

DMS Data Form 3

CG 5197 - Occupational History

Enclosure (6) to COMDTINST M6260.15
JAN 1983

DEPARTMENT OF TRANSPORTATION
U. S. COAST GUARD
CG-5197 (11-82)

OCCUPATIONAL HEALTH SURVEILLANCE QUESTIONNAIRE

DATE OF SUBMISSION

NAME	RANK/RATE	HOME ADDRESS/MILITARY UNIT	SEX	DATE OF BIRTH	CURRENT JOB DESIGNATION

PART I - OCCUPATIONAL HISTORY

INSTRUCTIONS: Please complete the following work history, begin with your present job or military assignment and list all jobs you have held. Be as specific as possible; if you held more than one job with the same employer, list each job title and activity. Use additional sheets as needed.

COMPANY OR MILITARY UNIT *County and state where worked*	DATES WORKED		FULL/PART TIME JOB CHECK		JOB TITLE AND WORK ACTIVITIES	POTENTIAL HAZARDS EXPOSED TO		PROTECTIVE EQUIPMENT WORN *Respirator, ear plugs, etc.*
	FROM MO/YR	TO MO/YR	FULL	PART		PHYSICAL *Noise, vibration, etc.*	CHEMICAL *Heavy metals, Freon, solvents etc.*	

PREVIOUS EDITIONS ARE OBSOLETE

SECONDARY (MOONLIGHTING) JOBS YOU HAVE HELD *(Firefighter, farmer, etc.)*	DATES (MO/YR)	
JOB TITLE	FROM	TO

HOBBIES & ACTIVE SPORTS *(Past and present, such as painting, woodworking, scuba diving, etc.)*		

WORK RELATED EXPERIENCES, COMMENT ON *(Those you feel may have been harmful to your health)*

PART II - RESPIRATORY SYMPTOMS

Since your last examination or visit to the doctor, have you experienced any of the following

SYMPTOM	YES	NO	NOT SURE	SYMPTOM	YES	NO	NOT SURE
a. COUGH				h. EXPECTORATION (PHLEGM)			
b. FEVER				i. STUFFY NOSE			
c. CHILLS				j. EYES BURNING OR WATERING			
d. MUSCLE ACHES				k. THROAT SORE OR BURNING			
e. SHORTNESS OF BREATH				l. LOSS OF APPETITE			
f. Chest pains, aching, tightness, burning				m. WEIGHT LOSS			
g. WHEEZING							
DO YOU SMOKE CIGARETTES, CIGARS OR PIPE?				HOW OLD WERE YOU WHEN YOU BEGAN TO SMOKE CIGARETTES, CIGARS OR PIPE?			

NUMBER OF CIGARETTES, CIGARS OR PIPEFULS SMOKED DAILY. GIVE BEST ESTIMATE *(A pack contains 20 cigarettes)*

_____CIGARETTES/DAY _____CIGARS/DAY _____PIPEFULS/DAY

PRIVACY ACT STATEMENT

Under Title 5 USC 552a(e)(3), the following information is provided to you when supplying personal information to the U.S. Coast Guard

1. AUTHORITY WHICH AUTHORIZED THE SOLICITATION OF THE INFORMATION: Occupational Safety Act of 29 December 1970, P. L. 91-596, 91st Congress S-2193.

2. PRINCIPAL PURPOSE(S) FOR WHICH THE INFORMATION IS INTENDED TO BE USED: To collect and monitor occupational safety and health hazards exposures of Coast Guard civilian and military personnel.

3. THE ROUTINE USES WHICH MAY BE MADE OF THE INFORMATION: To provide health care to affected personnel and to establish a data base of information for the enhancement of the physical environment.

4. DISCLOSURE OF THE INFORMATION IS MANDATORY AND THE EFFECTS ON THE INDIVIDUALS, IF ANY, OF NOT PROVIDING ALL OR ANY PART OF THE REQUESTED INFORMATION: It could result in incomplete or insufficient health care for the individual(s) and could prevent the removal or correction of existing hazard, due to incomplete or inadequate information.

DMS Data Form 4

SF 88 - Report of Medical Examination

[redacted]

General Services Administration
Interagency Comm. on Medical Records
FPMR 101-11.806-8

REPORT OF MEDICAL EXAMINATION

1. LAST NAME – FIRST NAME MIDDLE NAME			2. GRADE AND COMPONENT OR POSITION		3. IDENTIFICATION NO.
4. HOME ADDRESS (*Number, street or R.F.D., city or town, State and ZIP Code*)			5. PURPOSE OF EXAMINATION		6. DATE OF EXAMINATION
7. SEX	8. RACE	9. TOTAL YEARS GOVERNMENT SERVICE: MILITARY / CIVILIAN	10. AGENCY	11. ORGANIZATION UNIT	
12. DATE OF BIRTH	13. PLACE OF BIRTH		14. NAME, RELATIONSHIP, AND ADDRESS OF NEXT OF KIN		
15. EXAMINING FACILITY OR EXAMINER, AND ADDRESS			16. OTHER INFORMATION		
17. RATING OR SPECIALTY			TIME IN THIS CAPACITY (*Total*)	LAST SIX MONTHS	

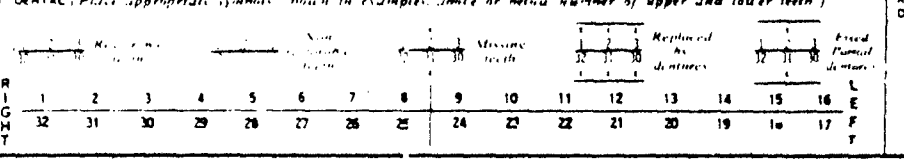
CLINICAL EVALUATION

NORMAL	(*Check each item in appropriate column, enter NE if not evaluated*)	ABNORMAL
	18 HEAD, FACE, NECK, AND SCALP	
	19 NOSE	
	20 SINUSES	
	21 MOUTH AND THROAT	
	22 EARS: GENERAL (*for hearing, see items 70 and 71*)	
	23 DRUMS (*Perforation*)	
	24 EYES: GENERAL (*Visual acuity and refraction under items 75 and 77*)	
	25 OPHTHALMOSCOPIC	
	26 PUPILS (*Equality and reaction*)	
	27 OCULAR MOTILITY (*Associated parallel movements, nystagmus*)	
	28 LUNGS AND CHEST (*Include breasts*)	
	29 HEART (*Thrill, size, rhythm, sounds*)	
	30 VASCULAR SYSTEM (*Varicosities, etc.*)	
	31 ABDOMEN AND VISCERA (*Include hernia*)	
	32 ANUS AND RECTUM (*Hemorrhoids, fistulae, fissure, if indicated*)	
	33 ENDOCRINE SYSTEM	
	34 G.U. SYSTEM	
	35 UPPER EXTREMITIES (*Strength, range of motion*)	
	36 FEET	
	37 LOWER EXTREMITIES (*Except feet: strength, range of motion*)	
	38 SPINE, OTHER MUSCULOSKELETAL	
	39 IDENTIFYING BODY MARKS, SCARS, TATTOOS	
	40 SKIN, LYMPHATICS	
	41 NEUROLOGIC (*Equilibrium tests under item 73*)	
	42 PSYCHIATRIC (*Specify any personality deviation*)	
	43 PELVIC (*Females only. Check how done:*) ☐ VAGINAL ☐ RECTAL	

