U.S. Department
of Transportation
United States
Coast Guard

NATIONAL PLAN FOR ATON BATTERY RECOVERY AND DISPOSAL

COMDTINST 16478.12
1995

U.S. Department of Transportation

United States Coast Guard

Commandant (G-ECV)
United States Coast Guard

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COMMANDANT INSTRUCTION 16478.12

Subj: NATIONAL PLAN FOR ATON BATTERY RECOVERY AND DISPOSAL

Ref: (a) COMDTINST 16478.10 ATON BATTERY RELEASES
(b) COMDTINST M10560.4A CG DIVING POLICIES & PROCEDURES
(c) COMDTINST 16478.11 ATON BATTERY TRACKING SYSTEM
(d) COMDT (G-CCS) ltr 5892 of 26 Nov 93 (NOTAL)
(e) COMDTINST M16500.3A ATON TECHNICAL MANUAL
(f) COMDTINST M16478.1B HAZARDOUS WASTE MANAGEMENT MANUAL
(g) ALDIST 032-95 DRMS ATON BATTERY DISPOSAL

Ref: (a) COMDTINST 16478.10 ATON BATTERY RELEASES

1. PURPOSE. This instruction promulgates the overall strategy, general policies and procedures to begin widespread, systematic recoveries of previously lost ATON batteries at fixed lighted aid sites. Procedures for new battery losses are contained in reference (a).

2. ACTION. District commanders, commanders of maintenance and logistics commands, commanding officers of headquarters units, Commander, Coast Guard Activities Europe shall comply with the provisions of this instruction.

3. DISCUSSION.

a. Recovery of lost aid to navigation (ATON) batteries from the environment is a priority for the U.S. Coast Guard. Although an objective assessment conducted by the Volpe Center (Enclosure (1)) found no significant environmental or human health effects associated with lost primary batteries, these batteries are a waste for which the Coast Guard is factually and legally responsible.

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b. Lost and discarded ATON batteries tarnish the Coast Guard's public image as an environmental steward and as the nation's premier maritime law enforcement agency. As set forth in the Commandant's Environmental Policy Statement, the Coast Guard must be a leader in ensuring that its vessels, facilities, operations and people fully comply with environmental laws. Our own "house" and actions must be in order to ensure continued public and Congressional support to carry out our missions.

4. GENERAL POLICIES

a. The Coast Guard is unequivocally committed to recovering and properly disposing of lost batteries found at ATON sites in the navigable waters and on adjacent shorelines of the United States. The only exceptions are ATON sites where, with concurrence of the affected state or other government resource manager, recovery would result in greater environmental injury, or where conditions preclude safe recovery.

b. The Coast Guard will request funds from Congress to fulfill this commitment. Except for recoveries made in the course of routine operations, costs will be paid through the Coast Guard's Environmental Compliance and Restoration (EC&R) appropriation as required by Federal law. Due to annual funding limitations and other environmental compliance requirements, recoveries will be made over a multi-year period.

c. The Coast Guard will work cooperatively with state regulators (or resource managers from other governmental agencies as appropriate) to develop recovery plans and schedules that satisfy legal requirements within available resources. District Commanders (oan), have the lead for state liaison and will direct the planning and recovery effort, in partnership with their servicing Civil Engineering Unit (CEU). CEU's have both contracting and environmental compliance technical expertise not normally available on district staffs.

d. The Volpe National Transportation Systems Center has prepared a Priority Ranking Plan (Enclosure (2)) for existing fixed lighted ATON sites. Sites are individually ranked, then placed in five priority categories based on their potential for having large concentrations of batteries and proximity to populated areas and sensitive habitats. District recovery plans

should, to the greatest extent allowed by state regulators and operational efficiency, address ATON sites in priority order.

e. Terrestrial recoveries will normally be done by appropriately trained and equipped Coast Guard personnel. Contractors may be used where the scope of work or logistics make contracting more appropriate. Aquatic recoveries will generally be done by qualified contractors, but properly trained military or government divers may be used when available and permitted by reference (b).

f. Recovered intact primary batteries and hazardous remnants will be properly handled, packaged, transported, stored and disposed of as hazardous waste in accordance with applicable laws and regulations.

g. Based on the scientific data collected, the Coast Guard will seek concurrence from regulators that scarce resources are best used for battery recovery and loss prevention, rather than further study and active remediation of potentially contaminated soils and sediment. This strategy reflects the principles of the EPA's 1994 Contaminated Sediment Management Strategy, which calls for control and removal of point sources and sediment restoration through natural processes at sites with low levels of contamination.

h. The Volpe Priority Ranking Plan does not address secondary batteries lost due to knock-downs, weather and vandalism. These losses should be reported in accordance with reference (a). Batteries that cannot be recovered by CG units should be included on the EC&R project backlog for future recovery as appropriate.

5. BACKGROUND

a. The problem of lost ATON batteries has been and will continue to be addressed in three ways:

- Reducing reliance on primary batteries.
- Preventing battery losses.
- Recovering lost batteries as they are discovered or reported.

b. Systematic surveys and battery recoveries at fixed, lighted ATON sites are the latest step in this effort. Past actions include:

1973: The Commandant instituted a policy forbidding on-site disposal of ATON batteries, requiring that they be recycled or properly disposed of.

1980's: The vast majority of primary battery powered ATONs were converted to solar power, substantially reducing the consumption of batteries. Only one percent of the approximately 12,200 fixed lighted ATON in use are now powered by primary batteries. Ninety two percent of fixed lighted ATON are now solar powered. The remaining seven percent of fixed lighted ATON are commercially or generator powered. "Secondary" batteries at solar powered aids can last five years compared to the average two year life of primary batteries.

1993: The Coast Guard initiated a comprehensive assessment of potential environmental effects from lost ATON batteries at aquatic sites. Researchers from the Volpe Center began a "prototype investigation" in the Chesapeake Bay, the first of four scheduled across the country to sample fixed ATON sites for battery contamination and test site survey and battery removal methods. In addition, a research team from the Massachusetts Institute of Technology began studying the fate of mercury from primary batteries at aquatic sites.

1994: Reference (c) inaugurated a "cradle to grave" ATON battery tracking system Coast Guard-wide. ATON batteries are labeled with a serial number and individually tracked from purchase to use to removal and transfer to a qualified recycler.

The Coast Guard produced and distributed an ATON Battery training video discussing current laws and policy, past disposal problems and proper battery accounting and disposal procedures. The video is required training for all Coast Guard personnel who service ATON.

The Volpe Center completed additional prototype investigations in Tampa Bay, the Tennessee River and Puget Sound. Volpe researchers also began developing a first-ever model to priority rank ATON sites for survey and battery recovery on a national basis.

Better methods of attaching batteries to fixed aids to prevent losses are explored. Hardware to improve the chances of recovering batteries when

structures are knocked down has been developed by COMDT (G-ECV-3) and is scheduled for implementation in mid-1995. Reference (a) instituted new policies and procedures for reporting and recovering accidental battery losses caused by collisions, bad weather or vandalism. All known battery losses are reported to appropriate state and federal authorities and recovered whenever possible.

The first large-scale ATON site survey and battery removal efforts were begun in Florida. Coast Guard units began surveying and removing batteries from terrestrial ATON sites nationwide.

6. GOALS

a. The primary goals of this effort are to:

(1) Prevent future releases of batteries into the environment and minimize potential harm to the local environment around ATONs during recovery.

(2) Work closely with state and other governmental regulators to fully comply with applicable federal and state legal requirements.

(3) Utilize limited budget, personnel and equipment resources in the most efficient manner possible.

(4) Perform this and other mandated compliance efforts within the amount of EC&R funds annually appropriated by Congress.

(5) Preserve public and interagency confidence in the Coast Guard as an environmental enforcement agency.

(6) Develop and implement a program that is environmentally and legally sound and minimizes the potential for future liability.

7. RESPONSIBILITIES

a. Headquarters Offices: G-N (NSR-1) and G-E (ECV-1) are partners in this program, and share responsibility for its successful performance. These offices will jointly develop guidance and advocate EC&R funding requests to give districts and CEUs the flexibility and resources needed to carry out this program in the most timely and efficient manner possible. G-NSR will be overall program manager, and will coordinate information sharing, collect progress reports and assist in developing funding priorities. G-ECV will administer and distribute EC&R funds, provide EC&R accounting and cost reporting procedures and arrange contracted technical support as

needed. G-LEL will provide advice to Headquarters offices concerning compliance agreements forwarded by districts for Commandant execution.

b. District Offices. District Commanders (oan) have the lead for this effort and will:
- be the focal point of contact with state regulatory officials and resource managers;
- in close coordination with their servicing CEU, develop and negotiate state recovery plans, timetables and any required agreements and prepare EC&R funding requests, spend plans and required reports;
- direct the tempo and sequence of recovery operations;
- collect site survey and battery recovery documentation and submit semi-annual progress reports to G-NSR;
- directly manage battery recoveries made by CG assets;
- coordinate with CEU's for contracted aquatic and large terrestrial battery recoveries;
- ensure recovery personnel are properly trained and equipped in accordance with Occupational Safety and Health Administration (OSHA) and CG regulations.

c. Maintenance and Logistics Commands: Monitor CEU workloads in support of this program and provide environmental law and occupational health and safety assistance when requested.

d. Civil Engineering Units: Analogous to the G-NSR/G-ECV partnership, CEU's are fully involved partners with districts in this effort and will:

- assist districts in developing recovery plans and timetables, EC&R funding requests and spend plans;
- provide contracting, technical and project management support for recoveries at aquatic and large terrestrial sites;
- provide environmental compliance technical assistance to districts and field units and assist with Defense Reutilization Marketing Office (DRMO) or other qualified contractor disposal arrangements.
- develop soil/sediment and waste characteristic sampling protocols as needed.

8. STATE RELATIONS AND RECOVERY PLANS

a. When prepared, District Commanders should inform the appropriate regulatory agencies about plans to address this issue. Proactive information sharing with regulators describing the source control, prevention,

assessment and recovery efforts to date and committing to work constructively on this problem has generally been successful.

b. Due to EC&R resource constraints, recovery efforts will take place over several years. Recovery plans should, to the greatest extent possible, address ATON sites in priority order using Enclosure (2) as a guide. States with predominately low priority sites may initially see few recoveries made beyond those done in the course of routine operations.

c. If a state or other government resource manager desires formal commitment on battery recovery, "partnering" or cooperative working agreements are the preferred instruments.

d. To ensure that environmental obligations are met, understandings with and approvals from cognizant state regulators or other government resource managers should be documented in writing, preferably prior to beginning recoveries. Unilateral recovery efforts are not recommended. Failure to secure "up front" agreement on what and how recoveries will be done and at what point recovery will be complete may result in a duplication of effort and an inefficient use of resources.

e. At a minimum, recovery plans submitted to state or other regulators should encompass the sequence, scope, time line for recoveries, safety, transportation and documentation plans, and criteria and procedures for sites in environmentally sensitive areas. Districts and CEU's may wish to solicit assistance from Reserve members of Team Coast Guard experienced in developing compliance plans with regulators in affected states.

9. <u>EC&R FUNDING</u>

a. Districts and CEUs should ensure that sufficient EC&R funds have been earmarked or planned for their proposed recovery/disposal costs prior to finalizing agreements with regulators. District Commanders have limited authority to execute environmental compliance agreements per reference (d) and should seek guidance from their legal officer. Agreements that obligate CG resources beyond the EC&R funds available in any fiscal year must be approved by Commandant (G-CCS). All agreements will be entered into subject to the availability of EC&R funds. EC&R funds must not be used for routine, recurring hazardous waste management and disposal costs derived from normal operations.

b. The Coast Guard will seek funding which will allow completion of the nationwide recovery program within the next 10 years. Since FY 96 is a "start up" year for most districts, funds will be allocated based on how much each District Commander realistically believes can be accomplished in their district, considering priority rankings, logistics constraints and interest from state regulators. If the funding requests exceed available funds, allocations will be made based upon the number of high priority sites contained in the district plans or by Commandant (G-NSR/G-ECV) to best address the needs of the Coast Guard.

c. Districts should, in partnership with their servicing CEU, prepare an FY 96 funding estimate and spend plan detailing the number and type of sites to be visited, expected disposal, travel/per diem, supply, training, and miscellaneous costs. This should be submitted to Commandant (G-ECV-1) not later than 01Sep95 and by 01Aug each succeeding FY until recovery efforts in the district are complete. The minimum information required is contained in Enclosure (3).

d. EC&R funds for executing ATON battery recovery and disposal will be transmitted to either the district or servicing CEU as agreed to in advance by those offices.

10. RECOVERY GUIDELINES

a. Based on the findings of the Volpe Scientific Assessment and the principles of the EPA's Contaminated Sediment Management Strategy, the recommended course of action for addressing this problem is:

(1) Preventing future battery losses.

(2) Removing easily recovered, visible batteries and remnants (point sources) with minimal soil and sediment disruption.

(3) Recovery of affected soils and sediments through natural processes.

b. Survey and recovery efforts should be limited to existing and locatable former fixed lighted ATON sites (some sites now commercially powered may have used batteries in the past). Buoy stations are not included in the priority ranking given the low probability of detecting batteries due to servicing practices, positioning accuracy and dredging. Buoy stations should only be surveyed upon report of batteries at the site.

c. At terrestrial sites, all visible, easily removed batteries and remnants found should be recovered; batteries revealed by removal of another battery should be recovered. At aquatic and intertidal sites, only visible batteries and remnants on top of the sediment should be recovered. It is imperative that aquatic and intertidal sediment disruption be kept to a minimum for low level metal contaminants to remain "fixed" in the sediment where they pose little potential for harm.

d. Buried batteries that are later exposed should be recovered in the course of routine operations or upon request of state or other regulatory authorities. For battery discoveries in sensitive environment or habitat areas (coral, sea grass beds, etc.), proposed recovery plans should be provided to the cognizant resource manager for concurrence before recoveries are begun.

e. Active remediation of soils and sediments at ATON sites is not recommended. Soil and sediment samples in the Prototype Investigations generally showed low levels of zinc, lead and elemental mercury contamination in proximity to broken primary batteries. In most cases, the contaminants were in barely detectable quantities and in no case exceeded thresholds for public health concern. The analysis indicated that sediment disruption from recoveries at aquatic and intertidal terrestrial sites created opportunities for elemental mercury to change into its harmful organic form (methylmercury) that can potentially enter the food chain. If not disturbed, the elemental mercury is expected to remain in place with no significant ecological impacts.

f. To date, field soil/sediment sampling has not yielded results substantially different than the Volpe Prototype Investigations (see 10 g. below). However, if required by regulators, soil/sediment sampling protocols may be negotiated. If performed, random site sampling or sampling limited to sites with large battery concentrations are preferred over widespread sampling or Toxic Characteristic Leaching Procedure (TCLP) analyses for contaminants beyond metals known to be in ATON batteries. To the greatest extent possible, funds should be preserved for battery recovery and disposal.

g. The Volpe Center Prototype Investigations were done at four locations that represent common marine ecosystems. Volpe's sampling found a consistent pattern of elemental mercury and zinc contamination in "lobes" of sediment in the immediate vicinity of broken batteries at aquatic sites. The Prototypes found no evidence of

mercury methylation when the elemental mercury was left undisturbed. No biological samples taken at aquatic sites showed mercury accumulation exceeding study background or Food and Drug Administration public health action levels.

11. TERRESTRIAL RECOVERIES

a. It is anticipated that the vast majority of terrestrial and intertidal site recoveries will be performed by properly trained and equipped Coast Guard personnel. District Commanders should consult with their servicing CEU and MLC(k) regarding site safety plans and procedures and conducting appropriate initial and recurrent occupational health and safety training.

b. Enclosure (4) contains a "hybrid" training plan developed by District One for personnel participating in terrestrial ATON battery recovery activities. This training plan incorporates the applicable sections of OSHA's Hazard Communication Standard (29 CFR 1910.1200) and the Hazardous Waste Operations and Emergency Response (HAZWOPER) Standards (29 CFR 1910.120). All recovery and on-site support personnel should have and use the personal protective equipment required for safe handling of ATON batteries listed in reference (e).

12. AQUATIC RECOVERIES

a. Battery surveys and recoveries at aquatic sites will be accomplished primarily by use of contracted commercial divers, but properly trained military or government divers may be used when available and permitted by reference (b). Coast Guard divers are not anticipated to be available for recovery activities beyond those in Districts Seven and Fourteen. No technology has been found that accurately locates and differentiates batteries from other objects at aquatic sites. All diving and support personnel must receive the required training as found in enclosure (4) or equivalent prior to participating in ATON battery recovery activities and operate under a Coast Guard site safety plan.

b. For sites in sensitive environmental areas (i.e. coral reefs, sea grass beds, etc.) or where significant habitat loss might result from recovery, state or other government resource managers should be consulted to determine if recovery is the best course of action. Given the indication that batteries left alone pose no particular threat to the aquatic environment, the resource manager may concur that recovery is not in the best interest of the local environment. Such

determinations and waivers from recovery requirements should be received in writing for each site where batteries will be left in place.

c. Diving may be dangerous at some aquatic locations. Visibility, currents, depth and exposure to ocean conditions and dangerous marine life are factors that District Commanders and on-site supervisors should consider in making a determination whether a site can be visited safely. Sites determined unsafe for survey and recovery should be documented in writing and forwarded to the cognizant environmental regulator for concurrence.

d. Enclosure (6) is a Commandant (G-NIO) site safety plan developed for aquatic recoveries in District Seven. This document may be tailored to meet local needs.

13. DOCUMENTATION AND REPORTING

a. Copies of the written site survey and recovery documentation for every fixed lighted ATON site surveyed should be kept in the permanent aid record at the servicing unit and district office. At a minimum, survey results should include the aid name, Light List and aid numbers, waterway and position, the date, name and signature of the person conducting the survey and/or recovery, the type, quantity, condition and weight of recovered batteries and a polar plot diagram showing bearing and distance of lost batteries and remnants from the aid. Survey and recovery documentation should be prepared for all terrestrial and aquatic sites whether batteries are found or not. A sample site documentation format developed by District One (oan) is included in enclosure (4).

b. Once survey and recovery efforts begin, districts should submit semi-annual status reports to Commandant (G-NSR-1) (copy to (G-ECV-1)) by most convenient means by 30 April and 30 October each year. Reports should contain the information listed in enclosure (5) plus comments on any non-ATON sites found with batteries, significant progress, problems or lessons learned. A final report should be submitted when all surveys and recoveries are complete.

c. District Seven (oan) has developed a PROGRESS-based Lost ATON Battery Reporting (LABR) database that runs on the CG Standard Workstation. District Seven has generously offered to provide copies to interested districts. The POC is LCDR Gene Gray at (305) 536-5621.

14. DISPOSITION OF RECOVERED BATTERIES

a. For the purpose of this program, all batteries and

remnants will be considered hazardous waste. We expect four types of waste from recovery efforts (see Figure 1):

i. Intact primary batteries.
ii. Intact secondary batteries.
iii. Primary and secondary battery "debris" per paragraph 14 d.
iv. Pieces and remnants that are not "debris".

b. It is important that the recovered batteries and remnants be segregated according to Figure 1 in order for DRMO's to dispose of the waste in the most cost-effective manner possible. Except for intact secondary batteries (see paragraph 14 c.), all batteries and remnants will be handled, packaged, stored, manifested, transported and disposed of properly as hazardous waste in accordance with reference (f).

c. Per reference (f), intact secondary lead acid batteries are exempt from hazardous waste generation, storage and disposal rules provided they are handled as a recyclable commodity.

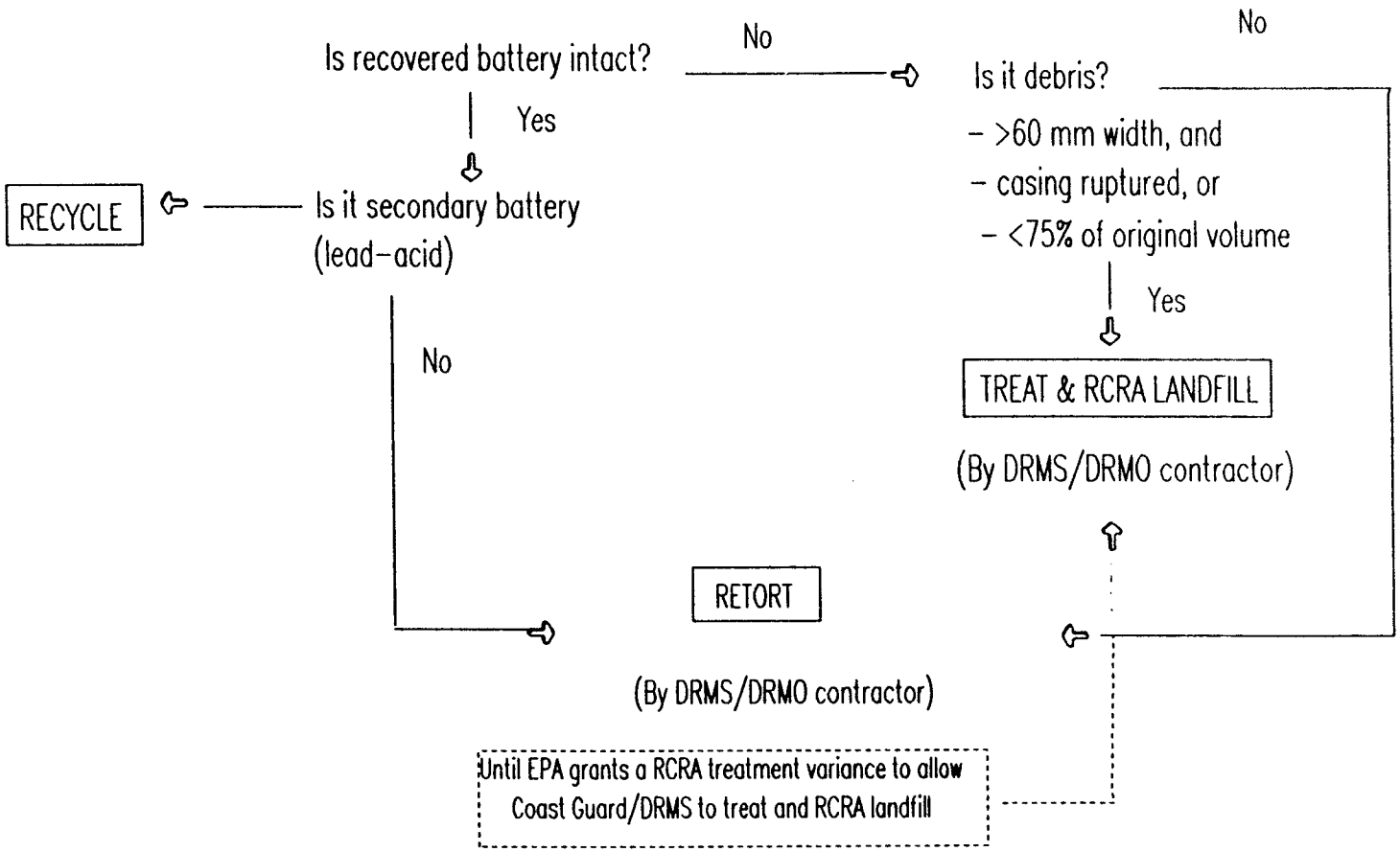
d. Broken batteries or remnants may be considered "debris" as defined in 40 CFR 268.2(g) if one or both of the following conditions apply:

- Ruptured batteries, remnants or battery pieces with a width greater than 60 mm (tennis ball sized); <u>or</u>
- the battery casing is less than 75% of its original volume

This characterization is important because a generator of Resource Conservation and Recovery Act (RCRA) debris (in the case of the Coast Guard, the servicing DRMO or private disposal contractor) has the option of managing the debris by <u>either</u> the treatment standards required for its specific hazardous waste code (D009) <u>or</u> by use of the extraction, destruction, or immobilization treatment options found in 40 CFR 268.45. The most practical and cost effective method for disposing of battery "debris" is immobilization by macroencapsulation (the hazardous waste contractor seals the batteries in specially designed receptacles that are placed in RCRA hazardous waste landfills).

Figure 1

WASTE BATTERY SEGREGATION AND TREATMENT OPTIONS



The significance of this is that primary battery "debris" can be given to DRMO disposal contractors and safely disposed as hazardous waste for projected costs of less than $1 per pound (only slightly more than the cost per pound for solid waste disposal) versus the $4 plus per pound for treatment by retorting. Primary batteries and remnants that cannot be classified as "debris" (intact batteries and small pieces), should be retorted. [Note: Headquarters (G-ECV/G-LEL) is initiating a request for a RCRA treatment variance for intact primary batteries that will also allow for their disposal by macroencapsulation and RCRA landfilling. Field units will be notified immediately when approved.]

e. Reference (g) strongly discourages use of non-DRMO contractors for disposal of recovered primary batteries. Qualified private hazardous waste contractors may be used only if DRMO services are not available. COMDT (G-ECV-1) is working with the Defense Reutilization Marketing Service (DRMS) to develop a nationwide contract for disposing of recovered primary batteries. Expected collection points will be group offices, bases and support centers, typically classified as large quantity generators. Districts requiring collection of recovered batteries at sites other than these should notify COMDT (G-ECV-1A) as soon as practical.

f. DRMS headquarters officials have expressed a commitment to provide timely, high quality service to customers. Units experiencing service problems with DRMOs or their contractors should first attempt to resolve them at the local level. For service problems that cannot be resolved locally, units may contact the following DRMS customer service managers for assistance:

Operations East of the Mississippi:
Mr. Greg Cliffel (DRMS Columbus)
(614) 692-3830

Operations West of the Mississippi:
Mr. Ken Bird (DRMS Ogden)
(801) 399-7616

DRMS Headquarters:
Mr. Roy Howell
(616) 961-5876

g. Districts planning to use DRMO disposal services for recovered batteries and remnants should contact Headquarters (G-ECV-1) (POC: Chris Hart, (202) 267-1918) to set up a disposal account through FINCEN applicable to EC&R funds.

15. PUBLIC AFFAIRS

a. Lost ATON batteries were the subject of intense media interest in 1994. Although recovery efforts to date have not been subjects of significant media interest, "tools" besides this instruction and its references available to help answer media inquiries include:

- Enclosure (1) to COMDTNOTE 16501 of 01 Jun 94 (ATON Battery Awareness Training Video) (distributed to all districts, CEU's and ATON units in Jun 94, some extra copies are still available from COMDT (G-ECV-1)).
- "A Commitment to Environmental Excellence" (booklet produced by COMDT (G-M)) outlining the Coast Guard's environmental missions and internal compliance policy.
- COMDT (G-CP) Media Advisories regarding ATON Batteries (enclosure (7)).

16. FURTHER INFORMATION

a. The points of contact for this program are: LCDR Chris Conklin (G-NSR-1) 202-267-0344; Mr. Ed Wandelt (G-ECV-1A) 202-267-6144; and Mr. Tom Hayes (G-LEL) 202-267-0056.

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Encl: (1) Volpe ATON Battery Scientific Assessment
(2) Volpe Priority Ranking Plan
(3) Sample FY 96 Spend Plan Format
(4) Extracts from CCGD1(oan) letter 16500 of 09 Jan 95
(5) Sample Semi-Annual Progress Report Format
(6) Aquatic ATON Site Safety Plan (model)
(7) ATON Battery Media Advisories (3)

Encl. (1) to COMDTINST 16478.12

USDOT
Research and Special Programs Administration
Volpe National Transportation Systems Center

ATON BATTERY SCIENTIFIC ASSESSMENT

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EXECUTIVE SUMMARY
ATON BATTERY SCIENTIFIC ASSESSMENT

INTRODUCTION

The United States Coast Guard (USCG) maintains about 12,000 fixed lighted aids to navigation (AtoN). These AtoNs, or lights, are located in or adjacent to all major waterways. Historically, many of these lights were powered by primary batteries containing small amounts of mercury, which was used to control the oxidation of the zinc anode. By the mid-1980's the vast majority of primary battery powered AtoNs were converted to solar power that utilize lead acid or "secondary" batteries. Spent primary batteries, when replaced, were sometimes disposed of at the AtoN sites. Since each of these discharged batteries contain 0.1- 3 grams of mercury, the USCG initiated an assessment of potential environmental effects.

The assessment was performed between October 1993 and December 1994 by the Volpe National Transportation Systems Center of the U.S. Department of Transportation's Research and Special Programs Administration with assistance from the Massachusetts Institute of Technology, R.M. Parsons Laboratory; the University of Maryland, Chesapeake Bay Biology Laboratory; Environmental Transportation Consultants/CH2M Hill; and technical consultation with the National Oceanographic and Atmospheric Administration (NOAA). On-site support was provided by the USCG, and diving services were provided by the U.S. Navy and Oceaneering Technologies International.

This work included laboratory studies and investigations at four prototype sites:

1. Chesapeake Bay
2. Tampa Bay
3. Tennessee River (Chattanooga)
4. Puget Sound (Budd Inlet)

Demonstration cleanup projects, which involved battery removals and post-removal sediment sampling were also performed at sites (2), (3), and (4).

This document reports the results obtained from laboratory studies and site investigations, the conclusions drawn from these results, and their implications for AtoN battery recovery. Specific results from the four prototype sites specific are in the appendices.

OBJECTIVES

The primary objective of the study was to determine whether the batteries disposed of at the terrestrial and aquatic AtoN sites posed a hazard to the environment and humans. It was concluded from the laboratory analysis of spent batteries that the long-term potential impact on human health or the environment is limited to the uncontrolled release of metals. Other battery parts, such as the plastic casing, pose no hazard, and caustic solutions quickly dissipate and neutralize in the aquatic environment. Since 99% of the recovered batteries were primary batteries, and since they were phased out by the mid-1980's, only their long-term effects are of concern. New primary batteries, contain a 500g zinc electrode that is coated with about 20g of elemental mercury (Hg^{o}). They do not contain lead, and lead levels in sediments around lighted AtoN's were not above the levels in control samples taken farther away. The individual prototype investigations fully evaluated zinc and mercury, determining their concentrations in sediment. Because of it's bioaccumulation potential and greater toxicity, this overview focuses on the direct evaluation of mercury effects.

The preliminary work refined the objectives:

(1) to describe the fate and transport of mercury from spent primary batteries

(2) to determine the concentration, spatial distribution and form of metals found near AtoN battery sites

(3) to determine whether aquatic biota were contaminated at AtoN due to spent batteries

(4) to determine whether hazardous mercury vapor is released at terrestrial AtoN sites.

STUDIES AND INVESTIGATIONS

Laboratory Studies

The laboratory studies at the Massachusetts Institute of Technology and at the University of Maryland analyzed spent batteries for total mercury and the solubility of mercury under salt water conditions. The form of mercury in spent batteries (elemental, organic, or ionic) was also determined. The laboratories measured the likelihood of release using a standard US Environmental Protection Agency protocol (TCLP). They also postulated and described mercury transport mechanisms. The results of TCLP analyses confirmed that the mercury present in spent primary batteries was at low concentrations and generally undetectable using the standard TCLP procedure (Mason, 1995).

AtoN Sites Prototype Investigations

The AtoNs that were investigated within the four prototype locations are listed in Table S-1. The following data are given for each AtoN studied:

(1) batteries found during investigation

(2) estimated maximum number of batteries assuming that all spent batteries were disposed of at the site

(3) type of bottom (e.g., mud, sand, etc.)

(4) the percent of AtoN sites in the corresponding USCG district that have a similar bottom type

(5) the water depth at the time of site investigation

(6) description of the aquatic environment

Table S-1: AtoNs and Environments Characterized During Prototype Investigations

AtoN Name/Location	Batteries Found	Maximum Est. Batts	Bottom	%Bot District	Depth	Fresh/Salt
Chesapeake Bay						
Greenbury Point Lt	80	64	Silty, mud	52	5 meters	Estuarine
Bodkin Point	2	49	Silty sand	52	5 meters	Estuarine
South River	9	36	Silty sand	52	3 meters	Estuarine
Rocky Creek (Unlighted AtoN)	None	None	Clay/silt	0.55	5 meters	Estuarine
Tampa Bay						
Gadsen Point #8	21	238	Sand	80	4 meters	Estuarine
Gadsen Point #10	37	328	Sand	80	5 meters	Estuarine
G Channel FRL	23	173	Sand	80	3 meters	Estuarine
G Channel RRL	12	238	Sand	80	4 meters	Estuarine
Alafia River FRL	33	47	Silty Sand	5	3 meters	Freshwater Inflow/Estuarine
Alafia River RRL	66	161	Silty Sand	5	3 meters	Freshwater Inflow/Estuarine
E Channel FRL	35	173	Sand	80	7 meters	Estuarine
E Channel RRL	68	238	Sand	80	7 meters	Estuarine
C Channel FRL	20	328	Sand	80	7 meters	Estuarine
C Channel RRL	6	622	Sand	80	7 meters	Estuarine
Tennessee River- Chattanooga						
Moon Light	16	55	Silty sand	80	3 meters	Fresh Water
Patton Island Upper	0	55	Silty sand	80	10 meters	Fresh Water
Patton Island Lower	0	55	Sandy silt	90	5 meters	Fresh Water
Selcer Lt	17	75	Sandy silt	90	5 meters	Fresh Water
Williams Island Lt	15	55	Silty sand	90	8 meters	Fresh Water
Chickamauga Unlighted	None	None	Sandy silt	90	5 meters	Fresh Water
Lake Nickajack Area	None	None	Silty sand	90	8 meters	Fresh Water
Puget Sound- Budd Inlet						
Olympia Range Lt	33	82	Silty mud	90	3 meters	Estuarine
Olympia Channel Lt	44	118	Silty mud	90	4 meters	Estuarine
Olympia Channel Unlighted	None	None	Silty mud	90	5 meters	Estuarine

The investigation addressed the dispersal patterns of mercury and zinc releases by collecting sediments close to discarded batteries, at increasing distances from batteries and AtoNs, and at background locations where batteries had never been used. Ionic and methyl mercury levels were also measured because of their increased bioaccumulation potential.

Mercury was also measured in aquatic biota attached to batteries and in nearby sediment, because accumulation in these organisms is the most critical exposure pathway for humans and the aquatic ecosystem as a whole.

Demonstration Battery Removals

In addition to the investigations at the prototype sites, batteries were removed at 35 AtoNs. Areas previously covered by battery piles were sampled to assess the residual mercury levels in sediments.

MEASURES AND CRITERIA

The data obtained during the prototype site investigations were compared against the following criteria: 1) differences from site specific background levels or background levels established by local or state authorities, or 2) levels above local or nationally established levels that could indicate adverse effects.

The specific measures used were:

Air

The applicable criteria for inhalation exposure are the Occupational Health and Safety Administration criteria for permissible exposure limits (PELs). The PEL for mercury is .05 mg/m^3.

Sediments

Background and comparison levels:

- collected at unlighted AtoNs,
- the perimeter of the AtoN sampling field (20 meters from the base of the AtoN),
- regional background levels established by states or other local investigations,
- NOAA National Screening Guidelines: low (ER-L), median (ER-M)
- State of Florida and Washington Criteria: No effects (NOEL) and Probable Effects Levels (PEL),
- Methyl mercury in sediments: comparisons to established background levels based upon the literature, percentage variation among local comparison stations.

Biota

Background and comparison levels:

- biota taken at comparison stations (unlighted AtoNs),

- Local criteria: established in literature, by states, etc,
- NOAA National Status and Trends studies of biota in selected environments,
- Food and Drug Adminsitration (FDA) Action Level for methyl mercury in tissue.

RESULTS

Results- Laboratory Studies

Spent batteries from Tampa Bay, Florida and Chattanooga, Tennessee were analyzed to determine their total mercury content and concentration in various components, and the form of mercury in each (elemental, ionic or methyl).

The total mercury content in spent batteries averaged to about three grams each, and most of it was concentrated in individual battery components. The component concentrations varied from .006 mg/kg in the plastic casing to 4040 mg/kg in the carbon electrodes. Only elemental mercury was found in aged batteries (over 1 year in the environment). Newly spent batteries and batteries that were disposed on land contained traces of ionic mercury.

Mercury dispersal from spent batteries was measured using the EPA protocol Toxicity Characteristic Leaching Procedure (TCLP) 7471 with whole batteries and their components. Batteries analyzed using TLCP 7471 yielded concentrations of mercury no greater than 109 μg/L. The TCLP maximum allowable concentration is 200 μg/L.

Results - Prototype Site Investigations

Analysis of Air Samples

The mercury remaining in spent primary batteries that are exposed to air can be released as vapor. Mercury vapor concentrations near batteries were measured at two terrestrial sites in the Tampa Bay area. At both of these locations, mercury vapor levels were measured over battery piles on the ground, which consisted of both intact and broken batteries. Mercury vapor levels were measured using two devices: (1) a photo ionization

detector (PID) meter and (2) a mercury vapor analyzer (MVA) , both capable of detecting concentrations as low as the OSHA PEL level (.05 mg/m^3). No measurable mercury concentrations were found in air samples measured at Anclotte Key Light and Egmont Light in Tampa Bay.

