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Planning Document For Hazardous Materials Research

FINAL REPORT

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Contract No. DCPA01-79-C-0239
Work Unit 2321C

SCIENTIFIC SERVICE, INC.

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The report discusses research needed to improve the management and control of hazardous materials.

Input was derived largely from material discussed at a conference comprising representatives of government agencies involved in hazardous materials control and management. Conference topics encompassed: instrumentation for material and for hazard identification; equipment for operations, communication, and safety; training and education; and

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) regulatory and environmental aspects and issues.

The objective was to develop a research program plan, based on practical needs, that could serve as the nucleus to foster evolution of an integrated effort among the agencies involved in the complex problem of managing and controlling hazardous materials. To provide a focal point for further action, areas of concern brought up at the conference are discussed and some specific programs and funding levels suggested. The latter are summarized briefly in tables included at the end of the main text.

(DETACHABLE SUMMARY)

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PLANNING DOCUMENT FOR HAZARDOUS MATERIALS RESEARCH

by

J.V. Zaccor and C. Wilton

for

Federal Emergency Management Agency
Washington, D.C. 20472

Contract No. DCPA01-79-C-0239, Work Unit 2321C
James W. Kerr, COTR

Scientific Service, Inc.
517 East Bayshore, Redwood City, CA 94063

(Detachable Summary)

PLANNING DOCUMENT FOR HAZARDOUS MATERIALS RESEARCH

Major national concerns relating to hazardous materials were identified at a conference held in Emmitsburg, Maryland in June 1979.* Based on the concerns identified there, and some additional analyses, this planning document has been developed, which should provide the Federal Emergency Management Agency with a basis for evolution of a comprehensive and coherent attack on these critical problems.

Historically, hazardous materials management has been founded on a sequence of ad hoc programs. As a consequence, there have been too many overlapping responsibilities, too little coordination, and too much effort that has not delivered noticeable end results. FEMA is in the enviable position of having a clear-cut mandate to alter this trend. A key part of this challenge will be effective integration of the programs and efforts of all agencies that are role players. This will require development of a comprehensive overview of these programs and efforts, and how they affect the hazardous materials problem and where it is headed, then the closing of gaps by simultaneous pursuit of programs that deliver highly visible results. Principally, the latter should include operational and safety benefits to the operating personnel in the field, and improved environmental and public health conditions in every political subdivision. An efficient R & D program will be required to deliver these. That means R & D programs based on specific requirements, resulting in identified products, keyed to complete practical implementation plans.

For FEMA to produce significant results will require substantial

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* A summary conference report is available in SSI Report No. 7911-5.

dollar commitment. An annual budget of several hundred thousand is scarcely substantial, and an immediate budget of one million increasing to several million, annually, is desirable for a few years if FEMA is to initiate activities on the several fronts discussed at the conference and to integrate them with existing programs. If a serious effort is not made at a sustaining level, one might as well not bother at all; it will be impossible to catch up with the problem, much less get ahead of it.

Because the level of effort fundable in the first year is unknown at this time, the planning document outlines three programs: #1 — very austere; i.e., strictly management support; #2 — somewhat more comprehensive; i.e., including some field operations, as well as management, support; and #3 — a program that provides strong R & D support from the outset for field operations, management and control, and interagency coordination. The table below summarizes annual expenditures for several years for each of the three funding rates in the early years. Considerably more extensive tables for the three program levels are presented in the planning document.

Because events and public reaction on the subject of hazardous materials are both accelerating, it might be prudent to initiate action along the broadest possible front as rapidly as possible; e.g., Program #3. It is expected these program plans would change periodically as interagency coordination increased, integration of activities improved, and new problems arose.

ANNUAL EXPENDITURES (in thousands)

RESEARCH AREA \ YEAR	1980	1981	1982	1983	1984	1985
Management Support	275	525	450	600	600	600
Field Operations Support	---	400	1,090	1,160	1,700	2,080
#1 Annual Totals	275	925	1,540	1,760	2,300	2,680
Management Support	275	375	600	600	600	600
Field Operations Support	400	850	1,090	1,810	2,080	530
#2 Annual Totals	675	1,225	1,690	2,410	2,680	1,130
Management Support	275	375	600	600	600	600
Field Operations Support	1,800	2,900	2,010	250	500	500
#3 Annual Totals	2,075	3,275	2,610	850	1,100	1,100

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FEMA REVIEW NOTICE:

This report has been reviewed in the Federal Emergency Management Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Federal Emergency Management Agency

Scientific Service, Inc.
517 East Bayshore, Redwood City, CA 94063

PREFACE

From reviewers comments it would appear that some perspective should be provided for readers of this Planning Document. It definitely should not be construed as an attempt to provide a final blueprint for management and control of hazardous materials, but rather an attempt to initiate development of such a blueprint using input from a variety of knowledgeable architects. The Federal Emergency Management Agency appears to be the central management body assigned to sort and assemble pieces of the hazardous materials control and management puzzle and begin to glue them together. This is likely to constitute a major technical, political and economic effort (based on observations of prior attempts); to take considerable time, care, and patience; and will certainly require the cooperation of all the agencies with roles to play in the hazardous materials management scenario. Daily, the task looms larger and ever more important. We shall gain from the Federal Emergency Management Agency's successes.

The first planning document for FEMA's entrance into hazardous materials management was intended to preface a suggested interim program with a look at and summary of general needs. Whether these needs were under investigation in existing projects was not a question for discussion; rather the question was, "What are the needs?"

Once a matrix of needed projects is fairly well established and either general concurrence or overruling rationale established, then it will be possible to evaluate how well these needs are being met by existing, or planned, programs and just which agencies might be best suited to carry on the tasks. To define this matrix of needs will take far more than a conference of role players; it will take the development of hard data and management decision information. We would hope this planning document might be considered a start and not, under any circumstances, a final plan for FEMA.

If, at the time of the conference, one or more of the needs identified there and in this document were already under investigation, then it is expected FEMA would be provided details by the agency conducting the study. If other programmatic needs identified herein have since been initiated, once again FEMA should be notified of details by the initiating agency, and this document and the conference will have served a useful purpose as a FEMA management tool.

ACKNOWLEDGEMENTS

Input to this planning document was supplied by many different individuals from over two dozen organizations. Though we haven't the space to acknowledge each contribution, individually, we are grateful to all.

We should like, particularly, to acknowledge Cliff McLain's support, which made this effort possible, and his personal interest in better management and control of hazardous materials and safer operating conditions for emergency response teams, both of which are sorely needed. We are indebted, also, to Jim Kerr, the major driving force behind this initial effort. Jim has been generous in supplying insight, ideas, and encouragement wherever and whenever needed.

Our special thanks to Joe Clark who has provided input from a previously untapped source of information and who acted as liaison with the Fire Academy to help ensure a smooth-running conference on hazardous materials at the Emmitsburg meeting. And we wish to express our sincere appreciation to the entire staff of the Fire Academy at Emmitsburg for their efficiency, foresight, and hospitality which enabled the conference to be both a productive and a pleasurable experience at the same time.

Finally, we should like to thank Guna Selvaduray, who made important contributions to sections of this document; Hway-ling Hsu, who sorted through isolated bits and pieces of information and put them into order; and Evelyn Kaplan, who reviewed, edited, and summarized hours of tape recordings.

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Section 1
INTRODUCTION

Statement of Problem

Historically, hazardous materials management has been based on ad hoc programs. As a result, there has often been a lack of coordination and continuity between programs. Confusion over responsibilities and areas of jurisdiction is a current problem.

Objective

This document, based largely on a conference held in June 1979, is an attempt to give a general overview of the areas where research programs are needed for improved management and control of hazardous materials. The conference, sponsored by the Defense Civil Preparedness Agency (DCPA), was conducted to obtain some initial input from other government agencies also playing roles in the management and control of hazardous materials.

The Conference

On June 25 and 26, 1979, 38 representatives of 21 Federal and local government agencies, and 6 DCPA contractors, participated in a hazardous materials conference at the National Fire Academy in Emmitsburg, Maryland. The participants divided up into four workshops to consider:

Short-term Needs
Long-term Needs
Devices, Technology, Hardware
Prevention, Mitigation, and Cleanup.

At the end of the second day, the group reconvened to hear reports from each workshop and to discuss the results.

DCPA/FEMA

The conference sponsor, DCPA, is now a part of the Federal Emergency Management Agency (FEMA). FEMA also includes the United States Fire Administration (USFA), the Federal Insurance Administration (FIA), the Federal Disaster Assistance Administration (FDAA), and the Federal Preparedness Agency (FPA). FEMA was created officially in 1979 by Executive Order to provide a single agency, and a single official (at its head), accountable to the President and the Congress for all Federal emergency-preparedness, mitigation and response activities. It is also intended that FEMA provide an improved basis for determining the cost-effectiveness of spending for hazard mitigation, preparedness planning, relief operation, and recovery assistance.

Developing A Planning Document

A first draft of this report was sent to each of the conference participants for their comments and criticism. All of the replies received were illuminating, and appreciated, and many have been incorporated in some fashion.

Some of the comments pointed out that programs and tasks suggested in the planning document have already been undertaken by government agencies. The observation is quite correct, this document was never intended to take into account the results and current status of ongoing programs. Rather, it is an attempt to gather and present a general picture of key pieces in the hazardous materials puzzle, not just the missing ones. To assess the current status of all ongoing hazardous materials programs is beyond the scope of this document, but it has been suggested as an important early task for FEMA in all the programs proposed herein.

A summary of the comments can be found in Appendix C.

Section 2
DISCUSSION

The initial thrust of the Emmitsburg conference was to discuss requirements for instrumentation and equipment for use in the identification and cleanup of hazardous materials spills. However, the discussion and workshops were not limited to these issues so that other relevant items would be included. Consequently, additional needs were identified that should be considered by FEMA for research. The areas tended to fall into five broad categories:

1. Instrumentation
2. Equipment
3. Training and Education
4. Regulatory
5. Environmental

Under each category a number of potential program areas have been identified. These are shown in Table 1. No attempt has been made to develop a formal ranking procedure (such was outside the scope of this program effort). There is a logic to the ranking of major categories, however. These are in an order related to the temporal need if they were strung along a response spectrum.

It seems very probable that one of the major reasons for creating FEMA is to apply management attention to the task of ranking Emergency Management in general. This will take considerable thought, time, and effort. In the meantime, it is possible to respond to needs identified by those working in the field, and to produce some desirable end results, even it these choices are not the ranking items for management attention.

The remainder of this section presents short discussions of each program area identified in Table 1.