NOTES (*Describe every abnormality in detail. Enter pertinent item number before each comment. Continue in item 73 and use additional sheets if necessary.*)

(*Continue in item 73*)

44 DENTAL (*Place appropriate symbols, listed in examples, above or below number of upper and lower teeth.*)



REMARKS AND ADDITIONAL DENTAL DEFECTS AND DISEASES

LABORATORY FINDINGS

45. URINALYSIS A. SPECIFIC GRAVITY		46. CHEST X RAY (*Place, date, film number and result*)
B. ALBUMIN	D. MICROSCOPIC	
C. SUGAR		

47. SEROLOGY (*Specify test used and result*)	48. EKG	49. BLOOD TYPE AND RH FACTOR	50. OTHER TESTS

88-118

MEASUREMENTS AND OTHER FINDINGS

51 HEIGHT	52. WEIGHT	53. COLOR HAIR	54. COLOR EYES	55. BUILD ☐ SLENDER ☐ MEDIUM ☐ HEAVY ☐ OBESE	56. TEMPERATURE

57. BLOOD PRESSURE (Arm at heart level)						58. PULSE (Arm at heart level)				
A SITTING	SYS / DIAS	B RECUMBENT	SYS / DIAS	C STANDING (3 min)	SYS / DIAS	A SITTING	B. AFTER EXERCISE	C 2 MIN AFTER	D. RECUMBENT	E AFTER STANDING 3 MIN

59 DISTANT VISION		60. REFRACTION			61. NEAR VISION	
RIGHT 20/	CORR TO 20/	BY	S.	CX	CORR TO	BY
LEFT 20/	CORR TO 20/	BY	S.	CX	CORR TO	BY

62 HETEROPHORIA (Specify distance)

ES° EX° R H L H PRISM DIV. PRISM CONV. CT PC PD

63. ACCOMMODATION		64. COLOR VISION (Test used and result)	65. DEPTH PERCEPTION (Test used and score)	UNCORRECTED
RIGHT	LEFT			CORRECTED
66. FIELD OF VISION		67. NIGHT VISION (Test used and score)	68. RED LENS TEST	69. INTRAOCULAR TENSION

70. HEARING			71 AUDIOMETER								72. PSYCHOLOGICAL AND PSYCHOMOTOR (Tests used and score)
RIGHT EAR	/15 SV	/15		500	1000	2000	3000	4000	6000	8000	
LEFT EAR	/15 SV	/15	RIGHT								
			LEFT								

73 NOTES (Continued) AND SIGNIFICANT OR INTERVAL HISTORY

(Use additional sheets if necessary)

74 SUMMARY OF DEFECTS AND DIAGNOSES (List diagnoses with item numbers)

75. RECOMMENDATIONS—FURTHER SPECIALIST EXAMINATIONS INDICATED (Specify)	76. A PHYSICAL PROFILE					
	P	U	L	H	E	S
77. EXAMINEE (Check) A ☐ IS QUALIFIED FOR B ☐ IS NOT QUALIFIED FOR	B PHYSICAL CATEGORY					
78. IF NOT QUALIFIED LIST DISQUALIFYING DEFECTS BY ITEM NUMBER	A	B	C	E		

79. TYPED OR PRINTED NAME OF PHYSICIAN	SIGNATURE	
80. TYPED OR PRINTED NAME OF PHYSICIAN	SIGNATURE	
81 TYPED OR PRINTED NAME OF DENTIST OR PHYSICIAN (Address attach)	SIGNATURE	
82. TYPED OR PRINTED NAME OF REVIEWING OFFICER OR APPROVING AUTHORITY	SIGNATURE	NUMBER OF ATTACHED SHEETS

* GPO . 1980 O - 341-526 (6156)

UMS Data Form 5

SF 507 - Clinical Record: Continuation of SF 88 for OMMP

Standard Form 507

CLINICAL RECORD

Report on _____
or
Continuation of S. F. 88 for OMMP
(Strike out one line) *(Specify type of examination or data)*

(Sign and date)

Pulmonary Functions

Age	Sex	Height	Ambient Temp	Type Spirometer

	FEV 1	FVC	FEV 1 FVC	FEF 25-75%
Observed				
Predicted				
% Predicted				

Predicted FEV1 and FVC must be multiplied by 0.85 in non-Caucasians

Date of PFT

Electrocardiogram

Interpretation	Date of EKG

Chemistry

Glucose mg dl	Creatinine mg dl	Albumin g dl	Alk Phosphatase mU ml	Total Cholesterol mg dl	SGOT-AST mU ml	LDH mU ml
BUN mg dl	Total Protein g dl	Globulin g dl	Total Bilirubin mg dl	HDL Cholesterol mg dl	SGPT-ALT mU ml	

Other Chemistry

Hematology

HGB	HCT	WBC (000)	Neutrophils	Lymphocytes	Eosinophils	Basophils	Monocytes	MCV	MCH	MCHC	Smear

Urinalysis

Color	Clearness	Specific Gravity	Appearance	pH	Albumin	Sugar	Blood	Ketones	Bilirubin	WBC HPF	RBC HPF	Bacteria	Casts	Crystals	Epith Cells	Sed. Casts	Other	Other

Other

X Ray

View	Date of Film

Interpretation

Special Lab Studies

Specimen Type	Analyzed for	Results

Other Diagnostic Procedure

Procedure	Date of Procedure

_____
Signature of Medical Officer

_____
Date

(Continue on reverse side)

PATIENT'S IDENTIFICATION *(For typed or written entries give Name—last, first, middle, grade, date, hospital or medical facility)*

REGISTER NO.	WARD NO.

REPORT ON _____ **or CONTINUATION OF** _____

Standard Form 507
GENERAL SERVICES ADMINISTRATION AND
INTERAGENCY COMMITTEE ON MEDICAL RECORDS
FPMR 101-11.20 6-0
OCTOBER 1970 507-108

U.S. Government Printing Office: 1970—381-667/8001

Standard Form 507

CLINICAL RECORD

Report on OMMP Periodic Examination

or

Continuation of S. F. _____

(Strike out one line) *(Specify type of examination or date)*

(Sign and date)

Age			
Sex	Female	Male	
Height	Inches		
Weight	Pounds		
% Body Fat (Military Only)			

Black	
Hispanic	
American Indian or Alaska Native	
Asian or Pacific Islander	
Other, Including Caucasian	

Sitting Blood Pressure	
Sitting Pulse	

	Distant Vision		Refraction			Near Vision		
Right	20/	Corrected to 20/	By	S.	Cx	20/	Corrected to 20/	By
Left	20/	Corrected to 20	By	S.	Cx	20/	Corrected to 20	By

Notes

Summary of Defects and Diagnoses

Signature of Examiner

Signature of Reviewing Officer or Approving Authority

Date

(Continue on reverse side)

Date

PATIENT'S IDENTIFICATION *(For typed or written entries give Name—last, first, middle, grade; date, hospital or medical facility)*

REGISTER NO.

WARD NO.