Analysis of Sediments

The results of sediment analyses are summarized in Table S-2. The average of the mean sample values grouped by proximity to the AtoN are reported for each location investigated during the prototype studies. The near field average is for samples taken within 10 meters of the base of the AtoN. Samples taken at distances greater than 10 meters are reported in the far field rows, and samples taken directly at batteries are reported separately. Reference values were measured at unlighted AtoNs near the sample locations. These AtoNs, which do not require batteries, were chosen due to their similarities to the prototype locations chosen for study. Additional comparative background levels are include the table; these have been established by state agencies or other research. The states of Florida and Washington each have sediment "criteria" levels relevant to these studies. NOAA publishes a set of screening "guidelines" which may also be used for comparison.

Analysis of Biota

In Chesapeake Bay, seven biological samples were collected from batteries and five were taken from structures near the AtoNs. The average mercury concentrations in the samples from batteries was 0.02 mg/kg (wet weight). No values above 0.05 mg/kg (wet weight) were reported. All of these values are well below the FDA action limit of 1 mg/kg (wet weight).

In Tampa Bay the biological samples showed a pattern similar to that seen in Chesapeake Bay. The average concentration was 0.03 mg/kg (wet weight) with a maximum value of 0.09 mg/kg (wet weight). These samples were taken near the Alafia River. In these cases, samples on pilings were less than the levels taken on batteries. These levels were six

times higher than those found in the mid-bay areas. The majority of AtoNs sampled in Tampa Bay exhibited levels less than 0.5 mg/kg.

In the Tennessee River all biological results were less than 0.13 mg/kg in tissue. In the Puget Sound, all sampled organisms tissue concentrations were less than 0.1 mg/kg. Near and far field averages for each station appear in Appendix A.

Table S-2: Average Measured Mercury Levels and Comparison Values - Total Mercury in Sediments

Area	Average Mean Values	Background [1]	State Criteria [2]	Long and MacDonald (ERL) [3]	Long and MacDopnald (ERM) [4]
Chesapeake Bay		0.25		**0.15**	**0.71**
Near Field [i]	0.169	NOAA 1991			
Far Field [ii]	0.235				
Battery [iii]	0.084				
Unlighted Reference AtoN [iv]	0.270				
Tampa Open Bay		0.05	**<.15**		
Near Field	0.655	CNSMS, 1992	Florida ERL		
Far Field	0.330		**1.41**		
Battery	1.320		FLORIDA (PEL) [5]		
Unlighted Reference AtoN [iv]	0.050			**0.15**	**0.71**
Tampa Alafia River		0.35	**<.15**		
Near Field	0.328	CNSMS, 1992	Florida ERL		
Far Field	0.124				
Battery	2.700				
Unlighted Reference AtoN [iv]	0.050			**0.15**	**0.71**
Tennessee Chicamauga	0.050	0.5			
Near Field	0.890	Meinert et.al. 1992			
Far Field	1.215				
Battery	0.330				
Unlighted Reference AtoN [iv]	0.090			**0.15**	**0.71**
Puget Sound (Budd Inlet)		0.16	0.41		
Near Field	0.498	Tetra Tech, 1988	Washington State Deparment of Ecology		
Far Field	0.443				
Battery	0.100				
Unlighted Reference AtoN [iv]	0.180				

(1): Values from literature

(2):Florida: No effects level

(3): NOAA Effects range low

(4): NOAA Effects range median

(5):Florida:Probable effects limit

(i): Sample < 10 meters from base of AtoN

(ii): Sample 10 to 20 meters from base of AtoN

(iii): Sample at battery

(iv): Samples at unlighted reference AtoN

Results - Demonstration Battery Removals

Several important findings were derived from the demonstration battery removal program conducted in Tampa Bay, Tennessee, and Puget Sound. First, the number of batteries likely to be found at aquatic locations is about one-half the maximum number used during the 20 years of primary battery service at AtoNs. Few secondary batteries (two of thirteen - hundred) were found in these locations. Most (62%) batteries were within 5 meters of the base of the AtoN, and almost all (95%) batteries ever found at any AtoN were within 20 meters of its base. About one-half of the batteries found in salt water environments are broken and decaying. Conversely, batteries found in fresh water, or where sediments are soft and muddy (for instance in Puget Sound), were generally found intact.

Sediments under battery piles were sampled after the batteries were removed. The measured mercury levels in these sediments were usually at or below the background levels, and were within the safe range established by NOAA (ER-M of 0.71 mg/kg). In two locations in Tampa Bay, where a large number of broken batteries were removed, sediment levels exceeded 5 mg/kg (total mercury). It is believed that these sediments contained some residue from the outside of the batteries that accumulated during removal, rather than mercury released directly from the batteries.

These levels indicate that care must be taken when batteries are removed to collect attached sediments and biota so that the contaminants will not be returned to the environment.

CONCLUSIONS

Mercury in spent AtoN batteries is primarily in elemental form. Although a small portion of the mercury originally in spent batteries (not submerged in an aquatic environment) was in ionic form; it was released to the environment and dissolved immediately at the time the battery was discarded. Thus, the contents of the batteries themselves is relatively harmless.

Human exposure through inhalation of mercury vapor or ingestion of contaminated water is not a concern. Contamination of drinking water is unlikely because elemental mercury does not easily dissolve. Neither is exposure through inhalation a concern because the mercury in spent batteries is tightly bonded to the carbon and zinc components, and no vapor was detected.

Given its low solubility, the most likely release of pathway for elemental mercury is to surrounding sediments through battery casing decay. Evidence from prototype investigations indicate that battery casings tend to remain intact in freshwater environments but decay in open marine environments (CH2M Hill, 1993(b), 1994(a), 1994(b)). When these casings decay, the components of the battery containing elemental mercury may be exposed. However, due to the properties of the open marine environment, *"methylation is not a pathway of primary concern at open marine sites"* (Matta, 1994). While the elemental mercury is still potentially toxic, its relative toxicity is significantly less than methyl mercury (EPA 1985). Therefore, it's direct threat to human health is negligible.

Elevated sediment concentrations near batteries may result in very small - localized environmental hazards. The potential for environmental impact will probably be limited to organisms that attach to batteries or reside in nearby sediments. Evidence from the prototype investigations indicate that some of these organisms have higher measured levels of mercury in their tissue than other biota at the same AtoN.

IMPLICATIONS FOR BATTERY REMOVAL

The evidence from the study, which indicates that the contents of batteries themselves is relatively harmless, suggests that the presence of batteries in most environments is not a hazard. Because of the potential effect on local organisms, removal of batteries and attached biota is prudent. Measured levels of mercury in surrounding sediments do not indicate that sediment removal along with batteries is warranted.

The section "Results - Demonstration Battery Removals" states that at two locations in Tampa Bay, where a large number of broken batteries were removed, sediment levels exceeded 5 mg/kg (total mercury). Furthermore, it is believed that these sediments contained matter previously attached to the outside of the batteries and lost during battery removal. This suggests that battery removal should be undertaken in a manner that will minimize the loss of attached sediment and biota during removal.

Although it is prudent to remove the subject batteries from the AtoN sites, a phased removal, subject to the availability of funds, is consistent with the low contaminant levels observed.

Chapter One

Background

The U.S. Coast Guard is responsible for the maintenance of over 12,000 fixed lighted aids to navigation (AtoNs) in the major rivers and coastal waters of the United States. From the 1960's to the mid-1980s, many of these AtoNs were powered by disposable primary batteries, containing small amounts of mercury. These batteries have a service life of one to three years depending on the power requirement of the AtoN. During their twenty years of use, some service crews disposed of spent batteries at the AtoN. In the mid-1980's, the Coast Guard's environmental concern and the development of reliable solar technology resulted in a primary battery replacement program, which has succeeded in upgrading the AtoN's power source to solar powered rechargeable batteries at almost all locations. In addition, the Coast Guard initiated a research program, conducted by the Volpe Center, to determine the environmental effect of spent batteries. The Volpe Center research program included: 1) a contaminant fate and transport assessment, by laboratory analyses of batteries, conducted at the Ralph Parsons Laboratory - Massachusetts Institute of Technology, and 2) environmental assessments at prototypical AtoN disposal sites in the Chesapeake Bay, Tampa Bay, Tennessee River and Puget Sound.

Contaminant Fate and Transport

Analysis of Spent Batteries

A laboratory study was conducted to estimate health and environmental hazards posed by discarded AtoN batteries, based on an understanding of the harmful effects of the contaminant mercury. The principal objective was to determine the ways that humans can encounter mercury released from primary AtoN batteries (which are referred to as *primary batteries* by the major battery industries, the Coast Guard, and the railroad industry), the volume of mercury released, and its potential effects.

The volume of mercury likely to be released from individual batteries was estimated by analyzing spent batteries in varying states of "decay". These states included batteries recently removed from an AtoN, those found intact in an aquatic environment, and those found in an aquatic environment with broken casings and missing internal contents. The total mercury released from all batteries was estimated based on the results of the laboratory analyses.

The Volpe Center contracted Drs. Françios Morel and Robert Mason of the Massachusetts Institute of Technology for this effort, which is being continued by Dr. Mason at the University of Maryland, Chesapeake Bay Biological Laboratory. They

chemically analyzed new, spent, and recovered primary batteries from trial cleanup operations, and they reviewed the Volpe Center's design of the environmental impact studies.

Battery Composition

The batteries examined were manufactured by Edison, McGraw-Edison, and Saft, and consist principally of a zinc anode and alkaline electrolyte. The electrolyte was found to be the largest component by weight in the samples taken, and it consisted of either nearly pure sodium hydroxide (NaOH) or potassium hydroxide (KOH). These materials are very corrosive. Electrolyte is classified as hazardous waste, but NaOH and KOH are non-toxic in low concentrations. The researchers concluded that electrolyte would be harmless when diluted by the water at an aquatic disposal site. However, elemental mercury (Hg^0) was found in all the samples taken from the zinc anodes. About 20 g of Hg^0 is applied to the zinc plates (anodes) during manufacture. This mercury coating helps catalyze the electricity producing reaction, and it keeps the zinc plate from corroding. No other hazardous battery materials were identified.

The potential threat of mercury is complex to assess because it may be found in many forms in the environment. Mercury exists in the environment in three principal forms: elemental (Hg^0), ionic (Hg^{2+}), and organometallic ($(CH_3)Hg^+$, $(CH_3)_2Hg$). Elemental mercury, because of it's low solubility, is considered the least potentially hazardous of the three forms, but the adverse effects of inhaling elemental mercury vapor are well documented (Heast, 1993), and vapor exposure standards have been established. Highly soluble ionic (oxidized) mercury is the dominant form of natural and anthropic mercury pollution. It is a precursor to formation of highly toxic organometallic mercury by bacteria in stagnant water. Organometallic mercury is water soluble, it is readily absorbed and retained by tissue, which results in it's bioaccumulation in biota, fish, and eventually humans. Therefore, the researchers were interested not only in the total amount of mercury at the disposal sites, but also in the potential for the mercury to be converted into this more bioavailable and toxic form.

Methyl mercury has long been considered a potent neurotoxin that can accumulate in the food chain, and recent studies have prompted the EPA to re-examine its standards for safe human exposure (Stern, 1993). The current EPA reference dose (0.3 μg/kg/day) may be revised to 0.07 μg /kg/day to limit the developmental effects, in utero, due to mercury exposure (USEPA,1990).

Analytical Techniques

Morel and Mason examined spent primary batteries taken directly from an AtoN. Even though these batteries were never submerged, less than 20 percent (3 g) of

the original mercury remained, nearly all of it in elemental form. It was shown to be tightly "bonded" to the zinc plate and carbon electrode, thus unlikely to dissolve or volatilize. They conjectured that the missing mercury was vaporized by the chemical reactions that produce electricity. A small amount of ionic mercury, was also present in the spent battery. If any of the ionic mercury were released in the water, it would quickly dissipate and avoid detection. No organometallic mercury was found.

Analysis of aquatically submerged discarded batteries confirmed the earlier results. These batteries contained less than 5 percent of their original mercury content, nearly all in elemental form. Some mercury was also found in broken batteries, apparently surviving for at least 25 years of exposure in an open marine environment (Morel and Mason, 1994).

To evaluate the possible effects of the released mercury on water quality, Morel and Mason also studied the rate of mercury dissolution in the laboratory. They immersed new and decaying battery cells in salt water tanks and measured the increase of mercury concentration in the water. Very low levels of elemental mercury were released. The researchers concluded that the elemental mercury bonds tightly to the zinc plates (especially when the battery is spent) and to the carbon in the electrodes (Mason and Morel 1993). At most, only microgram quantities of Hg^0 were released per day. When the submersion method was used, mercury concentrations were measured before and after submersion. For an intact battery cell (containing approximately .8 g of mercury) placed in a plastic drum containing 10 L of 0.5 M of salt water, with stirring, the increase in mercury concentration in water over 36 hours was <0.02 μg/L (reactive Hg was measured), and the dissolution rate was < 10^{-7} μg/L per day. Analysis of an intact battery with the top removed revealed a dissolution rate of 17 μg/L per day - higher than an intact battery.

Based on these results, the researchers concluded that batteries disposed of in sea water should retain half of their remaining mercury for at least 300 years. Because the analysis of salvaged batteries suggests a 20-year half life, an additional mercury release mechanism is involved. Drs. Morel and Mason did not speculate on this mechanism, but suggested further research.

Magnitude of Release

Morel and Mason also offer an environmental impact assessment of mercury from batteries. A generous estimate of all the mercury contained in all the primary AtoN batteries ever used by the Coast Guard would be:

(5 g per battery) x (200 batteries per AtoN) x (12000 AtoNs) = 13.25 tons

A conservative assumption is that all of this mercury is released into the environment in one year. To enter the food chain, the mercury must first be converted to Hg^{2+}. It may also be conservatively assumed that all of this mercury is somehow oxidized to Hg^{2+}. The earth itself, through volcanoes and along continental subduction zones, releases about 1,600 tons of mercury into the atmosphere each year. All of this mercury is Hg^{2+}. This material falls to earth constantly as acid rain. Morel and Mason estimated that as much mercury falls as acid rain on a 40-meter diameter circle around each AtoN as is released from the complete disintegration of ten batteries.

In addition to the mercury released by environmental sources, humans release 1,300 tons of mercury per year through waste incineration and 2,600 tons per year through burning of fossil fuels. Relative to these inputs, the mercury released form an AtoN battery into the rivers or the oceans is minuscule. The only significant measurable mercury pathway to humans from AtoNs would start with acute methylation and ingestion of mercury by biota living near the AtoN.

Site Characterizations

Drs. Morel and Mason suggested site characterizations for this potential pathway. They conjectured that any Hg^{o} released might stay in the surrounding sediment and migrate into deeper layers over time, forming "hot spots". Such hot spots may also be formed by Hg^{o} that is bonded to fragments from broken batteries. Benthic organisms living in these hot spots may accumulate mercury and pass it up the food chain. Based on the conclusions of this study, the Volpe center designed *in-situ* characterizations in battery fields to determine (1) whether elemental mercury indeed remained at the location after battery disposal and (2) whether any organic forms of mercury were evident.

Some environmental factors are likely to affect the behavior of elemental mercury, in turn affecting the conclusions drawn from the Morel and Mason study. These are factors that influence (1) whether batteries break, (2) whether elemental mercury is exposed to an organic material that promotes methylation, and (3) whether elemental mercury is exposed to a fresh water environment also promoting methylation. These factors were all considered in the development of a field sampling plan to confirm the results of the Morel and Mason study.

Conclusions

The general conclusions from this portion of the analysis were:

- The mercury in AtoN batteries is a minute fraction of the total mercury in the environment.

- A significant portion (at least 80%) of the mercury in batteries is volatilized during use.
- The ionic mercury left in the air depolarized battery at disposal poses some potential risk to human health, but has a high dissolution rate and has probably already disappeared from the environment.
- The remaining elemental mercury dissolves so slowly that its impact is likely to be minimal.

Chapter Two

Sampling Design and Methodology

Site Investigation Studies

The results of the Morel-Mason study suggest that the presence of discarded AtoN batteries have little environmental or biological impact. However, the conclusions were based on laboratory analysis of a small number of batteries retrieved from only two locations: the Columbia River Gorge in Washington and Tampa Bay in Florida. Because the results are critically important with far-reaching implications for treatment of AtoN battery disposal sites, some method of validating the results was needed.

The conclusion that mercury released from AtoN primary batteries into surrounding sediments would leave small traces (hot spots) of elemental mercury could be tested by field sampling. These traces would be difficult to detect through a sampling program, but if found and analyzed, Morel and Mason expected them to consist of elemental mercury. They expected that only a tiny fraction of the mercury in batteries to be scavenged by local bacteria and undergo a process that would convert it to a form (methyl mercury) that accumulate in biota. Thus, little, if any, biological contamination would result from battery disposal at AtoNs.

Several unanswered questions remained at the conclusion of Morel's and Mason's work. Were enough batteries analyzed to provide an accurate, reliable basis for the conclusions? Were there environmental factors that would negate them? If so, in what kinds of environments were batteries least likely to react as had in those analyzed by Morel and Mason (i.e.Tampa Bay)?

Each of these questions was addressed by the Volpe Center research program. This chapter discusses the design of the field sampling effort.

The sampling program was designed to assess the effect of environmental variability on the behavior of mercury released from primary batteries. For instance, had the environments studied by Morel and Mason been freshwater systems, with less current, the effects might have been different. Thus, the environmental assessment program studied a wide range of environments for unanticipated effects of battery disposal.

The assessment program had several additional purposes. Standardized operational protocols for site mapping and documentation prior to battery removal were developed. These protocols provided critical input into assessing the reliability of the results and verifying that batteries had been removed from the AtoN. A least-impact removal protocol was also developed. Site closure

after battery removal was addressed by post-removal sediment sampling. These techniques are documented in the site investigation program results (CH2M Hill (Maughan) 1993, 1994a, 1994b, 1995). However, the primary purpose of the sampling program was to assess the effect of spent primary batteries on human health and the environment.

Fixed AtoNs were examined in the Chesapeake Bay, Tampa Bay, Tennessee River, and Puget Sound. Two terrestrial locations were also examined in the Tampa Bay area.

The Chesapeake Bay study included two visits to AtoNs. During the first visit, a group of AtoNs was selected for survey, based on the high estimated battery use at the AtoN, maximizing the likelihood that batteries were present. These lights were surveyed using a remotely operated vehicle (ROV) to document AtoN characteristics and locate batteries. Very useful data were collected, allowing the Volpe Center to describe the dispersal of batteries at typical AtoNs, and to identify the area where most batteries were found. AtoNs where batteries were found were revisited to collect sediment and biological samples. During the second visit, only AtoNs known to have discarded batteries nearby were chosen for characterization. The Coast Guard had conducted independent surveys of the bottoms near AtoNs in these areas, and provided data identifying the number of batteries at each location. A subset of this group of surveyed AtoNs was characterized in the same manner as the AtoNs in the Chesapeake Bay; selection was based on representation of various AtoN characteristics, including salinity, bottom type, and depths.

Research scientists designing the aquatic characterization supposed that battery movement might result in casing deterioration with resulting low, but detectable mercury releases around the disposal field. During the many years following battery disposal, events such as storms and dredging have, in all likelihood, moved the batteries from their original resting place. The researchers hypothesized that battery movement could result in a dispersed mercury release rather than the "concentration spots" expected by Mason and Morel. Alternatively, some batteries remain at or near their original position, as indicated by biological overgrowth or burial in sediment. These batteries were more likely to have " concentration spots" of mercury near them. Location and variation in disposition of the batteries were studied by sampling near batteries and at random locations in varying distances around the AtoN base. Sediments were collected at randomly selected locations representing 5-meter strata up to the field perimeter around the AtoN (CH2M Hill, 1993a). The field perimeter was set at 20 meters, based on the results of the reconnaissance of battery locations in the Chesapeake Bay.

Other phenomena, in addition to battery movement, might effect the measured levels of mercury in sediments and biota. Just as some batteries become buried

in sediments due to sedimentation, mercury migrates deeper into sediments. Mercury migration past the active benthic layer into less biologically active zones reduces the overall exposure risk. Samples were collected from these zones, using 30-cm-core tubes, to describe this migratory path. An intact cross-section of the field sediments was retrieved. The samples were separated into top (10 cm) and bottom (10 cm) samples for independent laboratory analysis. Attached biota and species of opportunity were also collected at AtoNs. These biota were analyzed for total mercury content in tissue. Sediment samples were analyzed for total mercury, lead, zinc, and total organic carbon. In addition, some sediment samples were analyzed for methyl mercury.

Mercury concentrations and estimated risk to benthic invertebrates were evaluated in local sediment and biological tissue samples. Sediments were evaluated because elemental mercury concentrates in that medium due to low solubility and affinity for particles. No water column samples were taken because elemental mercury is insoluble and probably unmeasurable in the water column, and any ionic mercury (potentially released when a primary battery was first broken open) would have quickly dissipated after disposal. (Morel and Mason 1993).

Environmental Transportation Consultants, (ETC), working under direction of the Volpe Center, designed and implemented an investigation program to evaluate the fate of mercury at battery disposal sites in a variety of environments. The initial program design reflected recommendations from NOAA (Hoff and Beckvar 1993) and later was modified to include a general conceptual model of exposure also provided by NOAA (Matta 1994). Scientists from the Massachusetts Institute of Technology, and the U.S. Environmental Protection Agency (EPA) provided comments on the initial program design. Throughout the study presentations on the program design and results of the prototype investigations were provided to scientists at NOAA. Their suggestions and comments are reflected in the final study design.

Locations Studied

Due to the time constraints and cost considerations involved, only a few locations could be characterized during the field studies. These locations had to represent the range of possible environments, population/land use zones, water types, and aid types operated by the Coast Guard. Given the large number of lighted fixed aids, selection of the locations had to be based both on the representation of the many test variables at each site and on the likelihood that primary batteries would be found at the location. Some locations are more environmentally sensitive than others or represent critical variables (such as the presence of fresh water), and were thus included as study sites. In addition, the likelihood of exposure through any of the pathways (i.e., inhalation, skin, or ingestion) was included in the selection criteria. Thus, terrestrial locations and

aquatic areas easily accessible to humans (such as those in shallow water) were studied.

An important selection criterion was the environmental or human health sensitivity of the location. AtoNs deployed on land (0' of water) thereby accessible on foot; those in recreational areas; those where bottom types are particularly sensitive (such as coral reefs); or those that may promote the entrapment of elemental mercury (such as fine particulate soils) or the creation of methyl mercury are all potentially sensitive.

Based on the findings of the Morel-Mason study and other environmental characterizations, four characteristics affect the likelihood of formation of harmful forms of mercury in aquatic systems and can be used for site selection: (1) the salinity of the water (fresh vs. salt), (2) the organic content of sediment (high/low), higher organic content promoting the formation of methyl mercury (Preston, 1989) , (3) the sediment type or quality, ranging from coarse to fine grained where fine grained sediments attract metallic particles, and (4) the degree of mixing or "flushing" of the system.

Locations were chosen to represent a range of these four characteristics, and to provide us with data on particularly sensitive environments. Estuarine systems, such as those chosen for three of the four prototypes, were studied because they exhibit variety in salinity zones, bottom types, biota, and sediment quality.

Bottom types are often subdivided into a large number of categories, depending on the rockiness, muddiness, or sandiness of the sediments. Sixty-two percent of all fixed aids are located in some form of mud, and another 7 percent are found in "earth" bottoms (ATONIS 1993). In this sense, selected AtoNs located in "muddy" bottoms represent most of the bottom types of AtoNs in the field. However, the national distribution of AtoN location bottom types is not easily replicated at the state or even Coast Guard District level, since bottom types are more specific to certain areas of the country than are water depths. In addition, bottom types affect the likelihood of battery breakage, mercury entrapment or dissolution, and the presence of biota likely to ingest any released mercury. This makes it critical that a variety of bottom types be represented in the study, even if the number of locations exhibiting those characteristics was relatively small.

Thirty-six percent of all fixed aids are located on shore (i.e., in zero feet of water), 29 percent are in water more that 20 feet deep, 20 percent are in 0 to 10 feet of water, and 15 percent are in 10 to 20 feet of water. Therefore, AtoNs were selected from all water depths, where possible, in each of the environments studied.

The locations chosen represent sensitive environments, such as estuaries, a variety of salinity levels, ranging from fresh water to open marine environments;

bottom types, including mud, sand, rock, and shells; and water depths ranging 0 to 50 feet. The data reported here, for the Chesapeake Bay, Tampa Bay, Tennessee River, and Puget Sound, represent the majority of depths, salinities, and bottom types where AtoNs are located. Based on this representation, generalizations can be made about most fixed AtoNs operated by the Coast Guard, with respect to the number of batteries likely to be found, the condition of the batteries, the level of mercury likely to be found in sediments. Generalizations can even be made about cleanup time and expected costs.

Unusually sensitive environment, such as a coral reef area providing endangered species habitat, is the only type of location not yet addressed. Such an area has been chosen for special study in the near future. These results are not expected to vary significantly from the data already gathered.

Chesapeake Bay

The Chesapeake Bay, located on the east coast of the United States, is one of the largest and most productive estuaries in the world. The main stem of the Bay extends approximately 190 miles from Cape Henry, Virginia, to the mouth of the Susquehanna River. The Chesapeake Bay is a submerged river valley, a remnant of the Susquehanna River Valley which was inundated with rising sea level after the most recent glacial period.

The most important feature that distinguishes an estuary from a river or ocean is the temporal and geographic variations in salinity levels. In the Chesapeake, salinities range from about 35 parts per thousand at its outlet to the ocean to near zero at the head of the Bay and its estuarine tributaries. This variation in salinity is directly related to the quantity of freshwater inflow to the Bay from its tributaries. The estuary is fed by more than 50 tributaries comprising the 64,000 square mile drainage area; however, 90 percent of the freshwater contributed to the Bay originates in five major tributaries: the Susquehanna, Potomac, James, York, and Rappahannock Rivers. The Susquehanna, draining from Pennsylvania and New York, provides approximately half of the Bay's freshwater.

As with most estuaries, the Chesapeake Bay supports a highly productive biological community. This, in turn, supports a large commercial and sport fishery quite important to the regional economy. The Bay is also an important recreation area for the region's nearly 15 million residents and, in turn, provides a lucrative source of tourism for the economy. The Bay has also served for centuries as a commercial shipping center, with two major port complexes connected by interstate highway, air, and rail systems to important inland points.

Several different bottom types and AtoN structures were characterized in the study on the Chesapeake. These ranged from a large, caisson structure

surrounded by riprap, a multiple pile structure located in Annapolis Harbor, and two single pile AtoNs located in silty-bottom areas.

Tampa Bay, Florida

Tampa Bay is Florida's largest open water estuary and consists of a connected group of estuaries and embayments, which include Old Tampa Bay, Hillsborough Bay, Boca Ciega Bay, Terra Ceia Bay, and the Manatee River, as well as Tampa Bay proper.

Tampa Bay is a naturally shallow estuary, having an average depth of about 12 feet (Goodwin, 1984) and a maximum depth of about 90 feet in the Egmont Channel at the mouth of the bay. Sediments and bottom features in Tampa Bay are generally uniform, with the majority of coverage being unconsolidated sediments or soft bottom. Surface sediments in Tampa Bay consist of predominantly quartz sand. The average size of sediment particles increase from the upper to lower reaches of Tampa Bay. Organic sediments and fine silts and clays are found primarily in the upper portions of Hillsborough Bay. Sediments in the lower portion of the bay consist primarily of fine to coarse sands.

The Tennessee River

The Tennessee River is one of three major rivers (Tennessee, Cumberland, and Mississippi) that drain the state of Tennessee, providing hydroelectric power through the Tennessee Valley Authority Dam System. The study areas selected from the Tennessee River include Lakes Chickamauga and Nickajack, which are located in Hamilton County, Tennessee. Lake Chickamauga is multipurpose reservoir providing flood control, hydroelectric power, and recreation. Lake Nickajack is a run-of-the-river system providing similar benefits to the area. The tail waters of Lake Nickajack and the deep pool area of Lake Chickamauga border Chattanooga, with the dam at Lake Chickamauga located northeast of the city. The normal pool area of Lake Chickamauga covers approximately 35,400 acres at elevation 682.5 mean sea level (msl). Lake Nickajack surface area at normal pool is 10,370 acres at elevation 34 msl. Bottom types throughout the lake and river system are soft, muddy, highly organic material.

Puget Sound

The Puget Sound system was created by mountain building and glacial activity. The area (4,973 square meters) encompasses the San Juan Islands to the north, Hood Canal to the west, and the Tacoma Narrows to the south. The numerous inlets and bays form a rare dendritic system that makes up the Puget Sound.

The sediment and biotic sampling sites for the Puget Sound study were chose from Budd Inlet, which is a shallow estuary at the extreme southern end of Puget Sound. Located north of the city of Olympia, Budd Inlet is the major waterway connecting Olympia and Tumwater, and the Deschutes River is its major freshwater source. The inlet is approximately 6.9 miles long, with an average width of 1.15 miles and a maximum width of 1.61 miles. It is a partially mixed shallow estuary with muddy substrates. The average depth is 27 feet at mean low water. The shoreline and intertidal areas are moderately steep, and only the intertidal mud flats are located at the southern end of the inlet near Olympia Harbor. Puget Sound enters Budd Inlet through the Tacoma Narrows and Dana Passage, and is diluted at the inlet head by the Deschutes River. Water properties in Budd Inlet reflect these saltwater and freshwater sources. At times of high runoff, a surface layer of low-salinity water is observed in the inlet.

Development of Sampling Design

Environmental risk assessments involve numerous and complex receptors, endpoints, levels of acceptable risk, and methods of estimating risk. As a result of the complexity, there is no standard set of procedures applicable to all situations. Reference books on the subject strongly recommend a phased approach to environmental risk assessment. For instance, EPA guidance (EPA 1993) recommends a phased investigation allowing for the identification of potential problem areas before conducting detailed investigations of specific environmental media and receptors. This phased approach focuses attention and resources on areas of potential risk, eliminating media and receptors determined to be of no risk based on adequate data and simple screening techniques.

The environmental characterizations were designed to measure two types of AtoN battery risk; the direct effect on humans due to ingestion of mercury, and the environmental risk due to mercury releases into nearby sediments. If evident, human health risk results inhalation of mercury vapor or from bioaccumulation of mercury--i.e., consumption of marine animals that consume smaller biota contaminated with mercury from batteries. Environmental risks to the biological community in nearby sediment at AtoNs results from release of the contents of spent batteries. These two types of risk are inter-related since lower-level organisms are the food of higher-level (trophic) organisms, and evaluation of the impact on the benthic community translates into an estimate of broader marine animal effects.

Benthic biota and attached organisms were chosen for study to evaluate both human health and environmental risk because they were the best indicators of battery-specific effects. While humans normally consume larger marine animals, analysis of these species alone is an insufficient indicator of bioaccumulation risk directly attributable to mercury releases from spent batteries. The aquatic

characterizations have focused on measuring the concentration of mercury in the benthic sediment layers and biota attached to or near batteries.

In addition to the selection of sediments and biota to characterize, the field sampling design had to account for variation in battery condition and dispersal around the base of the AtoN. Batteries were routinely found in varying states of decay, and varying locations near AtoNs. It was thought that concomitant variations in the exposure of battery contents to the environment and resulting measured mercury concentrations could result. The result of the program design effort was a detailed Sediment and Aquatic Biota Tissue Sampling and Analysis Plan (including Health and Safety Plan and Quality Assurance and Quality Control Plan) for each prototype investigation. The field investigation program was modeled after Superfund sampling and analysis efforts and incorporated approved methodologies and critical Quality Assurance/Quality Control Measures such as:

- Collection and analysis of duplicate samples
- Analysis of blank and spiked samples
- Complete chain of custody procedures
- Independent supervision of sample collection
- Decontamination and sealing of all sample containers

An aquatic sampling and analysis effort, evaluating both sediment and organisms, was implemented at all prototype locations (Chesapeake Bay, Tampa Bay, the Tennessee River and Puget Sound). The objective of the sediment collection was to determine:

- Whether mercury was being released from the batteries to the sediments
- The extent that it accumulated and migrated
- The form in which it occurred in the sediments

The investigation was designed to address these questions by collecting sediments close to discarded batteries, at increasing distances from batteries and AtoNs, and at background locations where batteries had never been used. Sediment samples were collected using a tube that was carefully inserted into the sediment. When extracted, the tube contained an undisturbed core of sediment in the same state and configuration as it had existed on the sea floor. This procedure allowed analysis of sediment at increasing depths to describe mercury migration.

Sampling Densities

The number of samples and their spatial distribution addressed the general distribution of potential contamination at AtoN sites. The sample design also reflects NOAA's recommendation to *"determine the overall effects from contamination immediately around the ATON site, not to characterize the*

specific pattern of contamination relating to a particular battery". (Hoff and Beckvar 1993 p1). Determination of an appropriate number of samples and their spatial distribution was difficult to achieve since the pattern of contamination was unknown, therefore several assumptions had to be made.

First, the logical area which could be defined as "immediately around the ATON site" had to be established. A 20-meter area around the based of the AtoN was selected based the findings of battery reconnaissance operations conducted in the Chesapeake Bay . Later, results of a demonstration battery removal program in Tampa Bay supported the selection of a 20-meter field. In Tampa Bay, 62.5 percent of all batteries found were within a 5-meter radius of the base of the AtoN; 95 percent were found within 20 meters of its base (Borener 1994).

The number of samples taken at sites (10 per AtoN) reflects a sampling density of 126 square meters per sample. Table 2-1 compares the AtoN sampling program with other sediment sampling programs to show the level of consistency in the sampling density. Where applicable, the data were divided into (1) "Inner Zone" areas where the potential for elevated concentration of contaminants was the greatest and (2) the total area studied. For example, in the AtoN battery studies, the near-field areas were considered most likely to be affected by mercury (i.e., Inner Zone). A brief description of each project is included in Appendix B.

Since the sampling was not intended to be source-point-specific, a stratified random sampling approach was chosen. This approach reflected NOAA's concerns: *"we recommend against focusing sampling effort near visible batteries: the batteries may have moved over time, and may not represent all areas of contaminated sediment; inputs from buried batteries will be unaccounted for; sampling effort will focus on a few areas and may not represent the area of concern; and lastly, a battery-focused sample design will likely require greater sampling effort and provide less useful information for risk determination than a randomized approach."* (Hoff and Beckvar 1993). Sample stratification was implemented to reflect the observed distribution of batteries around the base of the AtoN (Ch2M Hill 1993) (Borener 1994).

Table 2-1: Sampling Densities

Site Type	Location	Site	Site Area (m^2)	No Samples	m^2 Samples
AtoN	Prototype Investigation	Inner Zone	314	5	62
AtoN	Prototype Investigation	Total Site	1,256	10	126
Superfund	Eagle Harbor	Total Site	80,963	53	1,527
Superfund	Sullivan's Ledge	Total Site	52,025	30	1,734
Superfund	Pine Street	Total Site	15,793	5	3,159
Superfund	Ice Creek	Inner Zone	21,774	4	5,444
Superfund	Ice Creek	Total Site	43,548	6	7,258
Superfund	Bay Drum	Inner Zone	70,899	10	7,090
Superfund	Bay Drum	Total Site	80,207	12	6,684
Superfund	Commencement Bay	Total Site	1,876,206	53	35,400
Other	Florida Survey	Total Site	1,786,000	972	1,837
Other	Morton Beverly	Inner Zone	11,288	16	706
Other	Morton Beverly	Total Site	66,890	21	3,185
Other	Seal Beach	Total Site	80,936	23	3,519
Other	Lake Martin	Inner Zone	230,667	11	20,970
Other	Lake Martin	Total Site	2,480,688	43	57.960

BIOLOGICAL SAMPLING:

The intent of the biological sampling and analysis program was to determine the potential uptake and bioaccumulation of mercury in animals in close proximity discarded batteries.