Table 1

RESEARCH NEEDS

1) Instrumentation
   - Material Identification
   - Hazard Identification (risk alarm)
   - Site Conditions

2) Equipment
   - Protective Clothing
   - Breathing Apparatus
   - Response Vehicles
   - Sampling Equipment
   - Communication

3) Training and Education
   - Development of Relevant Data Bases
   - Dissemination of Available Information & Data
   - Development of New Courses
     - Tactics
     - Recognition
     - Equipment Usage
     - Contingency/Evacuation Plan
     - Prevention/Mitigation
     - Mitigation Standards

4) Regulatory
   - Marking/Labeling
   - Classification
   - Documentation
   - Siting
   - Mitigation Standards; Re-entry/Reuse
   - Planning Requirements

5) Environmental
   - Response Protocols
   - Health Effects of Individual Materials
   - Health Effects of Mixtures
   - Hazard of Mixtures
   - Risk Analysis
   - Ultimate Disposal
   - Mitigation Requirements

1. INSTRUMENTATION

Conference participants generally agreed that instrumentation for hazardous material control was within the state of the art, but that considerable work in "engineering" would be required — primarily packaging — before general distribution could be made to users. The primary problem seems to be that most developments in this area were oriented towards laboratory use, and very little effort has been devoted to the development of rugged, portable, field-type instruments.

Instruments of varied levels of sophistication are needed. Some hardware should be placed on every fire truck, but more sophisticated hardware should be allocated on the basis of regions (e.g., counties) and the most complex gear allocated by state (or other convenient geographical subdivision). The proposed distribution of instrumentation presented in Table 2 follows this allocation concept. Some properties of specific concern that were discussed in regard to field instrumentation were: need for long-term reliability, since some local fire departments may deal with a hazardous material problem infrequently; need for simple, rugged, idiot-proof, self-calibrating equipment; need to avoid false alarms signifying no hazard.

Material Identification

Rapid, accurate identification of unknown hazardous materials is the key to almost all response activities. Handbooks, contingency plans, computer information banks such as CHEMTREC are all useless unless the material can be identified.

Currently available analytical equipment is, for the most part, large laboratory-type equipment requiring trained personnel and a variety of support services. It is generally believed, and an ongoing DCPA research

Table 2

POTENTIAL FEASIBLE ARRAY OF HARDWARE

Item or Type	Location or User		
	Every Fire Truck	One per County	State or Zone
Hydrocarbon "Sniffer"	X		
Other sniffers	X		
pH detector	X		
IR sensor	X	X	
Gas chromatograph		X	X
Biochemical sensor	X	X	
Emission spectrometer		X	X
Telemetering capability		X	X
Microprocessor backup		X	X
Tunable laser plus ionization potential readout		?	X
Readout for satellite sensors (many types)		?	X
Interferometer	?	X	
Application of military (war gas agent) hardware	?	?	X

program should confirm, that existing technology would be adequate state of the art for field equipment for hazardous materials identification. However, an engineering program is needed that will transfer the currently available technology into rugged, easily operated, reliable field instrumentation.

General program needs:

1. Assess the state of the art*
2. Implement development programs for the most promising instrumentation
3. Field test and evaluate prototype instrumentation
4. Distribute or make available developed instrumentation.

Hazard Identification (Risk Alarm)

While the accurate identification of a material is highly desirable, in many cases (particularly in fast-moving emergencies such as a fire) it is only necessary to know that some hazard to personnel is present. For example, a small portable detector that would sound an alarm in the presence of toxic smokes would remind firemen to use airpacks and would greatly reduce the incidence of inhalation injuries, the most prevalent lost-time accident by firemen today.

Another example of a desired capability for this type of instrumentation is flammability or explosive limit detectors for air/gas and air/dust mixtures.

General program needs:

1. Conduct a limited study program that would involve: medical experts — to establish threshold limits; chemists and hazardous materials experts — to define indicators for reactants that need to be measured; and instrumentation experts. Identify promising risk alarm projects.

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* Report of FEMA study" "Instrumentation for Detecting Hazardous Materials," by Gerard Gross, LOCUS, Inc., now in publication.

2. Implement as many development programs as possible for promising alternatives.

3. Field test and evaluate prototype instrumentation.

4. Distribute or make available developed instrumentation.

Site Conditions

In hazardous material incidents it is frequently necessary to obtain data very rapidly on wind speed and direction, for use in setting evacuation limits (or for use as input to computerized prediction techniques), or on river or stream flow velocity, for input to establish dam or boom locations, etc.

Most, if not all, the equipment for these measurements is readily available, but in most cases not in a package that can be used.

General program needs:

1. Conduct a limited study program to determine the types of measurements that are most frequently needed and the accuracy with which this data must be measured; survey the instrumentation that is available.

2. Develop a prototype kit, and field test and evaluate.

3. Distribute or make available the developed kit.

2. EQUIPMENT

Handling of hazardous materials imposes special and unusual risks. The quantity of such materials in use today requires serious and continuing consideration of equipment that can reduce or eliminate hazardous aspects to those handling such materials.

Vulnerability is especially high for those called upon to be society's front line in dealing with problems of disposal, routine cleanup, or emergency situations. Therefore, it is incumbent on society to develop equipment to reduce the risks from explosion, flammable or toxic effects, and to simplify isolation, neutralization, or elimination of wastes.

A number of specific areas of equipment development that are deserving of program support were identified in the conference. The need for equipment standards is inherent in each requirement and has not been addressed as a separate item.

Protective Clothing

In plant, whether in the production or end-use mode, the risk is generally well defined. Moreover, the responsibility for personnel safety is in the private sector. In emergency situations, whether in plants, in transit, or in cleanup and disposal, the risk is less well defined (and may be a combined risk, or perhaps unknown). In such instances and where responsbility for action and personnel safety transfer to the public sector, the concept of a sealed "supersuit" that provides complete protection from all existing chemicals is extremely appealing and may warrant a feasibility study. Alternatively, a set of specialty suits could be selected for the bulk of circumstances where special protection is needed. This alternative may be a considerably more pragmatic approach and would require: the assessment of limitations on existing protective clothing (which would be an immediately practical contribution), and definition of gaps in the line of protective clothing that would need to be covered. A disposable oversuit, or a suit with disposable modular elements, would provide another practical alternative to consider in evaluating protective clothing options and applications.

General program needs:

1. Define what protective clothing exists, costs and availability, and limitations of each; and define what protective clothing is needed.
2. Initiate a program to adapt existing suit technology or, if necessary, develop new technology for protective clothing.
3. Field test and evaluate.
4. Distribute or make available.

Breathing Apparatus

Self-contained breathing apparatus (SCBA) is the most demanding requirement in this category of equipment. SCBA will be required where sealed protective clothing is used, but circumstance may also warrant use of SCBA at times when protective clothing is not required. If all SCBA units were interchangeable, this could provide operational as well as cost efficiencies. Nevertheless, it may be that a built-in unit would make a sealed suit more comfortable. A study should weigh the merits of each option so a decision can be made. At the other extreme, filter masks will be sufficient in many situations, and no breathing apparatus at all will be necessary in others.

General program needs:

1. Define what breathing apparatus exists, costs and availability, and the limitations of each, and define what breathing apparatus is needed; assess feasibility of implementing regulations to require interchangeability of all SCBA units.

2. Conduct a feasibility program to determine if a specialized SCBA unit should be developed for fire and hazardous materials use.
3. Implement an R & D program to develop a special unit based on the results of item 2, and field test.
4. Distribute or make available.

Response Vehicles

Emergency response is characterized by immediate (short-term) hazards. For this situation, the concept of a "super-response vehicle" may be a higher priority than a "supersuit". An extremely flexible, sealed vehicle for remote hazard assessment is intriguing. (The Environmental Protection Agency is presumably working on one.) If such a vehicle were equipped with TV scanners, threshold detection instrumentation, satellite data links, with on-line surveillance by crack professional response team, the best expertise in the nation could be applied, at once, to any emergency. A second such vehicle, manned for initial response, might also be considered in a feasibility study. As a minimum it would seem prudent to make a survey of response vehicles available, limitations, costs, geographical distribution, etc., against both geographical and capability requirements.

Occasionally, environmental issues mandate cleanup situations, and mobile systems are required to detoxify surfaces, remove contaminants from soil matrices, and filter contaminated water bodies. The Environmental Protection Agency has this responsibility. EPA policy calls for contracting the design and demonstration prototypes and encouraging their commercialization and general use. An incentive/disincentive mechanism is used: EPA will eliminate multi-million dollar fines levied on companies responsible for spills, if they clean them up; if they do not, both the fine and the cleanup costs are levied. In the long-term response areas, a minimum management program should track the effectiveness of this approach as well as define standards for cleanup and dose limits acceptable to determine whether additional intervention is required.

Over the very long term, it appears possible that mobile systems will be required for the special task of visiting problem dump sites to assess hazards and carry out ultimate disposal (complete neutralization or degradation of hazardous materials). Unless a method is found that guarantees complete dissociation of 100% of the hazardous materials into constituent elements, then it will be necessary to develop data on dump contents and deal piecemeal with the critical problems. Moreover, the potentially critical problems will not be identifiable until a universally acceptable hazard potential rating is developed.

General program needs:

1. Survey existing response vehicles to determine limitations, costs, geographical distribution (practical availability) in terms of technological and deployment requirements.
2. Consider basic standards for response vehicles.
3. Define the need for and feasibility of a remote hazard-assessment vehicle.
4. Extrapolate the analyses of (3) above to the questions of a manned super vehicle for initial response.
5. Examine the feasibility of a mobile ultimate disposal system for hazardous materials.

Sampling Equipment

The term "sampling" implies a sufficiently leisurely time schedule to analyze the sample. When emergency situations arise, there is insufficient time for analyses, so that quick-response hazard-threshold detectors and alarms are a necessity. Thus, items that fall in the emergency response category have been classified for convenience as "instrumentation" (and have been discussed under that topic), and items that fall in the long-term response category have been classified as "sampling equipment".

Sampling and analysis will have major application during cleanup phases of spill and rehabilitation of dumps. For these applications, the principal uses of sampling equipment will be to assess the acceptability of the cleanup effort or to determine chemical classification of unknown hazardous materials in aging and failing containers in dumps. Therefore, not only the time scale, but sensitivities, will be different from those for (emergency) instrumentation.

Development of sampling equipment suitable for the assessment of cleanup operations (whether at a spill or a dump) will be aimed at detecting minute concentrations according to an environmental acceptability limit. This limit will have to be established and may require some regulatory input. Generally, the sampling and analysis procedures will provide considerably higher sensitivity for detecting trace elements than will field hazardous material identification instrumentation. Moreover, constituents of unknown waste mixtures in drums are more likely to be identified by sample analysis than by material identification instrumentation (which will be oriented more toward detecting chemically reactive radicals than specific molecular species). For the task of identifying hazardous materials in aging containers, the sample analyses will be oriented chiefly towards specific material identification to facilitate neutralization or ultimate disposal.