REPORT ON _____ or CONTINUATION S[illegible] _____

Standard Form 507
GENERAL SERVICES ADMINISTRATION AND
INTERAGENCY COMMITTEE ON MEDICAL RECORDS
FPMR 101-11.8 and 5-6
OCTOBER 1973
507-108

U.S. Government Printing Office 1979—661-667/2001

DMS Data Form 7

DD 2215 - Reference Audiogram (Baseline)

REFERENCE AUDIOGRAM

ZIP CODE/APO

DOD COMPONENT ☐ A–ARMY N–NAVY F–AIR FORCE M–MARINE CORPS 1–OTHER DOD ACTIVITY

SERVICE COMPONENT ☐ R–REGULAR V–RESERVE G–NATIONAL GUARD I–OTHER

PERSONAL DATA

SSN | LAST NAME–FIRST NAME–MIDDLE INITIAL

SEX ☐ M–MALE F–FEMALE | DATE OF BIRTH (year, month, day) | PAY GRADE, UNIFORMED SERVICES | GRADE, CIVILIAN | SERVICE DUTY OCCUPATION CODE

MAILING ADDRESS OF ASSIGNMENT

LOCATION–PLACE OF WORK | MAJOR COMMAND | DUTY PHONE

AUDIOMETRY

☐ 1. REFERENCE ESTABLISHED PRIOR TO INITIAL DUTY IN HAZARDOUS NOISE AREAS
2. REFERENCE ESTABLISHED FOLLOWING EXPOSURE IN NOISE DUTIES
3. REFERENCE RE–ESTABLISHED AFTER FOLLOWUP PROGRAM

HEARING THRESHOLD LEVELS OF TEST FREQUENCIES RE: ANSI S3.6

LEFT EAR						RIGHT EAR					
500	1000	2000	3000	4000	6000	500	1000	2000	3000	4000	6000

DATE OF AUDIOGRAM (year, month, day) | DAY OF WEEK ☐ 1-SUN 2-MON 3-TUES 4-WED 5-THURS 6-FRI 7-SAT | MIL-TIME-DAY | HOURS SINCE LAST NOISE EXPOSURE | ENT PROBLEM AT TIME OF TEST ☐ 1–NO 2–YES 3–UNKNOWN

EXAMINER

LAST NAME–FIRST NAME–MIDDLE INITIAL | TRAINING CERT NO. SSN | SERVICE DUTY OCCUPATION CODE | OFFICE SYMBOL

AUDIOMETER

TYPE ☐ 1-MANUAL 2-SELF RECORDING (automatic) 3-MICROPROCESSOR | MODEL | MANUFACTURER | SERIAL NUMBER | LAST ELECTROACOUSTIC CALIB DATE (year, month, day)

PERSONAL HEARING PROTECTION

TYPE USED ☐ 1-SINGLE FLANGE (VSTR) 2-TRIPLE FLANGE 3-HAND FORMED EARPLUGS 4-EAR CANAL CAPS 5-NOISE MUFFS 6-OTHER

EARPLUGS ISSUED ☐ 1-NO 2-YES 3-PREVIOUSLY ISSUED

SIZE EARPLUGS R L — 1-XS 2-S 3-M 4-L 5-XL

DOUBLE PROTECTION USED ☐ 1-NO 2-YES

GLASSES WORN (including goggles) ☐ 1-NO 2-YES

FREQUENCY GLASSES WORN ☐ 1-ALWAYS 2-SELDOM 3-N/A

REMARKS

CONTENTS REVIEWED AND VALIDATED BY

NAME OF REVIEWER (Signature) | SERVICE DUTY OCCUPATION CODE | AUTOVON | SSN | OFFICE SYMBOL

DD FORM 1 SEP 79 2215

S/N 0102-LF-002-2150

DMS Data Form 8

DD 2216 - Hearing Conservation Data (follow-up)

HEARING CONSERVATION DATA

DOD COMPONENT ☐ A-ARMY M-MARINE CORPS 1-OTHER DOD ACTIVITY N-NAVY F-AIR FORCE

SERVICE COMPONENT ☐ R-REGULAR G-NATIONAL GUARD V-RESERVE 1-OTHER

SSN | LAST NAME–FIRST NAME–MIDDLE INITIAL | SEX ☐ M-MALE F-FEMALE | DATE OF BIRTH year month day

PAY GRADE UMF SVCS | GRADE, CIVILIAN | SERVICE DUTY OCCUPATION CODE | MAILING ADDRESS OF ASSIGNMENT

LOCATION–PLACE OF WORK | MAJOR COMMAND | DUTY PHONE

AUDIOMETRY

PURPOSE ☐ 1–90 DAY 2–ANNUAL 3–TERMINATION 4–OTHER

AUDIOMETRIC DATA RE ANSI S3.6	LEFT 500	1000	2000	3000	4000	6000	RIGHT 500	1000	2000	3000	4000	6000
CURRENT AUDIOGRAM DATE year month day												
REFERENCE AUDIOGRAM DATE year month day												
THRESHOLD SHIFT +=Poorer −=Better												

☐ 1-No 2-Yes Significant threshold shift (STS) 20dB or greater

STS NO: ● Counsel ● Return to duty ● Retest in 12 mo. ● Validated by reviewer ● Orig in health record ● Send copy to registry

STS YES: ● Notify supervisor ● Followup No. 1 after minimum 15 hours noise free

NAME OF EXAMINER (Last, first, MI) | TRAINING CERT NO. | SSN | SERVICE DUTY OCCUPATION CODE | OFC SYMBOL

TYPE ☐ 1-Manual 2-Self-recording (auto) 3-Microprocessor | MODEL | MANUFACTURER | SERIAL NO. | LAST ELECTROACOUSTIC CALIB DATE year month day

FOLLOWUP NO 1 ☐ Minimum 15 hours noise free

AUDIOMETRIC DATA RE ANSI S3.6	LEFT 500	1000	2000	3000	4000	6000	RIGHT 500	1000	2000	3000	4000	6000
CURRENT AUDIOGRAM DATE year month day												
REFERENCE AUDIOGRAM DATE year month day												
THRESHOLD SHIFT +=Poorer −=Better												

☐ 1-No 2-Yes Significant threshold shift (STS) 20dB or greater

STS NO: ● Counsel ● Return to duty ● Retest in 12 mo. ● Validated by reviewer ● Orig in health record ● Send copy to registry

STS YES: ● Notify Supervisor ● Cleared by medical reviewer before Followup No. 2

NAME OF EXAMINER (Last, first, MI) | TRAINING CERT NO. | SSN | SERVICE DUTY OCCUPATION CODE | OFC SYMBOL

TYPE ☐ 1-Manual 2-Self-recording (auto) 3-Microprocessor | MODEL | MANUFACTURER | SERIAL NO. | LAST ELECTROACOUSTIC CALIB DATE year month day

FOLLOWUP NO 2 ☐ Minimum 40 hours noise free since Followup No. 1

AUDIOMETRIC DATA RE ANSI S3.6	LEFT 500	1000	2000	3000	4000	6000	RIGHT 500	1000	2000	3000	4000	6000
CURRENT AUDIOGRAM DATE year month day												
REFERENCE AUDIOGRAM DATE year month day												
THRESHOLD SHIFT +=Poorer −=Better												

Significant threshold shift (STS) 20dB or greater ☐ 1-No 2-Yes

STS NO: ● Counsel ● Return to duty ● Retest in 12 mo. ● Validated by reviewer ● Orig in health record ● Send copy to registry

STS YES: ● Refer to appro directive ● Requires medical disposition ● Validated by reviewer ● Orig in health record ● Send copy to registry