Aquatic Sites

In the Chesapeake and Tampa Bays, organisms attached to batteries or other hard surfaces associated with AtoNs were collected and analyzed, to determine whether mercury concentrations in such biota exceeded concentrations in similar organisms in other portions of the estuary. Attached organisms were studied because they are immobile. Their immobility removes the possibility that any elevated mercury concentrations found in the organisms could have been accumulated at a different location. Similarly, if the levels were not elevated (for animals which had been attached to batteries for their entire life) it would be unlikely that more transient animals, like fish or crabs, would accumulate mercury from batteries. The biological collection procedures used were designed specifically for the particular environments in which they were implemented. In the Chesapeake Bay, blue mussels (*Mytilus edulis*) were collected, where possible, because NOAA (NOAA 1989) and the EPA have used this mussel to evaluate national trends in water pollution, and there is a wealth of information on mercury concentrations in that species. Application of this planned procedure was limited by the absence of this species in sufficient numbers in the Chesapeake and Tampa Bays, and was modified for the Tennessee River study. In Tennessee and Puget Sound, organisms dwelling within the sediments were analyzed.
Total mercury concentrations in biological tissue were measured as an upper bound on the methyl mercury concentration. Methyl mercury persists much longer than elemental mercury in tissue (Riisgard and Hansen, 1990; Surma-Aho and Passivirta, 1986), therefore, if detected, mercury is more likely to be in methyl form in tissue than in elemental form. The total mercury concentration is, therefore, a conservative estimate of the total methyl mercury in biota.

Terrestrial Sites

In addition to the aquatic effort in the Tampa area, land-based (or terrestrial) AtoNs were evaluated. Two representative locations were examined: an active AtoN surrounded by dry land on Egmont Key and an inactive light surrounded by wetlands on Anclotte Key. Terrestrial locations were included in the study due to the multiple exposure pathways to humans that can be encountered at this type of location.

The additional possibility of exposure to contaminants through inhalation exists at terrestrial locations, whereas the exposure pathways at aquatic locations are

limited to drinking contaminated water, consuming a contaminated organism (such as fish or shellfish), or absorbing a contaminant through the skin while diving. Many terrestrial AtoNs are located in or near recreational areas, such as game preserves or state or national parks, increasing the likelihood of human exposure to mercury released from discarded batteries. Of particular concern is the possibility of exposure to mercury vapor, since discarded batteries may be piled above ground at some of these locations. Therefore, the possibility of harmful effects from mercury vapor was studied at the terrestrial sites.

The study program for each terrestrial AtoN had the following agenda:

- Monitor air quality near battery piles for mercury vapor.
- Collect and analyze soil samples outside the observed battery perimeter to use as background concentrations.
- Collect and analyze soil samples adjacent to and/or beneath broken and unbroken batteries.
- Collect and analyze soil samples at increasing distances from battery groups.
- Collect and analyze groundwater and surface water if it is adjacent to batteries.
- Describe physical attributes of the AtoN and surrounding area.
- Locate, describe, and count batteries at each AtoN.

Summary

The site investigations were designed to assess contamination from metals released from batteries found at AtoNs. Initial site investigations revealed that the only contaminants of concern were mercury and zinc (the components of primary batteries) since few secondary batteries were found at any AtoN. Of the two contaminants, mercury is considered the more potentially harmful to humans and biota, however, the investigations continued to assess both zinc and mercury levels since both metals were present in primary batteries.

The sampling program was conducted in locations that represented the variety of the water depths, bottom types, currents and salinities of most AtoNs. The program followed a typical approach to site investigation used at Superfund sites, including a high sampling density near the "hot spots" of contamination. Uncertainties exhibited at AtoNs, such as expected contaminant dispersal and concentration warranted sampling density at AtoNs an order of magnitude higher than at most Superfund site investigations. Sampling stratification was implemented to address potential variability in contaminant dispersal due to battery movement .

The biological sampling conducted at prototype sites was, by necessity, site-specific. Variability among locations chosen for study sometimes required that

different biota be collected, and that the method of collection be adapted to field conditions. In general, benthic invertebrates were collected at AtoNs. Where possible, species with known or previously characterized normal mercury levels were collected during the study.

Chapter Three
Environmental Characterization Results

Aquatic and terrestrial locations were studied in the Chesapeake Bay, Tampa Bay, Puget Sound and the Tenessee River using the sediment and biota analysis techniques described in the previous section. These results demonstrate low contamination (if any) in sediments associated with spent batteries, no human health risk and minimal biological impacts.

Chesapeake Bay

Mercury concentrations in sediments adjacent to AtoNs in the Baltimore Area of the Chesapeake Bay were generally the lowest found in all the prototype investigations. The values at the three AtoNs evaluated were low compared to background levels both measured and reported in the literature (Long and MacDonald 1992). (Figure 3-1). The levels were also below ecological effects range low (ER-L) and effects range median (ER-M) which are ecological benchmark concentrations. A full description of the sources of these values and the method of their calculation appears in Appendix C.

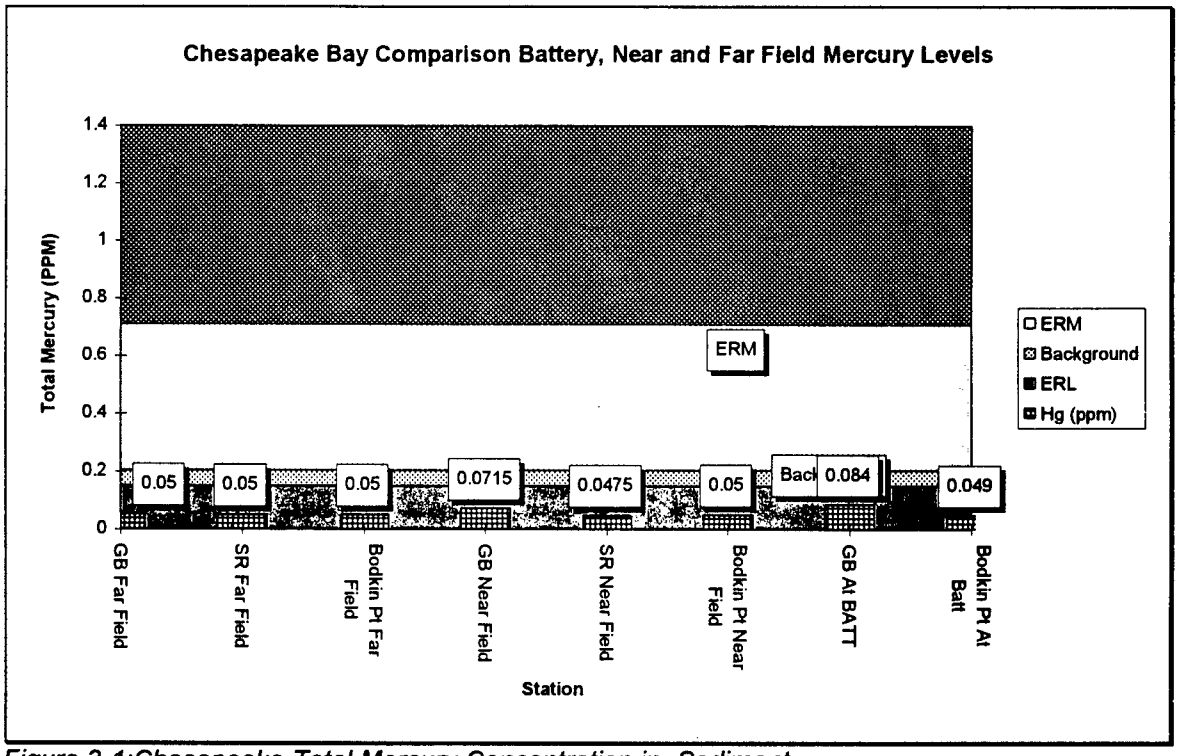


Figure 3-1:Chesapeake Total Mercury Concentration in Sediment

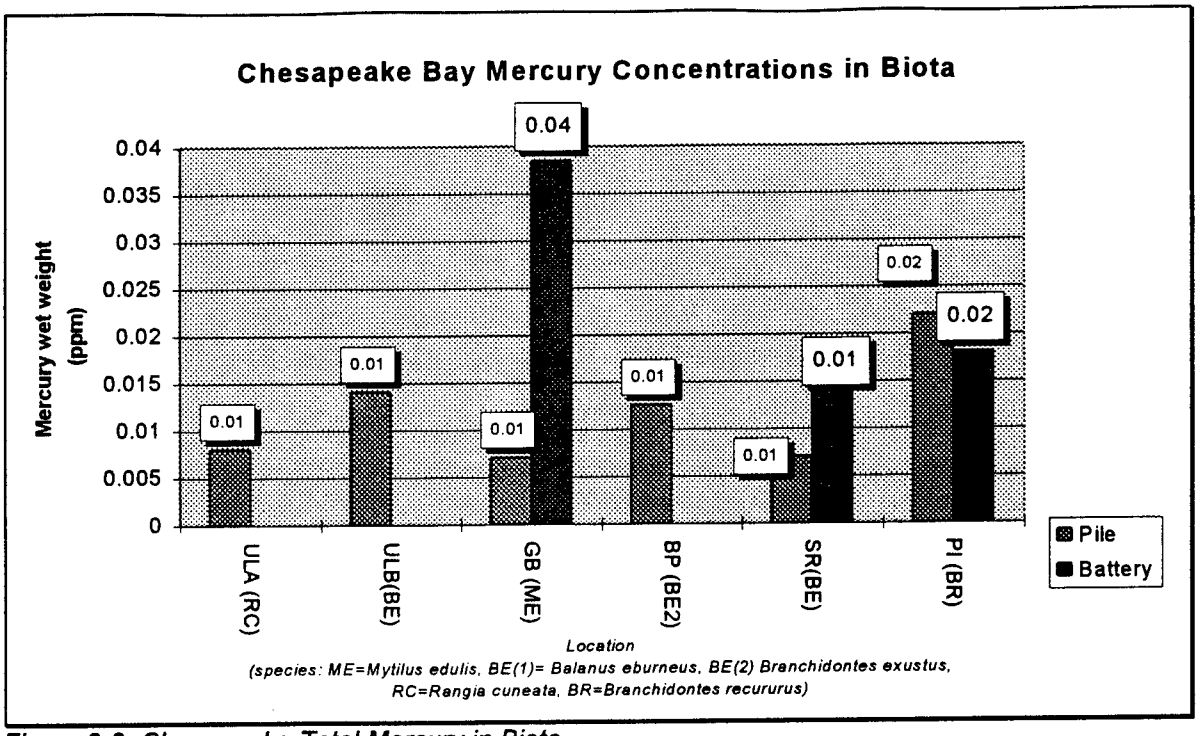


Figure 3-2: Chesapeake Total Mercury in Biota

There was a strong correlation between concentration of mercury and physical characteristics of the sediment seen at the Chesapeake Bay AtoNs (r^2 of 0.72) (CH2M Hill 1993b). In areas were there were fine grain sediments and abundant organic matter the concentrations were higher than in areas with larger grain size material such as sand. This correlation held whether there were batteries present or not.

The Pooles Island Light examined as part of the Chesapeake Prototype investigation exhibited a combination of characteristics which could result in environmental risk. The habitat around Pooles Island Light is abundant with fish, crabs, and other marine organisms which could accumulate mercury. Discarding batteries onto the rip rap (e.g. large rocks used to inhibit erosion) at the base of the light could result in a large number of broken batteries, and the oyster bar substrate could prevent mixing of the mercury from the batteries into the sediment. The result could be relatively high concentrations of mercury at the sediment interface.

Due to species abundance at the locations studied in Chesapeake Bay, biological samples of the same species could be collected within an AtoN site and among different AtoNs. The concentrations of mercury in biota at the AtoNs were generally at or below background levels, and well beneath the levels associated with risk in humans (CH2M Hill, 1993a).

Tampa Bay

The Tampa Bay Prototype investigation discovered large numbers of discarded batteries at several AtoNs, and a very high percentage of these were broken. The sediment mercury concentrations reflected this condition; at most of the AtoNs sampled, the nearfield sediment concentrations were above both the measured and the literature reported background levels (CNMS 1992). (Figure 3-3). Also, at approximately half the AtoNs the concentrations were above the more protective ecological benchmark for sediment dwelling organisms (ER-L).

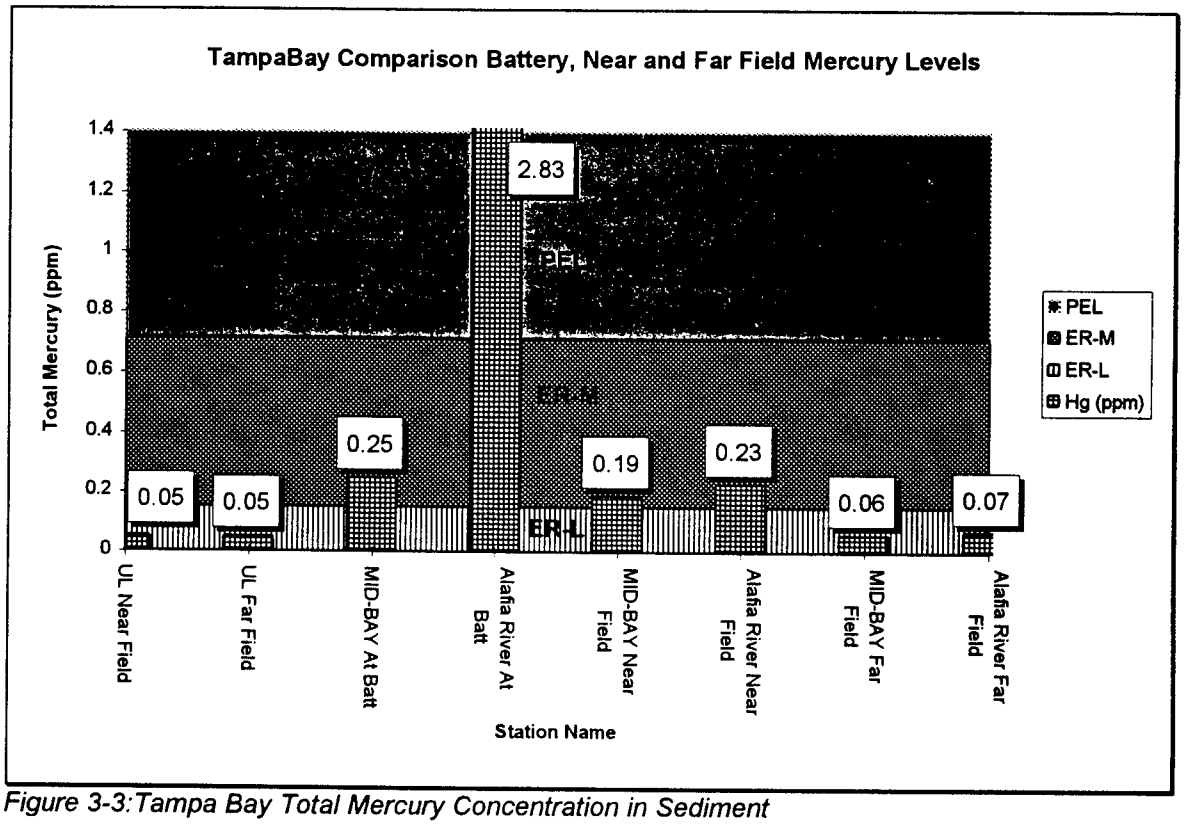


Figure 3-3:Tampa Bay Total Mercury Concentration in Sediment

Although concentrations found in animals were less than the FDA action level indicating risk to human health, metal concentrations in sediments indicated some potential risk to marine organisms in small localized areas close to high concentrations of batteries. Levels adjacent to batteries frequently exceeded concentrations usually associated with ecological effects (Long and Morgan, 1991) and always exceeded the most conservative concentrations considered to be associated with effects on sediment dwelling animals. Within 10 meters of AtoNs mercury levels did not exceed levels generally associated with effects but frequently were above the most protective ecological benchmarks. Beyond 10 meters no elevated levels were noted.

Sediment mercury concentrations in the eastern portion of the Tampa Bay system (Hillsborough Bay), have been previously documented as having a high

silt and organic carbon content and elevated mercury levels from a variety of sources (CNMS 1992). The AtoNs sampled at the mouth of the Alafia River reflected this condition and at one AtoN (Alafia River Range Front Light) even exceeded the Hillsborough Bay background levels.

At the terrestrial locations examined numerous batteries were located and the soil under and adjacent batteries piles had elevated mercury levels. However, the elevated levels were confined to a small area within a meter of the batteries and surface water samples collected within a meter of a battery pile had non detectable levels of mercury. Even maximum soil mercury levels found were well below levels associated with human health risk.

A wide variety of marine species were collected in Tampa Bay and mercury concentrations in all samples where well below benchmark values (NOAA 1991) (see Figure 3-4). The broad food web spectrum of animals collected, all with low mercury concentrations, in combination with the low percentages of methyl mercury measured provides strong evidence for a lack of human health or environmental risk. However the broad range of animals collected, with little overlap among AtoNs and conditions within AtoNs, makes it difficult to compare samples and evaluate bioconcentration of mercury originating from batteries. Even though all samples showed low levels there were some indications that the animals attached to batteries had slightly higher levels than similar animals attached to structures a few meters away. The animals on the AtoN structures adjacent to piles of batteries generally showed mercury concentrations at or below levels seen at reference stations with no batteries.

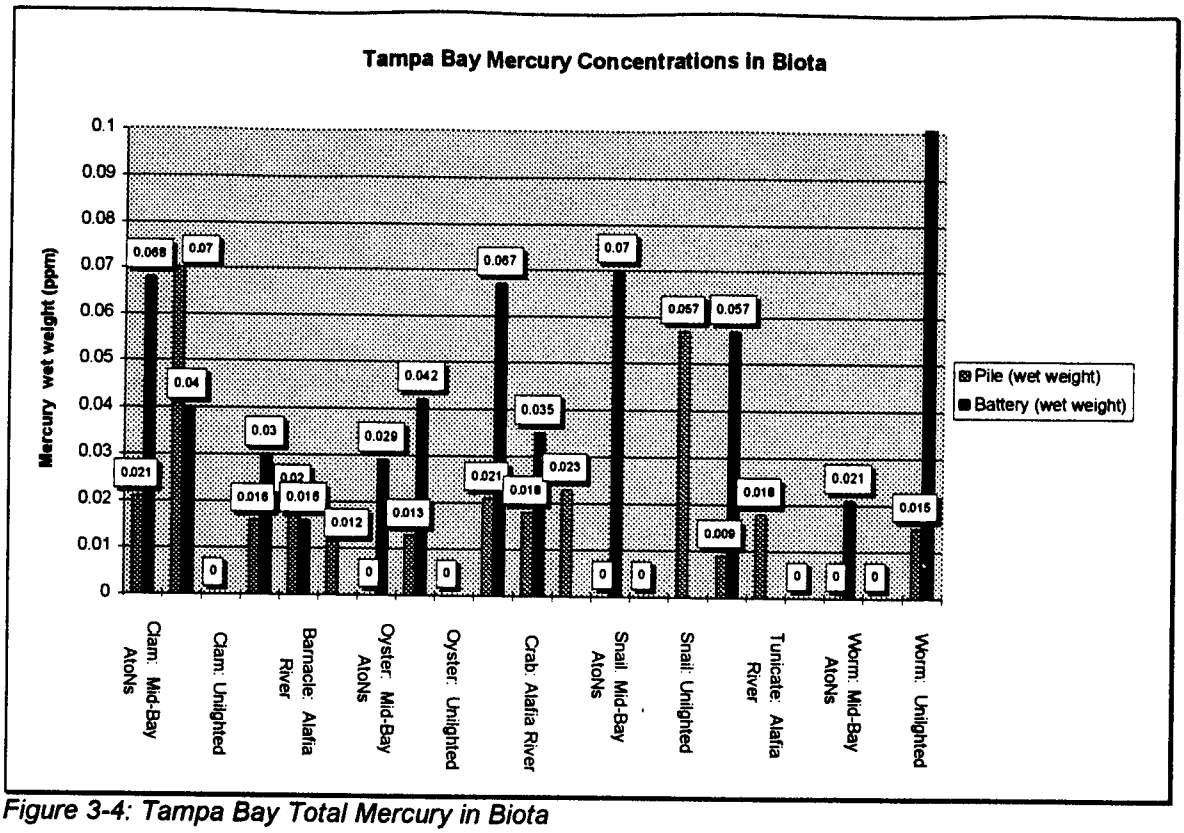


Figure 3-4: Tampa Bay Total Mercury in Biota

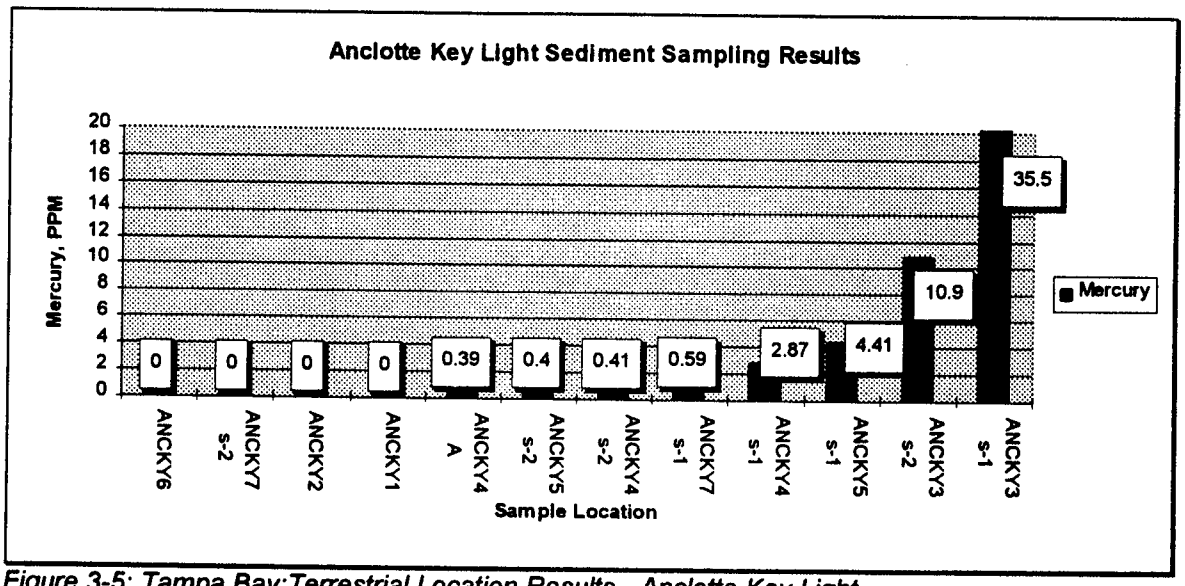


Figure 3-5: Tampa Bay:Terrestrial Location Results - Anclotte Key Light

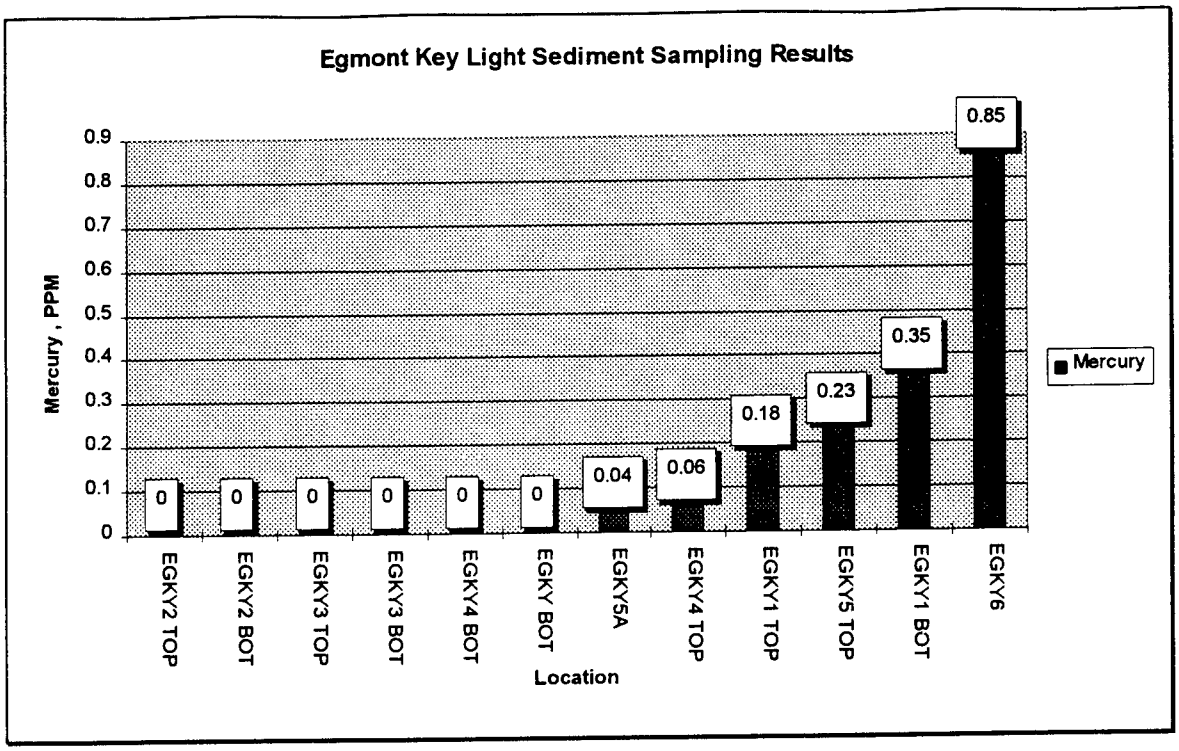


Figure 3-6: Tampa Bay: Terrestrial Location Results - Egmont Key Light

Tennessee River

The evaluation of sediment mercury concentrations at Tennessee River AtoNs revealed no patterns relative to number of batteries present or proximity to battery piles. Mercury values at all AtoNs were below literature reported background levels but generally comparable to or above background values measured as part of the investigation at unlighted AtoNs (Figure 3-7). Two AtoNs, Patton Island lower (PTL) and upper (PTU) had noticeably elevated mercury levels but literature researched showed that they were at the mouth of a tributary with documented mercury contamination in the watershed.

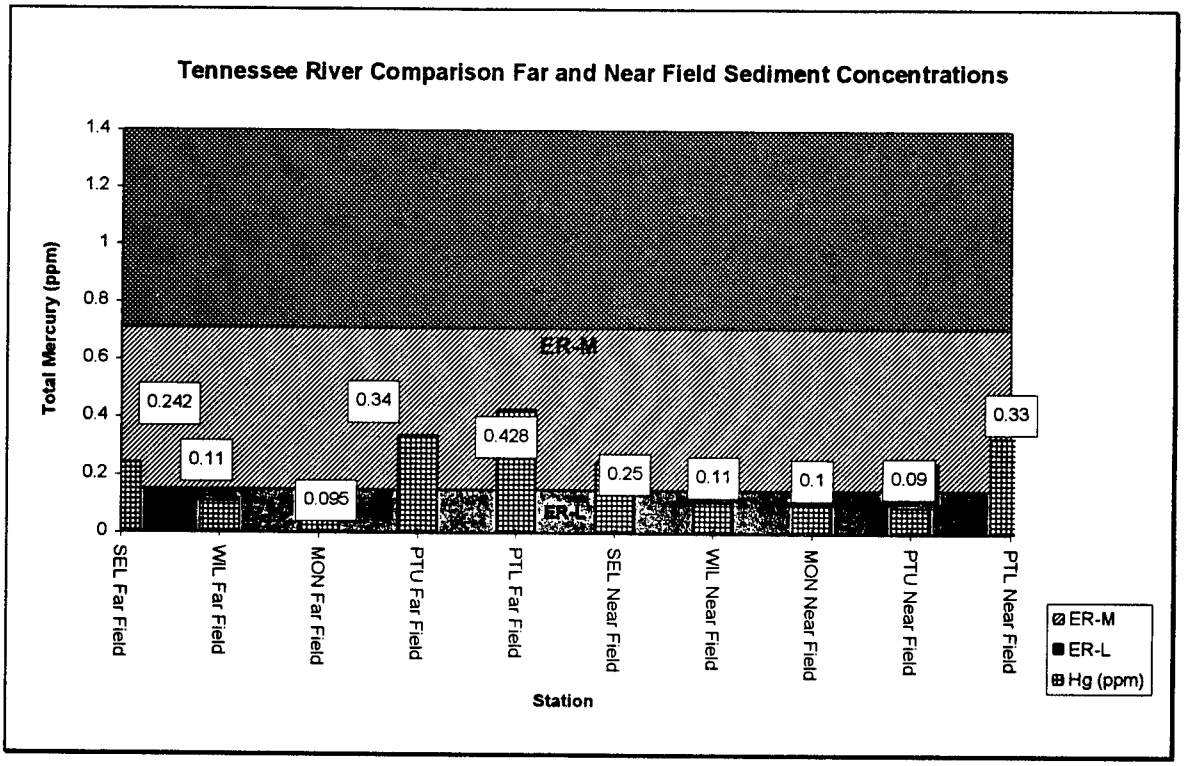


Figure 3-7: Tennessee River Total Mercury in Sediment

Similar to the sediment results, the analysis of biological tissue samples from the Tennessee River revealed no pattern of total mercury concentration relative to number or position of batteries. They also exhibited low concentrations relative to background, and in comparison to levels associated with risk. The levels of methyl mercury in the sediments were also low, substantiating the finding of low bioavailability and bioconcentration and thus low risk.

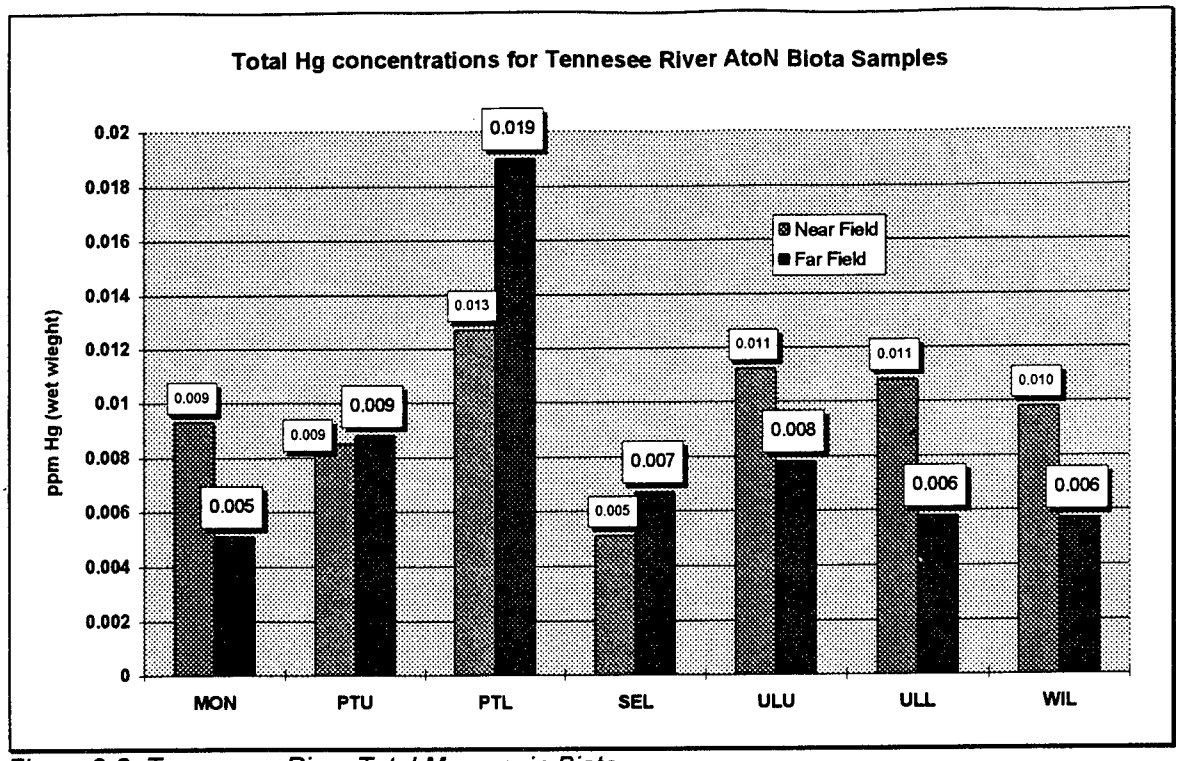


Figure 3-8: Tennessee River Total Mercury in Biota

Puget Sound

The concentrations of metals showed no increase with proximity to batteries and were similar at lighted and unlighted AtoNs. Average mercury and zinc sediment levels at AtoNs were similar to performance standards established in the Puget Sound Estuary Program for Puget Sound reference sites (i.e. uncontaminated sites) and background data from nearby areas in Budd Inlet not influenced by batteries. The highest concentrations of metals measured at the AtoN sites in Budd Inlet were well within the range of mercury and zinc measured a typical sites in Puget Sound, and even the highest concentrations observed were well below state standards for sediment mercury and zinc.

The sediment concentrations of mercury and zinc were below the levels at which ecological impacts to benthic infauna are considered "likely" to cause effects.(Long and MacDonald, 1992) There were areas where concentrations exceed levels reported in the literature to cause possible effects. The exceedances occurred at all sites, including the reference site ULO. Since the exceedance of the most conservative benchmarks was measured at the reference site, any effects due to mercury cannot be directly attributed to batteries. Based upon the low total and methyl mercury levels, the risk to benthic infauna, if any, is minimal and is apparently not attributable to AtoN batteries.

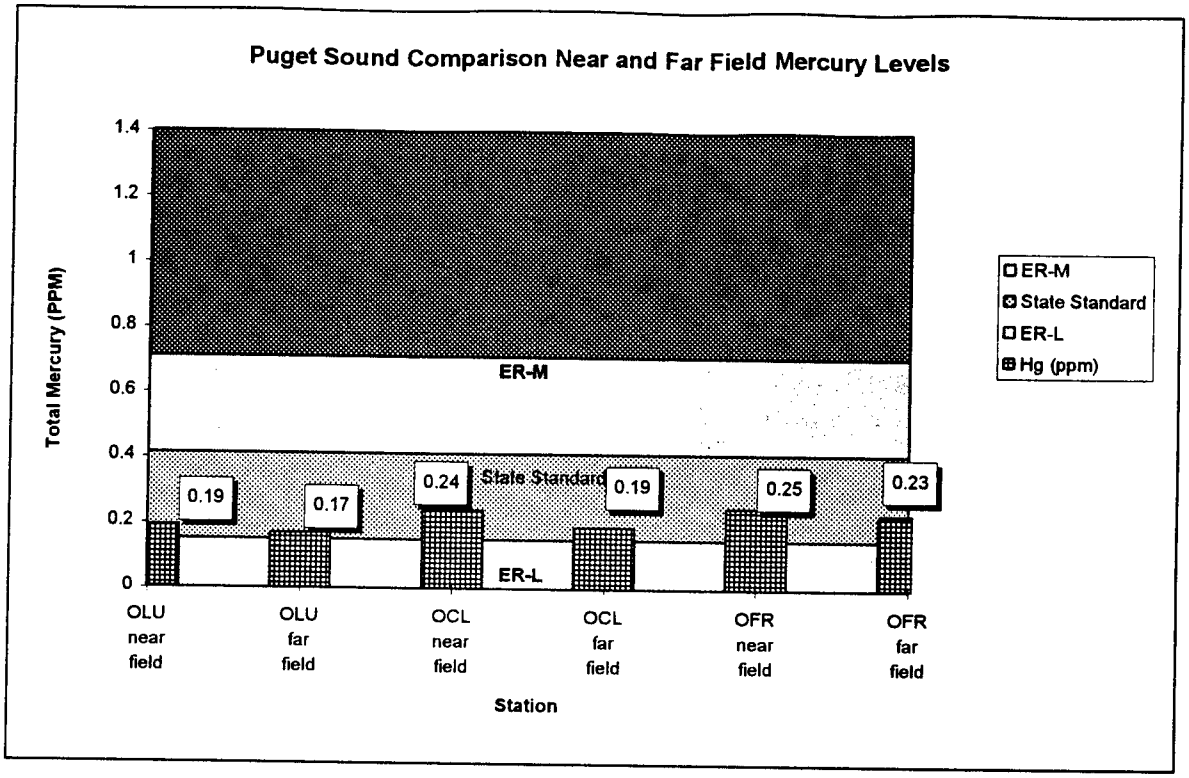


Figure 3-9: Puget Sound Total Mercury in Sediment

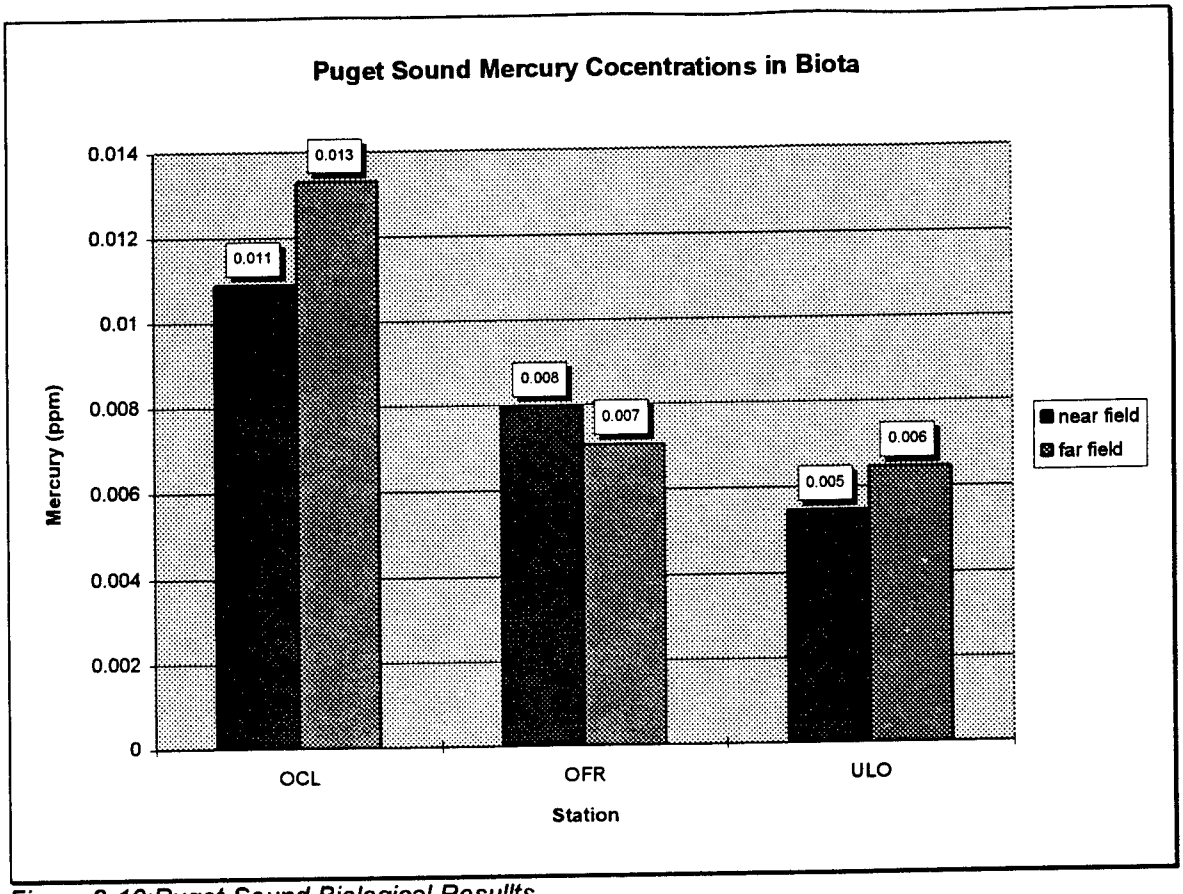


Figure 3-10:Puget Sound Biological Resullts

The concentrations of metal measured in animals collected from the AtoNs were extremely low. Maximum mercury concentrations measured in all organisms, including clams in areas where batteries could have been significant contributors, were less than 0.1 ppm (wet weight). None of the mercury found in tissue samples could be linked to batteries, since far-field samples had higher concentrations on average than those taken near batteries.