A potential alternative solution to identifying hazardous materials at dump sites surfaced at the conference. From a management point of view, a lower overall disposal cost might result if a system were to be developed that would completely destroy any waste hazardous material product. Then, identification could be bypassed altogether. This management alternative could have an important bearing on research programs and priorities relating to sampling equipment as well as on other areas, such as regulatory and ultimate disposal.

General program needs:

1. Develop sampling equipment (and analytical techniques) for detecting trace amounts of hazardous materials to support cleanup.

2. Institute a companion regulatory program to establish acceptable concentrations after spill cleanup; i.e., how clean is "clean"?

3. Compare the cost of developing an ultimate disposal scheme for unknown hazardous materials (using cement kilns or, eventually perhaps, the fusion reaction processes) with the costs of developing techniques for identifying the hazardous material species for separation and neutralization on an individual basis.

Communications Systems

Communication systems are critical to safe operation of emergency response teams and highly desirable for efficient operation of spill cleanup teams. Moreover, thorough communication networks, both additional talent and the best talent in the entire nation can be brought to bear on a problem. With TV coverage and satellite links added, response team actions could be monitored remotely to provide advice, record response, conduct operational reviews, and develop programs to improve training and education to upgrade team performance. Also, without an adequate communication system, a remote hazard assessment vehicle would be an impossibility.

Every emergency response team can use intra-team communications and team-to-base communications to advantage as a safety measure to keep out of trouble and to tap reserves. With cleanup teams, onsite communication links may be critical to operations, and field-to-base links can provide backup data and analyses in minimum time. Once a data base is established, onsite computer terminals could be used, for example, to check actual progress against forecasts of progress and thus, to detect possible operational errors.

General program needs:

1. Define the range of options that should be designed into emergency response and cleanup team communication networks.

2. Evaluate existing system suitability to meet the needs defined in (1).

3. TRAINING AND EDUCATION

The subject of adequate training came up numerous times throughout the conference. One major concern was that there are wide variations in the training of fire departments and response groups throughout the nation. Some, particularly those in large cities or who are located in areas of heavy industry and have to deal with hazardous materials frequently, are very well trained and experienced, while others, usually in the smaller, more remote areas where a hazardous materials incident may only occur every few months or years, are poorly trained or not trained at all.

Courses need to be developed, instructors need to be trained, and a nationwide training program needs to be implemented. A prototype training and education program should address two general areas:

Dissemination of Available Information

A nationwide program to raise the training level of all response agencies and groups should be initiated. Much of the material necessary for this is already available, and some courses are now being developed at the Fire Academy.

Development of New Courses

In many areas, adequate information is not yet available for the development of training courses. There is a need for a number of research programs to develop the data base necessary for the implementation of new training courses. The following subjects need to be addressed:

Tactics. — Firefighting tactics are very far advanced and have been based on many years of experience, research, and comprehensive studies of past incidents. A much smaller data base is available to help establish standard tactics for the handling of hazardous material incidents. The answers to such questions as — whether to evacuate; whether water should be used on a particular mixture of hazardous materials; when to move and when to move out — are very critical, and the wrong decision has in many instances resulted in loss of life and increased property damage.

General program needs:

1. Collect and analyze all available incident data;
2. Establish uniform procedures for reporting of incident data;
3. Conduct laboratory and field experiments using various techniques and equipment to develop data not available in the records;
4. Develop a training program to disseminate this information to the response community.

Recognition.— The adage "where there's smoke there's fire" is very useful in the fire community. Unfortunately, there is not, as yet, as simple a criterion for detecting harmful concentrations of hazardous materials. Under the Instrumentation section it was suggested that work be conducted to develop portable detectors for this purpose. It is probably also possible to train response people to detect many hazardous conditions by human senses (i.e., sight, smell). Many chemicals have a very recognizable odor, even in very small concentrations.

General program needs:

1. Initiate a study of the possibility of using indicators such as smell to detect many materials and combinations of materials. As part of this study consider the possibility of adding indicators to commonly spilled materials in order to "smell" code them for leak detection and possible rapid identification (e.g., as is done to natural gas).

2. Initiate a more sophisticated program to determine if a significant number of commonly handled hazardous materials might be identified by human sense through augmented reaction (e.g., catalysts that, if exposed to minute quantities of toxic material, would give off a recognizable odor or change color). Evaluate the hazards of implementing such methods.

3. Based on the results of the indicator research, develop a training kit and incorporate the technique into field training with periodic review by all response teams.

Equipment Usage. — It was strongly emphasized many times during the conference that more and better training is required in the use of currently available fire company and general construction equipment, as well as yet-to-be-developed equipment, to control hazardous material accidents and spills. It was also strongly emphasized that, when new equipment or instrumentation is developed, it should be distributed together with an adequate training program for operation and testing.

General program needs:

1. Survey readily available construction, manufacturing, and industrial equipment to determine how it could be adapted or used in an emergency to deal with a hazardous material situation. Examples: Bulldozers and trenchers could be used to stop or direct the flow of a hazardous material; storm drains could be used to trap, and cleaning trucks could vacuum up and transfer, large volumes of material very rapidly, including rocks, gravel, and liquid.

2. Develop and incorporate into a training course scenarios that make use of these generally available, but specialized items of equipment to deal with hazardous spill situations. An auxiliary task would include development of inventories of such items of equipment that are available locally, so that these could be included in hazardous material spill contingency plans.

3. Develop, on a continuing basis, manuals and training courses for new items of instrumentation and equipment as they become available.

Contingency/Evacuation Plans. — One of the more critical areas seems to be the lack of good, well organized contingency and evacuation plans for hazardous material incidents. Since many incidents involve numerous jurisdictions — Federal, State, and local — it is imperative that a plan be developed beforehand that coordinates the activities of all involved, and also establishes levels of responsibility and jurisdiction. Almost every experienced spill coordinator has many horror stories concerning jurisdictional disputes between various agencies during a spill situation. General program needs:

1. Develop prototype contingency plans (similar to the ones being developed by DCPA for Crisis Relocation) for various types of situations and emergencies.

2. Conduct field tests, both as dry runs, using actual response personnel, and also as tests against the experiences of past hazardous material incidents.

3. Based on these tests revise these prototype contingency plans as required; develop a series of training courses on how to develop suitable local contingency and evacuation plans for those who will be involved locally.

4. REGULATORY

While not originally included in the topics for the conference, the subject of the need for new, or reduction of excessive, regulations for solving the hazardous material/waste problem received considerable thought and discussion. The "excessive" label arises because often costs that are incurred by the private sector are not factored into the cost/benefit analysis of regulation and because no effort is made to coordinate regulatory actions between agencies with overlapping responsibilities.

Regulatory activities are viewed principally as being directed at maintaining organization and control. Implicit is the existence of the capability to force compliance.

Marking and Labeling

A very important aspect of marking and labeling applies to hazardous materials in transit, where an emergency could place a response team or an entire community in jeopardy. One study showed that perhaps as much as half of all shipments of hazardous materials are improperly labeled. Some of this is deliberate, some is carelessness, and some is due to ignorance. Whatever the reason, the practice poses potentially significant risk to the community at large, in view of the high order of non-compliance. It seems apparent that heavy doses of training and education, compliance assessment, and legal penalties may be required.

A major problem to be solved first is some kind of uniform marking and labeling system that will eliminate confusion. Some chemicals are known by many different names and a uniform (hazard) classification and labeling system would provide the opportunity to encode, in the marking information, emergency response information that will provide emergency response teams with vital information on "do's" and "dont's".

A label warning to end-users on all transshipped hazardous materials could also prevent unnecessary injury. Some of these recipients either have purchased the hazardous material for the first time and may not be aware of dangerous properties, or have inexperienced personnel receiving shipments. The time to obtain assurance that a handler, trucker, or recipient understands the need for care is at transfer of responsibility. And the incidence of unmarked drums of hazardous materials in dumps could be significantly reduced if there were a regulation against receipting for unmarked containers of hazardous materials.

Within production plants and in the end-use, personnel safety should require in-plant marking and labeling of storage tanks (including drums purchased for in-house use as well); drums transshipped should also be labeled). OSHA regulation could possibly be the force behind compliance.

The major management problems are the development of a uniform code, coordination in all sectors and at the transfer nodes, and compliance. The first item is currently under consideration by Committee F20 of the American Society for Testing and Materials. These efforts should be tracked and integrated with the other regulatory management tasks.

General program needs:

1. Define a preferred name for chemicals with aliases, and enforce a uniform labeling system.
2. Develop procedures that document transfer of responsibility of hazardous materials; e.g., producer to shipper and shipper to purchaser/consumer, which legally require the possessor to take necessary precautions.

Classification

Because many chemicals go by several names, a great deal of confusion can arise — even when there is no emergency. Where emergencies do arise, serious mistakes can result from lack of quick identification. To avoid unnecessary injuries and fatalities in either situation, a uniform classification scheme is clearly desirable. While hazardous materials under control in containers pose only a potential hazard, a scheme to identify the principal hazards and develop response protocols if the material were released would provide an extra measure of safety to emergency response teams and to communities unlucky enough to have spills. Moreover, to be effective, transporting and shipping regulations should be based on type of hazard (perhaps also, on quantity of material).

Present classifications include: flammable, combustible, explosive, corrosive, caustic, toxic, radioactive, etc. With more than one of these to contend with in an emergency, which takes precedence? A better classification scheme, oriented toward the emergency response possibility and response team safety might leave little doubt.

General program needs:

1. Evaluate event paths and probabilities to assess feasibility of the hazard precedence concept. Where unworkable, mixed loads of hazardous materials should be prohibited.
2. Define a uniform classification scheme that transcends the multiplicity of chemical names.
3. Develop a classification system that identifies the material with regard to the hazards (fire, explosion, health) inherent in it, and the mitigating measures that should be implemented.
4. Develop an "easy reference" manual related to (3) above, which could be carried in every truck, fire engine, etc.

Documentation

Documentation of causes, effect, and final outcome of hazardous material emergency events, and appropriate documentation of hazardous material shipments are management control tools that can be developed and maintained by regulatory action to the benefit of society. In addition, more intelligent management decisions can be derived if pertinent data bases are developed from the documentation and used for planning and forecasting.

A very critical area that needs documentation is the inventory buildup at hazardous waste dump sites. Ultimate "disposal" by landfill is a misnomer in any case. Unless the material is biodegradable, landfill dumps are simply long-term storage — generally in short-lived containers. It is in faulty conceptualization such as this that a large part of the dump problem lies.