NAME OF EXAMINER (Last, first, MI) | TRAINING CERT NO. | SSN | SERVICE DUTY OCCUPATION CODE | OFC SYMBOL

TYPE ☐ 1-Manual 2-Self-recording (auto) 3-Microprocessor | MODEL | MANUFACTURER | SERIAL NO. | LAST ELECTROACOUSTIC CALIB DATE year month day

REVIEWED & VALIDATED BY. | SERVICE DUTY OCCUPATION CODE | AUTOVON | SSN | OFC SYMBOL

DD FORM 1 SEP 79 2216

S/N 0102-LF-002-2160

OMS Data Form 9

CGHQ 5386 - Industrial Hygiene Workplace Monitoring Room

Report # _____

UNITED STATES COAST GUARD
INDUSTRIAL HYGIENE WORKPLACE MONITORING REPORT

File(s) (check one or more):
☐ IHSD (Fill out blocks 1, 2, 3, 4) ☐ HMIN (Fill out block 5) ☐ HMIS (Fill out block 6)

1. Worksite Description — Facility Sampled:

Worksite (Bldg., Shop, etc.) _____

Description of Work Operation _____

Workplace Conditions _____

Protective Equipment: _____

Eng. Controls: _____

2. Hazardous Materials In Use

Product # _____ Product Class _____

Product Name _____

3. Sampling and Analysis Data

a. Sampling Data

		Atmospheric Conditions		
		DB Temp (° F)	R. H. (%)	Wind
Sample #				
Sample Type (P, A or B)				
Sample Location				
Collection Medium (T;F;I)				
Sample Data (mo-da-yr)				
Sample Instrument				
Calibration Date				
Sample Rate (ℓ/min)				
Sample Time (min)				
Sample Volume (ℓ)				

Analysis Requested	CAS #	NAME	CAS #	NAME
	1	1	5	5
	2	2	6	6
	3	3	7	7
	4	4	8	8

Sampled by _____ Title _____

b. Analysis Data:

Analytical Method (CAM) SCP # if NIOSH Method):		
Analytical Results (mg/M3) (f/cc) (%)	1.	5.
	2.	6.
	3.	7.
	4.	8.

Date Sample Received	Date Results Reported	Lab Report #

Analyzed By _____ Laboratory _____

Comments: _____

UNITED STATES COAST GUARD
INDUSTRIAL HYGIENE WORKPLACE MONITORING REPORT

RNO Report # _____

4. Employee Exposure Sampling Data

EMP / SSN / RATE / ESNO / FREQ — Name: Last, First, MI	SSN*		Job Title, Rate	Sample #	Est. Exp. Time (hr/wk)
		( )			
		( )			
		( )			
		( )			
		( )			
		( )			

*Note: Insert an "x" after the SSN to indicate a personal sample.

5. Hazardous Materials Inventory

PNO / NM / CL / FSN / MFG / MATLO — Product No.	Product Name	Product Class	Fed. Stock No.	Manufacturer	Material Location

6. Hazardous Materials Information

Data Source (check one)
- ☐ CG-HMIS
- ☐ DOD-HMIS
- ☐ MFG.-MSDS (OSHA FORM 20)
- ☐ OTHER (Explain) _____

PNO / SORCE — Product No.
NM — Product Name
CL — Product Class
FSN — Fed. Stock No.
FED — FED Spec
ING / AMT — Major Chem. Ingredients (%)
HAZ — Hazard
PRO — Protective Measures

DMS Data Form 10

Potential Exposure Log

POTENTIAL EXPOSURE LOG
DMS FORM 10

Name and Title: _____

Employee Identification Number: _____

Date and Time	Facility - shipyard, terminal, vessel or barge	Operation at this Facility	Chemical Substance or Trade Name	Employee Activity	Duration (hrs)	Protective Equipment Worn	Other Comments

DMS Data Form 11

Record of Cargos Loaded

RECORD OF CARGOS LOADED
DMS FORM 11

Vessel Identification:

Date	Port/Terminal Identification	Type of Cargo Loaded	Quantity (tons)

DMS Data Form 12

Record of Ship's Personnel

RECORD OF SHIP'S PERSONNEL
DMS FORM 12

Date:

Vessel Identification:

Name	Title	I.D. Number

DMS Data Form 13

Incident Report Form

INCIDENT REPORT FORM
DMS FORM 13

Date of Incident or Accident:
Location of Incident or Accident:

Description of Incident or Accident

Personal injuries:
Exposures to toxic chemicals:
Exposures to physical agents:
Damage to equipment or facilities:
Descriptive comments:

Workplace Conditions

Work scenario description:
Protective equipment used:
Engineering controls employed:

Hazardous materials observed/measured

Chemical substances			
Concentrations Measured*			

Individuals with Known or Suspected Exposures*

Name	Title	SSN	Estimated Duration of Exposures

*Attach completed copy of DMS Form 9 (Form CG 5386) for documentation of sampling and analysis data.

DMS Data Form 14

Confined Space Entry Permit

CONFINED SPACE ENTRY PERMIT

PERMIT NO. 00001

FOR ENTRY INTO: CARGO TANKS, BALLAST TANKS, COFFERDAMS, DOUBLE BOTTOMS, FUEL OIL TANKS, WATER TANKS, LUBE OIL TANKS, AND OTHER NORMALLY CLOSED SPACES NOT INTENDED FOR CONTINUOUS EMPLOYEE OCCUPANCY.

VESSEL -

DATE -

TIME OF PERMIT -

EXPIRATION TIME (MAX. 24 HRS.) -

CONFINED SPACE TO BE ENTERED -

DESCRIPTION OF WORK TO BE PERFORMED -

HAZARDS EXPECTED -

---TOXIC MATERIALS

---FLAMMABLE MATERIALS

---CORROSIVE MATERIALS

---RESIDUAL LIQUIDS

---OXYGEN DEFICIENCY

---OTHERS (SPECIFY)

ALL QUESTIONS MUST BE ANSWERED	YES	NO	N/A
1. HAVE VALVES ON PIPING TO THE SPACE BEING WORKED BEEN BLANKED OR CLOSED AND LASHED TO PREVENT ACCIDENTAL OPENING?			
2. HAVE APPROPRIATE SIGNS BEEN POSTED OR TAGS ATTACHED TO THE APPROPRIATE VALVES?			
3. HAS THE SPACE BEEN VENTILATED?			
4. HAS THE SPACE ATMOSPHERE BEEN GAS TESTED AND FOUND SAFE FOR ENTRY AND SAFE FOR WORK TO BE DONE?			
5. HAS FORCED VENTILATION BEEN PROVIDED FOR USE DURING THE JOB?			
6. HAS THE WORKER BEEN FITTED WITH A SAFETY HARNESS OR SAFETY LINE?			
7. DOES THE WORKER HAVE THE PROPER TOOLS FOR THE JOB?			
8. HAS A MAN BEEN ASSIGNED TO WATCH THE WORKER AND HAS HE BEEN TOLD WHAT HE SHOULD DO IF THE WORKER GETS INTO TROUBLE?			
9 IS THE PROPER RESCUE AND PERSONAL PROTECTION EQUIPMENT AVAILABLE AT THE TANK TOP?			
10. HAS ADEQUATE ILLUMINATION BEEN PROVIDED?			
11. HAVE THE MEN INVOLVED IN THIS JOB BEEN INFORMED OF THE HAZARDS THAT MAY BE ENCOUNTERED?			
12. HAVE THE MEN INVOLVED IN THIS JOB BEEN GIVEN INSTRUCTIONS REGARDING THE SAFE AND EFFICIENT METHOD OF DOING THE WORK?			
13. HAVE THE MEN INVOLVED IN THIS JOB BEEN TRAINED AND TESTED ON THE USE OF ANY NECESSARY PROTECTIVE EQUIPMENT?			
14.			