Methyl mercury Results

Initial planning for the investigation considered an assessment of methyl mercury important because of the potential biological effects. However there were no bench marks for comparison or assessment of effects so several assumptions were made to add insight to the meaning of the data. The percentage of total mercury present in the methyl form was used for comparison because it provides some indication of methylation rates and bioavalability relative to other locations

Methyl mercury was measured in approximately 20% of the sediment samples to asses the form of mercury present and provide insight to the potential biological effects of mercury in the sediment Methyl mercury is generally considered to be more toxic than other forms of mercury and more easily accumulated in tissue of aquatic organisms (USEPA 1985) However methyl mercury is rarely measured in marine samples limiting the quantifability of toxicity or bioavailability of the methyl form in sediment. Consequently, the actual levels of methyl mercury found could not be compared to any screening levels or other benchmarcks. Instead, the relative proportion of methyl mercury present in sediments, compared to similar background stations or values reported in the literature was used to assess results

Similarly, methylation rates are difficult to measure and generally only attempted under highly controlled conditions. It was not feasible to measure methylation rates as part of this investigation. In the absence of direct measurements, the percentage of total mercury present in the methyl form was used as a relative measure of methylation rate This is based on the assumption that all other variables being similar, the higher the percentage of methyl mercury, the higher the rate of methylation or the presence of a source of methyl mercury. If higher rates, or a source of methyl mercury was indicated, there could be cause for concern. Methyl mercury occuring as approximately one percent of total mercury, as reported in the literature (Baudo et al 1990), was used in this investigation as the expected range A percentage above this level was considered an indication of either higher than expected methyation rates or a direct source methyl mercury. This is only an assumption but no data was available to more accurately assess rates of methylation or concern over levels of methyl mercury in sediments

Organisms at the highest trophic levels bioconcentrate mercury predominantly through the food chain; the higher the trophic level of the fish or animal, the greater the likelihood of biomagnification. This is especially true for longer-lived organisms such as predatory fish, fish-eating mammals, and predatory birds. Since methyl mercury is more easily assimilated and it can readily bioaccumulate, it is an important factor to be considered in sediment studies involving ecological risk .

The assessed level of methyl mercury in all locations sampled during the prototype investigations was less than one percent of total mercury. The following graphs illustrate both the low percentages of methyl mercury in sediment samples, and the fact the methyl mercury levels are uncorrelated to the total mercury levels in sediments

In the Chesapeake by, the methyl mercury values reported for AtoN stations were minimal, less than 1 percent at all locations, and except for the very silty

areas, (UL2) less than .3 percent. These percentages were at the low end of the range reported in the literature. (Baudo, et. al., 1990)

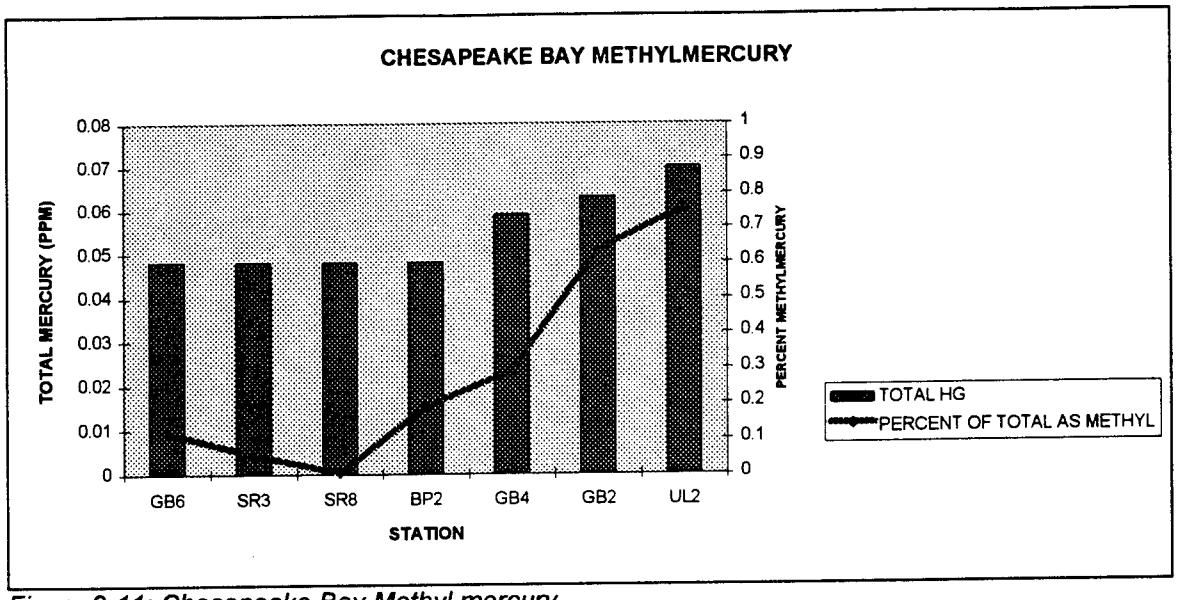


Figure 3-11: Chesapeake Bay Methyl mercury

Tampa Bay

The percent methyl mercury found in Tampa Bay samples ranges form 0.01 percent to 0.57 percent, and concentrations ranged from 0.000006 mg/kg to 0.000749 mg/kg. The sample with the lowest percentage of total mercury as methylmerucry was collected at the Alafia River Rear Range AtoN. A sample with a similar low percentage of methyl mercury (0.012 percent) was collected at the Gadsen Point Channel Day Beacon 10 (the UB AtoN). Samples with the highest percentage of mercury as methyl mercury were collected at station ER1 and ER5. These samples had methyl mercury percentages of 0.571 and 0.434. With the exception of the two samples collected at the E Cut Rear Range AtoN, all of the samples had methyl mercury values below 0.3 percent. These percentages are at the low end of the range reported in the literature.

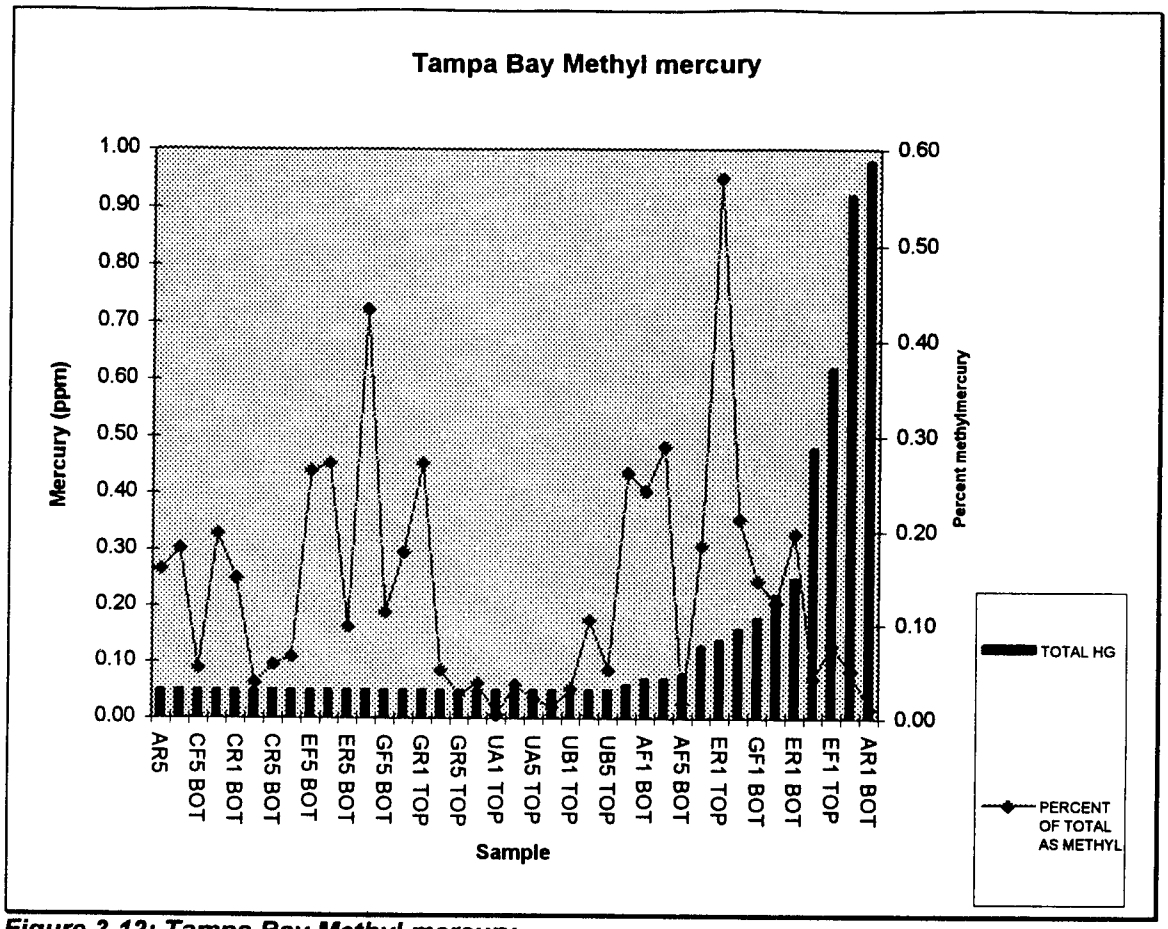


Figure 3-12: Tampa Bay Methyl mercury

Tennessee River

Methyl mercury in the Tennesse River samples ranges from 0.04% (Sample SEL4) to 0.23% (Sample PTU); concentrations range from 0.00009 mg/kg in samples ULU3 to 0.00045 mg/kg in sample SEL3. In Lake Chickamaugua, the data appear to show a pattern with respect to location similar to that of total mercury, increasing with distance downstream from Station MON to Station PTL and then decreasing to Station ULU. This pattern corresponds to the increasing and decreasing total organic carbon and clay, suggesting that the sediment characteristics have the expected influence on methyl mercury concentrations in sediments.

However, there does not appear to be any relationship between methyl mercury concentration and batteries. This lack of relationship can be seen in Figure 3-7.

Methyl mercury generally represents 0.1 to 1.0 percent of the total mercury in marine sediments. All samples had methyl mercury values below 0.23 percent, which is at the low end of the range reported in the literature. Based on

this comparison, there does not appear to be a risk to benthos due to methyl mercury.

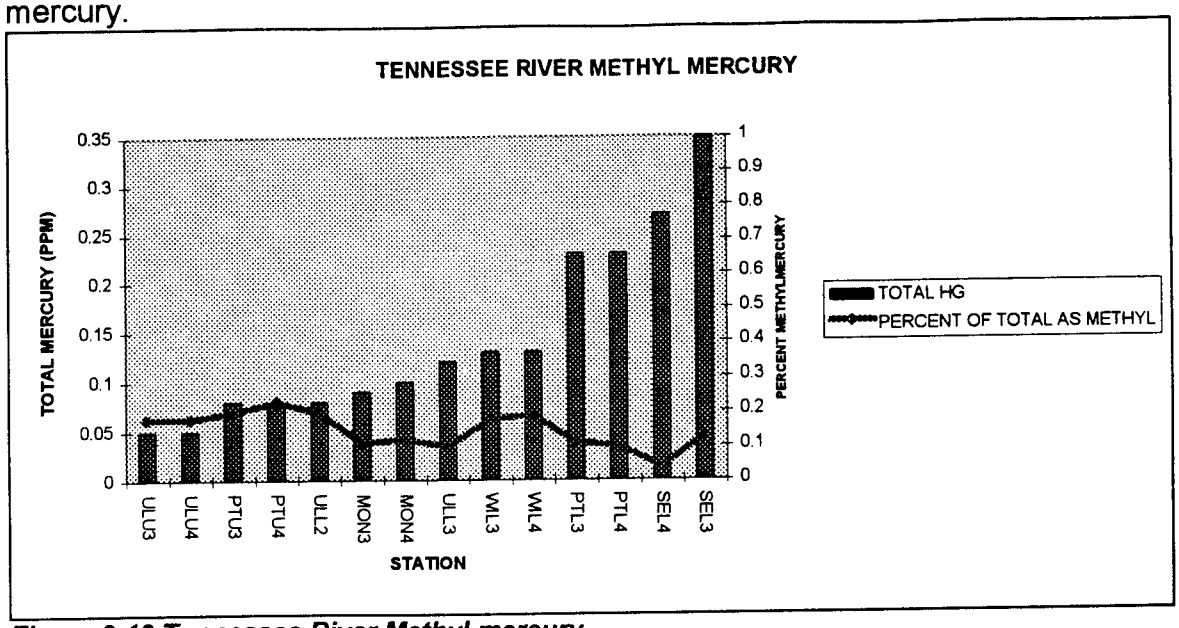


Figure 3-13 Tennessee River Methyl mercury

Puget Sound

The percent methyl mercury for the Puget Sound samples ranges from 0.34 (Sample OFR 2) to 1.10 (Sample COL 10); concentrations range from 0.000696 mg/kg to 0/0001862 mg/kg. Figure 3-8 illustrates the percent of total mercury as methyl mercury for Puget Sound samples. The data were variable and do not indicate a pattern with respect to battery proximity. The methyl mercury concentrations measured in Sample 3 (0.001962 mg/kg) collected well away from a group of batteries was between the range of methyl mercury values measured in sediment Samples 2 (0.000696 mg/kg) and 10 (0.003857 mg/kg), collected near a group of batteries.

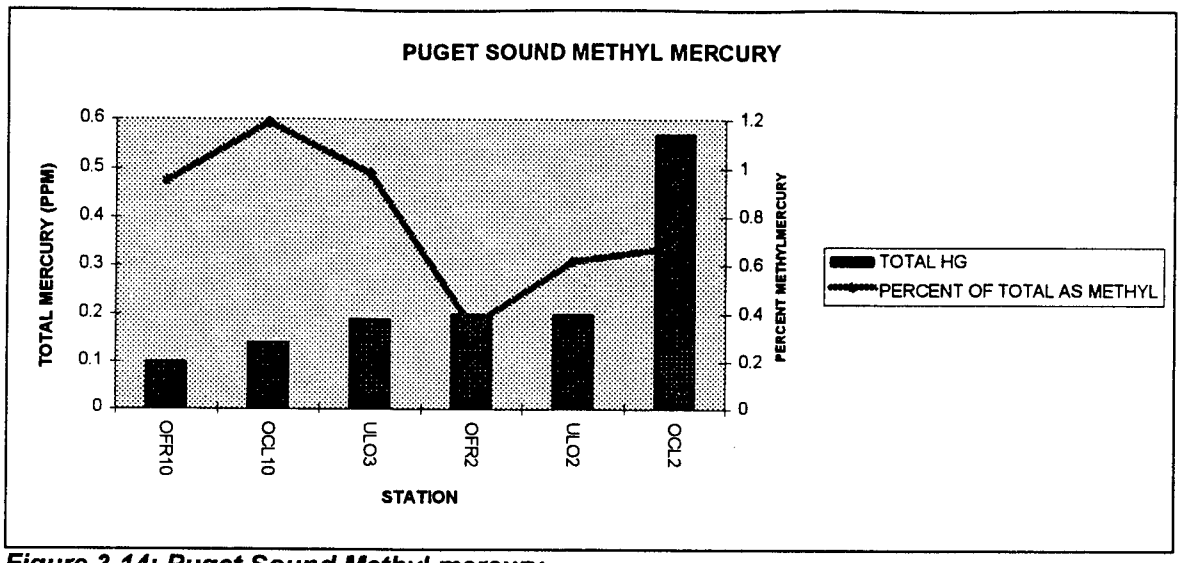


Figure 3-14: Puget Sound Methyl mercury

The results of methyl mercury analyses from all locations revealed no levels in exceedance of 1.0 percent methyl mercury. No location indicated a cause for concern.

Post Removal Results

The Volpe Center also conducted a demonstration cleanup project in the Tampa Bay area. The purpose of this project was to address the immediate remedial requirements in Tampa Bay and to develop a standard method for addressing other removal actions. Confirmatory sediment sampling and clean-up documentation was produced for each site.

Volpe Center staff and contractors began battery removals in the Tampa Bay area immediately following a battery site sampling and removal prototype effort on January 31, 1994. Battery removals took place at locations identified during a previous aquatic survey conducted by Law Engineering, Incorporated (Law Engineering, 1993). That survey identified 29 sites (of their surveyed 47) that had visible batteries, and they predicted that about eight hundred in total could be removed. The actual number exceeded 1300.

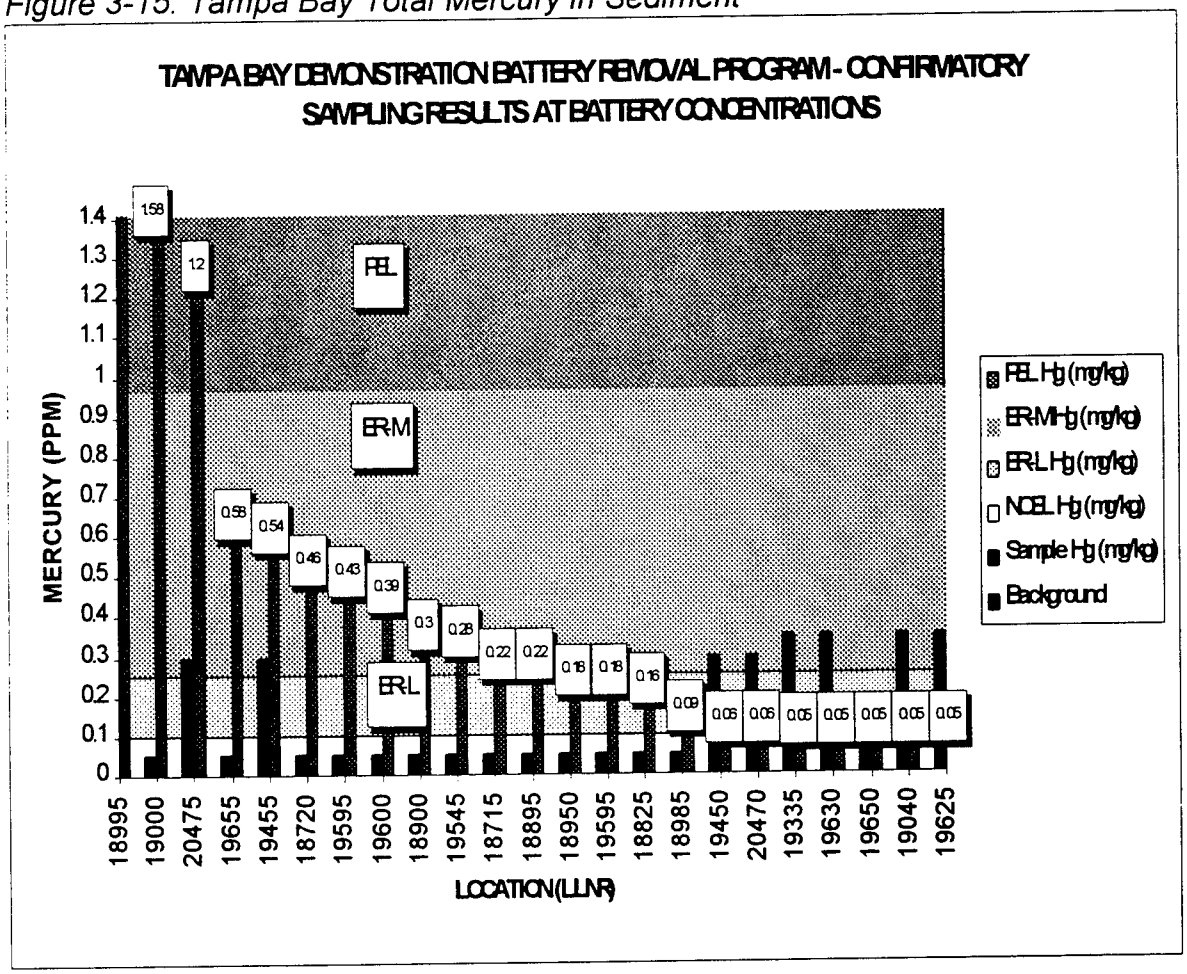
Sediment samples were collected during the demonstration project. Some AtoNs surveyed during the Tampa Bay prototype were resampled during the demonstration project; that is, after battery removal was conducted. Before and after comparisons at those sites, as well as the sediment sample results at other sites are included in this report.

As with all other locations, the important comparison criteria for AtoN battery sediment sample results are the established background levels (based on perimeter sampling) and the NOEL, ER-L, ER-M and ER-H levels. The former,

"background" level, was established at each location based upon the value of the "perimeter" of 20 meters. This level established an on-site comparison value for each mercury. The other values presented in Figure 3-9 reflect the state and nationally established levels of concern for these metals in sediment. These levels are established by a complex statistical method described in the notes following at the end of this chapter. The important point regarding these criteria is that they provide comparison values at which various environmental or health effects might be expected.

In most cases, sample values were at or below the ER-M levels, however, there were some elevated levels detected during post removal sampiling. In some cases the level of mercury in comparable samples before and after removal increased by over 800%, but they were not typical. Since the number of cases of increases are low (in fact in some cases the percent changes are negative), it appears that either the sample randomly discovered a "concentration spot" or battery removals contributed to a transient recontamination of the field.

Figure 3-15: Tampa Bay Total Mercury in Sediment



Summary of Results

Sediment and biological sampling was conducted in four locations, as part of the prototype investigation program. The results of these investigations revealed a pattern which indicates little, if any, detectable risk due to spent primary AtoN batteries.

While the results of the prototype investigations varied by location, some common trends were noted. A full description of each study is available in individual reports for each prototype investigation. In general the findings were:

- The extremely low percentage of methyl mercury, and thus low risk potential, was common at all of the characteristic aquatic environments examined. Very low mercury concentrations were detected in the aquatic organisms, even those attached to batteries. These findings indicate no significant risk to human health or the aquatic food chain.

- The limited spatial distribution of mercury within the sediment was another common pattern detected during the prototype program. In most cases elevated sediment concentrations, if any, were confined to the immediate vicinity (less than one meter) of batteries and in all cases if there were any slightly elevated concentrations detected beyond one meter, the condition was limited to 10 meters or less from the AtoN.

- In almost all cases, even the highest mercury concentrations measured around AtoNs was within the range of background concentrations measured as part of the investigation or reported in the literature for the general prototype investigation area.

- There appear to be elevated sediment concentrations of mercury associated with high density of discarded batteries, and also with broken batteries. When both of these conditions occur, the sediment levels approach and in some cases even exceed levels associated with adverse effects on sediment dwelling organisms. However, even in the areas of highest battery concentrations and greatest percentage of broken batteries methyl mercury concentrations and levels in aquatic organisms are well below those which pose a potential risk to humans or the aquatic food chain.

There are special circumstances and conditions which can occur at an AtoN, such as high biological productivity, hard sea bottom, and high number of broken batteries, which in combination can produce relatively high mercury concentrations and sensitive exposure pathways and thus potential environmental risk.

The prototype and demonstration programs estimated the risk associated with spent primary batteries in terrestrial and aquatic environments.

Risk indicators included:

- an assessment of total mercury in sediments
- an assessment of the percent of total mercury in methyl form
- and an assessment of the level of mercury in biota.

The findings of the prototype investigations showed:

- low to non-detectable levels of total mercury in sediments;
- little, if any, evidence of bioavailability of mercury as measured by the percent of total mercury in methylated form, and
- no evidence of harm to aquatic biota as measured by total mercury in biological tissue.

The results of the demonstration removal program indicated that battery removals may have a short-term effect of elevating the level of mercury in sediments immediately following removals.

Chapter Four

Results and Conclusions

Sources of Potential Concern

The long-term potential for human health or environmental concern from AtoN batteries is limited to the uncontrolled release of metals. Other contents of the battery either pose no hazard, such as the plastic casing, or rapidly dissipate and cause no long term threat, such as acid or caustic solutions. Since the batteries of concern (primary batteries, which represent over 99 percent of the type found) have generally not been used since the mid 1980s, only long-term effects are of concern. The metals present in batteries and thus of potential concern are lead, zinc, and mercury. The demonstration and prototype investigations revealed that virtually all the batteries found at AtoN locations were primary batteries, which contain only zinc and mercury. Prototype investigations in the Chesapeake Bay and in Tampa Bay analyzed the sediments in the vicinity of batteries for lead and found no correlation of lead concentrations with lighted AtoNs, proximity to batteries, condition of batteries, or number of batteries. Consequently, it was concluded and fully substantiated that lead, which is present in secondary but not primary batteries, was not of concern and posed no hazard at U.S. Coast Guard AtoNs.

Elevated concentrations of both zinc and mercury were found associated with at least some of the lighted AtoNs investigated during the prototype study. Consequently, these metals were determined to be the potential contaminants of concern, and the presence of both metals were recorded at each prototype site. (The site specific reports include the data for both metals.) Because of the greater toxicity and bioaccumulation potential of mercury, however, the following discussion focuses on mercury.

Mercury in AtoN batteries was originally present as an elemental amalgamate coating the electrodes. As the batteries were used to light the AtoN, laboratory investigations indicate that much of it vaporized to the atmosphere. The remainder of the mercury either dissolved in the solution within the battery, remained on the electrodes, or adsorbed to the particles associated with the discarded battery.

If mercury released from batteries is present in freshwater or marine systems, it will be more concentrated in the sediments than in the water column. Most of the mercury associated with batteries has low solubility (as determined by the laboratory portion of this study), and thus is associated with particles. In fact, studies have found that over 90 percent of mercury in lakes is associated with the sediments (Foust and Aly 1981). Similarly, at the one AtoN where mercury was measured in the water (in the

Chesapeake Bay), all of the detected mercury was particulate, and none of it had dissolved. Even if mercury from batteries does dissolve into the water column, the constant flushing, dilution, and dispersion, which is associated with tidal, riverine, and large lake systems where AtoNs are most commonly located, would diminish concentrations significantly below those of concern. These findings strongly support the conclusion that mercury from AtoN batteries is much more of a concern when in the sediments than in the water column. If there is not a very strong and extensive indication of hazard in the sediments, there is no reason to consider pathways associated with the water column at most AtoN locations. For this reason, the prototype investigations focused on sediments, and future consideration of potentialhazards associated with AtoNs should generally be directed at sediments.

Fate and Availability of Mercury

Most of the mercury from batteries discarded in the vicinity of AtoNs does not enter a human health or environmental exposure pathway.

If the casings of the discarded batteries were broken, the liquid contents was released immediately. In those cases, the dissolved ionic and methylated forms were quickly diluted and transported away from the AtoN. The elemental forms remaining on the electrodes, or other forms associated with the batteries, dissolved very slowly and were then rapidly diluted and dispersed away from the AtoN. Some of the dissolved form of mercury was most likely scavenged by particles, some of which were deposited in the immediate vicinity of the battery. Similarly some of the soluble mercury was converted and settled, some in the immediate vicinity of the batteries. Some of the particulate material associated with the batteries was likely deposited close to the AtoN, and the mercury adsorbed to the particles deposited in the sediment.

When primary batteries were discarded near the AtoN and not broken, a similar process has taken place, only over a longer time frame. In some cases, such as seen in the Tennessee River, the mercury is released very slowly, probably over several decades. In such cases, the dilution and dispersion during the release period results in such low concentrations that the presence of mercury, or ingestion by organisms (if any), cannot be detected above the natural variation. In areas such as Tampa Bay, the mercury was probably released over years, rather than decades, as the cases deteriorates and storms damage the batteries. In such cases, the releases may sometimes be detected.

The mercury which was released into the water column, either initially in the dissolved form from broken batteries or over time in other forms, entered the aquatic pool of mercury which undergoes extensive cycling and transformation. The mercury in this pool can enter exposure pathways through ingestion by aquatic organisms and vaporization. However, even on a very local scale the mercury from AtoN batteries is

an insignificantly small fraction of the total mercury pool in the freshwater or marine system.

Mercury which is deposited in the sediments close to the batteries can potentially be available for ingestion in or exposure to aquatic organisms. The quantity of mercury in the sediments close to batteries slowly decreases over time through (1) transformations followed by dissolution into the water column, (2) resuspension and transport of the sediment particles and the associated mercury, (3) burial and preservation in the sediments, or (4) ingestion by biota. Ingestion by biota is the pathway which can potentially result in exposure and hazard to human health and the environment. The other possible destinies of the mercury associated with sediments in the immediate AtoN area could pose a hazard, but the degree of hazard is only a fraction of that from ingestion and exposure by sediment dwelling organism in the proximity of the AtoN. If this pathway shows no or minimal hazard, there is no concern about entry of the mercury in the other pathways.

As described in detail in Section 1, mercury in the aquatic environment undergoes multiple and complex chemical transformations. The transformation of greatest concern is the formation of the organic or methyl form. Methylmercury is more soluble than the elemental form and also much more toxic and available for ingestion by organisms. The factors affecting and rates of methylization are not completely known but the process is complex and dynamic. Methylmercury in the sediments of aquatic systems generally represents only a small fraction of the total (about 1 percent or less) unless there is a source of methylmercury or conditions in the environment, such as flooded wetland soils, accelerate the rate of methylization.

Without exception, all of the prototype and laboratory investigations of AtoN batteries found that methylization rates in systems studied were low, batteries were not a source of methylmercury, and methylization rates adjacent to batteries were no different than in the general area. Laboratory studies directly measured methylmercury in AtoN batteries and found low concentrations. Similarly, the portion of mercury occurring in the methyl form (and thus an indication of methylization rate) was within the range of unaffected sites reported in the literature and generally at the extreme low end of the range. At no location was the percentage of methylmercury higher near batteries or in areas with a high concentration of batteries. The final fact substantiating the lack of effect from batteries on the bio availability of mercury were the low concentrations found in organisms. In areas with high methylmercury concentrations, organisms accumulate mercury in the tissue directly from water and sediments and also through the food chain. The levels of mercury in tissue at all the lighted AtoNs investigated was within the range seen in areas not affected by batteries.

Potential Human Health Hazard from Discarded AtoN Batteries

Based on comparison to conservative and accepted media specific standards, mercury from discarded AtoN batteries do not pose a hazard to human health from pathways related to air, soil, surface water, sediment, or consumption of aquatic biota.

Multiple measurements of mercury vapor from batteries at terrestrial AtoNs in the Tampa Bay area revealed levels well below levels of concern. The measurements were taken directly over the batteries and thus represent the most exposed pathway. Consequently exposure by inhalation pathways does not pose a hazard.

Soil samples were also taken at Tampa area terrestrial AtoNs. Samples were taken under, adjacent to, and at increasing distances from batteries. Although the mercury levels were slightly elevated at the batteries they were well below levels considered by the U. S. Environmental Protection Agency to pose a health hazard.

As discussed above, batteries in aqueous situations are not expected to result in measurable levels of mercury in the water column. Thus the only potential hazard from dissolved mercury would be through ingestion by aquatic organisms and human consumption of the organisms. The same is true for sediments where the most critical exposure pathways from sediments to human receptors is through consumption of aquatic organisms.

The laboratory analysis of batteries indicate the mercury is not in the available form. This is substantiated by the low percentage of methylmercury in sediments associated with lighted AtoNs. It is also directly confirmed by the measurement of low tissue levels of aquatic organisms in the vicinity of AtoNs.

During the prototype investigation mercury levels in aquatic organisms was only a fraction of the levels considered by the U.S. Food and Drug Administration (FDA) to result in a hazard from consumption. During all the prototype investigations, approximately 200 biological samples were analyzed for mercury. None of these samples were more than 10 percent of the FDA level and most were closer to 1 percent. Even this is a very conservative comparison because only total mercury was measured in the tissue and the FDA limit is based on methylmercury (which is generally on about 40 to 60 percent of the total in invertebrate tissue). Consequently consumption of aquatic organisms from areas around AtoNs is not expected to pose a health hazard to humans.

Mercury Concentrations in Sediments Associated with AtoNs

At most locations there was no indication that AtoN batteries resulted in elevated levels of mercury in the sediment. Tampa Bay, where there were many batteries and a high percentage of broken cases, was an exception.

The measurement of metals in sediments in Chesapeake Bay, Tennessee River, and Puget Sound showed no correlation with proximity to batteries or lighted AtoNs. In the Chesapeake Bay the measured mercury concentrations correlated well with physical characteristics of the sediment, particularly organic carbon in the sediment. This is a common phenomena in certain estuaries were the small size particles associated with high organic carbon levels have large surface areas and thus more metal can adhere to the surface of the particles. In the Chesapeake Bay the relationship with sediment type was the same whether or not batteries were present. Neither the number of batteries found, the proximity of sediments to batteries, nor proximity of sediments to lighted AtoNs was found to affect sediment mercury concentrations in the Chesapeake Bay Prototype investigation. The mercury concentrations in sediments around AtoNs in the bay, were well within the range of reference concentrations reported in the literature for the portion of the bay investigated. Similarly the concentrations at lighted AtoNs was similar to or below the concentrations measured at unlighted (and thus no batteries present) AtoNs during the prototype investigation.

In the Tennessee River investigation elevated mercury concentrations were found but associated with sources other than AtoN batteries in the subwatersheds of the river. Samples collected within 20 meters of AtoNs, revealed similar sediment concentrations regardless of proximity to batteries. Statistical as well as subjective evaluation of the data revealed no differences in concentrations between samples close to batteries (generally within 10 meters of the AtoN) and samples beyond the area where batteries were found. Except where a munitions manufacturing facility in the subwatershed was a documented source of mercury, measured concentrations at lighted AtoNs was within the range reported in the literature at unaffected areas and measured at unlighted AtoNs. Where elevated mercury levels were found, samples located 20 meters or more from batteries had similar concentrations to samples adjacent to battery piles.

There is a relatively extensive body of information of background or reference area mercury concentrations in Puget Sound sediments. There has even been a background range established for unaffected areas of Budd Inlet, which is the inlet where the Puget Sound AtoN Prototype investigation was conducted. All of the samples collected at AtoNs, both lighted and unlighted had very similar concentrations and were within the established background range for Budd Inlet and Puget Sound. Samples were collected within and adjacent to battery piles and at increasing differences from the concentrations of batteries. Both statistical tests and qualitative

assessments concluded there was no difference in mercury concentrations close to batteries compared to locations up to 30 meters away. Similar tests also concluded no difference between samples from lighted and unlighted AtoNs.