Current estimates are that the cost to clean up dumps may run $50 to $80 billion. Perhaps the most critical problem is the identification of the contents of thousands of aging (and failing) containers. Undoubtedly it would be simpler and cheaper to label and chart containers as waste inventory builds up than to identify thousands of unknowns, later. More important, if there is serious thought of neutralizing, destroying, or otherwise re-disposing of hazardous materials in dumps now, then it makes little sense to continue to consign additional volumes of such materials to dumps on the same basis as previously (or, perhaps, on any basis other than neutralization). Data are needed on inventory buildup in order to make rational management decisions. The whole question of dump regulation management, and control is (or will become) a major issue when the public examines the shortcomings and the tax dollars involved.

Perhaps an effective way to control buildup of hazardous material wastes would be to require, as part of a licensing requirement, that producers of hazardous materials manufacture neutralizers, wherever possible, in quantities sufficient to balance the annual waste inventory buildup of each product manufactured. Again, data on waste hazardous material streams would be required.

General program needs:

1. Lay out a matrix of regulatory options extant. Include

also the above cited and related issues.

2. Develop an assessment of the expected gains to be made with regulation versus the cost of those gains.

Siting, Licensing, Dumps

Documentation of waste sources and inventory buildup in dumps will create a data base that could theoretically be used to establish limits on dump sites (in order not to exceed, locally, the environmental recovery rates from forecast releases). Also, production allowances could be set beyond which cost for ultimate disposal would be borne by the manufacturer. It does not make sense to manufacture excess hazardous materials, which wind up consigned to dumps because of overproduction or careless and inefficient use. The public and the environment should not bear this burden; it should be borne by the manufacturers and users. Licensing of producers and regulation of inventory buildup in the general environment and at dump sites need to be geared to environmental recovery rates for hazardous material loads.

General program needs:

1. Identify all existing dump sites, and track the types and quantities of wastes/hazardous materials these are receiving.
2. Assess the hazardous material release to the environment at each (or most) of these sites.
3. Develop neutralizing methods (countermeasures) for hazardous materials accumulating or being released at existing dumps.
4. Develop criteria to assess maximum limits acceptable for each dump site.
5. Develop "decommissioning" procedures/standards for existing dumps.
6. Develop criteria and guidelines for opening up of new dump sites.

5. ENVIRONMENTAL

One of the primary purposes of hazardous materials management is to minimize (and if possible eliminate) any adverse effect these materials could have on the environment, particularly the health of the population in and around the affected area. Towards this end, it is felt that the environmental (health) effects can be divided into the following four categories.

Health Effects of Individual Materials

There are several pathways by which materials can come into contact, or enter, the human body. The potential health hazard will be dependent on the nature of the specific material, its concentration, conducting media, and part(s) of the human body reached. For instance, while physical contact with mercury might not be that harmful, the inhalation of mercury vapors, or consumption through other pathways (as in the Minamata case in Kyushu, Japan) is known to have disastrous health effects.

In the case of radionuclides, extensive research has been done on maximum permissible concentrations in water and air, exposure doses for occupational personnel and general public, and health hazard in terms of the organ(s) affected. This form of extensive preventive planning is generally lacking with respect to other hazardous materials.

General program needs:

1. Identify the health hazard of individual materials (i.e., does it cause cancer, asphyxiate, burn skin, embrittle burns?)
2. Identify the pathways manifested by the health hazard (skin contact, inhalation, ingestion) and the organ(s) affected.
3. Establish maximum permissible concentrations in (a) air, water; (b) dissolved, suspended solids/particulates, etc.

4. Develop emergency response measures to minimize (and if possible eliminate) health effects.

Health Effects of Mixtures

While some individual materials in themselves might not pose any major health hazard, there could be combination effects resulting from the mixture of two or more materials. Conversely, by "correctly" mixing two hazardous materials, the hazards might be mutually neutralized. An example is the solubility of metallic cations (say Pb^{+}) in aqueous solution which is dependent on not only the temperature, but also the concentration of specific anions (SO_4^{2-}, OH^-, NO_3^{2-}, etc.). Hence, the type and concentration of anion contributor will affect the concentration of cations in solution,and therefore the health hazard posed.

General program needs:

1. Determine the interaction effects between pairs of hazardous materials, with special emphasis on identifying "multiplier" effects (i.e., increase in health hazard) and "mutually nullifying" effects.
2. Determine the factors that control such interactions; i.e., temperature, pressure, chemical form, concentration.
3. Identify suitable chemicals that could be employed to eliminate the health hazard posed by individual hazardous materials from the findings in (1) and (2) above.

Hazards of Mixtures

Mixtures pose other hazards than health effects, which should be considered (e.g., fire and explosion).

A recent laboratory experiment at San Jose State University resulted in an explosion. A 50% nitric and 50% ethanol solution was being used as an etchant. After a sufficient amount of this mixture was poured into a petrie dish for etching, the remainder was capped in a reagent bottle.

Within a few minutes the bottle exploded. Upon later investigation, it was found that the nitric acid-ethanol reaction is a time-delayed reaction which releases NO_2 . (In the past the solution had been mixed in beakers and used, which meant that there was no pressure buildup.) The point here is that in moving from "sloppy" practice (mixing solutions in a beaker and leaving them there) to careful laboratory practice (putting mixture in a reagent bottle and capping it), the solution actually became hazardous.

In other cases, exothermic reactions result in an increase in temperature (consequently speeding up reactions) that could lead to fires, explosions, or the formation of corrosive reagents.

General program needs:

1. Determine the interaction effects of chemicals and hazardous materials, leading to a classification of flammable/combustible mixtures, explosive mixtures, etc.
2. Document the chemicals/materials/reagents that can be mixed safely, and those that cannot.
3. Apply findings in (1) and (2) to hazardous materials management. (For example, water should not be used on fluorine containers whenever there is a possibility the water might get inside the container — as might occur if an acid were released and water was applied to dilute it.)

Risk Analysis

Risk is generally defined as the product of the probability (frequency) of occurrence of an event with adverse effects and the consequence of such an event. Risk analysis is essential for quantifying the risks as a function of frequency, so that decisions to rank R & D objectives can be made on a rational basis.

Two factors that will be instrumental in developing a valid risk analysis system are: (1) a reliable data base, and (2) a realistic model. Frequently these two can contradict one another; i.e., the data base could be so limited as to impose *a priori* statistical validity limits on the model developed; alternatively the "realistic" model developed could call for far more data than are available. Hence, what is called for is a reiterative system that provides for further refinement. Such an analytical model should be developed for all types of hazards — spills, fires, explosions, releases, etc. — in terms of inventories, release modes, environmental impact, and other related factors.

General program needs:

1. Develop a data format for each hazard type.
2. Develop a data base for each hazard type.
3. Develop a mathematical model for risk analysis of each hazard type.
4. Test model vis-a-vis the data base, with reiterations for refinement.
5. Use risk analysis model for identification of future programs in terms of technical areas and geographical areas.

Ultimate Disposal

The major disposal method today for hazardous materials is "secure landfill", which in essence implies long-term storage with no treatment whatsoever. In the case of nuclear wastes, ultimate disposal is limited to long-term storage because of the potential threat of long-term radiation to future generations, so that the property of being secure is given emphasis. Non-radioactive hazardous wastes can be neutralized so that ultimate disposal need not be limited to long-term storage. Consequently, and erroneously, considerably less emphasis has been placed on storage security for these materials. The accelerating accumulation of hazardous wastes clearly calls for increase emphasis and/or for alternative disposal methods that eliminate the possible need for future consideration. (An example of such an alternative is given following the "General program needs" summary.)

A problem regarding dump sites is that the quantity of wastes generated is generally proportional to population density and the regional density of industries, two factors which in turn are also directly proportional. Because of transportation costs, dump sites are located as close to waste sources as possible. Consequently, with constant growth in populated areas, a dump (or disposal site, incineration facility, etc.) which 30 years ago was sufficiently far away, is today part of the metropolitan area. The accumulation of wastes within such populated areas could lead to a permanent adverse impact on the local environment that would become apparent with time. To avoid this, treatment of wastes to innocuous levels, not only individually, but also cumulatively, is called for.

General program needs:

1. Survey current disposal techniques, technologies, quantities, etc.
2. Identify optimum disposal methods for individual hazardous materials. Include consideration of methods for permanent neutralization of hazardous properties.
3. Identify (and/or develop) treatment methods to reduce potential hazard to below innocuous levels.
4. Assess cumulative effects of hazardous material disposal methods.
5. Develop optimum/maximum values for quantities of hazardous materials disposal in terms of specific materials, geographic region, and disposal (treatment) technology.
6. Define the requirement for a mobile system for disposal of hazardous materials in dump sites.

Biological Treatment — Example of an Ultimate Disposal Research Option

Microbiological systems and micro-organisms have been developed in extractive metallurgy for removal of specific metallic ions from low-grade ore bodies, using in-situ leaching techniques; this approach has been utilized for heavy metals and copper. Biological treatment can be employed in hazardous waste management for detoxification and possibly volume reduction (e.g., activated sludge and aerobic and anaerobic digestion). The main advantage offered by this technique is in-situ treatment of hazardous wastes currently sitting in dump sites. Another possible advantage is the tying-up of toxic ions with specific organisms, thus keeping them out of the pathway back into the human ecosphere.

Research in this area is remarkably lacking, and might eventually prove to be the most fruitful approach because there are seemingly infinite possibilities for genetic manipulations of plants and micro-organisms to create strains capable of breaking down specific wastes, resulting in pollutant-specific scavenger techniques.

A program in this area should include the following:

1. Survey and identify microbiological organisms in current use and those that have been researched. Examples of the latter are heavy metal extraction, Department of Agriculture study on uptake of synthetic compounds and metals, Department of Energy study on vegetative uptake of radioactive elements.
2. Identify and develop new strains of microbiological organisms for hazardous waste cleanup. These studies should include biochemistry, thermodynamics, and kinetics.
3. Identify surface aquatic and terrestrial plants and vertebrate levels in food chains for harvest of bio-accumulated constituents of hazardous wastes.
4. Use (1), (2), and (3) to develop techniques for proper disposal of contaminated biomass and biological concentration technologies.
5. Develop biotreatment systems for in-situ treatment of the wastes that occur at dump sites.

Section 3
RECOMMENDATIONS

Introduction

Historically, hazardous materials management has been based on a sequence of ad hoc programs. As a consequence there have been too many overlapping responsibilities, too little coordination, and too much effort that has not delivered a noticeable end result.

FEMA is in the enviable position of having a clear-cut mandate to alter this trend. A key part of this challenge will be to develop coordination between all agencies and role players. This will require:

1. Development of a comprehensive overview of the hazardous materials problem and where it is headed.
2. The simultaneous pursuit of programs that deliver —
   - A. Noticeable (operational and safety) benefits to the operating personnel in the field;
   - B. Improved environmental and public health conditions in every political subdivision.

An efficient R & D program will be required to deliver these. That means R & D programs based on specified requirements, resulting in identified products, keyed to complete practical implementation (commercial utilization) program plans.