RESULTS OF GAS TESTING

CHEMICALS PREVIOUSLY IN THE SPACE	ACGIH TLV-TWA (PPM)	ACGIH TLV-STEL (PPM)	IDLH (PPM)	USCG SUBCHAPTER (O OR D)
1.				
2.				
3.				
4.				
5.				
6.				
7.				

OXYGEN CONCENTRATION -------% MEASUREMENT METHOD ----------

MEASUREMENT LOCATION ----------

COMBUSTIBLE GAS TEST -------%LEL MEASUREMENT METHOD ----------

MEASUREMENT LOCATION ----------

CALIBRATION GAS ----------

TOXIC CONCENTRATIONS MEASURED:

CHEMICAL MEASURED	CONCENTRATION (PPM)	MEASUREMENT LOCATION	MEASUREMENT METHOD
1			
2.			
3.			
4			
5.			
6			
7.			

CONDITIONS FOR VALIDITY OF PERMIT

REQUIRED PERIODIC OR CONTINUOUS MONITORING -

VENTILATION REQUIREMENT -

PROTECTIVE EQUIPMENT

--HARD HAT --CHEMICAL GOGGLES --HEARING PROTECTION --GLOVES

--CHEMICAL RESISTANT CLOTHING --BREATHING APPARATUS

--SAFETY HARNESS --SAFETY LINE --GAS TESTER

--FIRE EXTINGUISHER --FLASHLIGHT --OTHER (SPECIFY)

SPECIAL INSTRUCTIONS -

I HAVE INSPECTED EACH REQUIREMENT ON THIS PERMIT AND STATE THAT THIS WORK CAN BE DONE SAFELY AND IN COMPLIANCE WITH THE RULES OF THE U.S. COAST GUARD (46 CFR PARTS 30-30 AND 150-154), COMPANY POLICY, AND THOSE OF ANY APPLICABLE LOCAL AUTHORITY.

SIGNATURE OF THE OFFICER IN CHARGE OF THIS WORK:

I HAVE READ THE ABOVE PERMIT SIGNED BY THE OFFICER IN CHARGE. (BY SIGNING THIS FORM THE WORKER INDICATES THAT HE HAS READ AND UNDERSTANDS THE ABOVE PERMIT AND WILL ABIDE BY ITS CONDITIONS)

SIGNATURE OF WORKER TIME IN- TIME OUT-	SIGNATURE OF WORKER TIME IN- TIME OUT-
-SIGNATURE OF WORKER TIME IN- TIME OUT-	-SIGNATURE OF WORKER TIME IN- TIME OUT-
-SIGNATURE OF WORKER TIME IN- TIME OUT-	-SIGNATURE OF WORKER TIME IN- TIME OUT-

LOG OF PERIODIC OR CONTINUOUS MONITORING

VESSEL _____ DATE _____

ENTRY PERMIT NUMBER _____

CONFINED SPACE TO BE ENTERED -

TIME	CHEMICAL MEASURED	CONCENTRATION (PPM)	MEASUREMENT LOCATION	MEASUREMENT METHOD	INITIALS

OFFICER IN CHARGE _____

NAMES OF PERSONS WHOSE INITIALS APPEAR ON THIS FORM

_____

_____

_____

DMS Data Form 15

Request for Industrial Hygiene Data

REQUEST FOR INDUSTRIAL HYGIENE DATA
DMS FORM 15

Requestor Identification

Name: _____

Title: _____

Organization: _____

Address: _____

Telephone No.: _____

Patient Identification

Name: _____

Title: _____

Identification Number: _____

Organization: _____

Current Assignment Location: _____

Reason for Request

Acute Exposure Episode: _____

Chronic Exposure Potential: _____

Symptoms: _____

Special Comments: _____

_____

_____

Descriptive Information on Acute or Chronic Exposures:

Workplace: _____

Date(s) and Time(s): _____

Exposure Conditions: _____

Job Activity: _____

Information Requested

Chemical Substance(s): _____

Job Scenario(s): _____

APPENDIX H

Medical Monitoring Program Flow Chart

Prepared by

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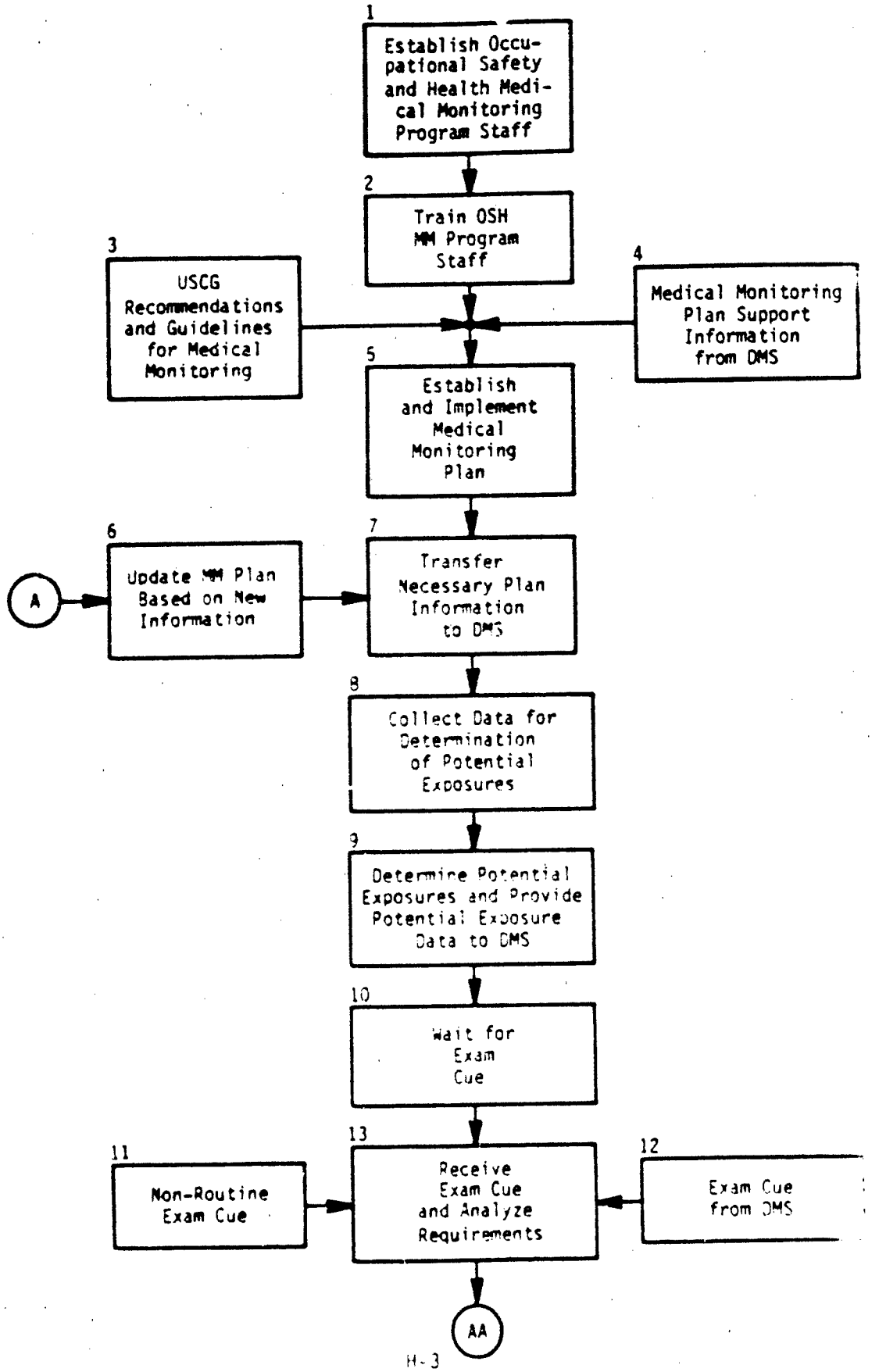
April 1985