In Tampa Bay conditions varied considerably from those observed at the other prototype investigations. There were over 200 batteries found at some AtoNs and it was not unusual to have over 50 primary batteries per AtoN. Also, a high percentage of the batteries were broken, either when they were discarded or subsequently as the cases deteriorated. As a result of these conditions, the findings of the Tampa Bay prototype investigation indicate that mercury was released from the batteries and some accumulated in the sediments.

The distribution of mercury sediment concentration around the eight lighted AtoNs investigated in Tampa Bay showed a very similar pattern. The average concentration of samples taken 10 meters or more from the AtoN (where batteries were only rarely found) was comparable to concentrations at unlighted AtoNs and the background concentration reported in the literature (about 0.06 mg/kg). Within 10 meters of lighted AtoNs, where most batteries were found, the average concentration of mercury (about 0.20 mg/kg) was about four times background concentration. The average of samples collected adjacent to batteries, the concentration measured was even higher (0.25 mg/kg).

Potential Environmental Hazard from Discarded AtoN Batteries

AtoN batteries generally do not pose a hazard to organisms in freshwater or marine ecosystems through direct exposure to sediment or water column dwelling organisms or through bioaccumulation in the tissue of organisms. However, under certain combinations of environmental and AtoN conditions there may be hazard to sediment dwelling organisms in the immediate vicinity or batteries (i.e. less than 10 meters). The hazard is expected to be low and over a very small area and thus even in extreme cases there does not appear to be any hazard at the community level.

Hazard to aquatic ecosystems was investigated by examining both sediments (because as described above they are the most likely pathway of exposure) and tissue concentrations of sediment dwelling organisms (because they are the most likely and direct receptors). The investigation of sediment focused on the total and methylmercury concentrations in sediments around AtoNs.

Potential for hazard from mercury in sediments was evaluated by comparing measured concentrations at AtoNs to values reported in the literature to cause adverse effects to benthic animals and sediment values in reference areas. Possible hazards from mercury ingestion and bioaccumulation was evaluated in a similar fashion by comparing mercury concentration in animals collected on or near batteries to other values as was done for sediments.

In the Chesapeake Bay mercury concentrations in sediments were below even the most protective benchmark concentration [National Oceanographic and Atmospheric Administration Effects Range Low (ER-L), which represents the lowest 10 percent of concentrations found to produce an effect in sediment dwelling organisms]. All areas of all lighted AtoNs had values below the ER-L (0.15 mg/kg) even though the values found at the unlighted AtoN and values reported in the literature for the area were above 0.2 mg/kg. Consequently in the Chesapeake Bay, it is highly unlikely that mercury from AtoN batteries in sediments is affecting sediment dwelling organisms, which represent the segment of the marine community most likely to be adversely impacted.

The mercury concentrations found at AtoNs in the Tennessee River were slightly higher than those found in the Chesapeake Bay (average values ranging from 0.1 to 0.4 mg/kg), but they were well below the Effects Range Medium (ER-M), i.e., the 50th percentile of reported values showing an effect, of 0.71 mg/kg. AtoNs within the subwatershed where there were documented sources of mercury were at the high end of the range but at other lighted AtoNs average values were below the ER-L. Consequently it is unlikely that batteries are causing an adverse effect to sediment dwelling and even where background concentrations are elevated, adverse effects do not appear to be likely.

Sediment concentrations of mercury found in Puget Sound were slightly higher than the ER-L, ranging from 0.1 mg/kg to 0.25 mg/kg. This was true for the unlighted as well as the lighted AtoN investigated. The samples collected adjacent to batteries were at the low end of the range and below the ER-L of 0.15 mg/kg. The state of Washington has also establish a sediment standard of 0.41 mg/kg mercury for sediment quality that will result in no adverse effects on biological resources and no significant health hazard to humans. All of the areas associated with AtoNs in Puget sound were less than half this value. Consequently no adverse effects are indicated.

The results from Tampa Bay differ somewhat from the findings from the other prototype locations with regard to potential impacts to sediment dwelling organisms. The results indicate that average concentrations 20 meters or more from the lighted AtoNs are well

below even the most stringent benchmarks for protection of sediment dwelling organisms [ER-L, and the state No Observed Effects Level (NOEL) of 0.1 mg/kg]. In the area 10 to 20 meters from the AtoN, the average (about 0.06 mg/kg) value is well below the NOEL, but about 9 percent of the individual samples exceed the NOEL. The average value of the samples within 10 meters of the AtoN (about 0.2 mg/kg) was above the NOEL, and about 40 percent of the individual samples were above the most protective. Between 75 and 100 percent of the individual samples collected adjacent to batteries exceeded the NOEL. Approximately half the samples adjacent to batteries exceeded the ER-M and the state Probable Effects Level (PEL) of 1.4 mg/kg in the Alafia River area, which has a higher mercury background do to watershed sources and sediment characteristics. However none of the samples collected next to batteries exceeded the PEL or ER-M at the mid bay AtoNs.

The sediment effects levels used for comparison are general and do not take into account site specific conditions such as species present, sediment characteristics, or bioavailability of mercury. Such general effects levels tend to be more protective than levels developed for specific conditions and areas. Even using possible overprotective effects levels for comparison, the implication of the sediment concentration findings are that benthic species density and diversity could be reduced to a measurable extent in the immediate vicinity of the batteries. The could also be some effects on community parameters within 10 meters of AtoNs. However there is very little potential for environmental hazard beyond 10 meters from AtoNs. The effects anticipated adjacent to batteries and to a lesser extent within the 10 meter radius are not expected to be acute (e.g., mortality or gross histopathologic effects). At the most, only chronic effects (e.g., measurable reduction in reproductive rate) would be expected and since the effects would be over such a small area no overall community or even population impacts would be expected.

Investigation of mercury concentrations in tissues of marine organisms in Chesapeake and Tampa Bays was limited to collection of species of opportunity. Animals attached to batteries and the AtoN structure were analyzed and compared to background samples reported in the literature and at unlighted AtoNs. In the Chesapeake the samples collected on batteries and attached to lighted AtoNs were similar to specimens collected at the unlighted AtoN and within the range of background values reported in the literature. The values were also below concentrations reported in the literature associated with adverse effects. However the comparisons were limited because the same species could not be collected at every location and there were not values reported in the literature for all species collected.

The results of tissue analysis from Tampa Bay were generally similar to the findings from Chesapeake Bay. Tissue levels were generally below values considered background and below levels reported in the literature as being associated with adverse effects. The findings did differ from those in the Chesapeake in that there was an indication that animals attached to batteries often had higher tissue concentrations than organisms of the same species attached to AtoN structures. All of these findings are qualitative and inconclusive because there were over a dozen species collected, most of which had no background values reported in the literature or comparable samples at unlighted AtoNs.

Based on the indication of possible elevated levels of animals close to batteries found in Tampa, more rigorous biological investigations were conducted in the Tennessee River and Puget Sound. Large amounts of sediment was collected and seived for organisms from the areas where sediment for mercury analysis was collected (i.e. at multiple locations at batteries and in a random pattern around the AtoN). The animals form these locations were analyzed for mercury. This approach allowed comparison of mercury levels in the same species in relation to proximity to batteries.

In the Tennessee River, two species were collected at almost all locations so the possible effects of mercury from batteries on sediment dwelling organisms from could be made on a species basis. The investigation revealed no elevated tissue concentrations compared to levels known to cause effects or background concentrations for the area. The spatial cover of the sampling and collocation with analytical samples permitted an evaluation of sediment concentration distribution. This evaluation showed no correlation with proximity to batteries or sediment concentrations. The lack of similarity with sediment concentrations is attributable to the very low concentrations in media and the high natural variability in sediment and biological tissue.

The biological investigation for Puget Sound revealed almost identical conditions to those seen for the Tennessee River. The number of species collected were more diverse but general comparisons could be made. There was no indication of elevated tissue concentrations relative to batteries, background concentrations, or levels known to cause effects. Based on these findings it seems clear that mercury from batteries is not affecting biota at the AtoNs included in the Puget Sound or Tennessee River investigations.

These results are supported by the low percentage of methylmercury found in sediments at all AtoNs investigated. The highest percentage methylmercury found was

1.2 percent, and the vast majorities of samples were below 0.6 percent. These values are at the extreme low end of the range reported in the literature for unaffected sites. Thus bioavailability of mercury from batteries is low and hazard to aquatic organisms is low.

Applicability of Results

In combination with the laboratory examinations, the four prototype investigations (Chesapeake Bay, Tampa Bay, Tennessee River, and Puget Sound) examined a wide range of AtoN types and environments. The conditions examined represent most, but not all, of the situations where lighted U.S. Coast Guard AtoNs exist. There were commonalties in results among the different locations, permitting general conclusions. As discussed below, even though some findings varied among prototype locations, the entire range of results was well below levels known to produce hazard to humans or the environmental. Therefore, the general conclusions regarding the absence of a hazard can be drawn and apply to virtually all AtoNs.

The general conclusions may not apply to coral and endangered habitats, floc, and areas where the total organic carbon is high and the sediment grain size is small. These exceptions are due to (1) the absence of data for coral environments (they were not sampled), (2) the elevated levels observed in floc, and (3) the elevated levels observed in samples where the total organic carbon was high and the small grain sizel.

Also, unusual conditions at some of the AtoNs examined indicate environmental factors or AtoN conditions that may represent a higher-than-normal hazard potential. Based on the findings of the prototype investigations, site specific consideration of hazards should be considered at AtoNs with hard substrate (i.e., other than silt, sand, or mud) where a large number of primary batteries were used and discarded at the site. The presence of hard substrate increases probability of broken batteries and accumulation of fine particles and high biological activity.

Certain trends were consistently observed during the prototype and laboratory investigations which substantiate general conclusions, however site specific conditions which may cause variations from general conclusions were noted.

The potential hazard posed by AtoN Batteries is generally limited to mercury and in aqueous environments. Sediments and aquatic biota are the only media of concern.

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Appendix A: Table S-3

AtoN Name/Location		Sample (Mercury)	STDDEV	N
Chesapeake Bay				
Bodkin Point	Battery	0.050 *	0.0007	4
	Far	0.052	0.0000	2
	Near	0.050	0.0021	2
Greenbury Point Lt	Battery	0.084	0.0354	4
	Far	0.056	0.0145	4
	Near	0.072	0.0219	2
South River	Far	0.127	0.1203	2
	Near	0.048	0.0006	5
Unlighted	Near	0.288	0.1512	3
TAMPA BAY				
Alafia River Rear	Far	0.074	0.0167	5
	Near	0.078	0.0295	5
	Battery	2.700		1
Alafia River Front	Far	0.050	0.0000	5
	Near	0.250	0.2800	4
C Cut Range Front	Battery	0.170	0.1131	5
	Far	0.050	0.0000	5
	Near	0.090	0.0735	4
C Cut Range Rear	Battery	0.050	n/a	5
	Far	0.050	0.0000	1
	Near	0.050	0.0000	4
E Cut Range Front	Battery	0.920	n/a	1
	Far	0.070	0.0447	4
	Near	0.535	0.1888	5
E Cut Range Rear	Battery	0.180	n/a	1
	Far	0.076	0.0581	5
	Near	0.295	0.2726	5
G Cut Range Front	Far	0.084	0.0760	5
	Near	0.168	0.2092	4
G Cut Range Rear	Far	0.050	0.0000	4
	Near	0.053	0.0050	2
Gadsen Point #8	Far	0.050	n/a	1
	Near	0.053	0.0050	3
Gadsen Ppoint #10	Far	0.050	0.0000	4
	Near	0.050	0.0000	4

TENNESSE				
Moon Light	Far	0.095	0.0058	4
	Near	0.102	0.0164	4
	Battery	0.080	n/a	1
Patton Island Upper	Far	0.428	0.1147	5
	Near	0.328	0.1128	4
Patton Island lower	Far	0.340	0.0632	5
	Near	0.086	0.0082	4
Selcer Lt	Battery	0.130	n/a	1
	Far	0.243	0.1078	5
	Near	0.260	0.1322	1
Williams Island	Battery	0.120	n/a	1
	Far	0.110	0.0408	4
	Near	0.114	0.0365	4
Chickamauga Unlighted	Far	0.135	0.0451	1
	Near	0.112	0.0356	4
Lake Nickajack Area	Far	0.050	0.0000	4
	Near	0.073	0.0287	4
PUGET SOUND				
Olympia Channel Lt	Battery	0.140	n/a	1
	Far	0.193	0.0556	1
	Near	0.238	0.1968	4
Olympia Inner Front Range	Battery	0.100	n/a	5
	Far	0.250	0.0707	4
	Near	0.260	0.1140	5
Reference - Unlighted	Far	0.168	0.0655	2
	Near	0.190	0.0173	5

* All values (.05) are reported as the observed level (even though this value is in fact the detection limit) in order to perform calculations on the data (such as estimating a standard deviation). The effect is to conservatively bias the resulting estimates.

Appendix B: Superfund Sampling Locations

Morton Beverly Site

The Morton Beverly Investigation (CH2M Hill, 1993a), was a state hazardous waste site in Massachusetts. Tidal and subtidal areas in the Danvers River, which is a tributary of Massachusetts Bay, had elevated levels of mercury. The sampling plan was designed and implemented to determine the risk, extent of contamination, and area of sediments requiring mitigation.

Sullivan's Ledge

Sullivan's Ledge (Metcalf & Eddy, 1991) was a CERCLA investigation of a freshwater wetland contaminated with PCB. The sediments were the focus of the investigation and samples were collected not only to evaluate the extent of risk, but also to delineate the area requiring excavation and remediation.

Pine Street

The Pine Street investigation (Kappleman, 1993) was an evaluation of a Lake Champlain Canal, declared a CERCLA site due to contaminated sediments and groundwater. Sampling was done in the canal to delineate the extent of contamination and degree of human health and ecological risk.

Bay Drum Wetland Impact

Sediments were sampled in wetlands (1) to evaluate the ecological status of wetlands associated with the Bay Drums, Peak Oil, and Reves Southeastern hazardous waste sites near Tampa Bay and (2) to identify the possible sources of toxicity (EPA, 1993c). A total of 12 samples were collected, 10 from three wetland test sites (affected areas or hot spots) and 1 from each of two reference stations.

Ice Creek

This study represents an impact assessment rather than a risk assessment. The study site was a small stream in southeastern Ohio (EPA, 1993a). The stream received long-term waste discharges from a coke production facility before closing in the 1980s. The study included examinations of the surface water and sediment chemistry for organic and inorganic chemicals, as well as aquatic biota.

Commencement Bay

An ecological assessment of Commencement Bay, Washington, was performed near shore/tidal flats areas (EPA, 1993b). Field studies were designed to document the extent of sediment contamination and adverse biological effects, including sediment toxicity, alternations to benthic macroinvertebrate assemblages, chemical residues in tissues of crab and English sole, and liver lesions in English sole. The study approach was based on three premises: (1) site-specific field data were needed to establish cleanup goals, (2) no single biological indicator could be used to define areas of risk, and (3) adverse biological effects were linked to sediment contamination, and chemical-biological relationships could be characterized empirically. The site was divided into nine study areas, depending on industry and associated waterways. A total of 53 sample stations were established.

Eagle Harbor

CH2M HILL conducted a remedial investigation (CH2M Hill 1989) of sediment contamination in Eagle Harbor, a 2-square-km embayment in central Puget Sound, on the eastern border of Bainbridge Island. The contaminants of concern included polynuclear aromatic hydrocarbons and metals with probable sources including boat repair facilities and other types of shipyard activities (including Navy ship work during the war), marinas, and an 80-year-old wood-treatment facility. Sediment sampling was conducted over a 1-year period and included collection and analysis of sediment from subtidal and intertidal areas using a phased approach. Sediment was collected for screening-level analysis in a 20-acre area, primarily in areas not included in prior studies, followed by detailed studies in the subtidal and intertidal areas of concern and at background sties. Subtidal samples were collected using a "van Veen grab," and intertidal samples were collected using trowels and/or shovels. Analyses included VOCs, SVOCs, PAHs, chlorophenols, metals and conventional analysis (e.g., TOC, grain size), benthic infauna, and bioassays.

Florida Sediment Survey

Sediment studies were conducted in Florida's coastal waters as part of the sediment standards program (MacDonald, 1993). The chemical measurements taken were organized in a database according to 20 general geographic areas. Samples were collected from the entire coastline, within 1 linear meter of the seashore.

Lake Martin Sediment Survey

As part of an Administrative Order, sediment samples were collected in a 613-acre area of Lake Martin, Alabama, to determine whether solids from nearby WWTP had been discharged (CH2M Hill, 1993b). A total of 43 sediment samples were analyzed for metals to determine whether sediments contained constituents similar to the solids from WEPT.

Seal Beach

Seal Beach National Wildlife Refuge Project was a voluntary investigation conducted for the US Navy (SWDIV 1992). The presence and magnitude of possible chemical contaminants in sediments and key indicator biota was studied. A total of three samples were collected in a 20-acre intertidal zone along the California coastline, to confirm the presence of hazardous waste contamination. Sample collection was based on a 400-to-500-foot wide spaced grid system in the 20-acre area.

Appendix C:

Note: Establishment of Effects Level Criteria
There are a variety of complexities in establishing a reliable relationship between the measured level of a contaminant in sediment and a measurable biological effect due to that contaminant affecting the surrounding aquatic environment. Uptake (and therefore, effects) of sediment-associated contaminants is largely a function of bioavailability. Bioavailability is strongly influenced by an array of physical, chemical, and biological factors in the sediments; that is, the contaminant can be adsorbed at particulate surfaces, bound to organic matter, sulfide-bound, matrix bound, or dissolved in the interstitial water. The relative bioavailability of trace metals associated with these phases has the effect of hindering the prediction of effects, based upon bulk sediment chemical analyses.

Ideally, sediment quality criteria guidelines should be developed from detailed dose-response data which describe the acute and chronic toxicity of individual contaminants to sensitive life stages of aquatic organisms. Unfortunately, insufficient data are currently available to support the derivation of numerical sediment quality guidelines using the ideal approach. Only a limited number of controlled laboratory studies (i.e., spiked-sediment bioassays) have been conducted to assess the effects of sediment-associated contaminants on estuarine and marine organisms. Many more studies are available that match sediment chemistry to their corresponding biological effects data. This has led to other methods of developing sediment quality criteria.

National Status and Trends Program Approach (NSTPA)
Overall Approach

With no nationally adopted, official effects-based standards available, NOAA developed a guidance for interpreting sediment data. A three-step approach was followed to complete the evaluation:

(1) Report Review
(2) Determination of Contaminant Effects Ranges
(3) Evaluation of the NS&T Program Sediment Data Relative to the Effects Ranges.

Report Review

The first step involved the compilation and review of available information in which estimates of the sediment concentrations of chemicals associated with adverse biological effects were determined or could be derived. Some reports included controlled laboratory studies of effects of sediments spiked with individual chemicals. Others included field studies that matched chemical and biological measurements. Calculations of unacceptable concentrations based upon theoretical partitioning principles were considered (Long and Morgan, 1991.).

Determination of Contaminant Effects Ranges

The second step included screening the data by examining the degree of agreement between the biological and chemical data, sorting the remaining data in ascending order, and determining ranges associated with adverse effects. In order to develop a preponderance of evidence, data compilation and analysis was as inclusive as possible and no weighing was given to data derived from one approach or another. In addition, data derived in freshwater and saltwater were merged and treated equally, despite the possibility that bioavailability may differ between the two regimes and the concentration levels may affect the two different ecosystems differently (Long and Morgan, 1991).

Approximately 150 reports were reviewed for possible use, and about half were incomplete for the purposes of this analysis, and not used. An example of an incomplete data set is one that has no biological data to accompany the sediment chemistry data for that report. The data from the remaining 85 reports were assembled.

The reports were then subject to a screening step, where no reports were considered where the contaminant was not likely a contributor to the gradient in biological effects. These included studies where the investigators observed high concentrations of other harmful compounds that could have led to the observed biological effects. It is important to note that the screening step was not performed to force consensus where none existed. It was performed *before* the data were sorted, so that it was impossible to have *a priori* knowledge of the consensus range (Long and Morgan, 1991).

The data that remained following this screening step were from studies in which effects were either predicted or observed in association with increasing concentrations of the contaminant levels measured in the sediment. Then they were sorted in ascending order of the contaminant levels in the sediment. The sites which made up the list were located throughout the United States in both saline and freshwater environments. The final sample size used for mercury and lead were 32 and 49, respectively. Two values were determined from the remaining data for each chemical: an ER-L and ER-M.

ER-L - Effects Range Low

The ER-L level represents the lower 10-percentile concentration level of the sorted data set. In other words, it is the level measured in the sediment below which adverse biological effects were measured in the aquatic environment 10% of the time (Long and Morgan, 1991). It may be thought of an approximation of the concentrations at which adverse ecological effects were first detected. The calculation of percentiles of the data help eliminate the undue influence of a single (possibly outlier) data point upon the establishment of the ER-L and ER-M ranges. For the contaminants of concern, the ER-L for mercury is 0.15 ppm, while the ER-L for lead is 35 ppm.

ER-M - Effects Range Median

The ER-M level is similar to the ER-L level, except that it corresponds to the mercury level measured in the sediment below which adverse biological effects were measured 50% of the time (Long and Morgan, 1991). Both the ER-L and ER-M values have been determined objectively because they simply represent percentile points where sediment levels can be attributed to ecological health effects. The ER-M levels for mercury and lead are 1.3 ppm and 110 ppm, respectively.

Evaluation of the NS&T Program Sediment Data Relative to the Effects Ranges

The third step in the National Status and Trends Approach compared the ambient sediment chemistry data from the NS&T Program with the respective ranges in chemical concentrations apparently associated with observations and effects. Contaminant field measurements conducted for the AtoN battery project can be compared with background levels and with the ER-L and ER-M levels in order to make conclusions about the possibility of environmental harm due to battery disposal. However, it should be noted that NOAA clearly states that the ER-L and ER-M concentrations may be used by others as guidance in evaluating sediment contamination data, but there is no expressed or implied intent of establishing these values as official NOAA standards.

Strengths of the National Status and Trends Program Approach

There are several advantages to the methodology used in the NSTPA. One of the most important benefits is that it provides a weight of evidence approach to the assessment of sediment quality. Numerous biological effects-based approaches were employed for determining associations between chemical quality and biological effects. This adds to the credibility of the resulting guidelines.

For both mercury and lead, the degree of confidence in the ER-L estimate is considered by NOAA to be moderate, while the degree of confidence in the ER-M estimate is considered by NOAA to be high. With respect to mercury, there are clusters around the 0.15 and 1.3 ppm values, suggesting that these values are supported by a preponderance of evidence. A relatively large amount of data exist for lead to relate sediment concentrations with measures of effects (Long and Morgan, 1991).

Another main advantage of the NS&T approach is that it can be conducted with existing data, and no additional field work or laboratory investigations are required. But at the same time, the database is expandable to encompass data collected from additional studies. In addition, the method facilitates the identification of ranges of contaminant concentrations which provide a means of determining the probability of observing adverse biological effects at a given contaminant concentration.

The NSTPA has been extensively reviewed by experts from across North America. It has been peer reviewed and been selected for incorporation into an EPA sediment classification document. Also, it has been adopted and/or modified for implementation by a variety of states (MacDonald, 1993).

Weaknesses of the National Status and Trends Program Approach

The main limitation of this approach is associated with the quality and compatibility of the available data. The data were often generated using different analytical procedures in numerous laboratories and considered many species and locations across the United States. Therefore, information on a wide variety of sediment types (i.e., with different particle sizes and concentrations of substances that influence bioavailability) were combined, and may have resulted in unknown biases. This amalgamation of the data may have resulted in the interpretation of responses as being attributable to a single contaminant when, in fact, synergistic and/or additive effects were actually driving the response. The shortcomings may be compounded by locations where only a moderate amount of data exists, or only acute toxicity data are represented, and could result in inappropriate guidelines.

Florida Sediment Quality Assessment Guidelines (SQAG)
Overall Approach

Several modifications were made to the NSTPA by the Florida Department of Environmental Regulation in order to increase its applicability to Florida. These modifications are designed to increase the quantity and suitability of data used to evaluate

the biological significance of sediment-associated contaminants. This was done by incorporating data from Florida and other southeastern areas and recent data from elsewhere in North America, to increase the level of internal consistency in the database. The procedure developed by the Florida DER will subsequently be referred to as the Weight of Evidence Approach, or WEA.

One of the principal limitations of the original NSTP database on the biological effects of sediment-associated contaminants is its bias toward data derived from studies in northeastern and western coastal areas of the country. To address this, a major initiative was undertaken to expand the original NSTP database. Investigators in the field of sediment quality assessment located in the Gulf coast and southern Atlantic coast states were contacted and asked to identify studies they had conducted that contained matching sediment chemistry and biological effects data. Over the course of the study, more than 300 publications were retrieved and evaluated to determine their suitability for use in the derivation of the SQAGs. Acceptable data sets were integrated into the databases.

Derivation of Numerical Sediment Quality Assessment Guidelines

Each entry in the database was assigned an "effects/no effects" descriptor, based on the degree of concordance between the sediment concentration of the contaminant and the endpoint measured in the investigation. Those labeled "effects" comprised a database called BEDS (Biological Effects Data Set) in which specific adverse biological effects (as indicated from the results of sediment toxicity bioassays or benthic invertebrate community assessments) were observed at some of the sites samples. A separate data set was also established called NBEDS (No Biological Effects Data Set). These entries consisted of data from bioassays in which exposure of aquatic organisms to test sediments did not result in significant biological effects (MacDonald, 1993).

NOEL - No Observed Effects Level

Concentrations of sediment-associated contaminants below the *No Observed Effects Level* (NOEL) are not considered to represent significant hazards to aquatic organisms. The level was defined by using a two-step process. First, a *Threshold Effects Level* (TEL) was calculated, and is considered to represent the upper limit of the range on sediment contaminant concentrations that is dominated by no effects data entries. The TEL was calculated as follows (MacDonald, 1993):

$$TEL = \sqrt{(BEDS\text{-}L) \times (NBEDS\text{-}M)}$$

where:

TEL	=	Threshold Effect Level
BEDS-L	=	15th percentile concentration in the biological effects data set;
NBEDS-M	=	50th percentile concentration in the no biological effects data set.

The mathematical expression represents the geometric mean of BEDS-L and NBEDS-M, and is used because these data are not necessarily normally distributed. A safety factor was applied to the TEL to estimate a no observed effects level (NOEL) for the contaminant (MacDonald, 1993):

$$NOEL = TEL \div SF$$

where:

NOEL	=	No Observed Effect Level
SF	=	Safety Factor = 2

Application of this safety factor was considered to provide a pragmatic means of compensating for the limitations on the database with respect to the lack of chronic toxicity data, and a resulting bias toward acute toxicity data. The NOEL is considered to represent the upper limit of the no effects range of contaminant concentrations. The resulting NOEL levels for mercury and lead are 0.1 ppm and 21 ppm, respectively.

PEL - Probable Effects Level

The probable effects level (PEL) is defined as the lower limit of the range of contaminant concentrations that are usually or always associated with adverse biological effects. The procedure utilized to calculate the PEL is designed to define a range of concentrations that is dominated by entries from the BEDS. Within the probable effects range, concentrations are considered to represent significant and immediate hazards to aquatic organisms. The PEL was calculated as follows (MacDonald, 1993):

$$PEL = \sqrt{(BEDS\text{-}M) \times (NBEDS\text{-}H)}$$

where:

PEL = Probable Effects Level
BEDS-M = 50th percentile concentration in the biological effects data set;
NBEDS-H = 85th percentile concentration in the no biological effects data set.

If there were a total of 100 entries in each of the data sets, then the PEL would define the lower limit of a range of concentrations within which there would be, on average 50 entries from the BEDS and 15 entries from the NBEDS. This is predicted to be the case because the PEL is calculated as the geometric mean of the 50th percentile of the effects data set and the 85th percentile of the NBEDS. The geometric mean is used to account for uncertainty in the distributions of the data sets. The PEL levels for mercury and lead are 1.4 ppm and 160 ppm, respectively.

The range of concentrations that could, potentially be associated with biological effects (i.e., possible effects range) is bounded on the lower end by the NOEL and on the upper end by the PEL. Within the range, adverse biological effects are possible, however, it is difficult to reliably predict the occurrence, nature, and/or severity of these effects. Site-specific conditions are likely to control the expression of toxic effects at these locations.

Strengths of Sediment Quality Assessment Guidelines

The WEA is supported by a comprehensive database on the biological effects of sediment-associated contaminants. It provides a compelling rational for placing a high degree of confidence on the resultant guidelines. By considering matching sediment chemistry and biological effects data from studies conducted in the field, the influence of mixtures of chemicals in sediments is incorporated from studies conducted in the resultant SQAGs. A large number of data were conducted from studies conducted in the southeastern United States (including Florida). Therefore, the resulting guidelines are probably most appropriate for implementation in Florida.

In addition, the procedure considers both BEDS and NBEDS for each chemical constituent, and does not rely heavily on individual data points. Thus, outliers do not carry much weight in the overall guidelines derivation process.

Weaknesses of the Sediment Quality Assessment Guidelines

Many of the weaknesses of the NSTPA also plague the WEA. For instance, it is not possible to express the guidelines in terms of the factors that influence the bioavailability of these contaminants. The reason is that there is little comprehensive information with which to reliably predict the bioavailability of sediment-associated contaminants.

In addition, the method does not fully support the quantitative evaluation of cause and effect relationships between contaminant concentrations and biological responses. A wide variety of factors other than concentrations of the contaminant under consideration could have influenced the actual response observed in any situation. Only limited data exists on the chronic responses of marine and estuarine organisms to sediment-based contaminants. This should be recognized as a limitation to the approach.

However, the results of the evaluation indicate that SQAGs developed using the approach procedure outlined here are likely to be appropriate tools for conducting assessments of sediment quality in Florida. However, care should be exercised in applying these guidelines.

Summary

The chart below summarizes the National Status and Trends guidelines as well as the SQAG guidelines:

Contaminant	NOEL (ppm)	ER-L (ppm)	ER-M (ppm)	PEL (ppm)
Mercury	0.1	0.15	1.3	1.4
Lead	21	35	110	160

USDOT
Research and Special Programs Administration
Volpe National Transportation Systems Center

PRIORITY RANKING PLAN FOR
Coast Guard Aid to Navigation Battery Recovery

Prepared by:
Environmental Engineering Divison

PRIORITY RANKING PLAN FOR ATON BATTERY RECOVERY 3

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PRIORITY RANKING PLAN FOR ATON BATTERY RECOVERY

1.0 Introduction

The U.S. Coast Guard maintains approximately 12,000 fixed lighted aids to navigation (AtoN) in the major rivers, coastal waters and adjacent shorelines of the United States, its territories and possessions. From the 1960's to the mid-1980's, most lighted AtoN were powered by disposable "primary" batteries that contained small amounts of mercury. During this period, many spent batteries were disposed of at the AtoN. These batteries also entered the environment as a result of AtoN being destroyed by collisions, storms, floods and vandals.

The Coast Guard has undertaken the following steps to address this problem:

- Reduced the number of batteries used by converting the vast majority of lighted AtoN to solar power.
- Implemented policies prohibiting improper disposal and creating a battery tracking system to account for every battery used.
- Begun a systematic, phased program to recover lost batteries nationwide.

The Volpe Center has provided technical and scientific assistance to the Coast Guard in its recovery effort. This document presents the methodology and results of a model developed to priority rank aquatic and terrestrial AtoN sites for survey and possible recovery operations. The rankings are based on objective criteria, and are intended to assist Coast Guard decision makers choose where to concentrate limited resources in a multi-year effort.

The priority ranking of an AtoN site is not proof that batteries are located at the site, or a recommendation whether any batteries found should or should not be recovered. The ranking model relies on projections of historic battery consumption at fixed lighted AtoN and implicitly assumes that the batteries used were left at the site. To date, the prototype survey and recovery investigations, as well as Coast Guard survey efforts, have found that

approximately 40% of fixed lighted AtoN sites are free of batteries. Environmental factors that we recommend be considered before recoveries are undertaken at AtoN sites are discussed in the companion study titled Volpe Scientific Assessment of Coast Guard AtoN Batteries.

2.0 Scope

The analysis consists of two sections:

- a **Priority Ranking Model** that applies the extracted or projected characteristics of individual fixed lighted AtoN sites against quantitative **operational measures** of **attributes** we selected to represent four primary **criteria** discussed below. Every fixed lighted AtoN in the ATONIS data base is **scored** and ranked relative to all other sites. Individual sites are then assigned to small geographic "**clusters**" and each AtoN is placed in one of five **priority categories** based on the combined score of nearby sites which reflect the individual and local priority of an AtoN, and;

- **Priority Ranking Maps** that graphically present the location and concentration of fixed lighted AtoNs based upon the five priority categories by Coast Guard District and State. These priorities were assigned by the ranking method described in Appendix II. These are intended to assist the Coast Guard plan their survey and recovery operations.

The priority ranking model integrates data from the Coast Guard's internal AtoN management information system called ATONIS. ATONIS information on 12,075 fixed lighted AtoN was integrated with oceanographic data provided by the National Oceanographic and Atmospheric Administration (NOAA), and population data from the U.S. Census Bureau to compile the score of each site. ATONIS provided descriptive data on the name, location and light characteristics of AtoN currently in use. The priority ranking model permits rankings to be updated based on new ranking criteria or information about the attributes of AtoN sites. Table I (below) provides a location summary of fixed lighted AtoN in each Coast Guard District by state and territory.

The priority ranking model does not rank "floating" lighted AtoNs and does not include former or other AtoN sites not listed in ATONIS. Floating lighted AtoN (buoys) were excluded from this study because:

1. They generally use much less power, and therefore few batteries.

2. Buoy siting is not always precise. Even if batteries were lost from a floating AtoN in the past, the AtoN is presently unlikely to be at the same exact location. Differential Global Positioning System (DGPS) technology will likely reduce future siting variance, but will not increase the chance of finding past battery losses.

3. Floating AtoN are normally serviced aboard larger vessels where their batteries are changed and returned to port for disposal. Fixed lighted AtoN are more often serviced from boats or shore, in some cases making return transport of batteries more difficult.

4. Buoy batteries are normally installed inside of a sealed compartment. If the aid is knocked down or sunk, the batteries are usually recovered with it.

Table I: AtoNs By District and State

	Number of Fixed lighted AtoNs in Each District										
State	1	2	5	7	8	9	11	13	14	17	Total*
AK										619	619
AL		55			188						243
AR		293									293
CA							570				570
CT	129										129
DE			109								109
FL				1282	252						1534
GA				286							286
HI									145		145
IA		71									71
IL		279				20					299
IN		57				17					74
KY		163									163
LA		81			813						894
MA	123										123
MD			525								525
ME	106										106
MI						357					357
MN		73				36					109
MO		147									147
MS		93			166						259
NC			739	5							744
ND		12									12
NH	2										2
NJ	66		223								289
NY	221					76					297
OH		73				83					156
OK		10									10
OR								526			526
PA		83				7					90
RI	32										32
SC				293							293
TN		281									281
TX					716						716
VA			584								584
VT	2										2
WA								504			504
WI		81				103					184
WV		120									120
Total	681	1972	2180	1866	2135	699	570	1030	145	619	11897

Table I (continued)

Fixed AtoNs By Location and District

Location	1	2	5	7	8	9	11	13	14	17	Total
American Somoa									7		
Cuba				19							
Guam									16		
Isla De Culebra				4							
Isla De Vieques				3							
Johnston Atoll									2		
Kwajalein Atoll									2		
Navassa Island				1							
Palau									1		
Puerto Rico				99							
Rota											
Saipan									2		
St. Croix				11					3		
St. John				3							
St. Thomas				4							
Tinian									1		
Total	0	0	0	144	0	0	0	0	34	0	178
Grand Total	**681**	**1972**	**2180**	**2010**	**2135**	**2135**	**699**	**1030**	**179**	**619**	**12075**

3.0 Ranking Criteria

To perform the priority rankings, we selected objective criteria based on data collected in the Scientific Assessment that we believe reasonably measure the most commonly expressed concerns about discarded AtoN primary batteries. As discussed in the Scientific Assessment, no evidence of actual harm to people or the environment was found that could be directly attributed to discarded AtoN batteries. We nonetheless felt it appropriate that the selected criteria reflect potential and perceived effects as well as actualities to ensure that primary concerns are adequately addressed in the Coast Guard's decision making process.

3.1 Potential Human Health Effects

For the purposes of this study, we concentrated on three potential mercury exposure pathways from discarded AtoN batteries:

- Inhalation from exposed mercury or intentional/accidental burning of a battery;
- Ingestion by drinking mercury contaminated water; and
- Uptake through eating fish with mercury levels above Food and Drug Administration maximums.