It has already been suggested (at the Emmitsburg conference) that a steering committe would be a good mechanism for testing ideas and directions. This should be done. FEMA should supply the chairman to organize and operate the task force and select representation from governmental and private agencies knowledgeable in the field and likely to supply good, pragmatic advice. Because a good start was made at the conference, there is no reason why such a task force shouldn't be selected from conference participants. Many of the individual program ideas presented there were excellent. There will be a strong need to coordinate selectively among the many options available in order to deliver a program with highly visible satisfactory end results. Significant results are going to require substantial dollar commitment. It will take a minimum of several hundred thousand just to get started, and it is clear that a budget of several million a year for a few years is likely to be required to get on top of the snowballing hazardous materials problem. If a serious effort of this magnitude is not made at a sustaining level, one might as well not bother at all; it will be impossible to catch up with the problem, much less get ahead of it.*

FEMA _is_ emergency management. The heart of all crack management systems is the development of an effective arsenal of management tools, preferably founded on hard data, to solve clear-cut problems. To date, random observations (generally with high visibility) and expert opinions have been the data base for hazardous material management, and programs have been "band-aid" in nature. These are the first items that need to be changed. To be sure, when there is no management budget to develop effective management tools, the "band-aid" approach can still produce some successes, particularly where it is possible to use leverage. The Emmitsburg conference is just such an example; an instrument manufacturers' conference is a possibility for another. There is no reason to lay such techniques aside, but it is important to augment these efforts as soon as possible. Item (2), above, can be moved along, for the present, by the steering committee and a followup conference or two. However, considerable effort is required to piece together the fragmented program in hazardous materials management in order to get rolling on item (1).

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* For example, organizing and managing a hypothetical $50 billion dump cleanup program alone could require a research and management budget of a few billion dollars. A portion, perhaps one or two hundred million dollars (5 percent), of this should be at the top management level (FEMA).

Suggested Program

Besides commissioning of the steering committee, the development of a data base and the organization of decision information should be started to provide FEMA with up-to-date rationale for actions. This will require immediate development of: (1) a Program Assessment to define the direction, status, and schedule of research completed and in progress nationwide on the general subject of hazardous materials handling and disposal; (2) a Technical Assessment directed at defining the technical adequacy of and gaps in the overall program with recommended remedial action. What is envisioned is an assessment that would result in a program matrix and flow diagrams that could be used as a long-term management planning and programs assessment document. The Emmitsburg conference provided contact with many of the agencies from which such programmatic data and overviews should be obtained to piece together a current consensus based on existing hardware and chemical products, and current policy.

The Program and Technical Assessments should be ongoing efforts to keep FEMA abreast of hazardous materials management and control. Because the hazardous material problem is dynamic in nature, it will be important to give continuous consideration to new hazards (i.e., new chemicals) that are developed, to developments in R & D, policy changes, impact of regulations enacted, etc. As a base for maintaining pertinence of management decision capability, a format and data acquisition system should be developed that will provide continuing input; this effort should be initiated in the first year.

Concurrently with the above efforts (i.e., the organization of the steering committee, the Program and Technical Assessment efforts, and initiation of a management data base — all of which are necessary to develop a long-range plan) work should be started as soon as funds permit on some of the research needs listed in Table 1 (which have been rearranged and reproduced in Table 3, ranked, subjectively). The number of these that are funded during the upcoming fiscal year will, of course, depend on the monies available, but the management criteria for selection will

Table 3

RESEARCH NEEDS

MANAGEMENT SUPPORT

<u>Decision Information</u>

- o Program and Technical Assessments
- o Data Base and Risk Analysis
- o Regulatory
  Marking/Labeling; Classification; Documentation; Siting; Mitigation Standards; Re-entry/Reuse; Planning Requirements

<u>Training and Education</u>

- o Dissemination of Available Information
- o Development of New Courses
  Tactics; Recognition; Equipment Usage; Contingency/Evacuation Plan; Prevention/ Mitigation/Standards

FIELD OPERATIONS SUPPORT

<u>Instrumentation</u>

- o Material Identification
- o Hazard Identification (risk alarm)
- o Site Conditions

<u>Equipment</u>

- o Protective Clothing
- o Breathing Apparatus
- o Response Vehicles
- o Sampling Equipment
- o Communication

<u>Environmental</u>

- o Response Protocols
- o Health Effects of Individual Materials
- o Health Effects of Mixtures
- o Hazard of Mixtures
- o Mitigation Requirements
- o Ultimate Disposal

have to be programs that will: be of immediate benefit to the end-user — the spill response team, volunteer firemen, etc.; have a high payoff potential at minimum cost; and be highly visible at the State and local level.

Since the level of effort likely to be fundable in the first year is unknown at this time, three programs are outlined: #1 — very austere; i.e., strictly management support; #2 — somewhat more comprehensive; i.e., including some field operations, as well as management, support; and #3 — one we believe to be justifiable considering the importance and magnitude of this complex problem; i.e., providing strong R & D support of field operations, as well as strong management support, to control hazardous materials. These three program levels reflect relative priorities.

Tables 4, 5, and 6 summarize the three programs in terms of tasks, schedules, and costs. All three tables reflect the fact that the most important initial task for FEMA is to get on top of the hazardous materials problem; i.e., to make a program assessment and a technical evaluation of existing programs in all government agencies so that they can be integrated into a coherent, organized whole. This is a management necessity even with an austere program. Moreover, for FEMA to remain on top of the problem, it will be necessary to accumulate and organize pertinent information on the manufacture, handling, use, and disposal of hazardous materials. Development of a data base can be used to establish priorities for management attention, and to develop models for risk analysis and forecasting that will minimize hazards to emergency response teams and to the community at large.

TABLE 4: MINIMAL FIRST Y

Research Area	Sub Task	1980	1981	1982
				MANAGEMENT SUP
MANAGEMENT INFORMATION AND CONTROL	PROGRAMS AND TECHNICAL ASSESSMENTS	Compile summary of all ongoing programs; document objectives, methodologies, schedules; Assess merit; define overlaps, gaps, remedial action. $ 175,000	Track and update; identify progress and new problems, priorities, new directions. Assess quality, transfer technology, publicize impact. $ 200,000	Continue to track, u integrate forecastin from data base, anti problem areas from ne manufacturing; devel countermeasures. $ 2
	DATA BASE AND RISK ANALYSIS	Develop data acquisition format and compile data on incidents, causes, effects, response, economic and environmental impact, etc. $ 100,000	Expand data base: HM production, use, transportation, disposal. Initiate development of models for risk analysis, optimize preparedness. $ 250,000	Update data bases, management tools; i into tracking, fore HM problems. $ 10
	REGULATORY	As management data are developed on manufacture, use, transportation, disposal, incidents, initiate development of appropriate regulations. $ Steering Committee	→	→
TRAINING AND EDUCATION	PROGRAMS DEVELOPMENT AND TECHNOLOGY TRANSFER	Assess state of the art in tactics, recognition methods, equipment usage, contingency planning, HM release prevention. Update all response agencies. $ USFA Staff	Utilize incidents data base to develop better tactics. Identify innovative response using common equipment; develop contingency plans; transfer technology. $ 75,000	Update training cou reflect instrumenta ment, and managemen developments. $ 1
				FIELD OPERATION
INSTRUMENTATION	MATERIAL IDENTIFICATION			Development program or five most promis instruments. * $ 4
	HAZARD IDENTIFICATION (RISK ALARM)		Study state of technology; Establish threshold limits; Define indicators for reactants to be measured. $ 250,000	Implement R & D pr three instrument t $ 3
	SITE CONDITIONS		Determine types of measurements and accuracy needed. Survey instruments available. $ 30,000	Develop prototype Field test and eva $ 1

* State-of-the-art assessment under contract to LOCUS FY 197

MINIMAL FIRST YEAR PROGRAM

	1982	1983	1984	1985
MANAGEMENT SUPPORT				
ch-	Continue to track, update; integrate forecasting capability from data base, anticipate problem areas from new chemical manufacturing; develop countermeasures. $ 200,000	→ †		
c- ment s. .	Update data bases, develop management tools; integrate into tracking, forecasting HM problems. $100,000	Continue to update, improve, apply to HM management. $250,000		
	→	→		
e to se velop r	Update training courses to reflect instrumentation, equipment, and management developments. $150,000	→		
FIELD OPERATIONS SUPPORT				
	Development program for four or five most promising instruments. * $ 400,000	Field test -- evaluate -- and develop training/education program. $ 450,000	Available for distributio...	
; tants D	Implement R & D orogram three instrument types. $300,000	Field test -- evaluate -- and develop training/education program. $ 250,000	Available for distribution.	
ments ble. D	Develop prototype kit; Field test and evaluate. $100,000	Available for distribution.		

ct to LOCUS FY 1979. † Arrow signifies an ongoing effort at the same dollar level at the prior year.

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TABLE 4: MINIMAL FIRST Y

Research Area	Sub Task	1980	1981	1
		FIELD OPERATION		
EQUIPMENT	PROTECTIVE CLOTHING		Survey existing items -- costs, availability, limitations; Assess needs for 1) supersuit; 2) throwaway(one-use) suit. Establish standards. $ 80,000	Develop proto protective cl
	BREATHING APPARATUS		Survey available equipment; assess need for interchangeability regulations. Assess need for new technology. $ 40,000	Implement R & field test.
	SAMPLING EQUIPMENT			
	RESPONSE VEHICLES			
	COMMUNICATION EQUIPMENT			
ENVIRONMENTAL	HEALTH EFFECTS OF INDIVIDUAL HAZARDOUS MATERIAL (EPIDEMIOLOGY)			
	HEALTH EFFECTS OF MIXTURES (EPIDEMIOLOGY)			
	NON-TOXIC HAZARDS OF MIXTURES			
	ULTIMATE DISPOSAL			

IMAL FIRST YEAR PROGRAM (CONTD)

	1982	1983	1984	1985
LD OPERATIONS SUPPORT (contd)				
ts, it;	Develop prototype protective clothing. $250,000	Field test and evaluate. $ 60,000	Available for Distribution.	
abil- ed	Implement R & D program and field test. $ 40,000	Available for distribution.		
		Survey currently available sampling equipment and technology. $100,000	Develop field-type instrumentation for detecting trace quantities of HM. $300,000	Field test -- evaluate -- and develop training/education program. $ 150,000
		Survey existing response vehicles -- limitations, costs, and geographic distribution. Assess need for remote control & manned vehicles. $100,000	Establish standards for improved vehicles and conduct R & D program. $300,000	Field test and evaluate, $ 600,000
		Evaluate existing technology Assess need for helmet radio -- satellite links -- scramble system. Establish equipment standards. $200,000	Initiate two or three R & D programs. $250,000	Field test and evaluate. $ 200,000
			Identify principal health hazards by material; cancer, cell deterioration, etc. Start with most hazardous material. $ 300,000	Identify pathways into body — ingestion, inhalation, absorption — the statistics thereof, and organs affected. $ 500,000
			Determine interaction effects of binary mixtures of common HM Identify disproportionate health effects; i.e., worsened or nullified. $ 100,000	Examine spill and controlled mixing-mechanics for impact of reaction process, effect on pathways to body, etc. $ 300,000
			Determine mixtures of common chemicals that become flammable, combustible, explosive. $ 200,000	Define common chemicals, materials, reagents that can and that cannot be safely mixed. $ 80,000
			Survey disposal techniques, materials, quantities, procedures Assess cumulative effects. Evaluate neutralization. Identify optimum disposal. $ 250,000	Define optimum disposal methods for HM (starting with most common). Initiate permanent neutralization development studies. $ 250,000