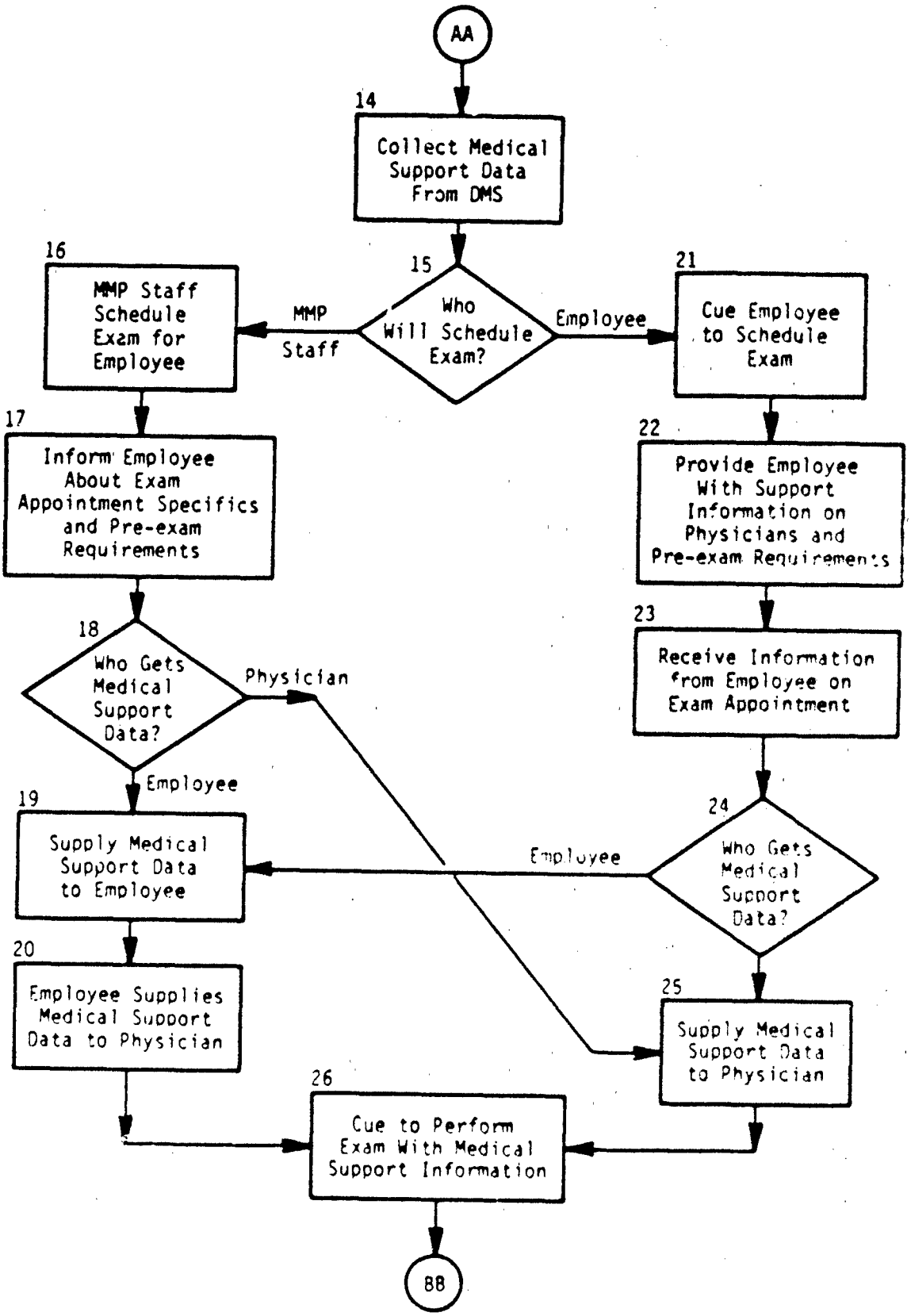
MEDICAL MONITORING PROGRAM FLOW CHART

A flow chart which depicts the sequence of events in the MMMP is presented in this appendix. Each block in the flow chart represents an event or specific type of information and is identified by a number. A brief description of the event or information represented by each block is provided in a numbered listing that corresponds to the numbered blocks and follows the completion of the flow chart.

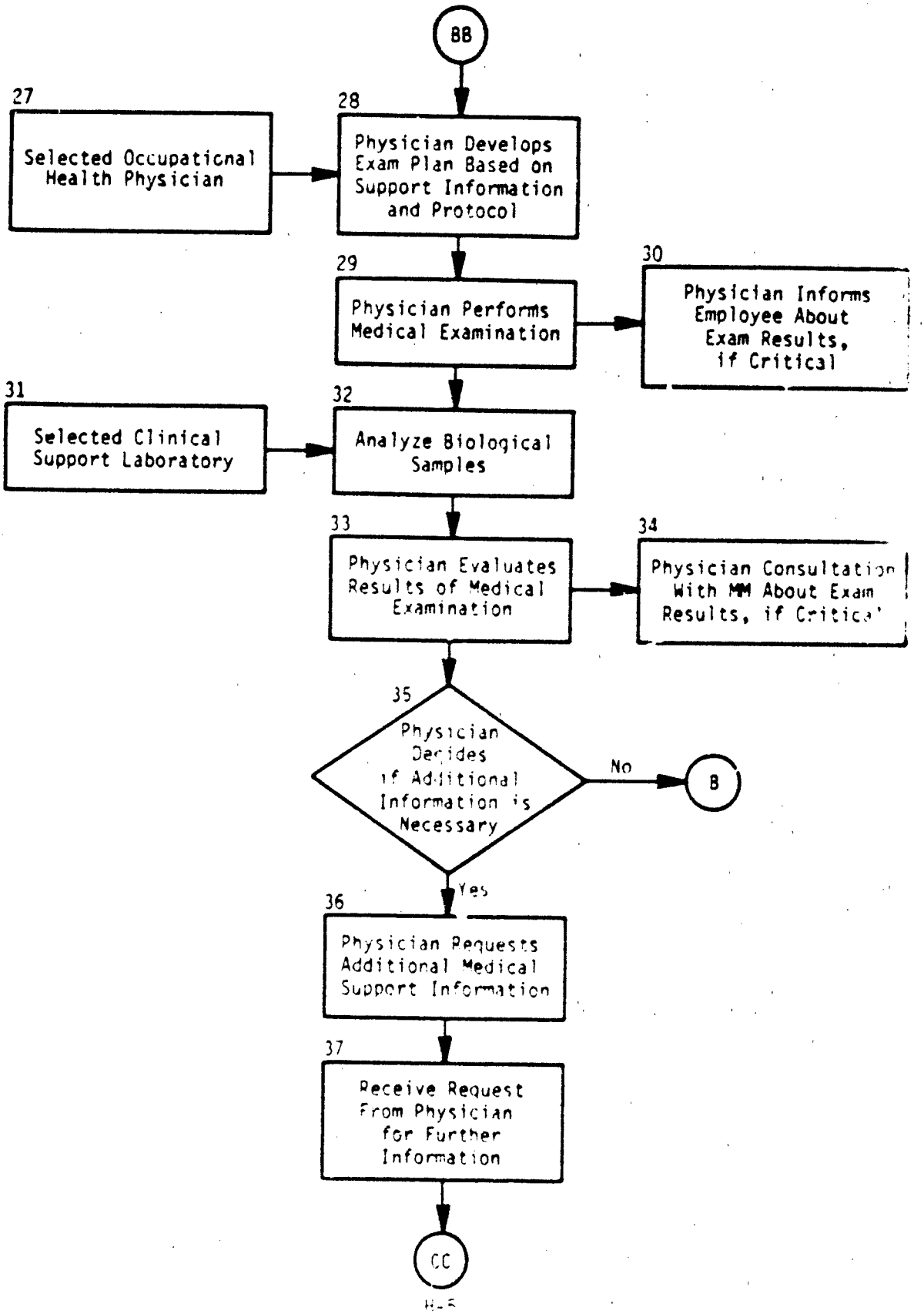
GENERIC MEDICAL MONITORING PROGRAM FLOW CHART