The site attributes selected to indicate the potential for human health effects are the projected number of batteries (total mercury potential), the bottom type (indicative of the potential for broken batteries) and sediment type (indicative of the potential for mercury retention and Methylization), whether the site is terrestrial or under water (indicative of the potential for human contact), the proximity of the AtoN site to population concentrations and its salinity (indicative of possible use as a drinking water supply).

3.2 Potential Environmental Quality Effects

The concern is that discarded AtoN batteries could potentially affect environmental quality by contaminating biological habitat. Additionally, as discussed in the Scientific Assessment, some aquatic areas may be

particularly conducive to the methylation process. Habitats such as oyster beds and very fine-grained sediments are high priorities for battery removal because they appear more likely to provide opportunities for methylmercury formation.

The site attributes selected to indicate the potential for environmental effects are the same ones used to predict the potential for human health effects, except that we are not concerned with a site's potential for use as a drinking water supply. The model gives additional weight to sensitive habitat sites with clay, silt or other fine grained bottom/sediment types, reflecting their potential for methylmercury formation.

3.3 Potential Selected Public Recreation Impacts

The concern is that recreational diving and swimming could be diminished if they are avoided due to the presence of discarded AtoN batteries, or if the batteries lower the aesthetic appeal of the location. In the unlikely event of a direct release of battery contents into a recreational swimming or diving area, there may be short term potential for mercury exposure in the immediate vicinity of the battery. Additionally, recreational divers in popular areas (such as the Florida Keys) could come upon batteries in shallow depths around fixed lighted AtoN, degrading the diving experience.

The site attributes selected to indicate the potential for public recreation impacts are the projected number of batteries and location in potential swimming or diving areas (shallow coastal depths, certain bottom types).

3.4 Potential Selected Private and Commercial Fishing Impacts

The concern is that discarded batteries could reduce the number of fish taken from around AtoN sites or make fish from a particular area less appealing to consumers concerned about contamination. As discussed in the Scientific Assessment, tissue samples from biota on and near AtoN showed mercury levels consistent with "background" measures and are unlikely to be harmful. Nonetheless, the perception that marine life could be contaminated by the batteries could alter fishing and consumption patterns.

The site attributes selected to indicate the potential for private and commercial fishing impacts are the projected number of batteries and location in potential fishing areas (deeper near-coastal depths, certain bottom types).

The four criteria, the attributes selected for characterization and the quantitative measures used to score each site are summarized in Table II below. The Technical Appendix contains more detail of the ranking mechanisms.

4.0 Priority Categories

Once completed, the ranking list was divided into five priority categories that may be used as a guide for planning survey and recovery operations. Priority 1 sites are those with the highest scores (sum of their operational measures) reflecting the attributes of the four primary criteria. Priority 5 sites are those with the lowest sum scores. Some generalities of sites within the five priority levels:

Priority 1 Sites - Generally, these are freshwater, very shallow or terrestrial sites with high projected numbers of batteries in areas of dense population. The attribute driving these high scores is the possibility that the AtoN may be located in or near sources of drinking water. These may also be sites with fine grain sediments conducive to methylmercury formation.

Priority 2 Sites - Similar to priority 1 sites, these locations are in fresh water areas, nearer to residential areas. The major distinction between these sites and priority 1 is the estimated number of batteries at the location.

Priority 3 Sites - Priority three sites generally are found in both saltwater and freshwater environments. If they are in freshwater environments they are characterized by having a low expected number of batteries, or the locations are relatively isolated from nearby populations. The AtoNs rated in this category may be in marine environments that are particularly sensitive - such as inter-tidal areas or "wetlands". The many fixed AtoNs on shore may be assigned this priority due to their increased potential for exposure.

Priority 4 Sites - Priority 4 sites are usually located in salt-water environments where population concentrations are low, and the expected number of batteries at the locations are relatively low as well.

Priority 5 Sites - At these locations all the risk factors are minimized: the locations have few batteries, they are in salt water environments, they are over 5 miles from residential populations, and they are not in a sensitive environment.

Table II - Summary of Selected Ranking Criteria, Their Attributes and Measures

CRITERION	SELECTED ATTRIBUTES	OPERATIONAL MEASURES
Potential for Human Health Effects	- Potential total mercury in sediment. - Potential percent methylmercury. - Proximity to population. - Potential recreational/ commercial fishing use. - Potential swimming/ diving use. - Potential freshwater drinking supply.	- Bottom type and sediment character. - Projected number and condition of batteries. - Proximity to population. - Water depth and salinity. - Projected grain size and Total Organic Carbon of sediment (for percent methylmercury).
Potential for Environmental Quality Effects	- Potential total mercury in sediment. - Potential percent methylmercury. - Potential sensitive aquatic habitat.	- Bottom type and sediment character. - Projected number and condition of batteries. - Water depth and salinity. - Projected grain size and Total Organic Carbon of sediment.
Potential for Public Recreation Impacts	- Potential swimming/ diving use.	- Shallow water depths and coral bottom type. - Proximity to population.
Potential for Private and Commercial Fishing Impacts	- Potential private/ commercial fishing use.	- Deeper water depths and coral bottom type. - Offshore coastal areas.

The general characteristics of the "typical" AtoN in each priority category are summarized in Table III below. Of course, this is intended as a general guide for comparison purposes only. Individual aids in each category may have different characteristics, but their sum ranking scores should be comparable.

Table III - "Typical" Characteristics of AtoN Sites in Each Ranking Category

Characteristic	Priority 1	Priority 2	Priority 3	Priority 4	Priority 5
Power Demand	High	High	Medium	Medium	Low
Aquatic or Terrestrial	Terrestrial	Terrestrial or intertidal	Intertidal or Aquatic	Both	Aquatic
Fresh or Salt Water	Fresh water site	Freshwater site	Mostly fresh, some salt	Mostly salt, some fresh	Mostly salt, a few fresh
Population Density	High population areas	High population areas	Aquatic near population, terrestrial away from population	Away from dense populations	Away from dense populations
Potential for location in sensitive habitat	High potential	Moderate potential	Some potential	Lower potential	Slight potential

5.0 Rankings by Coast Guard District

The results of the priority ranking model are summarized in Table IV (Summary of Priority Rankings by Coast Guard District) and Table V (Summary of Priority Rankings by State). The distribution and ranking of AtoNs are displayed graphically in Appendix I (Priority Ranking Maps). Over 70% of the 12,075 sites ranked fell into the two lowest priority categories. The majority of lower priority sites are located in offshore and coastal areas or on major rivers, away from dense population areas. The 13% of AtoN in the two highest priority categories are generally located near inland population concentrations on navigable freshwater lakes and rivers, reflecting the concern that these could be potential drinking water supplies, or have sediment characteristics that make them a high priority for consideration.

Table IV - Summary of AtoN Site Priority Rankings by Coast Guard District

	Number of AtoN's with Priority					District
District	**1**	**2**	**3**	**4**	**5**	**Total**
1			66	491	124	681
2	146	1081	745			1972
5			161	1752	267	2180
7			283	1461	266	2010
8	27	73	144	1188	703	2135
9		41	383	214	61	699
11			164	364	42	570
13			126	635	269	1030
14			53	58	68	179
17			2	241	376	619
Total	173	1195	2127	6404	2176	12075

TABLE V - Summary of Priority Rankings by State/Location

	Number of AtoN's with Priority					State
State	1	2	3	4	5	Total*
AK			2	241	376	619
AL	3	27	48	136	29	243
AR	21	166	106			293
CA			164	364	42	570
CT			9	110	10	129
DE			20	69	20	109
FL			167	1130	237	1534
GA			63	215	8	286
HI			53	56	36	145
IA	1	43	27			71
IL	34	156	103	6		299
IN	3	16	53	2		74
KY	11	74	78			163
LA	32	114	112	343	293	894
MA			21	78	24	123
MD			17	441	67	525
ME			12	50	44	106
MI		27	183	115	32	357
MN	5	26	54	20	4	109
MO	13	88	46			147
MS	3	48	67	99	42	259
NC			36	588	120	744
ND		11	1			12
NH				1	1	2
NJ			78	186	25	289
NY			53	212	32	297
OH	3	62	78	8	5	156
OK	2	5	3			10
OR			89	383	54	526
PA	3	58	27		2	90
RI			6	16	10	32
SC			55	226	12	293
TN	31	153	97			281
TX			17	445	254	716
VA			17	524	43	584
VT				2		2
WA			37	252	215	504
WI	2	37	98	34	13	184
WV	6	84	30			120
Total	173	1195	2127	6352	2050	11897

	Number of AtoN's with Priority					Location
Location	1	2	3	4	5	Total*
American Samoa					7	7
Cuba					19	19
Guam					16	16
Isla De Culebra					4	4
Isla De Vieques					3	3
Johnston Atol				2		2
Kwajalein Atol					2	2
Navassa Island					1	1
Palau					1	1
PR				50	49	99
Rota					2	2
Saipan					3	3
St. Croix					11	11
St. John					3	3
St. Thomas					4	4
Tinian					1	1
Totals	0	0	0	52	126	178
Grand Total	173	1195	2127	6404	2176	12075

6.0 Conclusions

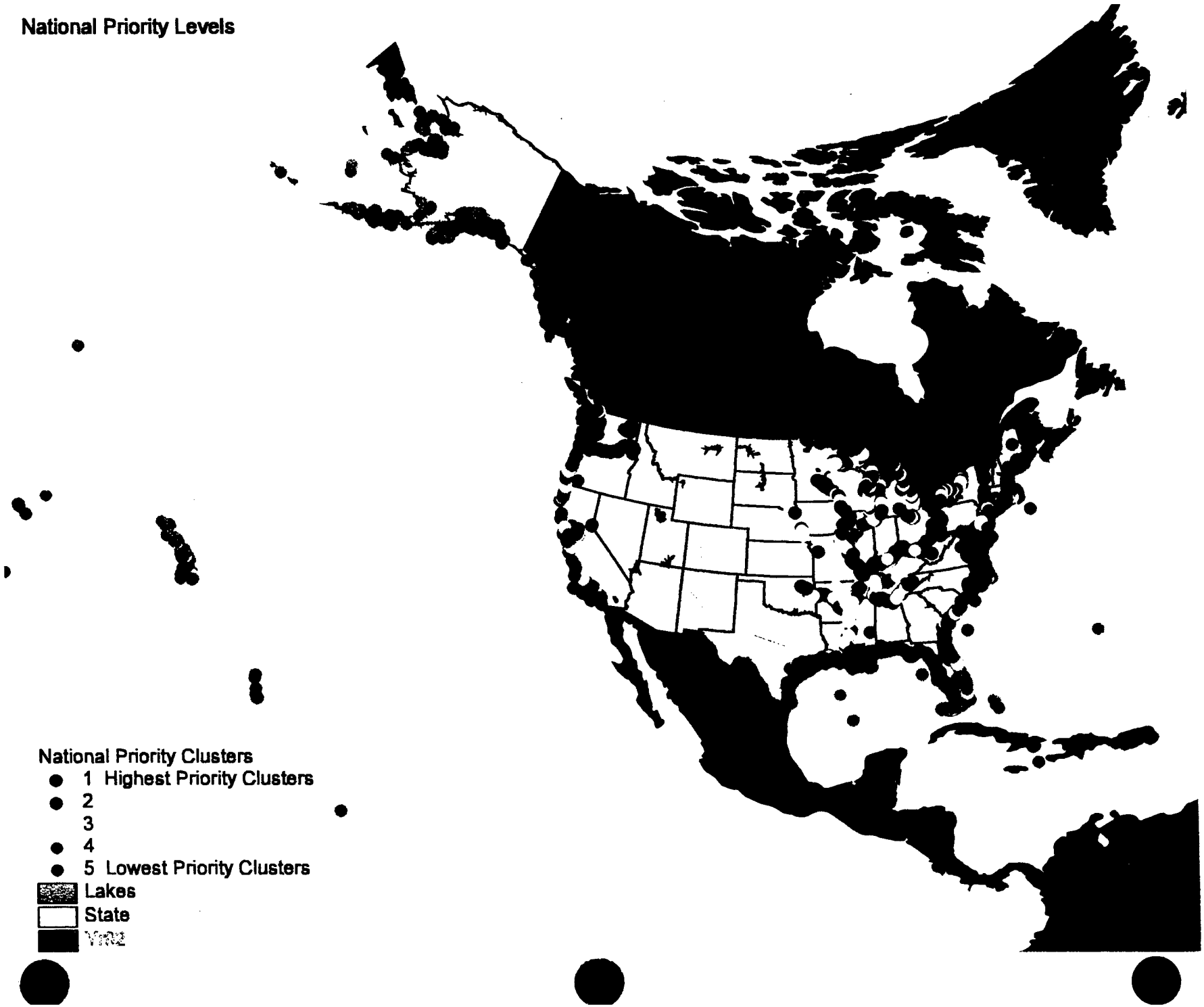
The priority rankings of fixed lighted AtoN sites in this study are recommendations for planning operations to recover AtoN batteries based on consideration of actual, potential and perceived risks. The priority rankings should not be confused with actual risk levels assigned to locations employing legally defined environmental impact assessments.

Of the 12,000 plus fixed lighted AtoN sites evaluated in the study, less than 200 ranked in the highest priority category. In contrast, the preponderant majority of sites ranked in the two lowest priority categories. These lower priority rankings do not negate the need the Coast Guard may have to recover AtoN batteries. They illustrate that most AtoN sites do not appear to require immediate recovery action, based on their potential for affecting select aspects of human health, the ecology, quality of life or the economy.

Due to greatly limited budget resources, the Coast Guard has proposed to conduct survey and recovery operations on a phased, multi-year basis, as Congress makes funds available for this effort. Based on the overall analysis of this matter, this approach appears reasonable, provided locations with high priority AtoN are addressed early whenever possible.