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TABLE 5: INTERMEDIATE FIRST

Research Area	Sub Task	1980	1981	1982
		MANAGEMENT SUP		
MANAGEMENT INFORMATION AND CONTROL	PROGRAMS AND TECHNICAL ASSESSMENTS	Compile summary of all ongoing programs; document objectives, methodologies, schedules; Assess merit; define overlaps, gaps, remedial action. $ 175,000	Track and update; identify progress and new problems, priorities, new directions. Assess quality, transfer technology, publicize impact. $ 200,000	Continue to track, u integrate forecastin from data base, anti problem areas from ne manufacturing; devel countermeasures. $ 2
	DATA BASE AND RISK ANALYSIS	Develop data acquisition format and compile data on incidents, causes, effects, response, economic and environmental impact, etc. $ 100,000	Update data bases, develop management tools; integrate into tracking, forecasting HM problems. $ 100,000	Expand data base: tion, use, transpor disposal. Initiate of models for risk optimize preparedne $ 25
	REGULATORY	As management data are developed on manufacture, use, transportation, disposal, incidents, initiate development of appropriate regulations. $ Steering Committee	→	→
TRAINING AND EDUCATION	PROGRAMS DEVELOPMENT AND TECHNOLOGY TRANSFER	Assess state of the art in tactics, recognition methods, equipment usage, contingency planning, HM release prevention. Update all response agencies. $ USFA Staff	Utilize incidents data base to develop better tactics. Identify innovative response using common equipment; develop contingency plans; transfer technology. $ 75,000	Update training cou reflect instrumenta ment, and managemen developments. $ 1
		FIELD OPERATIONS		
INSTRUMENTATION	MATERIAL IDENTIFICATION	Development program for four or five most promising instruments. * $ 400,000	Field test -- evaluate -- and develop training/education program. $ 450,000	Available for dist
	HAZARD IDENTIFICATION (RISK ALARM)		Study state of technology; Establish threshold limits; Define indicators for reactants to be measured. $ 250,000	Implement R & D pro three instrument t $ 3
	SITE CONDITIONS		Determine types of measurements and accuracy needed. Survey instruments available. $ 30,000	Develop prototype Field test and eva $ 1

* State-of=the-art assessment under contract to LOCUS FY 1979.

EDIATE FIRST YEAR PROGRAM

1982	1983	1984	1985
MANAGEMENT SUPPORT			
Continue to track, update; integrate forecasting capability from data base, anticipate problem areas from new chemical manufacturing; develop countermeasures. $ 200,000	→ †		
Expand data base: HM production, use, transportation, disposal. Initiate development of models for risk analysis, optimize preparedness. $ 250,000	Continue to update, improve, apply to HM management. $ 250,000		
→	→		
Update training courses to reflect instrumentation, equipment, and management developments. $150,000	→		
ELD OPERATIONS SUPPORT			
Available for distribution.			
Implement R & D program three instrument types. $ 300,000	Field test -- evaluate -- and develop training/education program. $ 250,000	Available for distribution.	
Develop prototype kit; Field test and evaluate. $ 100,000	Available for distribution.		

LOCUS FY 1979. † Arrow signifies an ongoing effort at the same dollar level as the prior year.

TABLE 5: INTERMEDIATE

Research Area	Sub Task	1980	1981	
		FIELD OPERATI		
EQUIPMENT	PROTECTIVE CLOTHING		Survey existing items -- costs, availability, limitations; Assess needs for 1) supersuit; 2) throwaway(one-use) suit. Establish standards. $ 80,000	Develop pro protective
	BREATHING APPARATUS		Survey available equipment· assess need for interchangeability regulations. Assess need for new technology. $ 40,000	Implement R field test.
	SAMPLING EQUIPMENT			Survey curr sampling eq technology.
	RESPONSE VEHICLES			Survey exist vehicles -- and geograph Assess need & manned ve
	COMMUNICATION EQUIPMENT			Evaluate ex Assess need satellite l system. Es standards.
ENVIRONMENTAL	HEALTH EFFECTS OF INDIVIDUAL HAZARDOUS MATERIALS (EPIDEMIOLOGY)			
	HEALTH EFFECTS OF MIXTURES (EPIDEMIOLOGY)			
	NON-TOXIC HAZARDS OF MIXTURES			
	ULTIMATE DISPOSAL			

NTERMEDIATE FIRST YEAR PROGRAM (CONTD)

	1982	1983	1984	1985
IELD OPERATIONS SUPPORT (contd)				
osts, suit;	Develop prototype protective clothing. $250,000	Field test and evaluate. $ 60,000	Available for Distribution.	
; geabil- need	Implement R & D program and field test. $ 40,000	Available for distribution.		
	Survey currently available sampling equipment and technology. $100,000	Develop field-type instrumentation for detecting trace quantities of HM. $300,000	Field test -- evaluate -- and develop training/education program. $ 150,000	Available for distribution.
	Survey existing response vehicles -- limitations, costs, and geographic distribution. Assess need for remote control & manned vehicles. $100,000	Establish standards for improved vehicles and conduct R & D program. $300,000	Field test and evaluate. $ 600,000	Available for distribution.
	Evaluate existing technology Assess need for helmet radio -- satellite links -- scramble system. Establish equipment standards. $200,000	Initiate two or three R & D programs. $250,000	Field test and evaluate. $ 200,000	Available for distribution.
		Identify principal health hazards by material; cancer, cell deterioration, etc. Start with most hazardous material. $ 300,000	Identify pathways into body — ingestion, inhalation, absorption — the statistics thereof, and organs affected. $ 500,000	Establish maximum permissible concentrations in environment. Define requirements for tracking. $100,000
		Determine interaction effects of binary mixtures of common HM Identify disproportionate health effects; i.e., worsened or nullified. $ 100,000	Examine spill and controlled mixing-mechanics for impact of reaction process, effect on pathways to body, etc. $ 300,000	Identify and develop neutralizing techniques; Develop controlling regulations for proximities if hazardous pairs form. $ 80,000
		Determine mixtures of common chemicals that become flammable, combustible, explosive. $ 200,000	Define common chemicals, materials, reagents that can and that cannot be safely mixed. $ 80,000	Develop management controls for transporting, dumping, etc. $100,000
		Survey disposal techniques, materials, quantities, procedures Assess cumulative effects. Evaluate neutralization. Identify optimum disposal. $ 250,000	Define optimum disposal methods for HM (starting with most common). Initiate permanent neutralization development studies. $ 250,000	Identify treatment methods, procedures to reduce cumulative effects of HM disposal to innocuous levels. $ 250,000

2

TABLE 6: COMPREHENSIVE FIRS

Research Area	Sub Task	1980	1981	1982
				MANAGEMENT SUPPORT
MANAGEMENT INFORMATION AND CONTROL	PROGRAMS AND TECHNICAL ASSESSMENTS	Compile summary of all ongoing programs; document objectives, methodologies, schedules; Assess merit; define overlaps, gaps, remedial action. $ 175,000	Track and update; identify progress and new problems, priorities, new directions. Assess quality, transfer technology, publicize impact. $ 200,000	Continue to track, u integrate forecastin from data base, anti problem areas from ne manufacturing; devel countermeasures. $ 20
	DATA BASE AND RISK ANALYSIS	Develop data acquisition format and compile data on incidents, causes, effects, response, economic and environmental impact, etc. $ 100,000	Update data bases, develop management tools; integrate into tracking, forecasting HM problems. $ 100,000	Expand data base: H tion, use, transpor disposal. Initiate of models for risk a optimize preparedne $ 25
	REGULATORY	As management data are developed on manufacture, use, transportation, disposal, incidents, initiate development of appropriate regulations. $ Steering Committee	→	→
TRAINING AND EDUCATION	PROGRAMS DEVELOPMENT AND TECHNOLOGY TRANSFER	Assess state of the art in tactics, recognition methods, equipment usage, contingency planning, HM release prevention. Update all response agencies. $ USFA Staff	Utilize incidents data base to develop better tactics. Identify innovative response using common equipment; develop contingency plans; transfer technology. $ 75,000	Update training cou reflect instrumenta ment, and managemen developments. $ 1
				FIELD OPERATIONS SU
INSTRUMENTATION	MATERIAL IDENTIFICATION	Development program for four or five most promising instruments. * $ 400,000	Field test -- evaluate -- and develop training/education program. $ 450,000	Available for distr
	HAZARD IDENTIFICATION (RISK ALARM)	Study state of technology; Establish threshold limits; Define indicators for reactants to be measured. $ 250,000	Implement R & D program three instrument types. $ 300,000	Field test -- evalu develop training/ed program. $ 2
	SITE CONDITIONS	Determine types of measurements and accuracy needed. Survey instruments available. $ 30,000	Develop prototype kit; Field test and evaluate. $ 100,000	Available for dist

* State-of-the-art assessment under contract to LOCUS FY 1979.

OMPREHENSIVE FIRST YEAR PROGRAM

	1982	1983	1984	1985
ANAGEMENT SUPPORT				
ech-	Continue to track, update; integrate forecasting capability from data base, anticipate problem areas from new chemical manufacturing; develop countermeasures. $ 200,000	→ †		
e	Expand data base: HM production, use, transportation, disposal. Initiate development of models for risk analysis, optimize preparedness. $ 250,000	Continue to update, improve, apply to HM management. $250,000		
	→	→		
e to se velop r	Update training courses to reflect instrumentation, equipment, and management developments. $150,000	→		
ELD OPERATIONS SUPPORT				
nd	Available for distribution.			
	Field test -- evaluate -- and develop training/education program. $ 250,000	Available for distribution.		
	Available for distribution.			

to LOCUS FY 1979. † Arrow signifies an ongoing effort at the same dollar level as the prior year.