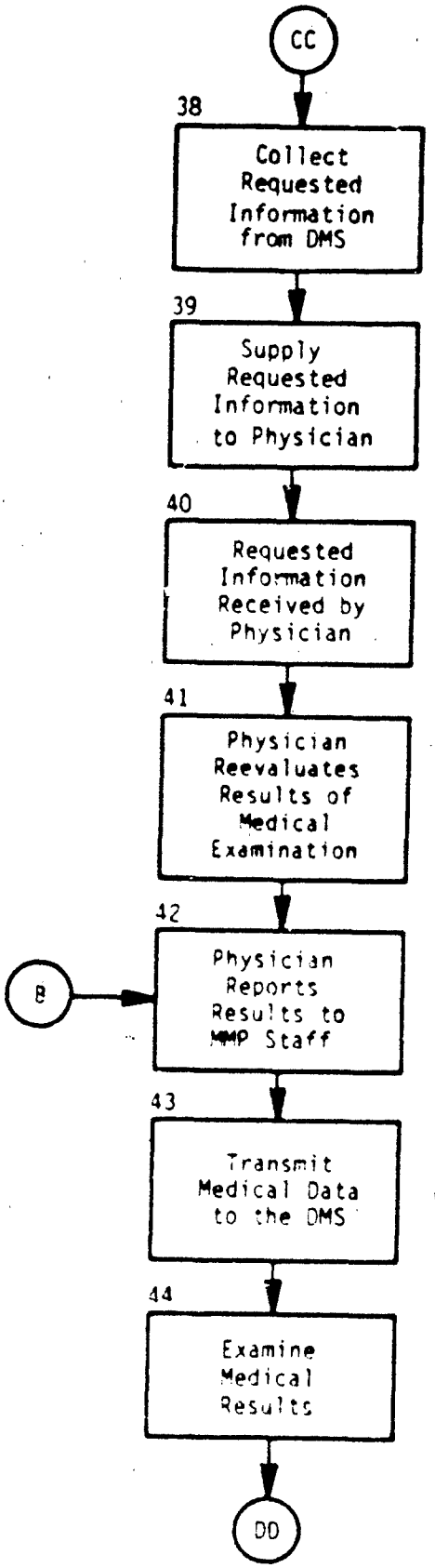
GENERIC MEDICAL MONITORING PROGRAM FLOW CHART (CONTINUED)



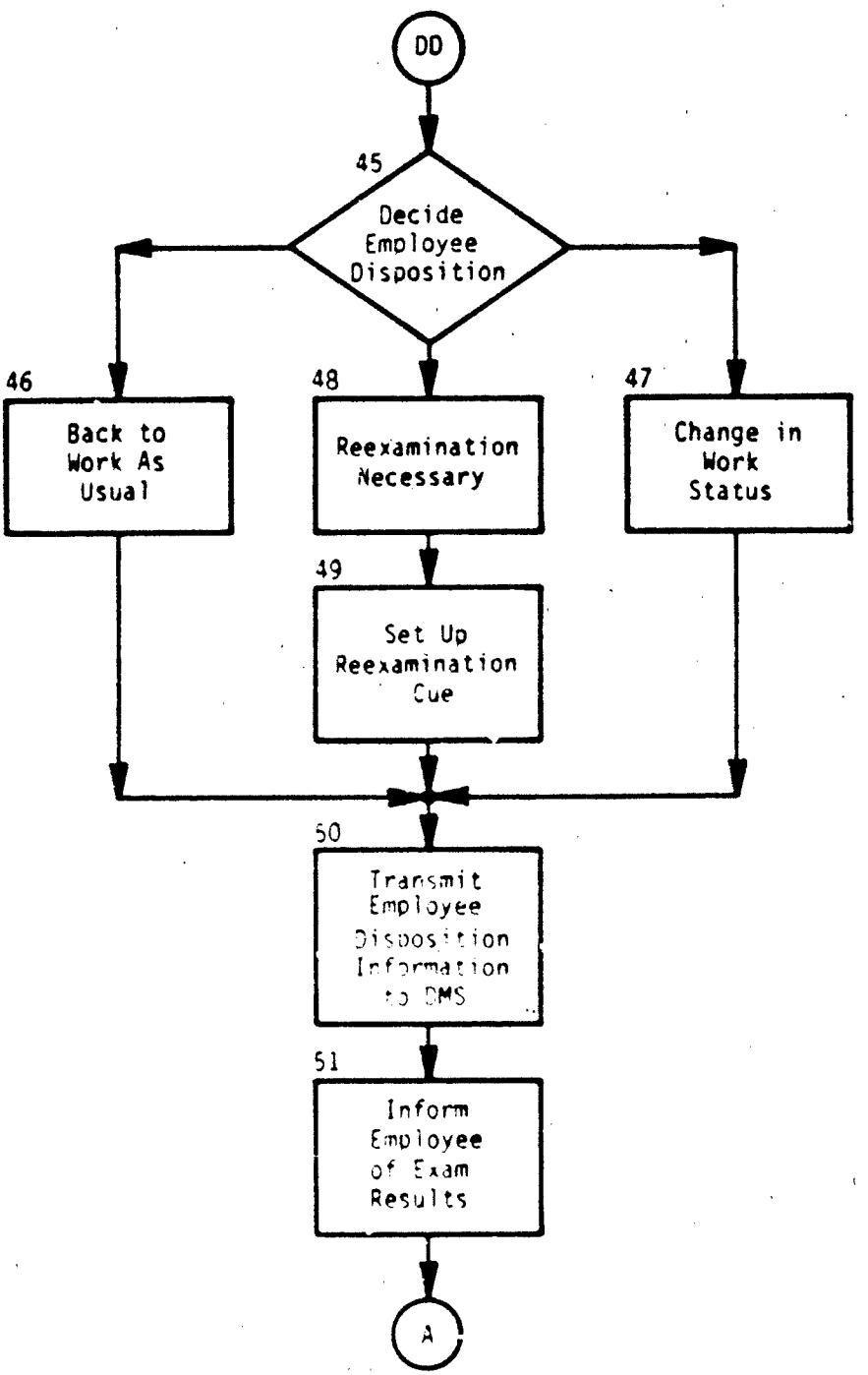
GENERIC MEDICAL MONITORING PROGRAM FLOW CHART (CONTINUED)