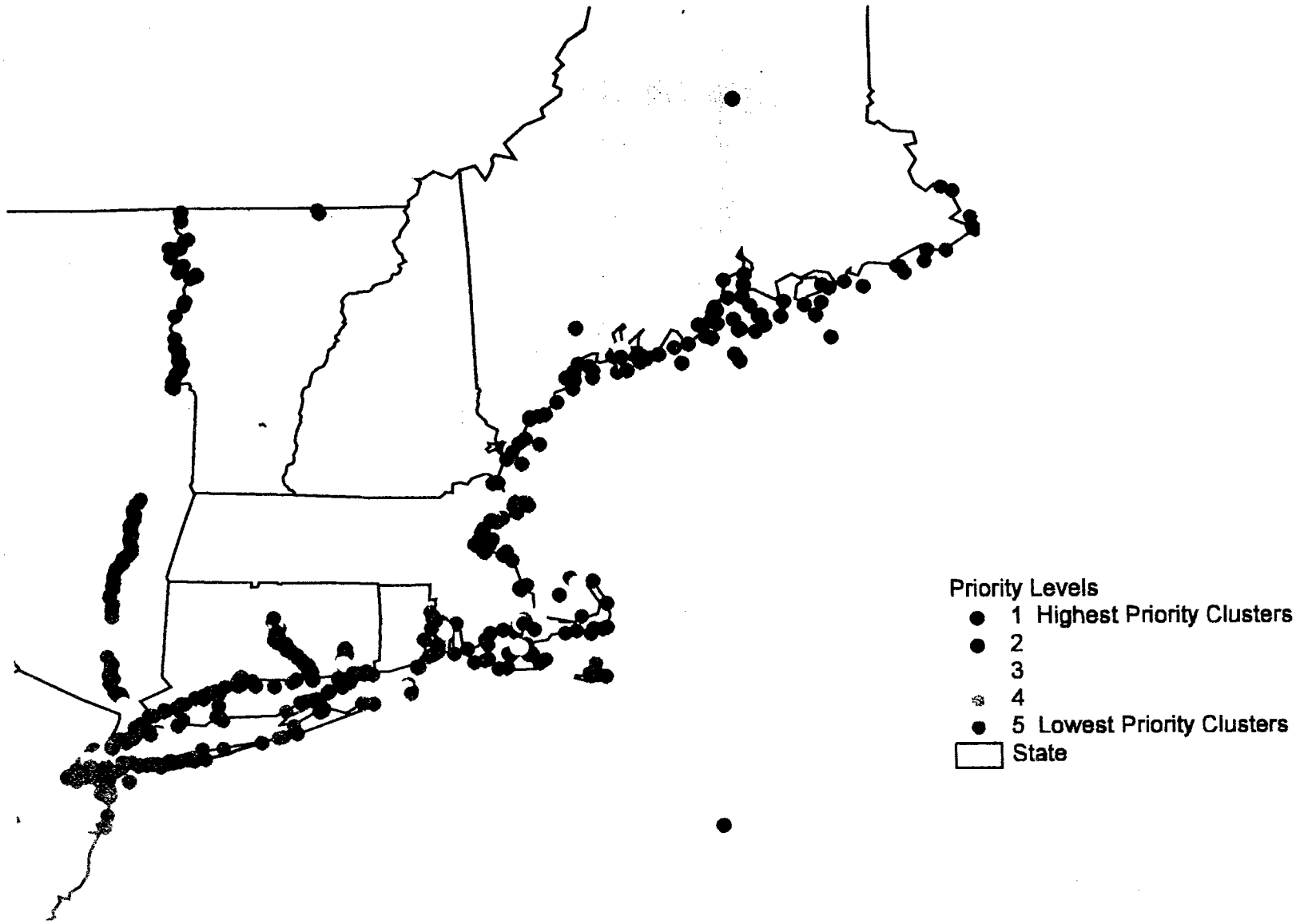
APPENDIX I - PRIORITY RANKING MAPS

National Priority Levels



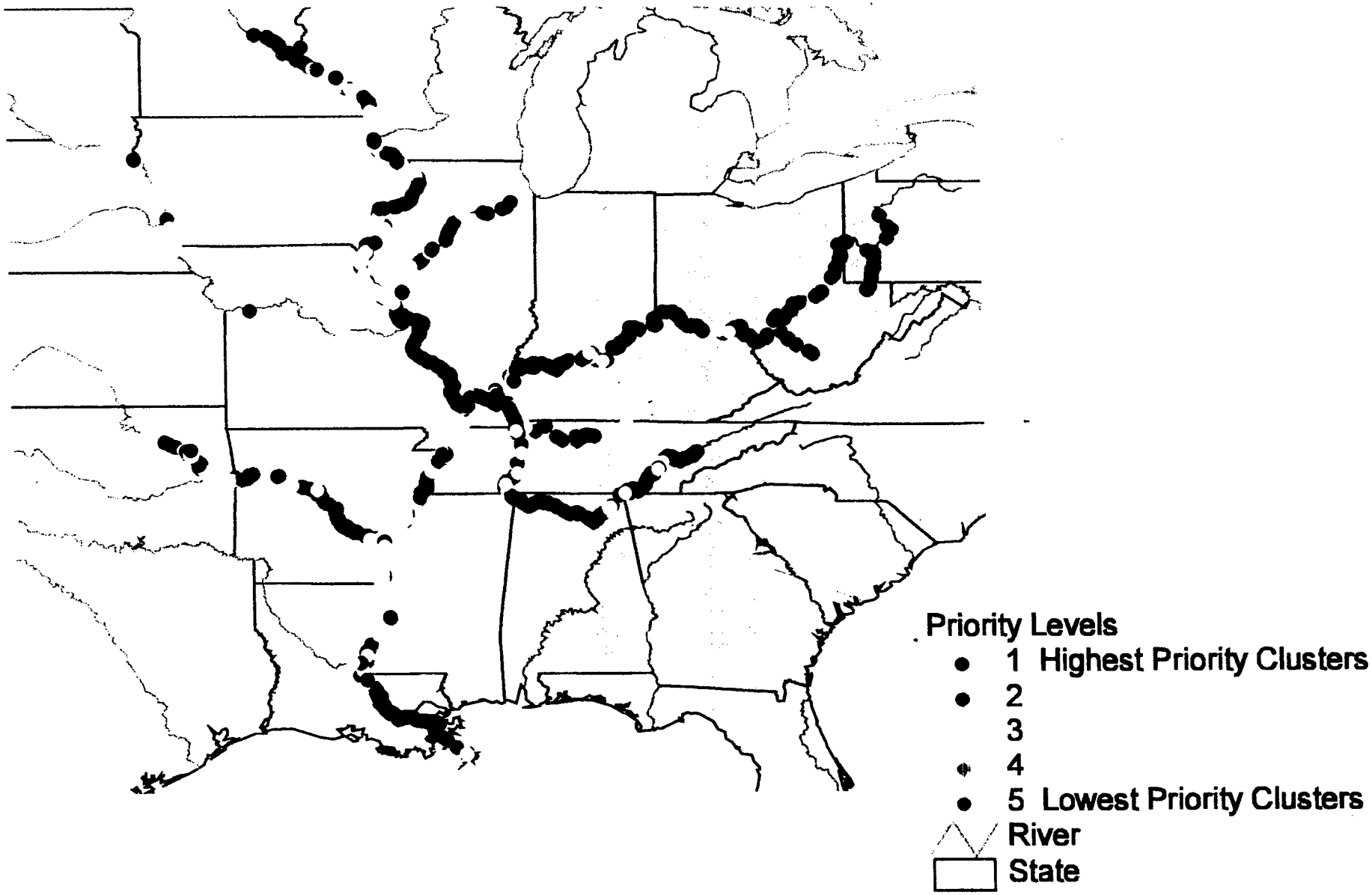
MAP B

District 1 and Environs

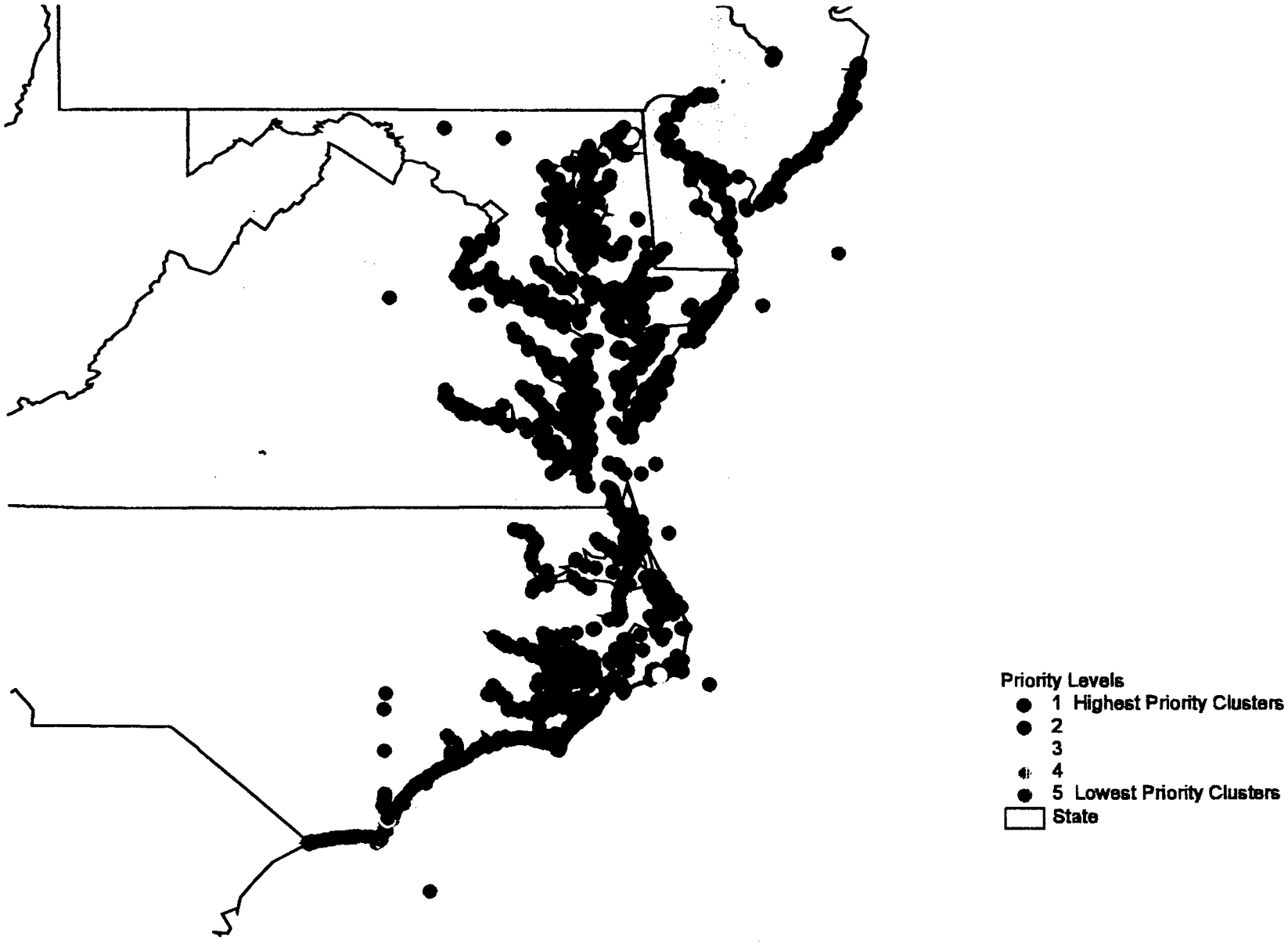


MAP C

District 2 and Environs

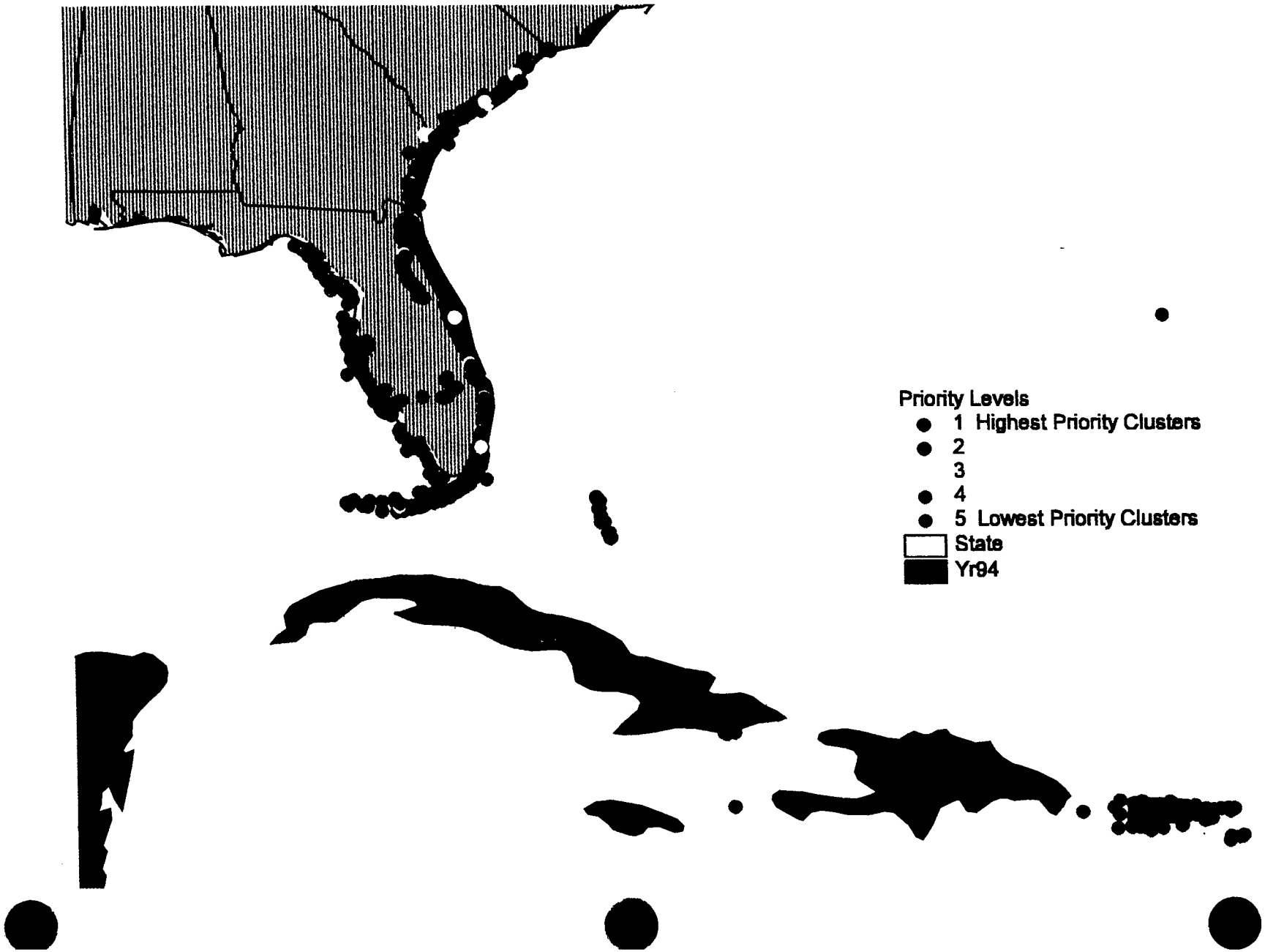


District 5 and Environs



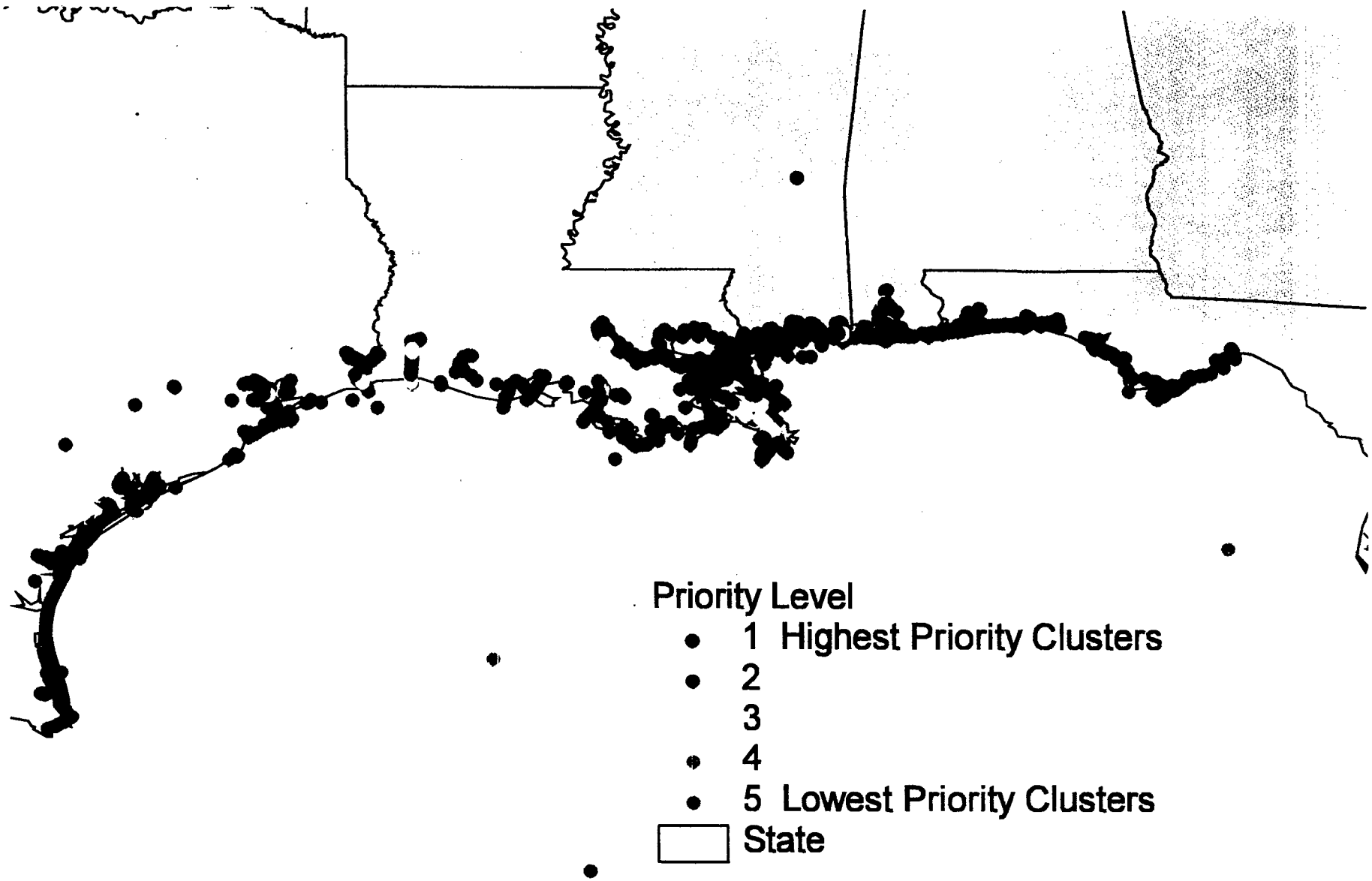
MAP E

District 7 and Environs



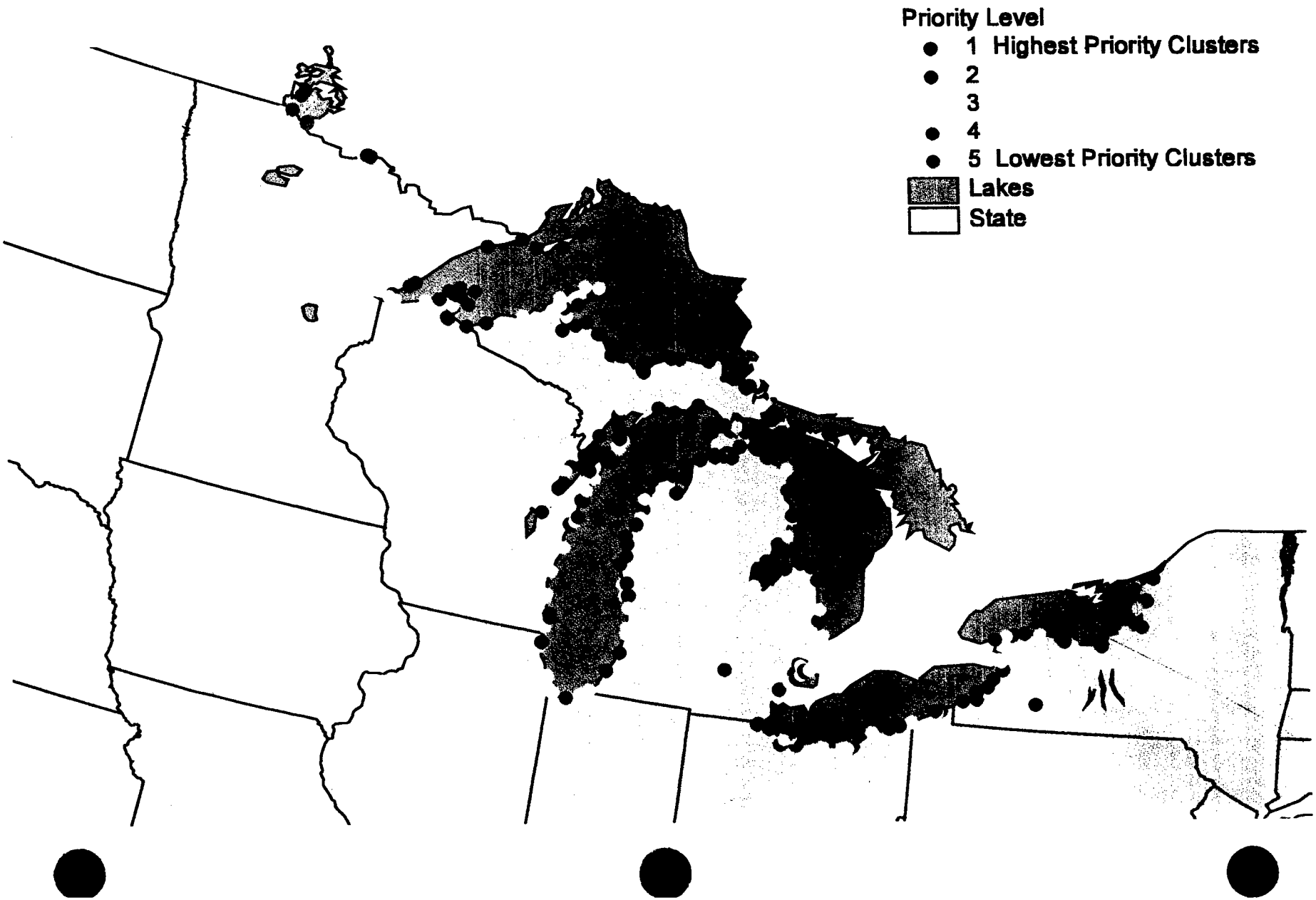
MAP F

District 8 and Environs



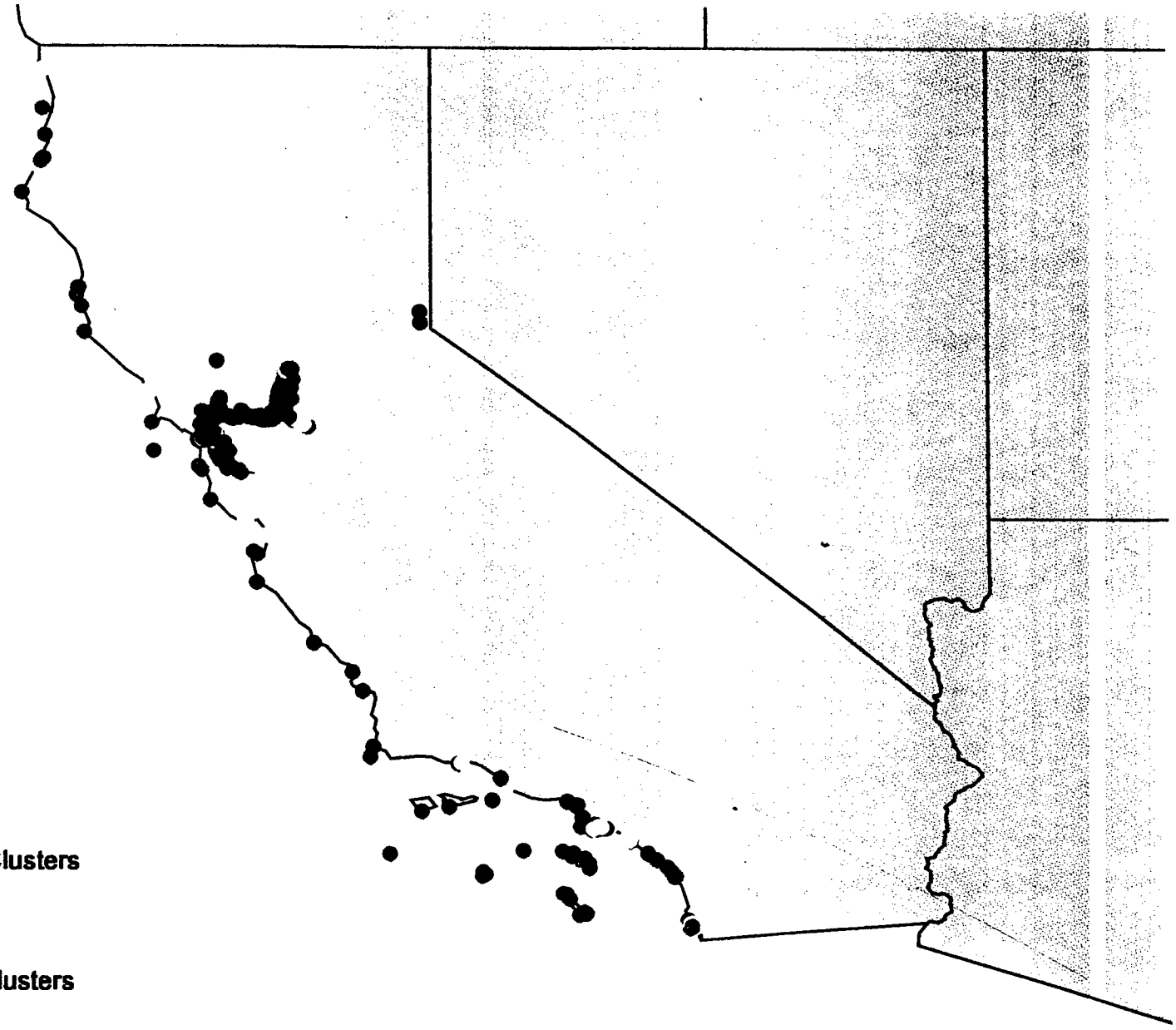
MAP G

District 9 and Environs



MAP H

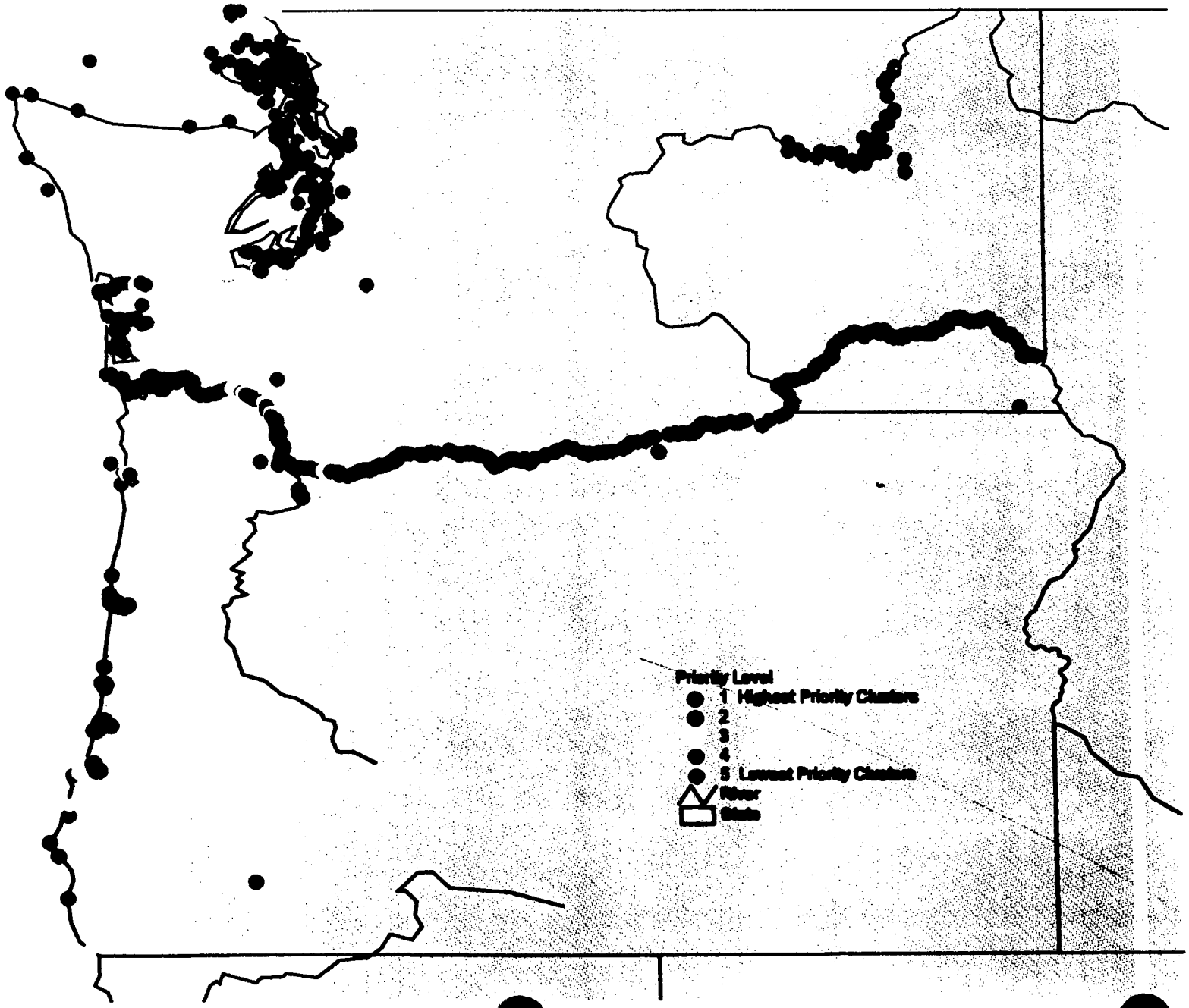
District 11 and Environs



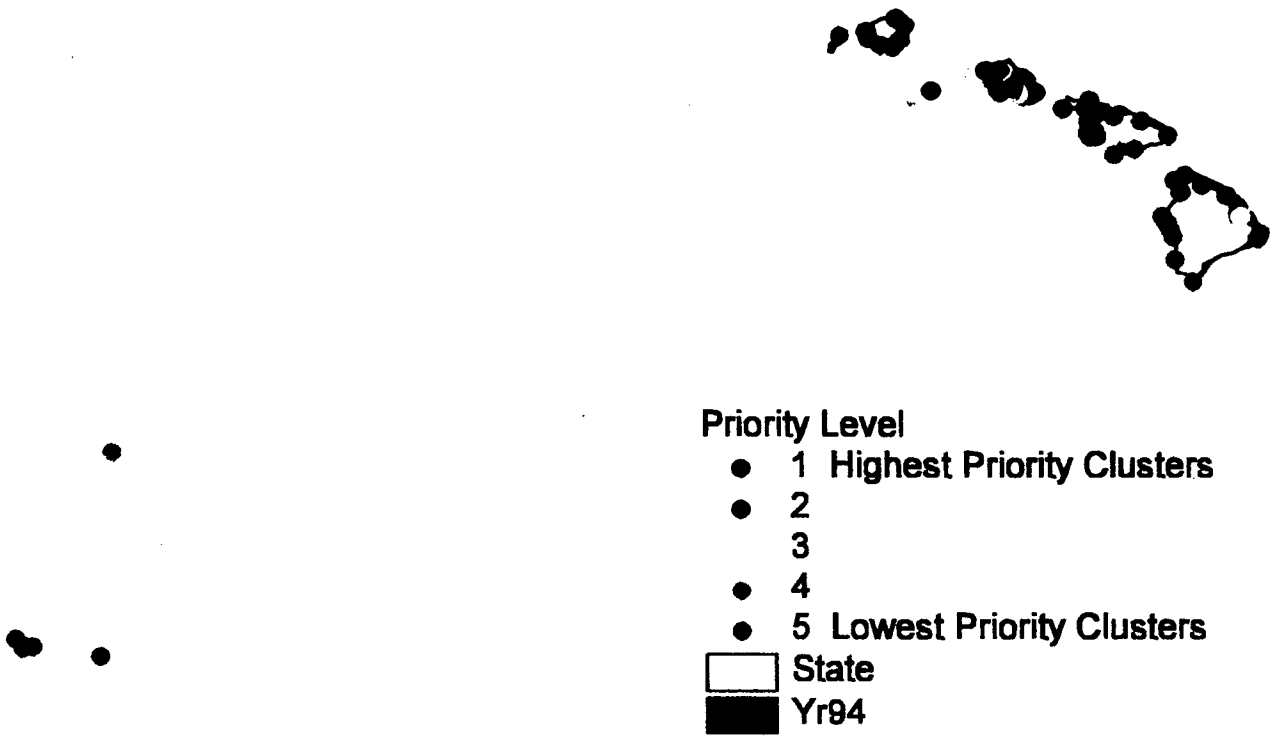
Priority Level
- 1 Highest Priority Clusters
- 2
- 3
- 4
- 5 Lowest Priority Clusters

State

District 13 and Environs



District 14 and Environs



MAP K

District 17 and Environs

Priority Level
- 1 Highest Priority Clusters
- 2
- 3
- 4
- 5 Lowest Priority Clusters
- State

APPENDIX II - TECHNICAL APPENDIX

I. DATA SOURCES

ATONIS

Most basic information about the AtoN sites was derived from raw data in the Coast Guard's Aids to Navigation Information System (ATONIS). We selected data to help us identify the location, power demand and potential environmental sensitivity of each fixed lighted AtoN.

Identifying information in ATONIS for individual aids included the aid name, aid number, and Light List Number (1993 data). Aid locations were defined using the assigned position of the AtoN, usually given in latitude and longitude. However, AtoNs located on some Western Rivers were listed in terms of "River Mile". In those cases, we manually estimated the latitude and longitude of the aid and entered it in the data base. ATONIS included location-specific bottom type (i.e. mud, rock, etc.) and mean low tide water depth for about 25% of the aids, both of which were used to determine environmental characteristics of the aid's location. ATONIS also included data on the lamp, flasher and changer characteristics of each aid that we used to estimate power demand and battery usage.

Each aid in the priority ranking data base was given a unique identifier. Aid numbers are not unique among districts - therefore matching data from other sources onto ATONIS required an additional identifier. We found that any two descriptors among the aid name, aid number or latitude/longitude coordinates would uniquely identify each aid. In most cases, the unique identifier was the ATONIS aid name and aid number. These unique identifiers were crucial to determining the actual number and location of fixed AtoNs to be ranked. Since light list numbers are reassigned frequently, this number is not sufficient to track AtoNs. Some data are omitted from the final report listing AtoNs by District, State and Priority rank. These data were unavailable at the time of the compilation of this version of the priority ranking report. State identifiers for 392 AtoNs are omitted from this report; however, priority ranks were assigned to these AtoNs and they appear in the tabular report for District 2.

II. APPENDED FIELDS

NOAA Data on Bottom Types and Depths

National Oceanographic and Atmospheric Administration (NOAA) sounding records were used to fill in depth and bottom type information where it was missing in ATONIS (approximately 75% of the records). NOAA depth and bottom type data was used if it was collected from within 30 meters of the assigned position of the AtoN.

III. AtoN descriptors

The following table describes the raw data used to identify and prioritize AtoN's for cleanup.

AtoN descriptor	Comments
District	National Districts: 1, 2, 5, 7, 8, 9, 11, 13, 14, and 17
State **	
Light Name	Unique by district only. *
Aid ID	National Aid ID. Unique by district only*
HQ94 LLNR	District light list number. Some districts use the National # for LLNR. Some districts change these numbers annually. These numbers were provided by Coast Guard Headquarters in 1994. Unique by district only*
Bottom	Sediment type at AtoN, e.g. chalk, clay, coral, earth, gravel, lava, mud, riprap, rock, sand, shells. Incomplete records.
Depth	Water Depth at AtoN. Incomplete records.
Longitude, Latitude	
Risk Estimate	Risk calculation raw score. Range: 0 (lowest risk) to 250,000 (highest risk)
Population Density	Census data was used to calculate the total population with 1,5,10, and 20 mile radii of the AtoN.
Maximum Battery Estimate	Biased on power demand. Estimated total number of primary (mercury) batteries used during their estimated 20 years of use
Cumulative Risk Score	Risk Analysis Raw score. Calculated for AtoN's with the most complete information. Assigned to less well known AtoN's biased on their cluster.
Cluster	AtoN's were geographically grouped for Risk Score and Priority assignments.
Priority	Risk Score interpretation: 1 (highest priority) to 5 (lowest priority)

*Aid name, LLNR, and National ID number uniquely identify AtoN's within districts only. Many AtoN's share the same name and numbers with other AtoN's in other districts. Any two among name, National ID, and LLNR will uniquely specify an AtoN.

**In a few cases, the assigned state locations of individual AtoN may need to be corrected. The Coast Guard does not track AtoN locations by state. Whenever possible, state assignments were made based on the latitude and longitude of the AtoN using a Geographic Information System program. However, accuracy was difficult to attain on waterways dividing states, where AtoN are not widely separated. In these cases, we made a "best guess" and placed based on available information, such as location of the Coast Guard unit servicing the aid or position of the next closest AtoN with a known state assignment. State of assignment is a location descriptor only and in no way affects a site's priority ranking.

III. Clustering and Prioritization

(A) A clustering algorithm, described below, was used to partition the set of the approximately 12,000 fixed lighted AtoNs into smaller groups, or clusters. The partitioning was based on geographic proximity, and the prioritization of clusters was based on potential environmental effects (see Table II in the text). The algorithm performs as follows:

Step 1: The distance from each AtoN in the set of 12,000 to its nearest neighboring AtoN is obtained;

Step 2: All these nearest distances from Step 1 are added and then divided by the number of AtoNs in the set (12,000);

Step 3: The quotient from Step 2, the average of the nearest distances, is designated as the 'mean of the nearest paths', M, of the set;

Step 4: One considers each individual AtoN in the set and draws a circle with a radius equal to the mean path M around it;

Step 5: A 'cluster' is then defined by either a group of circles from Step 4 that touch (a chain-like assembly), or a single circle if it does not touch other circles;

Step 6: From a separate computation, obtain the potential environmental effect index, R, for each AtoN (this index is based on the attributes given in the text of this document);

Step 7: For each cluster a score, S, is computed which is equal to the sum of the indices, or Rs, of all the AtoNs within the cluster;

Step 8: List the scores from Step 7 in descending order.

It is to be noted that if the value of R for an AtoN within a cluster was not known it was assumed to be equal to zero.

The list that results from Step 8 provides prioritization on the basis of clusters which includes the chained circles mentioned above.

(B) Another ranking was obtained by proceeding from Step 4 in (A) above as follows:

Around each AtoN a circle of radius M was drawn. The values of R of all the AtoNs within this circle, including the value of R of the subject AtoN, were summed. This sum was then defined as the score for this AtoN. The range of values thus obtained were partitioned into five categories on a logarithmic scale. Each AtoN was then assigned into one of these

categories (categories 1 to 5) based on its score. Also in this case, if the value of R was not known it was assigned a zero value.

(C) It should be noted that prioritization of AtoNs on the basis of their potential environmental effects index R, or the AtoN score defined in (B) above, or on the basis of the cluster score defined in (A) above will not necessarily yield the same order of prioritization. Issues of potential environmental sensitivities which may be affected by AtoN grouping, and logistic considerations, may dictate the choice of prioritization methods.

ATTACHMENT ONE - PRIORITY RANKING RESULTS

[NOTE: DUE TO THE EXTENSIVE NUMBER OF PAGES IN THIS ATTACHMENT (269), IT HAS BEEN INTENTIONALLY OMITTED FROM THIS COMDTINST. THE INFORMATION CONTAINED THEREIN IS AVAILABLE FROM 1 - YOUR COGNIZANT CEU, 2- DISTRICT (oan), 3- COMDT (G-ECV-1).

SAMPLE FORMAT

FY 96 EC&R FUND SPEND PLAN

No. of terrestrial sites to be worked in FY 96	:	_____
No. of aquatic sites to be worked in FY 96	:	_____
Total No. of sites to be worked in FY 96	:	_____
Est. No. of batteries to be recovered	:	_____
Est. disposal costs (___ lbs @ $___/lb)	:	_____
Est. travel/per diem costs	:	_____
Est. miscellaneous supplies (drums, etc.)	:	_____
Est. diving/diving support costs	:	_____
Est. personnel training costs	:	_____
Est. other costs (list below)	:	_____
TOTAL EC&R FUNDING REQUESTED	:	_____

U.S. Department of Transportation
United States Coast Guard

Commander
First Coast Guard District

408 Atlantic Avenue
Boston, MA 02210-3350
Staff Symbol:
Phone:

16500
DEC 09 1994

From: Commander, First Coast Guard District
To: Officer In Charge, USCGC BOLLARD (WYTL 65614)

Subj: ATON ORDER 12-94-004, BATTERY RECOVERY CONNECTICUT RIVER

Ref: (a) Your 221809Z NOV 94

1. Prior to 23 DEC 94, recover those ATON batteries identified in reference (a) at the following terrestrial sites:

a. Straights Hill LT (LLNR 23095)
b. CT River RR "B" (LLNR 22970)

2. Ensure all recovery personnel meet or exceed the training requirements contained in 29 CFR 1901.1200 for "Hazard Communication".

3. Follow the instructions provided in the enclosed Standard Site Safety Plan (SSP). Retain the SSP for guidance on future battery recovery evolutions. Recovered batteries shall be transported to your battery storage facility where they can be disposed of through your battery recycler.

4. Complete page 3 of the SSP and forward it to CEU Providence, copy to this office with the After Action Report (AAR). The following points of contact are provided to identify those individuals listed on page 11 of enclosure (1):

Recovery Coordinator:
CAPT C. C. Beck, First District (oan)
(617) 223-8340 (voice)

Recovery Project Officer:
LT Keith Bills, First District (oan)
(617) 223-8385 (work)
(508) 761-9787 (home)

Site Safety And Health Officer
LCDR Steve Danielczyk, First District (mseh)
(617) 223-8436 (work)
(508) 655-7321 (home)
1-800-US1-PAGE (PIN: 622-1395) (pager)

16500

Subj: ATON ORDER 12-94-004, BATTERY RECOVERY CONNECTICUT RIVER

Environmental Specialist
Mr. Georges Bockstael, CEU Providence
(401) 736-1744 (work)

5. Notify this office by priority message upon completion of this ATON Order. My POC is Lieutenant Keith Bills at (617) 223-8385.

C. C. BECK

Encl: (1) Standard Site Safety Plan

Copy: CG GP Long Island Sound(w/o enclosure)
CG CEU Providence(w/o enclosure)
CG ANT Long Island Sound(w/o enclosure)

STANDARD SITE SAFETY PLAN FOR ATON BATTERY CLEANUP OPERATIONS (INITIAL RESPONSE PHASES--POST-EMERGENCY)

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ATTACHMENTS

(01) SITE PLAN (file 02)
(02) SAFE WORK PRACTICES FOR LIFTING/HANDLING BATTERIES(file 24)
(03) DRUM HANDLING & STORAGE PROCEDURES (file 24)
(04) WORK PLAN MODIFICATIONS. . . . . .(file 09)
(05) COMMAND AND CONTROL DIAGRAM
(06) GENERIC HAZARDOUS SUBSTANCE INFORMATION SHEETS, . (file 01A)
MSDS/RIDS/CHRIS/CHEMTOX/TOMES)
(07) PPE ENSEMBLE SHEETS (Level D). . . . . .(file 13)
(08) DECON LAYOUT . . . . . .(file 11A)
(09) SANITATION REQUIREMENTS . . . . . (file 06)
(10) PROCEDURES FOR BITES, STINGS, & POISONOUS PLANTS. (file 23)
(11) AFTER ACTION REPORT FORMAT
(12) ADDITIONAL FIRST AID KIT CONTENTS

First CG District ATON Battery Recovery Site Safety Plan

References:
(a) 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response.
(b) 29 CFR 1910 Sub-part I, Personal Protective Equipment.
(c) 33 CFR 159, Marine Sanitation Devices.
(d) 40 CFR 311, Worker Protection.

A. SCOPE AND APPLICATION.

A.1. This Site Specific Safety and Health plan addresses health and safety issues for U. S. Government response or contract personnel during the federally directed response to recover Aids to Navigation (ATON) Batteries at terrestrial sites. Only properly equipped and trained personnel are permitted to enter the controlled area of the site.

A.2. All U. S. Government and contract personnel assigned to this project shall review this Site Safety Plan (SSP) and abide by its contents.

B. SITE DESCRIPTION.

B.1. GENERAL SITE DESCRIPTION: Batteries have been lost into the water from Coast Guard Aids to Navigation through accidents and acts of nature. The ATON battery response project has been undertaken by the Coast Guard to remove these potential threats to the environment.

Each site at which batteries may have been lost can be described as falling into one of the following categories:

(a) Fixed Aids: Those aids which are currently located at a fixed, known locations, designated on nautical charts and light lists, by latitude and longitude, and are attached to the bottom with piles or other construction.

(b) Floating Aids: Those aids which are currently located at a known location, designated on nautical charts and light lists, by latitude and longitude, and are anchored in place by a mooring system.

(c) Historic Aids: Fixed or floating aids that have been discontinued

First CG District ATON Battery Recovery Site Safety Plan

B.2. PHYSICAL LOCATION:

Site is Generally Referred to as:

_____

LLNR: _____ LAT/LONG: _____
Aid Description: _____

Geographic Description:

_____

_____

Surrounding Area: Populated Unpopulated

Topography: Rock Thick Vegetation Mud
Marsh Rip Rap Other: _____

Closest Hospital and Phone Number:

_____

Closest Police Department with Phone Number

_____

Closest Fire Department with Phone Number:

_____

Recovery Personnel:

Senior Member: (first class petty officer or above)

_____

Other Members (at least two additional required):

_____

First Aid Kit (Additional items listed in Att. 12)

_____

B.3 Primary Hazards:
(a) CHEMICAL: Historical information for Coast Guard ATON batteries indicates that the following hazardous or potentially hazardous materials may be present at the site as a result of ATON batteries:

1) Mercury (Hg):
0.035 to 0.15 pounds /battery for primary batteries. For intact battery casings this material is expected to be contained within the battery case.

2) Potassium Hydroxide (KOH):
Less than 10.5 pounds/battery for primary batteries.

3) Lead Sulfate (PbSO4):
12.60 to 20.60 pounds for secondary (lead acid) batteries

4) Sulfuric Acid (H2SO4):
10-18 pounds/battery for secondary (lead acid) batteries

5) Nickel Hydroxide (NiOH2)
Small quantities associated with some types of batteries

6) Lead (Pb)
Component of plates in secondary (lead acid) batteries

7) Nickel Cadmium (NiCd)
Constituent of some types of batteries. Unable to estimate quantities.

8) Methyl Mercury (CH3Hg)
By product of elemental mercury exposed to the environment. Unable to estimate quantities.

9) Hydrogen Sulfide (H2S)
By product of decaying vegetation that may be naturally occurring at work sites. Unable to estimate quantities.

Mercury (UN2809), Potassium Hydroxide (UN1814), Lead Sulfate, Lead, Sulfuric Acid (UN1830) and Nickel Hydroxide are hazardous substances defined under Section 101(14) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended.

Methyl Mercury (CAS:22967-92-6) may or may not be listed as a hazardous substance under Section 101(14) depending on the specific compound involved.

(a) EXPLOSION: Battery Explosion

(b) BIOLOGICAL: Mosquitoes, Fleas, Ticks, Snakes

(c) SAFETY: Tripping, Heat Stress, Trapped in mud, Generation of Hydrogen sulfide (addressed under chemical hazard), weight/drum handling (see attachments 2 and 3), brush clearing.

C. WORK PLAN AND ENTRY OBJECTIVES.
Government recovery personnel will conduct site surveys and battery recovery work on visible batteries. Site surveys will consist of site identification, mapping and sampling. Recovery work will consist of

transporting batteries from the original site to a suitable Coast Guard vessel or motor vehicle. Once aboard, the recovered batteries will be transported to authorized hazardous waste staging facilities for ultimate disposal/recycling options. Transportation of recovered batteries via Coast Guard vessel is preferred to motor vehicles due to exemptions and quantity restrictions. Contact the Recovery Project Officer for further guidance.

Only U.S. Coast Guard personnel who have completed appropriate training as outlined in this document and who are familiar with the hazard of battery handling are authorized to conduct operations. All work shall be conducted in accordance with procedures established during pre-entry briefings and attached work plans.

Only batteries that are on the surface or partially uncovered shall be recovered. Any batteries that are entirely below the surface and that must be dug around to recover shall not be moved or uncovered since movement may release contamination into the environment. Note all batteries that cannot be recovered on the Site Plan.

Recovery operations will be under the direction of the Recovery Coordinator or his representative. Any work plan modifications shall be reflected in attachment 4.

Recovery operations include:

C.1. INITIAL SITE RECONNAISSANCE

a. Upon arrival at the site take a few minutes to orient yourself and get a feel for the lay of the land. Using a standard Site Plan 1" = 20' (or other appropriate scale), draw in the relative position of the shoreline and the position of the aid.

b. All members of recovery team meet to determine who will go where and where the stage-out area will be set up along with position of safety equipment, "tailgate site safety plan" will be developed. Search zones will be established.

c. Personal protective equipment (rain gear or tyveks and boots) is donned, pH paper, a Site Plan 1" = 20' and a supply of flags or other marking devices are taken into the search zone.

d. Upon discovery of a battery, note it's position on the Site Plan, identify it's type (L = Lead Acid, Z = Zinc Air), condition (intact or

ruptured), test the battery casing with pH paper (H = "hot, C = Corrosive), flag the battery and continue outward.

e. Return to stage-out area. Determine number of buckets, bags, tape, barrels, and labels that will be required. If the scope of the recovery is within the capability of the recovery team's ability and equipment, proceed to the recovery phase.

C.2 BATTERY RECOVERY

a. Don appropriate personal protective equipment (may also include safety glasses and gloves).

b. All batteries and battery pieces will be placed in plastic bags, one battery per bag. The bags will be taped closed and placed in transportation buckets. Intact batteries may be handled in the same way that spent batteries are routinely removed from the aid during normal replacement. Leaking batteries must be handled as hazardous waste. (Leaking batteries are batteries that have "hot" corrosive fluid from the battery interior located on the outside of the battery as measured by pH paper wipe test) Discovery of a leaking battery should be an uncommon event. Leaking batteries should be double bagged, placed into a transportation bucket and the bucket should be labeled HAZARDOUS WASTE, CORROSIVE. The transportation bucket lid should be screwed on and the bucket isolated from the other batteries. Should contact with any corrosive material be made, it will be necessary to immediately decontaminate the affected area/s (Wash off). Prior to any battery handling, all personnel should become familiar with the attached Material Substance Data Sheet (MSDS).

c. Broken or ruptured batteries should also be double bagged (bag, tape and bag, tape) to prevent battery casings from tearing their bags. There may be value in using an outer burlap bag for support and strength. Bring battery back to the servicing vessel for transportation to the Unit.

d. Note on the site map any batteries that were not recovered.

e. Information necessary for transportation.

1. Zinc Air Primary Batteries

a) GENERAL: The air-depolarized batteries consist of an inert plastic or hard rubber case, potassium hydroxide liquid electrolyte, zinc-mercury alloy anode, carbon cathode, and an insoluble residue or lime bed. The SAFT batteries will also contain a starch based electrolyte gelling agent. The pH of the electrolyte is close to 14. The EPA Hazardous Waste Identification Number for these batteries should be D002 (corrosivity). You may note that under COMDTINST M 16478.1B they are also identified as waste code D009 (toxicity characteristic for mercury). Actual TCLP analysis for mercury indicates that the D009 is not necessary, see Figure C.2.a for TCLP analysis results. Also, if the batteries have been broken open and the electrolyte has been diluted/neutralized by contact with sea water or the pH otherwise cannot be measured as 12.5 or more, the battery carcass does not meet the definition of a hazardous waste, but should be disposed of or recycled utilizing normal battery disposal procedures.

b) LABELING: A battery which contains electrolyte (intact) or a broken battery which fails the field pH test, must be handled as a hazardous waste. Transportation of these batteries requires the following information:

* Proper Shipping Name = Waste Battery, electric storage, wet, filled with alkali
* Hazard Class = Corrosive material
* Identification Number UN2795
* Label = CORROSIVE
* EPA Hazardous Waste Number D002

c) PACKAGING: Intact batteries shall be double-wrapped in plastic bags, palletized, and banded. Batteries will be placed upright with layers separated by plywood or cardboard. The total pallet is not to exceed 4 layers in height. On-board the recovery vessel the batteries can be double-wrapped and placed into a drum with absorbent material filling the voids. Any battery which is determined to be currently leaking electrolyte must be packed into an individual container and isolated. Upon return to the unit, batteries will be off-loaded and handled according to the same procedures used for spent batteries being returned from ATON servicing. If primary batteries are not

recycled, they must be included in the unit calculation of hazardous waste generated per month.

2. Lead-Acid Batteries

a) GENERAL: Lead-acid batteries are wet, rechargeable, and usually six-celled. Each cell consists of a lead (anode) and lead dioxide (cathode) plates totally immersed in sulfuric acid electrolyte. The EPA Hazardous Waste Identification Numbers are D002 (corrosivity) and D008 (toxicity characteristic for lead). Intact, non-leaking lead acid batteries which are recycled do not need to be disposed of as hazardous waste. Pieces of lead acid battery cases which do not fail the field pH screening, are solid waste (debris) and should be recovered, returned to the unit and disposed of as landfill waste. The lead plates from these batteries should be collected in plastic bags (using PPE), returned to the unit and boxed for recycling.

b) Upon return to the unit, lead acid batteries should be handled according to standard operating procedures established in COMDTINST M 16478.1B.

c) LABELING: A leaking lead acid battery will require the following information to meet transportation rules:

* Proper Shipping Name = Waste battery, Electric Storage, wet, filled with acid
* Hazard Class = Corrosive material
* Identification Number UN2794
* Label = CORROSIVE
* EPA Hazardous Waste Numbers D002 and D008

d) PACKAGING: Intact batteries shall be double-wrapped in plastic bags, palletized, and banded. Batteries will be placed upright with layers separated by plywood or cardboard. On-board the recovery vessel the batteries can be placed in a drum. Leaking batteries or broken battery casings and internal components must be packed into individual containers with absorbent material and shall be isolated.

e) The primary concern when handling the lead acid batteries is the sulfuric acid electrolyte, the lead and the toxicity of the

lead is a secondary issue. Unlike the primary batteries the pH of the lead acid batteries is more difficult to characterize and will be found to cover a wide range of values. Any leaking lead acid battery which field pH test at a value of 2 or less is a hazardous waste.

f) Leaking lead acid batteries and primary batteries which fail the field pH test are a hazardous waste. They must be individually packaged, labeled, and stored separately. As hazardous waste they will have to be disposed of under a Hazardous Waste Manifest, using the unit's EPA ID Number or a temporary ID Number will need to be assigned by the state. Batteries and battery pieces which are determined not to be hazardous waste may be shipped under a bill of lading.

C.3. ENVIRONMENTAL MONITORING

a. Environmental monitoring serves three main functions: a) It provides the documentation necessary to show that the site has been cleared of spent batteries. b) Soil samples taken can be used to assess potential environmental impact of batteries in the environment, and to determine if there is a need for additional site remediation. c) Monitoring can be use to show that potential environmental impacts from the cleanup actions have been minimized, and that a Quality Assurance Plan (QAP) has been followed, resulting in valid documentation/sample collection.

b. On the site plan, identify the aid name, aid number, number of batteries, location of batteries, battery type(s) and condition. The center or datum of the Site Plan is the largest concentration of batteries. Indicate a fixed or surveyed object on the Site Plan for reference. Indicate the direction of North and insert the appropriate scale. Normally, a 40 foot radius is used. The entire terrestrial area within the 40 foot radius will be searched for batteries. If batteries are found outside the 40 foot radius adjust the scale to fit the site.

The distance from the aid to the last battery found will be considered one (1) SITE RADIUS. The search for batteries should be extended outward for one additional SITE RADIUS. For

example, if the last battery found is 40' from the aid, the search pattern should be out to a minimal distance of 80' from the aid. Take a minimum of four (4) photos at each site.

Using the site plan drawing determine the area which represents the greatest concentration of batteries. From the center of the area with the greatest number of batteries you will take soil sample #1. Soil sample #2 will be taken out at 1 SITE RADIUS within three feet of the position of the outermost battery. Soil sample #3 should be taken out at SITE RADIUS 2. Soil sample #3 will be used as a background sample.

c. SOIL SAMPLE COLLECTION

Sampling devices shall be decontaminated between individual soil samples. The following steps shall be followed, for decontamination of sampling devices:

1. Remove all bulk solids.

2. Scrub with detergent and potable water solution.

3. Rinse with isopropyl alcohol, and

4. Rinse with de-ionized water.

The recovery team shall collect one soil sample from each of the three indicated areas at each aid. A stainless steel sampling tool shall be used to collect soil samples.

Each soil sample shall be placed in a clean, plastic container or plastic bag. A two inch diameter by four inch deep soil sample should be taken from the surface at each of the three locations. As each sample is packaged, a chain of custody form shall be retained by the sampling personnel. A copy of the chain of Custody form shall be mailed to CEU Providence along with the soil samples and After Action Report.

Secure a sample label to each soil sample container collected in the field. The sample label shall contain the following data:

a. Aid name and number
b. Sample number
c. Distance and direction from aid
d. Date

e. Time
f. Initials of sampling personnel

C.4. AFTER ACTION REPORT
Upon completion of on-site activities, an after action report (format provided in attachment 12) shall be completed and forwarded along with the soil samples to CEU Providence. Copies of the Site Plan and first page of the Site Safety Plan will be forwarded to the project officer. Ensure locations of all observed but un-recovered batteries are noted.

C.5. RECORD KEEPING

Record keeping serves several important functions including regulatory, operations, environmental and planning. The most important records are the Training records, site plan, the photographs, the chain of custody/sample documentation and the bill of lading/waste manifest. Units are required to scrupulously maintain these records.

D. Site Organization:

D.1 Definitions and Key Personnel: A diagram of the command and control structure for this response is included as attachment 5.

D.1.a Recovery Coordinator: The recovery coordinator (RC) is the designated official responsible for incident/recovery management. The RC for this site is:

Commander First Coast Guard District (oan)
408 Atlantic Ave., Boston, MA 02110
Phone: 617-223-8337

D.1.b The Site Safety and Health Officer (SSHO), often referred to as the Site Safety Officer (SSO), is the single individual responsible for developing and implementing the OSC's Site Specific Safety and Health Plan, in accordance with 29 CFR 1910.120. The SSHO for this incident is:

Commander (mseh)
First Coast Guard District
Boston, MA
Phone (617) 223-8436

D.1.c Site Safety and Health Supervisor(s) (SSHP): A mandatory position under 29 CFR 1910.120. The SSHP, often referred to simply as the Site Safety

Supervisor, is the individual(s) in the field responsible for enforcing the SSHO's site-specific site safety and health plan, coordinating all safety and health concerns for the work site, keeping this plan current and coordination with site safety officers from other organizations. An SSHP must be on-site at all times while the SSHO may be with the OSC or at other locations. In instances where more that one individual is designated to act as SSHP, a single individual must be designated as the lead or senior SSHP.