TABLE 6: COMPREHENSIVE FIRST

Research Area	Sub Task	1980	1981	19
		FIELD OPERATIONS		
EQUIPMENT	PROTECTIVE CLOTHING	Survey existing items -- costs, availability, limitations; Assess needs for 1) supersuit; 2) throwaway(one-use) suit. Establish standards. $ 80,000	Develop prototype protective clothing. $ 250,000	Field test and $
	BREATHING APPARATUS	Survey available equipment; assess need for interchangeability regulations. Assess need for new technology. $ 40,000	Implement R & D program and field test. $ 40,000	Available for d
	SAMPLING EQUIPMENT	Survey currently available sampling equipment and technology. $ 100,000	Develop field-type instrumentation for detecting trace quantities of HM. $ 300,000	Field test -- e develop trainin program. $
	RESPONSE VEHICLES	Survey existing response vehicles -- limitations, costs, and geographic distribution. Assess need for remote control & manned vehicles. $ 100,000	Establish standards for improved vehicles and conduct R & D program. $ 300,000	Field test and
	COMMUNICATION EQUIPMENT	Evaluate existing technology Assess need for helmet radio -- satellite links -- scramble system. Establish equipment standards. $ 200,000	Initiate two or three R & D programs. $ 250,000	Field test and
ENVIRONMENTAL	HEALTH EFFECTS OF INDIVIDUAL HAZARDOUS MATERIALS (EPIDEMIOLOGY)	Identify principal health hazards by material; cancer, cell deterioration, etc. Start with most hazardous material. $ 300,000	Identify pathways into body — ingestion, inhalation, absorption — the statistics thereof, and organs affected. $ 500,000	Establish maxi concentrations Define requirem tracking.
	HEALTH EFFECTS OF MIXTURES (EPIDEMIOLOGY)	Determine interaction effects of binary mixtures of common HM Identify disproportionate health effects; i.e., worsened or nullified. $ 100,000	Identify and develop neutralizing techniques; Develop controlling regulations for proximities if hazardous pairs form. $ 80,000	Examine spill mixing-mechani reaction proce pathways to bo
	NON-TOXIC HAZARDS OF MIXTURES	Determine mixtures of common chemicals that become flammable, combustible, explosive. $ 200,000	Define common chemicals, materials, reagents that can and that cannot be safely mixed. $ 80,000	Develop manager for transporti
	ULTIMATE DISPOSAL		Survey disposal techniques, materials, quantities, procedures Assess cumulative effects. Evaluate neutralization. Identify optimum disposal. $ 250,000	Define optimum for HM (starti common). Init neutralization studies.

PREHENSIVE FIRST YEAR PROGRAM (CONTD)

	1982	1983	1984	1985
FIELD OPERATIONS SUPPORT (contd)				
000	Field test and evaluate. $ 60,000	Available for Distribution.		
and 000	Available for distribution.			
strumen- trace 000	Field test -- evaluate -- and develop training/education program. $ 150,000	Available for distribution.		
for . 000	Field test and evaluate, $ 600,000	Available for distribution.		
R & D 000	Field test and evaluate. $ 200,000	Available for distribution.		
to body — , absorp- cs thereof, 0,000	Establish maximum permissible concentrations in environment. Define requirements for tracking. $ 100,000	Define response tactics where tracking shows limits are exceeded.		
neutraliz- regulations zardous ,000	Examine spill and controlled mixing-mechanics for impact of reaction process, effect on pathways to body, etc. $ 300,000	Disseminate information developed.		
cals, mate- can and y mixed. 0,000	Develop management controls for transporting, dumping, etc. $ 100,000	Promulgate.		
iques, , procedures ects. on. osal. 0,000	Define optimum disposal methods for HM (starting with most common). Initiate permanent neutralization development studies. $ 250,000	Identify treatment methods, procedures to reduce cumulative effects of HM disposal to innocuous levels. $ 250,000	Establish optimum/maximum values for quantities of HM disposal vs material, method, location. $ 500,000	Define requirement for mobile units to neutralize HM in dumps. $ 500,000

2

Appendix A

LIST OF EMMITSBURG CONFERENCE ATTENDEES

June 25-26, 1979

LIST OF EMMITSBURG CONFERENCE ATTENDEES

Name	Organization
Benjamin, Irwin	National Bureau of Standards
Blair, Louis	Office of Science & Technology Policy
Clark, Joe	FEMA
Clarke, F.	National Bureau of Standards
Combs, Gerald L.	Department of Energy
Crisman, H.C., Jr.	Jackson County Planning Commission
Custer, Richard	DOC, National Bureau of Standards
Dick, Marshall	Environmental Protection Agency
Fink, Marvin	Drug Enforcement Administration
Hanbury, Bill	FEMA
Harton, Erskine	U.S. Department of Transportation
Holmes, Robert	Environmental Protection Agency
Kay, Fredie	U.S. Conference of Mayors, Emergency Preparedness Staff
Kerr, J.W.	DCPA
Kronenberg, Stanley	ERADCOM, U.S. Army
Lafornara, Joseph P.	Environmental Protection Agency
Lee, Myra	Multnomah County Office of Emergency Services
Loucks, Charles S.	Department of Transportation
Manno, D.	National Fire Academy
Mastracci, Michael L.	Environmental Protection Agency
McLain, Clifford	DCPA
Meyer, George C.	DCPA
Miller, Raymond	U.S. Coast Guard, National Response Center
Mitchell, G.D.	National Fire Academy
Moore, Michael R.	U.S. Department of Labor
Powell, R. Wayne	National Fire Academy
Rex, John	Air Force Geophysics Lab.

Name	Organization
Richitt, Don	U.S. Customs
Royce, Douglas L.	U.S. Army Environmental Hygiene Agency
Sacco, Bill	Chemical Systems Lab., Aberdeen Proving Ground
Silvestri, Achille	Chemical Systems Lab., Aberdeen Proving Ground
Stevens, Warren E.	Montgomery County Department Fire/Rescue
Sunday, Arthur	DES, Jackson County
Thomas, James A.	Federal Preparedness Agency
Thompson, Donald L.	HEW/FDA
Tovey, Henry	USFA/National Fire Data Center
West, David	NIOSH
Wilder, Ira	Environmental Protection Agency
Wineman, Phil	U.S. Treasury/BATF

Contractors

Dillman, Robert	Locus, Inc.
Harker, R.A.	Systan, Inc.
Harris, David E.	Locus, Inc.
Melvold, Robert	Rockwell International
Wilton, Chuck	Scientific Service, Inc.
Zaccor, James V.	Scientific Service, Inc.

Appendix B

SUMMARY OF HAZARDOUS MATERIALS CONFERENCE

at the National Fire Academy, Emmitsburg, MD

June 25 and 26, 1979

SUMMARY OF HAZARDOUS MATERIALS CONFERENCE

This conference was sponsored by the Defense Civil Preparedness Agency (now part of the Federal Emergency Management Agency) in order to obtain input from other interested government agencies to help establish priorities for FEMA-sponsored research activities in the hazardous materials area. The meeting was attended by 38 representatives of 21 Federal and local government agencies and 6 DCPA contractor representatives who, after an opening keynote session, divided into four workshops dealing with Short-Term Needs; Long-Term Needs; Devices, Technology, Hardware; and Prevention and Cleanup. A concluding session on the second day involved reports from the workshops and a general discussion by all participants.

While instrumentation was the major focus of the conference, discussions were not limited solely to problems solvable by means of better instrumentation/equipment. In fact, problems faced by first responder were discussed in general, with emphasis on conflicts between the emergency, or "acute", phase and the long-term, non-emergency phase.*

<u>Specific Concerns of First Responder in Acute Situations That Were Discussed</u>

- o Accidental fires and explosions, concurrent with the hazardous materials problem.
- o Lack of necessary technology or <u>the time to apply the technology</u> in an emergency.
- o Material identification: Need for a means to identify the material to classify the problem and tie an appropriate control response to

* Ed. Note: Implicit in this difference is the possibility that the emergency response can aggravate the long-term problem, and conversely, that concern with long-term consequences may inhibit the most effective emergency response.

it. Instrumentation approach: — a portable detection unit on every fire truck; alternative — a system for labeling.

- o Material identification: elimination of conflicting information from different sources — need for coordination geared to local level.
- o Lines of responsibility: Who's in charge?
- o Variation in expertise and information at local levels — a function of experience, hence frequency of incidents; small-town fire departments may handle many types only once every couple of years.

Specific Long-term, Non-emergency Concerns That Were Identified:

- o Need for management coordination.
- o Jurisdictional disputes — who has prime responsibility — local, State or Federal:
- o Material identification — example of cannister in a dump with undecipherable or missing labels: how to sample and identify.
- o Ultimate disposal — how to dispose of material once it has been cleaned up.
- o Data collection — need for, and applications of, feedback from incidents; how to ensure accuracy and completeness of data collected.
- o Need to simplify identification analyses to reduce testing to a manageable level.
- o How clean is clean: What are acceptable levels of risk?
- o Data-centered management approach to facilitate better deployment of manpower and equipment — how to implement? (A jurisdictional or political question.)

General Concerns:

- o Two levels of instrumentation appear needed — one for first responders, another for later sampling and monitoring.

- How to get instrumentation developed and <u>into users' hands</u> (the latter a marketing and training issue).
- Adequate protection for the first responder and for the research technician who goes in to take samples in non-emergency situation.

At the conclusion of the conference, participants were asked to complete a questionnaire. The questionnaire asked first for the statutory or other authority of the agency to conduct hazardous materials programs and the resources committed to such programs, then for information on R & D, planning, or programs on hazardous materials either currently being conducted or needed, and for comments on additional issues and on the conference itself. A detailed summary of the responses to the latter questions is appended. Responses were received from 18 individuals representing: FEMA (2); NFA (2); EPA (2); DOT (1); OSHA (1); FPA (1); U.S. Environmental Hygiene Agency (1); Chemical Systems Laboratory, Aberdeen Proving Ground (1); U.S. Conference of Mayors (1); two counties (Multnomah, OR and Montgomery, MD); three contractors (LOCUS, Systan, Rockwell).

Questionnaire Summary

Question 3: Please list any R & D, planning, or other programs on hazardous materials

Current:

Courses

"Disaster Planning" for fire service (NFA)

"Decision Making Process for Handling Hazardous Materials" (Montgomery County, MD)

Segments of other courses are related to hazardous material identification (Montgomery County, MD)

Training course development (DOT)

Monitoring/Detection

Chemical and biological detection and warning (Chemical Systems Lab., Aberdeen Proving Ground)

Environmental monitoring (Rockwell)

Management/Planning

Development of an HM management system that incorporates a risk analysis; accesses an information retrieval system; establishes a response vehicle; and coordinates a training program (Multromah County, OR)

Countywide disaster plan for instant implementation (Montgomery County, MD)

Risk assessment, economic and environmental impact analysis, hazard classification (DOT)

Equipment/Packaging/Containers

HM packaging/containers; component failure analyses, tank truck and tank car integrity (DOT)

Development and demonstration of new or improved equipment, devices and systems for the prevention, detection, identification, containment, control, removal, cleanup and disposition of spills or acute releases of oil and hazardous polluting substances (EPA)

Respirator (SCBA) programs (with NIOSH) (OSHA)

Safety

Safety factors affecting pipelines in severe environments (arctic, offshore, deep water) (DOT)

Accident analysis, HM emergency response information (DOT)

Questionnaire Summary

Question 3: (contd) Please list any R & D, planning or other programs in hazardous materials

Other

Liquefied energy gases (DOT)

Grain dust investigations (with National Academy of Sciences) (OSHA)

Planned:

Courses

Need for 20 courses in areas of hazardous materials (NFA)

Monitoring/Detection

Continuation of present programs (Aberdeen, Rockwell, et al.)