GENERIC MEDICAL MONITORING PROGRAM FLOW CHART (CONTINUED)



GENERIC MEDICAL MONITORING PROGRAM FLOW CHART (CONCLUDED)



GENERIC MEDICAL MONITORING PROGRAM*

1. Establish Occupational Safety and Health Medical Monitoring Staff

   - o Corporate policy statement/corporate commitment to OSH program
   - o Director - organization wide
   - o Remaining Staff - depth of staff is a function of degree of in-house involement, size is a function of company
   - o Resident or consultant M.D.

2. OSH MM Program Staff Qualifications and Background

   - o Background in occupational health, public health, industrial hygiene
   - o Knowledgeable of toxic substances
   - o Knowledgeable of work scenarios and work practices
   - o M.D. support with occupational health and knowledge of industrial toxicology
   - o Hazard communication methods

3. USCG Recommendations and Guidelines for MM

   - o Regulations or NVC
   - o 7223 Final Report
     - o Work scenarios
     - o MM program design
     - o Implementation

4. Medical Monitoring Plan Support Information from CMS

   - o Potential physician/clinic support
   - o Information on hazardous substances
   - o Personnel information (assignments, job title, training)
   - o Workplace information
   - o Incident reports

5. Establish and Implement MM Plan

   - o MM consultant MD as necessary
   - o Frequency of medical examinations
   - o Medical protocol and guidelines
   - o Personnel covered
   - o Physician support (medical examination)
   - o Hazardous substance classification
   - o Criteria and procedures for determination of potential exposure data
   - o Implement MM plan established

*Numbers correspond to numbered blocks on the Generic Medical Monitoring Program Flow Chart (3/1/85).

GENERIC MEDICAL MONITORING PROGRAM (CONTINUED)

6. Update MM Plan Based on New Information

   - o Personnel changes
   - o Physician changes
   - o Changes in protocol, frequency, or guidelines
   - o Changes in hazardous substances list or classification

7. Transfer Plan Information to DMS

   - o Logic for cueing medical exams
   - o Specification of personnel covered
   - o General medical monitoring strategy

8. Collect Data for Determination of Potential Exposures

   - o Protocol defined in MM plan
   - o Initiate collection for all personnel covered
   - o Continue collection as long as individual is enrolled in MM program

9. Determine Potential Exposures and Provide Potential Exposure Data to DMS

10. Wait for Exam Cue

11. Non-Routine Exam Cue

    - o Incident report
    - o Employee request
    - o MM staff decision
    - o Sickness related to duty

12. Exam Cue from DMS

    - o Standard frequency
    - o Follow-up exam

13. Receive Exam Cue/Analyze Requirements

14. Collect Medical Support Data from DMS

    - o Work history
    - o Exposure history
      - o Measured exposures, if any
      - o Reported exposure episodes/incident reports
      - o Record of potential exposures - identification of the toxic substances the individual has potentially contacted in work activities
    - o Medical history
    - o Employee specific data

15. Who Will Schedule Exam?

- o MMP staff
- o Employee

16. MMP Staff Schedules Exam for Employee

- o Specific physician/clinic/location
- o Appointment established

17. Inform Employee About Exam Appointment and Pre-Exam Requirements

- o Physician/clinic/location
- o Appointment schedule
- o Requirements for fasting for necessary lab tests
- o Requirements for abstinence from ETOH or prescription medications
- o Expected length of time required for exam

18. Who Gets Medical Support Data?

- o Physician or employee

19. Supply Medical Support Data to Employee

- o Prior to exam appointment date

20. Employee Supplies Medical Support Data to Physician

- o At time of medical examination

21. Cue Employee to Schedule Exam

- o Need for exam called to attention of employee
- o Deadline indicated for accomplishment of exam

22. Provide Employee with Support Information on Physicians and Pre-exam Requirements

- o Physicians or clinics recommended
- o Locations/availability
- o Requirements for fasting for necessary lab tests
- o Requirements for abstinence from ETOH or prescription medications
- o Expected length of time required for exam

23. Receive Information from Employee on Exam Appointment

- o Specific physician/clinic/location
- o Appointment date and time

24. Who Gets Medical Support Data?

    - Physician or employee

25. Supply Medical Support Data to Physician

    - Previously established exam appointment confirmed
    - Package received by physician's office prior to appointment date

26. Cue to Perform Exam with Medical Support Information

    - Received by physician

27. Selected Occupational Health Physician

    - Authorized/approved by MMP staff
    - Meets minimum qualifications prescribed by MMP guidelines

28. Physician Develops Exam Plan

    - Per MMP protocol and guidelines
    - Based on support information

29. Physician Performs Medical Examination

    - Per exam plan (Item 28)
    - Standard MMP forms used to collect and record all information
    - Biological samples collected for laboratory analysis

30. Physician Informs Employee About Exam Results, If Critical

    - Physician recommends immediate course of action to deal with critical need

31. Selected Clinical Support Laboratory

    - Qualified/certified to perform required sample analyses

32. Analyze Biological Samples

    - Samples analyzed per physician instructions
    - Results reported to physician

33. Physician Evaluates Results of Medical Examination

    - Determines if critical situation exists needing specific, immediate follow-up

34. Physician Consultation with MMP Staff About Exam Results, If Critical

35. Physician Decides if Additional Information is Necessary

- o IH data for similar work activities
- o Other data omitted from original data package

36. Physician Requests Additional Medical Support Information

- o Request sent to MMP staff

37. Receive Request from Physician for Further Information

38. Collect Requested Information from DMS

39. Supply Requested Information to Physician

40. Requested Information Received by Physician

41. Physician Reevaluates Results of Medical Examination

42. Physician Reports Results to MMP

- o Use of standard information forms

43. Transmit Medical Data to DMS

- o Data from standard forms reduced for DMS input
- o Reduced data input to DMS

44. Examine Medical Results

- o MMP staff reviews physician findings
- o Use of SHE-0, if applicable, to screen results

45. Decide Employee Disposition

- o Decisions made by MM staff/personnel department

46. Back to Work as Usual

- o Fit for duty

47. Change in Work Status

- o Restricted work assignment to reduce or eliminate specific occupational exposures
- o Temporary not-fit-for-duty status
- o Permanent not-fit-for-duty status

GENERIC MEDICAL MONITORING PROGRAM (CONCLUDED)

48. Reexamination Necessary

- o Follow-up examination prescribed by examining physician
- o MMP staff requires reexamination

49. Set Up Reexamination Cue

- o Determine schedule for reexamination

50. Transmit Employee Disposition Information to DMS

51. Inform Employee of Exam Results

- o Health status
- o Diagnoses
- o Abnormal lab results
- o Recommended changes in work status