Management/Planning

Development of an appropriate hazardous materials ordinance and enforcement program (Multnomah County, OR)

Update all contingency planning (Montgomery County, MD)

Utilize intergovernmental resources in coordinated effort (Montgomery County, MD)

Equipment/Packaging/Containers

Continuation of present DOT programs (DOT)

Storage facilities and containers for hazardous materials (OSHA)

Other

Continued efforts with dust explosions (OSHA)

Measurements of hazardous environments in confined spaces (OSHA)

Adaptation of spill technology for application to hazardous materials waste problem at abandoned industrial disposal sites (dump sites) (EPA)

Questionnaire Summary

Question 4: Please list any R & D, planning or other programs that should be conducted by your agency or other Federal agencies. (List or number in order of priorities if possible)

Of the 18 questionnaires received, five had no response to this question, and two referred to the report from Workshop 4 in their responses. Responses took two forms: 1) listing of programs (generally already existing) that should be with a particular agency — e.g., DOT responsible for transportation safety — and 2) listing of programs that are needed (i.e., generally not now existing) without specifying any agency.

Programs that should be with a particular agency

with DOT:

Transportation safety programs

Training programs for other agencies on subjects of mutual interest

with USFA:

Data gathering from fire services; clearing house for information

Training courses for fire and affiliated personnel

Use of facilities for teaching courses, seminars, etc.

with Chemical Systems Laboratory (Aberdeen)

Chemical and biological detection and warning

Conference of Mayors

Coordination/cooperation within a city government

Programs that are needed (listed in order of frequency of mention)

1. Data system (see Workshop 4) and resource identification coordination (3)
2. Labeling/placarding requirements: a uniform marking of shipments; more definitive means of commodity identification (3) (One response suggested this should be responsibility of DOT.)
3. Coordination/cooperation between Federal, State, and local governments, and interagency communications (3)
4. Effective enforcement program (or stricter enforcement) for regulations (3)

Questionnaire Summary

Question 4: (contd) Please list any R & D, planning or other programs that should be conducted by your agency or other Federal agencies.

5. Additional training courses (2)
6. Equipment/Instrumentation (2)
   - Greater emphasis on development of devices, equipment, procedures, manuals, etc., for first-on-the-scene personnel.
   - Sophistication and miniaturization of hazardous materials detectors for employee safety and for investigatory personnel.
7. Incident management. Standardization of response protocols (1)

Question 5: Please note any additional facts, issues, questions or comments that you believe would be helpful to FEMA management in establishing hazardous materials programs

FEMA's Role

- o FEMA should remember that the rules of Federal involvement in hazardous materials emergencies are set down in the National Oil and Hazardous Substances Contingency Plan, which sets up a structure for the coordination of Federal resources and responsibilities not only during spills or potential spills, but also during presidentially declared disasters. FEMA would do well to coordinate its efforts under this plan lest it run afoul of other agencies. Conference was an excellent first step in such coordination.
- o Mechanism needed for interested groups to exchange views and accomplishments on a periodic basis. Provide FEMA with a strong leadership role in this area.
- o Insure information flow between various elements of FEMA working in similar areas.
- o Continue to coordinate with other agencies (e.g., EPA) who are heavily involved in this area.

Other Agencies/Contractors

- o Do not overlook National Fire Academy as a delivery mechanism
- o Because of background, Chemical Systems Lab (Aberdeen Proving Ground) can be a focal point in directing programs in chemical detection and warning.

Questionnaire Summary

Question 5: Please note any additional facts, issues, questions or comments (contd) that you believe would be helpful to FEMA management in establishing hazardous materials programs

Other Agencies/Contractors (contd)

- Training in hazard assessment through the Fire Academy.
- Utilize existing courses, equipment etc., with some modification, but do not reinvent the wheel. There must be an end to parochialism among emergency forces.
- FEMA might consider, with only several 100 k funding available, the contracting of a couple of programs designed to fabricate a detection system from commercially available hardware and components. Recognizing that devices are to be hand-held and portable, design criteria become critical, and will have to be realistically set in light of limited funding.

Issues

- Issue of WHO IS IN CHARGE very important — should be worked out before an incident (communication/coordination/authority).
- Guidance is needed for all levels of government.
- Planning should emphasize a comprehensive program rather than any one specific element.
- Management needs a more realistic feel for the problems of the first responder in order to develop meaningful plans of coordination.
- For the proper response, we must know the material to identify the hazard. Depth to which identification must go may simply be the functional, or active, group in the molecule.

Questionnaire Summary

Question 6: Was this conference useful and how might the next one be improved?

Very useful/excellent —7; useful — 7; noncommittal or no response — 3; not useful — 1.

Comments on meeting

- Very helpful to start a Federal dialog in a difficult area.

- Well run; objectives stated at beginning and meeting structured to meet them.

- First responders were able to impart first-hand knowledge and experience to those individuals largely responsible for implementation and R & D.

- Purpose of meeting was not clear and assignments to workshops not well defined. Therefore outcome was also very general.

- Helped to establish interfacing of several disciplines, and this is vital for technology and other information interchange. Excellent opportunity to meet a number of key persons in the emergency response R & D and other areas; to learn what is going on; to provide encouragement; and certainly it is always good to have the opportunity to suggest directions for R & D. That some one is seriously looking at the instrumentation problem re hazardous materials detection (identification) is very encouraging, because it is the most significant missing portion of the emergency response picture. It is the limiting factor.

- Workshop approach was especially good (2); good interchange of ideas.

- Funneled the various problems into a common bucket and got the various groups represented thinking about the "Big" picture, as opposed to their own corner of it.

- Beautiful place to hold it.

- Helped focus attention on proper planning, need for additional knowledge on incidents, need for better clothing for on-scene personnel, obvious need for a hand-held device for use by first personnel on scene, development of proper disposal techniques, resolution of chronic waste problems, and identification, locating and quantification of hazardous materials in waterways by in-situ sensors as well as portable systems brought to the scene upon notification of incident.

Questionnaire Summary

Question 6: (contd) Was this conference useful and how might the next one be improved?

Suggestions for Improvement

1. More advance notice (4)
   - With more explicit intentions so that participants could bring salient literature.
   - Helpful to have clearer identification of specific objectives and desired product.
2. Advance preparation (2)
   - Listing of attendees at beginning of meeting and introductory guidelines (felt I walked into middle of discussion).
   - Group chairmen meet together ahead of time to get clearer idea of where group sessions ought to be going.
3. More of same type of meeting of the minds (3)
   - Useful to determine progress and direction as a result of this conference.
   - Similar conference in a year or so to indicate extent to which the present one spurred developments.
4. Workshop (2)
   - Allow participants to rotate through workshops.
   - Give workshops two chances to get together (first day, and shorter time second day to pull it all together, then go to plenary session).
5. Should be a better and more detailed "cross-briefing" to the plenary session at the end.
6. More time than one-half day should be devoted to developing issues.
7. More time should be given to defining the problems than to proposing solutions.

Appendix C

SUMMARY OF COMMENTS RECEIVED ON THE PLANNING DOCUMENT

SUMMARY OF COMMENTS RECEIVED ON THE PLANNING DOCUMENT

Some respondents pointed out the need to assess the state of the art in instrumentation, and to find out what research programs were already underway. These important needs have been recognized (see Tables 4, 5 and 6) in Section 3.

Other respondents mentioned ongoing programs by agencies, which this report's recommendations would duplicate. Reiterating, the purpose of this report has not been to assess the current status of ongoing programs, but to identify what pieces are involved in the hazardous materials puzzle. Many pieces are being studied, but a survey and technical assessment of all current work is a fairly large task in itself. Note that Table 4 of the planning document is the recommended minimum first year program to enable FEMA to start the difficult task of Emergency Management; just such a technical assessment is the first item listed on the minimum program.

There were several comments on the need for ranking programs and specific needs. Ranking is necessary; moreover, a means for making decisions is the essence of management. Unfortunately, the data and methodologies needed to determine priorities have yet to be developed. Perhaps if they had been, the hazardous materials management problem would not have fallen so far behind. We believe the creation of FEMA might have been at least partly prompted by the apparent need for more coordinated planning.

Another respondent observed that detection and monitoring were stressed at the expense of control and cleanup. Quite possibly this is true. There often seems to be a need for detection and monitoring instrumentation before cleanup can begin (the Chemical Control Corp. is an example). A related comment suggested that, at the scene of a disaster, the rapid identification of the proper response is preferable to the rapid identification of the material. This would certainly be ideal, but might be easier to accomplish if the material were identified first. The point is well taken, however, that it is the proper response that is being sought, and the suggestion that the material assessment output feed directly into a response protocol I.D. system should be kept in mind.

Another respondent was concerned that the suggestion for coding and detecting hazardous materials by sense of smell using added recognizable odors (as is done with natural gas) might prove dangerous. His concern that response personnel would remove their SCBA's to detect and identify materials must definitely be factored into the assessment of this idea.

Finally, a respondent suggested that FEMA's role should be to encourage industry to develop contingency plans and hardware for hazardous materials disasters. This may be a most promising direction, which FEMA will be better able to pursue once it gets a picture of what is going on and what can reasonably be done before they can determine where to act.

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PLANNING DOCUMENT FOR HAZARDOUS MATERIALS RESEARCH — Unclassified

Scientific Service, Inc., Redwood City, CA, July 1980 — 68 pages
Contract No. DCPA01-79-C-0239, Work Unit 2321C

The report discusses research needed to improve the management and control of hazardous materials.

Input was derived largely from material discussed at a conference comprising representatives of government agencies involved in hazardous materials control and management. Conference topics encompassed: instrumentation for material and for hazard identification; equipment for operations, communication, and safety; training and education, and regulatory and environmental aspects and issues.

The objective was to develop a research program plan, based on practical needs, that could serve as the nucleus to foster evolution of an integrated effort among the agencies involved in the complex problem of managing and controlling hazardous materials. To provide a focal point for further action, areas of concern brought up at the conference are discussed and some specific programs and funding levels suggested. The latter are summarized briefly in tables included at the end of the main text.

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