As this site is not expected to contain any air contaminates over permissible exposure limits and recovery operations should pose minimal splash hazards and personnel safety hazards, SSHPs shall only permit the use of splash gear including tyvek coveralls. If personnel require higher than level D protection, the SSHP shall contact the SSHO and Recovery Project Officer immediately. All SSHPs shall be trained on how to conduct environmental sampling and how to conduct hazard assessment on site.

D.1.d. The designated SSHPs at this site as listed on page 2, is the senior person on-scene, E-6 or above. For the purpose of this recovery, the site supervisor and site safety and health supervisor are the same individuals.

D.1.e. Public Affairs: Provided through the Coast Guards First District Public Affairs office at (617) 223-8515 (Boston) or (212)668-7144 (New York).

D.1.f. Hazardous Waste/State Liaison:

Civil Engineering Unit Providence
300 Metro Center BLVD
Warwick, RI (401) 736-1744

D.1.g. First District ATON Battery Project Officer is assigned to the First District (oan) and is the POC indicated on the accompanying ATON Order.

E. SITE CONTROL

E.1 Anyone entering or departing the work area or any associated control zones shall report to the site supervisor.

E.2 No person is allowed to enter the work area without subscribing to this Site Safety Plan. All persons entering the site shall have proper training as described below. All personnel

entering the site shall be informed of potential hazards and safe work practices prior to entering the site.

E.3 All persons shall observe the buddy system while on site.

E.4 Medical Monitoring:

E.4.a. Based on the hazard evaluation conducted by the SSHP, after consultation with the SSHO, a determination on personal monitoring of people in Level A, B or C will be made. Any evaluation rating higher than a Level D response shall be referred to the ATON Battery Project Officer and SSHO.

E.5 Control zones. No control zones or contamination reduction areas are anticipated at this site. Should control zones be established, all zones should be marked on the site map (Attachment 01).

E.5.a. The HOT ZONE, or EXCLUSION ZONE, is the area where contamination or battery splash hazards are expected.

(1) The site safety and health supervisor shall maintain a hot zone boundary based on the most recent site characterization and monitoring information.

(2) Any needed hot zone is marked at the site as follows:

_____

_____

_____

E.5.b. The WARM ZONE, or CONTAMINATION REDUCTION ZONE, is a transition area between the HOT ZONE and the COLD ZONE. It is the area where a DECONTAMINATION CORRIDOR is established to remove possible contamination from personnel and equipment leaving the HOT ZONE; and it provides a safety buffer for accidents or migration of contaminants.

(1) The site safety and health supervisor shall maintain a warm zone boundary based on the most recent site characterization and monitoring information.

(2) The warm zone is marked at the site as follows:

_____

_____

_____

E.5.c. The COLD ZONE, or SUPPORT ZONE, is an area adjacent to the WARM ZONE that is intended to remain safe and as free of contamination as possible. The cold zone is the outer most area of site control surrounding the HOT ZONE and should be established to provide an adequate margin of safety for the population and workers outside of the cold zone (e.g., residential areas, staging areas, support functions, and other activities outside of the cold zone).

The site safety and health supervisor shall maintain a cold zone boundary based on the most recent site characterization and monitoring information.

E.6. Training.

E.6.a. Barring on site emergencies, the recovery of terrestrial ATON batteries is classified as a post-emergency response operation. General requirements are described in 29 CFR 1910.120(q)(11), which simply refers to the training requirements for GENERAL HAZARDOUS WASTE OPERATIONS (i.e., routine controlled sites) per 29 CFR 1910.120(e). The regulations require initial training, management/supervisory training, and annual refresher training.

E.6.b. In general, all personnel on site shall be adequately trained to perform their assigned tasks safely. The general training level requirement for recovery activities is minimal hazard worker (minimum of 24 hours and one day OJT) except as noted below:

JOB DESCRIPTION:	TRAINING LEVEL:
NON-TRAINED COLD-ZONE OBSERVERS	NONE

For this incident, the proper level of training is met by training provided at USCG RTC ATON schools for battery makeup and proper handling instruction. An additional 8-16 hours training specific to the recovery issues including hazard assessment, materials handling, PPE use/selection and need, and disposal is needed to round out prior training and OJT experience.

E.6.c. Additional guidance on training requirements and qualifications for ATON battery recovery operations should be referred to the Project Officer or the Site Safety and Health Officer.

E.6.d. All personnel entering the site shall be fully informed about applicable hazards and procedures on site. See section M for on-site informational briefings program.

F. HAZARD EVALUATION

F.1. The following potential hazards have been identified for assessment. Each general category has been assigned a probability ranging from low to high.

1)	Chemical hazards	Low.
2)	Noise hazards	Low to Medium.
3)	Pressure (hyperbarism)	Very Low.
4)	Sunburn/sun exposure	Low to High.
5)	Physical hazards	Low to High.
6)	Explosive hazards	Very low.
7)	Thermal hazards	Low.
8)	Motion sickness	Medium.
9)	Oxygen Imbalance	Very Low.
10)	Biological hazards	Low to Medium.
11)	Radiation hazards	Very low.
12)	Heat/cold stress	Medium to high.

F.1.a CHEMICAL HAZARDS: Nine possible chemical hazards have been identified. Each hazard has been assigned a hazard rating based on its projected fate and potential toxicity ranging from low to high. The primary reference source for the following information is the chemical information database TOMES (Micromedex, Inc.). Generic hazardous substance information sheets, MSDS's, and TOMES data sheets are attached as Attachment 6 to this safety plan.

1) Mercury Low.

2)	Potassium Hydroxide	Medium.
3)	Lead Sulfate	Medium.
4)	Sulfuric Acid	Low.
5)	Nickel Hydroxide	Low.
6)	Lead	Medium.
7)	Nickel Cadmium	Low.
8)	Methyl Mercury	Low.
9)	Hydrogen Sulfide	Low.

MERCURY: (Hg; CHRIS Code: MCR; UN 2809, CAS 7439-97-6) is the primary chemical hazard anticipated on scene. Levels of mercury at each site will vary in accordance with several factors including the number and condition of batteries at the site and site topography. The following primary batteries which contained mercury may be potentially recovered during this operation: Edison/NIFE/Saft-NIFE, Saft America, CEGASA/AMCEL, and Union Carbide. According to manufacturer's information the total amount of mercury in the batteries ranges from 0.035 to 0.150 pounds.

GENERAL DESCRIPTION: Mercury is a silvery-white heavy, liquid metal. It is highly mobile and has a tendency to disperse, forming alloys. It is corrosive to most alloys with the exception of iron or steel.

ACUTE TOXICITY TO HUMANS: Mercury is a corrosive chemical and is readily absorbed via the respiratory tract (elemental mercury vapor, mercury compound dusts), intact skin, and gastro-intestinal tract. Occasional incidental swallowing of metallic mercury is generally without harm, as Mercury in its elemental form is usually non-toxic unless a GI fistula or other GI inflammatory disease is present or the mercury is retained for a prolonged period in the GI tract. Mercury vapor will cause severe pulmonary damage if inhaled, as well as central nervous system damage. Soluble salts of Mercury have a violent corrosive effect on skin and mucous membranes. Acute exposures may result in severe nausea, vomiting, abdominal pain, bloody diarrhea, and kidney damage. In severe exposures, death may result within 10 days.

CHRONIC TOXICITY TO HUMANS: Chronic toxicity is likely to follow repeated exposures with

conditions manifesting themselves over long periods of time. Conditions resulting from chronic exposures to mercury have included inflammation of mouth and gums, excessive salivation, loosening of the teeth, kidney damage, muscle tremors, jerky gait, spasms of the extremities, personality changes, depression, irritability and nervousness.

EXPOSURE LIMITS: Occupational exposure limits are based on requirements for elemental Mercury.

ACGIH TLV:	0.05 mg/M3.
ACGIH STEL:	None (Elemental, non-vapor).
OSHA PEL:	None.
OSHA CEILING:	0.1 mg/M3.
NIOSH REL:	0.05 mg/M3.
IDLH:	28 mg/M3.

POTASSIUM HYDROXIDE: Potassium hydroxide (KOH; CHRIS Code: PTH; UN1814; CAS 1310-58-3) is an electrolyte in primary batteries. Since potassium hydroxide is in solution in primary batteries, the presence of this chemical at the site will depend upon the condition and watertight integrity of the batteries.

GENERAL DESCRIPTION: Potassium hydroxide is a white odorless and nonvolatile solid which can be dissolved in water as a colorless solution. In the primary batteries, potassium hydroxide is in solution. In solution, potassium hydroxide is corrosive and may potentially generate explosive hydrogen gas upon contact with aluminum, tin, lead or zinc. Density of this material in solution is 12.8 pounds per gallon.

TOXICITY TO HUMANS: Potassium hydroxide is corrosive to bodily tissues by all routes of exposure. Contact with concentrated solution may result in severe burns of the skin or eyes. Breathing concentrated mists in air from a potassium hydroxide solution may result in irritation of the upper respiratory tract, inflammation of the lungs, and possibly pneumonitis.

EXPOSURE LIMITS: The occupational exposure levels are:

ACGIH TLV:	2.0 mg/M3
ACHIH STEL:	None

LEAD SULFATE: Lead sulfate ($PbSO_4$; CHRIS code: LSF; CAS 7446-14-2) is a constituent of secondary (lead acid) batteries. During the operation of secondary batteries, the lead plates in these batteries react with sulfuric acid to produce lead sulfate as a by-product. Lead sulfate may be present in each secondary battery and may, depending upon the condition and structural integrity of the batteries, be present on the exterior of the batteries.

GENERAL DESCRIPTION: Lead sulfate appears as white crystals in solid form.. It is practically insoluble in water, but is soluble in acid.

HEALTH HAZARDS: Lead sulfate is a corrosive irritant to the skin, eyes, and mucous membranes. It is moderately toxic by ingestion. Ingestion of lead sulfate may result in abdominal pain, diarrhea, constipation, loss of appetite, muscular weakness, headache, blue line on gums, metallic taste, nausea, and vomiting.

EXPOSURE LIMITS: The occupational exposure limits to lead sulfate are:

ACGIH TLV:	0.15 mg/M3
ACGIH STEL:	NONE
OSHA PEL:	0.05 mg/M3
OSHA CEILING:	NONE
NIOSH REL:	0.10 mg/M3.
IDLH:	NONE

SULFURIC ACID: Sulfuric acid (H_2SO_4; CHRIS CODE: SFA; UN1830; CAS 7664-93-9) is a constituent of secondary (lead acid) batteries. The presence and concentration of this material in the secondary batteries will depend upon the condition and the watertight integrity of the batteries.

GENERAL DESCRIPTION: Sulfuric acid is a colorless to dark brown oily liquid that is odorless when cool but may evolve choking vapors when hot. This material is highly corrosive to bodily tissues, many metals and is reactive with a wide variety of chemicals and substances. Concentrated sulfuric acid reacts violently with water.

HEALTH HAZARDS: Contact with sulfuric acid may cause severe burns to the skin or eyes. Inhalation of sulfuric acid mist can cause

severe irritation and inflammation of the upper respiratory tract.

EXPOSURE LIMITS: Exposure limits for sulfuric acid are as follows:

ACGIH TLV:	1 mg/M3
ACGIH STEL:	NONE
OSHA TWA:	1 mg/M3
NIOSH REL:	1 mg/M3
IDLH:	NONE

NICKEL HYDROXIDE: Nickel hydroxide (NiOH2; CAS 12054-48-7) is a constituent of nickel cadmium batteries.

GENERAL DESCRIPTION: Nickel hydroxide in solid form is a light green crystal.

HEALTH HAZARDS: Nickel hydroxide is a confirmed carcinogen.

EXPOSURE LIMITS: Exposure limits for nickel hydroxide are as follows:

ACGIH TLV:	1 mg/M3.
ACGIH STEL:	NONE
OSHA TWA:	1 mg/M3.
NIOSH REL:	1 mg/M3.
IDLH:	NONE

LEAD: Lead (Pb CAS 7439-92-1) is a constituent of secondary (lead acid) batteries. During the operation of secondary batteries, the lead plates in these batteries react with sulfuric acid to produce lead sulfate as a by-product (see earlier description of lead sulfate). Lead will be present in each secondary battery and may, depending upon the condition and structural integrity of the batteries, be present on the exterior of the batteries.

GENERAL DESCRIPTION: Lead is a bluish-gray soft metal.

HEALTH HAZARDS: Lead is a suspected human carcinogen and may be poisonous if ingested. Short-term systemic effects following ingestion include: loss of appetite, anemia, malaise, insomnia, headache, irritability, muscle and joint pains, and tremors. Major organ systems affected are the nervous system, blood system, and kidneys. Chronic or ling-term exposure to lead may result in severe kidney damage.

EXPOSURE LIMITS: Exposure limits for lead are as follows:

ACGIH TLV:	0.15 mg/M3.
ACGIH STEL:	NONE
ACGIH Biological Exposure Indices(BEI):	50 micrograms (lead) per liter in blood; 150 micrograms (lead) per gram creatine in urine
OSHA PEL:	0.05 mg/M3
OSHA CEILING:	NONE
NIOSH REL:	0.10 mg/M3
IDLH:	NONE

CADMIUM: Cadmium (Cd CAS 7440-43-9) is a constituent in batteries which have been used in lighthouses such as: Nickel-Cadmium HED and ED Series, Exide EI and FHGS Series, and GNB Absolyte-II Series. Since these batteries were used at lighthouses, the likelihood of release of these batteries into the aquatic environment around aids to navigation is minimal.

GENERAL DESCRIPTION: Cadmium is a silver-white, malleable metal.

HEALTH HAZARDS: Cadmium is a confirmed human lung carcinogen. Inhalation is the primary route of exposure. Acute exposure to cadmium dust may result in pulmonary irritation. Repeated exposure to lower levels of airborne cadmium may result in chronic poisoning characterized by irreversible lung injury. Short term symptoms of airborne cadmium exposure include anemia, eosinophilies, yellow discoloration of the teeth, and rhinitis.

EXPOSURE LIMITS:

ACGIH TLV:	0.05 mg/M3.
ACGIH Biological Exposure Indices(BEI):	10 micrograms per liter in blood; 10 micrograms (lead) per gram creatine in urine
OSHA PEL:	0.2 mg/M3.(as dust)
OSHA CEILING:	0.6 mg/M3.
NIOSH REL:	0.10 mg/M3.
IDLH:	NONE

METHYL MERCURY: Methyl mercury (CH3Hg; CAS: 22967-92-6) may be present at primary battery

sites. The mercury present in primary batteries may react with the surrounding aquatic environment to produce methyl mercury.

GENERAL DESCRIPTION: Methyl mercury is a colorless liquid.

HEALTH HAZARDS: Methyl mercury is a poison of the central nervous system. Primary routes of exposure are skin absorption, inhalation, and ingestion. Symptoms of poisoning include numbness and tingling of the lips, hands, and feet as well as dizziness, emotional disturbances and jerking movements of the limbs, head or shoulders. There may be a delay in the onset of symptoms (latency period) for a single toxic dose from one to several weeks. Biological half-life for methyl mercury (the time needed to eliminate half of it from the body) is about 70 days. There is a considerable risk of accumulation of mercury to toxic levels. Methyl mercury can cause irritation of the skin, eyes, and mucous membranes.

EXPOSURE LIMITS:

ACGIH TLV:	0.01 mg/M3
OSHA PEL:	NONE
OSHA CEILING:	NONE
IDLH:	NONE

HYDROGEN SULFIDE: Hydrogen sulfide (H_2S_2; UN1053; CAS 7783-06-4) is a by-product of decaying organic material (such as rotting vegetation) that may be naturally occurring at underwater work sites.

GENERAL DESCRIPTION: Hydrogen sulfide is colorless, flammable gas with an offensive odor (i.e., smells like "rotten eggs").

HEALTH HAZARDS: Hydrogen sulfide is an acute poison by inhalation. Low airborne concentrations can cause irritation of the eyes and upper respiratory tract. Acute exposure to higher concentrations may result in coma or chronic pulmonary edema. Hydrogen sulfide is a "chemical asphyxiant" which means that it acts as a poison by paralyzing the respiratory center of the body. It is an insidious poison since a person's sense of smell may become fatigued to the "rotten egg" smell of hydrogen sulfide. The odor and

irritating effects do not offer a dependable warning to workers who may be exposed to gradually increasing amounts and therefore become used to it. Hydrogen sulfide is a dangerous fire hazard when exposed to heat, flame, or oxidizers.

EXPOSURE LIMITS:

ACGIH TLV:	14 mg/M3 (10 PPM)	
ACGIH STEL:	21 mg/M3 (15 PPM)	
OSHA PEL:	14 mg/M3 (10 PPM)	
OSHA CEILING:	21 mg/M3 (15 PPM)	
NIOSH REL:	15 mg/M3 (10 PPM)	Ceiling
IDLH:	300 PPM	

F.1.b. ENVIRONMENTAL MONITORING FOR CHEMICAL HAZARDS: The following monitoring shall be conducted. Monitoring equipment shall be calibrated and maintained in accordance with the manufacturer's instructions (electronic equipment shall be calibrated before each day's use).

pH: Upon initial entry to determine if battery contents spilled and upon discovery of cracked batteries

DELMAR H2S MINI CHECKS:

Continuous during any activity that might release decaying organic material(work in marshes, wet lands, etc.)

G. **GENERAL SAFE WORK PRACTICES.** The following safe work practices shall be adhered to while on site (check those that are appropriate & add any additional).

G.1. **BUDDY SYSTEM.** The buddy system shall be observed inside the Work Area. Personnel must work within sight of their assigned partner at all times. Partners shall be assigned by the site safety supervisor. Personnel shall use whistles to indicate that they need assistance in areas where personnel may be obscured from supervisors (e.g. high grass, boulders, or warehouse areas) as noted on the Project Map.

G.2. FIRES. Each recovery operation shall have at least one fully charged extinguisher appropriate for the hazard anticipated and a way to notify personnel of hazard (car horn):

- Class A fire extinguisher for ordinary fires
- Class B fire extinguisher for liquid fires

The fire extinguisher shall be maintained in a readily accessible location and the location noted on the project map.

G.3. LIGHTING. No work is anticipated before dawn and after dusk. Should work be preformed at night fixed or portable lighting shall be maintained for dark areas or work after sunset to ensure that sufficient illumination is provided. (See TABLE H-120.1 of 29 CFR 1910.120(m) for Minimum Illumination Intensities.)

G.4. WORK NEAR WATER. All personnel working in boats, on docks, or generally within 10 feet of water deeper than 3 feet, shall wear Coast Guard approved Personal Flotation Devices (PFDs) or work vests.

G.5. TRAP HAZARDS. Open, pits, trenches, or similar hazards are noted on the site map. The site safety supervisor shall ensure that these locations are periodically checked during the day.

G.6. BRUSH CLEARING OPERATIONS. Recovery personnel may need to clear brush to obtain access and provide suitable walking surfaces. Clearing activities should be limited in scope. Any clearing tools or equipment used shall be used following manufacture's instructions and using needed safety gear (including hard hats, chaps, ear/face and face protection).

G.7. MOTOR VEHICLES. Drivers shall maintain a safe speed at all times, and shall not be allowed to operate vehicles in a reckless manner. A vehicle safety briefing can be provided as an attachment. Contact the Site Safety & Health Officer or Project manger for details.

G.8. DRUM HANDLING.

a. Drums and containers must be handled in accordance with 29 CFR 1910.120. Containers must be labeled and constructed in accordance with EPA (40 CFR 264-265, and 300), and DOT (49 CFR 171-178) regulations.

b. Temporary holding/staging areas for drums and containers containing waste materials shall be set up to contain spillage, runoff, or accidental releases of materials.

c. Manual lifting and handling of drums and containers shall be kept to a minimum. To the extent possible, mechanical devices, drum slings or other mechanical assisting devices designed for that purpose shall be used.

d. Safe Drum Lifting/Handling Procedures are included in attachment 3.

G.9. POISONOUS\INFECTIOUS INSECTS, BITES, STINGS, PLANTS.

a. BEE STINGS (also hornet or wasp bites)
b. POISONOUS SPIDERS (black widows or brown recluse)
c. TICKS (carriers of rocky mountain spotted fever, and Lymes disease)
d. ANIMAL BITES (infection hazard, and/or rabies from some common sources such as: skunks, prairie dogs, foxes, bats, dogs, cats, raccoons, and cows).
e. POISONOUS PLANTS (poison ivy, oak, or sumac)

GENERAL PREVENTION:

___ During morning safety briefings, provide information on the location of hazards and how to deal with problems.

___ Personnel should be provided with
- ___long sleeved clothing
- ___chemical resistant coveralls (TYVEK or Rain Suits)
- ___insect repellant
- ___Knee waders

___ Personnel should inspect each other for ticks and signs of infected bites during breaks when working in designated areas.

___ Personnel with allergies to bee stings or insect bites may suffer a medical emergency if bitten. Supervisors on site should be prepared to deal with these medical emergencies.

___ Personnel with severe allergies must work in areas away from known/suspected hazards.

___ Personnel with allergies to bee stings or other insect bites should notify their supervisors AND the site safety supervisor when reporting on this site.

Procedures for bites, stings and poisonous plants are included as attachment 12.

H. **PERSONAL PROTECTIVE EQUIPMENT (PPE)**
Only Level D PPE ensembles shall be used while on site. Any sites suspected as needing a higher level of personal protective equipment shall be referred to the ATON Battery Project Officer and the Site Safety and Health Officer

I. **DECONTAMINATION PROCEDURES.** Personnel showing signs of contamination shall be decontaminated in accordance with the instructions of the site safety and health supervisor. For recovery operations and the substances expected to be encountered, a water wash should serve as the primary means of decontamination. Any contaminated clothing shall be properly decontaminated prior to next wear or disposed of. A suggested DECON layout is included as attachment 8.

J. **SANITATION & PERSONAL HYGIENE:** Potable water, non-potable water, toilets and personal hygiene facilities shall be readily available. For further information see attachment 9.

K. EMERGENCY PROCEDURES.

K.1. In all cases when an on-site emergency occurs, personnel shall not reenter the work area or restart work until:

- o the condition resulting in the emergency has been investigated by supervisory personnel, and has been Corrected;
- o hazards have been reassessed; and
- o site personnel have been briefed on any changes in the operation and site safety plan.

K.2. Emergency Medical Procedures:

- o Contact designated hospital/ambulance service (see the posted organization/work plan).
- o Do not attempt to move seriously injured personnel, call for an ambulance to come to the injured person.
- o The closest hospital for regular emergencies is listed on page 2.
- o Contact Agency for Toxic Substances and Disease Registry (ATSDR) (404) 639-0615 (24 hr) for chemical exposure emergencies.

K.3. Emergency Fire Procedures:

- o **DO NOT attempt to fight fires other than small fires. A small fire is generally considered to be a fire in the early stages of development, which can readily be extinguished with personnel and equipment in the immediate area within a few minutes time and with one extinguisher.**
- o **DO NOT take extraordinary measures to fight fires.**
- o **YOU MUST sound the appropriate fire signal if fire can not be put out quickly.**
- o **Alert nearby personnel to call fire department.**
- o Notify supervisor.
- o **When the fire alarm is sounded, personnel shall immediately leave the work area WITH THEIR ASSIGNED BUDDY, to the pre-designated assembly point by the most appropriate evacuation route.**

o The Site Supervisor OR the Fire Department shall ensure that the fire is extinguished and a temporary fire watch has been posted BEFORE restarting work.

K. 4. Evacuation.

FIRE & EVACUATION SIGNAL(S):
MOUTH PIECE WHISTLE, HAND MOTION TO RETURN, BOAT HORN, CAR HORN

EVACUATION ROUTES: A primary and secondary evacuation routes and assembly shall be agreed upon prior to operations beginning and shall be noted on the site plan.

L. COMMUNICATIONS

L.1. Radio communications:
Working freq: 157.15, CH: 23 or 21A (VHF-FM)
Emergency freq: 156.8, CH: 16 (VHF-FM)

L.2. Phone communications:

Recovery Coordinator:

(617)223-8340 (voice)

First District ATON Project Officer:

(617)223-8385 (voice)

Site Safety and Health Officer:

(617) 223-8436 (voice)
1-800-USI-PAGE (PIN: 622-1395) (pager)

Hazardous Waste/State Liaison Issues:

(401)736-1744 (voice)

Agency for Toxic Substance and Disease Registry (ATSDR)
(404)639-0615 (24 hr) (voice)/0655 (fax)
ATSDR can provide emergency medical and toxicological information, assist in determining procedures for potential chemical overexposures, and can provide on scene assistance for certain chemical emergencies.

Police, Fire, and Hospitals are listed on Page 2.

M. SITE SAFETY BRIEFINGS/MEETINGS.

M.1. All personnel, employees, contractors, and subcontractors shall be provided with an initial site

safety briefing to communicate the nature, level and degree of hazards expected on site.

M.2. Personnel will also receive regular briefings before and after each shift, before making a LEVEL A/B hot zone entry, and when significant changes are made in the work procedures or safety plans. These site safety meetings/briefings shall be held by the Site Supervisor. At a minimum these meetings will describe the work to be accomplished, discuss safety procedure changes, and note any items which need to be passed to other crews. General safety training topics should also be covered based on points raised in previous meetings and the site safety plan attachments.

___A briefing log is provided as attachment 11.

N. AUTHORIZATIONS:

SITE SAFETY OFFICER:

_____

DATE: 6 Dec 94

RECOVERY COORDINATOR:

_____

DATE: 94 12 09

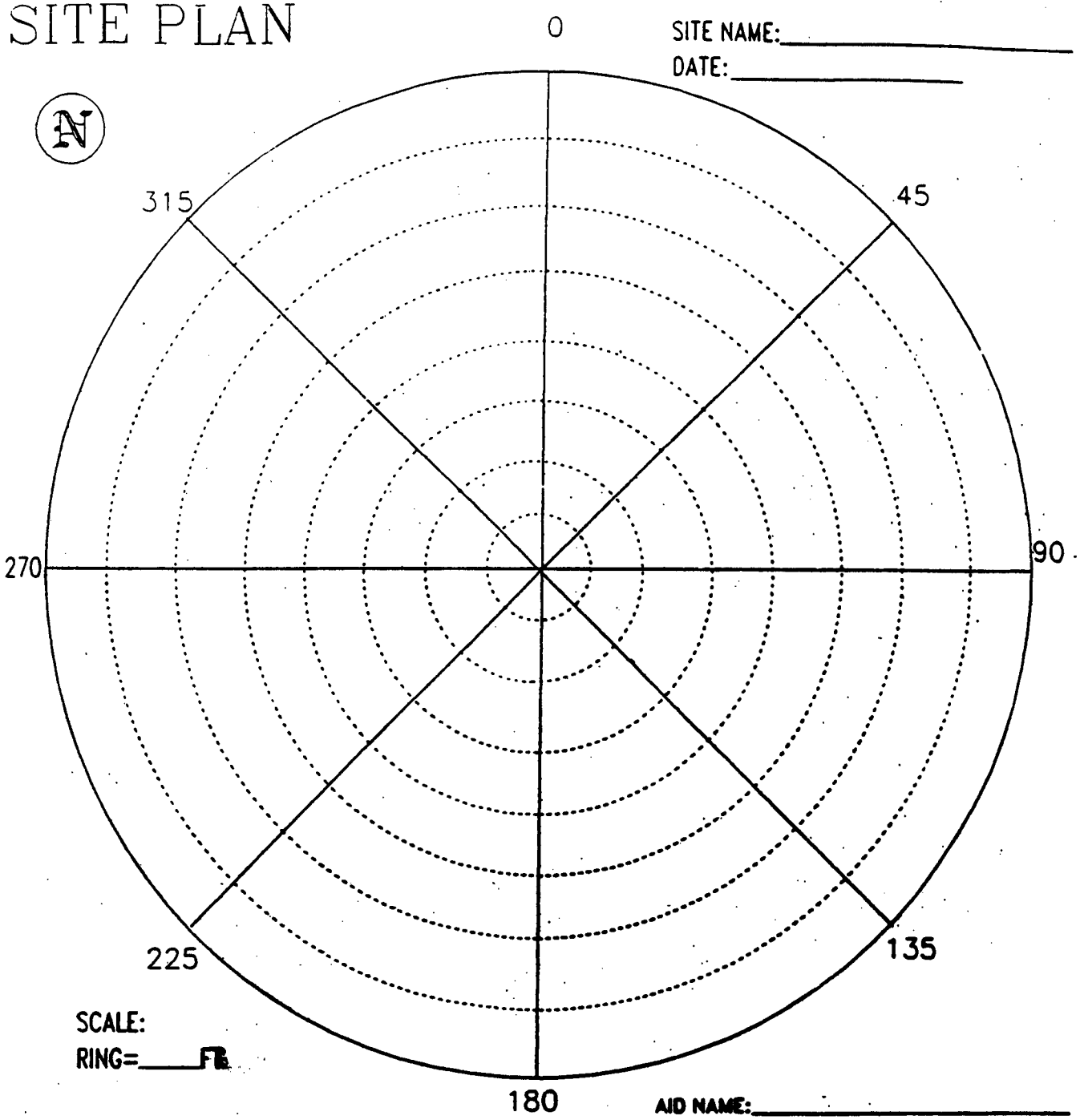
First CG District ATON Battery Recovery Site Safety Plan

ATTACHMENT 1: **SITE PLAN (Radar Plot)**

SITE PLAN

SITE NAME:_____

DATE:_____



SCALE:

RING=_____FT.

AID NAME:_____

LLNR:_____

POSITION: LAT_____

LON_____

SIGNATURE:_____

1. LOCATE EVERY BATTERY ON THE SITE PLAN.
2. THE DATUM IS THE HIGHEST CONCENTRATION OF BATTERIES
3. DENOTE A FIXED REFERENCE OBJECT ON THE SITE PLAN.
4. USE SYMBOLS LISTED ON THE LEGEND.
5. CIRCLE RUPTURED BATTERIES.
6. DRAW A SQUARE AROUND BATTERIES THAT WERE REMOVED.

TABLE

BATTERY TYPE	QTY	CONDITION	
		#INTACT	#RUPTURED
ZINC(MERCURY)			
LEAD ACID			
TOTAL L & Z			

LEGEND
L=LEAD ACID BATTERY
Z=ZINC/MERCURY (PRIMARY)
S1=SAMPLE #1
A=ATON STRUCTURE

First CG District ATON Battery Recovery Site Safety Plan

ATTACHMENT 2: SAFE WORK PRACTICES FOR LIFTING/HANDLING BATTERIES

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Drum and container handling procedures and spill containment plans are provided as attachment 3.

- Use available machinery and lift aiding equipment before lifting heavy loads manually.

- Have someone help you with a heavy load (even a load within personal capacity can cause back injury). Use team work for numerous small loads (e.g., stock piles of trash bags full of oily debris). Do not rush the work.

- Use of Chemical Protective Ensembles will restrict movement and visibility. Use extra care while lifting in these ensembles.

- Position feet properly. Of greatest importance here is to simply maintain balance and avoid twisting motions while lifting. Feet should not be close together. The feet should be close to the load to help keep the body close to the center of gravity. One foot should be positioned in the direction the load will be moved to avoid twisting or turning of the back during the lift. Turn using your feet and not by twisting the back.

- Before and during the lift pull the load close to you to keep the center of gravity over your feet.

- Check your grip and test the weight of the load before lifting.

- The back should be straight when starting the lift and the knees should be doing the bending. This will help to ensure that much of the lifting is done with the legs. To help keep the back straight the chin should be tucked in and head kept up.

- Keep the stomach muscles tight while lifting. Keep your back straight during the lift and avoid twisting motions in particular.

- Move slowly and deliberately.

ATTACHMENT (3): DRUM HANDLING AND STORAGE PROCEDURES .24
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Detailed regulations regarding drum handling and spill containment can be found at 29 CFR 1910.120(j)

I. Handling Drums.

A. Drums shall be inspected and given a unique identification prior to being moved.

B. Movement of drums must be kept to a minimum.

C. To the greatest extent possible, drums shall not be moved by unaided manual methods. Safe manual lifting procedures for batteries are provided as attachment 2.

D. Prior to shipment, each drum must be in good condition (or over-packed) and properly labeled in accordance with 49 CFR requirements.

E. A log shall be maintained to keep track of sampling, re-packing/over-packing, bulking/consolidation, on-site movement, off-site shipment, and any other significant events related to each individual drum.

F. Bulking or product consolidation is allowed only after individual product contents have been characterized.

III. Staging and containment areas.

A. Pathways for hazardous substance dispersion:

__Pathways are depicted on the site safety plan provided as attachment 1.

B. When drums are moved from their original locations to a work area or staging area, a spill containment must be addressed. The containment should be able to contain the maximum loss from any of the containers in the area.

C. Safe access and egress points must be provided to all staging areas. Adequate room and ramps must be provided for equipment used to handle drums.

First CG District ATON Battery Recovery Site Safety Plan

ATTACHMENT 4: WORK PLAN MODIFICATIONS:_____
page___ of___ (site name)

This form should be used to quickly document plans during the initial phases of emergency/post-emergency response operations, or as a means to readily modify general plans provided in the Comprehensive Work Plan.

A. ENTRY OBJECTIVES:

_____

MONITORING REQUIREMENTS:

_____

C. Decon considerations and special procedures:

_____

First CG District ATON Battery Recovery Site Safety Plan

ATTACHMENT 5: COMMAND AND CONTROL DIAGRAM

```
RECOVERY COORDINATOR
                                  ____Site Safety & Health Officer.
First District (oan)             |                                 .
          |                      |____D1 ATON Recovery Proj Mgr    .
          |                      |                                 .
          |---------------------|____CEU Providence                .
          |                          (HAZWASTE/State Issues)       .
          |                                                        .
          |                                                        .
          |                                                        .
          V                                                        .
  Site Supervisor  - - -  Site Safety & Health Supervisor.         .
    Must be Second Class Petty Officer or Above
    Listed on Page 2 of Site Safety Plan
          |
          |
          V
  Recovery Team Members
    Appropriately Trained
    Listed on Page 2 of Site Safety Plan
```

First CG District ATON Battery Recovery Site Safety Plan

ATTACHMENT 6: HAZARDOUS SUBSTANCE INFORMATION SHEETS MSDS/RIDS/CHRIS/CHEMTOX/TOMES/etc.

GNB BATTERY TECHNOLOGIES MATERIAL SAFETY DATA SHEET

I. Product Identification

Chemical/Trade Name (Identity used on label): STOWAWAY /12-5000 Sealed Lead Acid Battery	Chemical Family/Classification: Electric Storage Battery
Company Name GNB Battery Technologies	Address: 829 Parkview Boulevard Lombard, IL 60148-3249
Division or Department Industrial Battery Company - Stationary	
Contact	Telephone Number
Questions concerning MSDS Contact Environmental Assurance Department	Day: 612-681-5000 Richard B. Crowell
Transportation Emergencies: CHEMTREC	24 hours: 800-424-9300

II. Hazardous Ingredients

MATERIAL	% by Weight or Volume	CAS NUMBER	Exposure Limits OSHA	ACGIH
Lead	64-69	7439-92-1	.05 mg/m^3	.15 mg/m^3
Electrolyte: (Sulfuric Acid)	21-23	7664-93-9	1 mg/m^3	1 mg/m^3
Case Material: Polypropylene	6-7	9003-07-0	N/A	N/A
Talc (Non-Asbestos Type)	<1	14807-96-6	2 mg/m^3*	2 mg/m^3*
Separator Material: Glass	2-3	N/A	N/A	N/A
Tin	<1.0	N/A	2 mg/m^3	N/A
Antimony	<0.2	7440-36-0	0.5 mg/m^3	0.5 mg/m^3
Selenium	<0.01	7782-49-2	0.2 mg/m^3	0.2 mg/m^3
			*Respirable Dust	*Respirable Dust

III. Physical Data

Materials (at normal temperatures) Electrolyte	Appearance and Odor Electrolyte is a clear liquid with a sharp, penetrating, pungent odor.
Boiling Point (at 760 MM Hg) 203° F	Melting Point N/A
Specific Gravity (H_2O=1) 1.230-1.350	Vapor Pressure (mm Hg at 20° C) 10
Vapor Density (AIR=1) Greater than 1	Solubility in Water 100%
% Volatiles by Weight N/A	Evaporation Rate (Butyl Acetate=1) Less than 1

IV. Health Hazard Information

ROUTES AND METHODS OF ENTRY

Inhalation: Sulfuric Acid vapors or mist may cause severe respiratory irritation. Lead dust or fumes may cause irritation of upper respiratory tract or lungs.
Skin Contact: Sulfuric Acid may cause severe irritation, burns and ulceration. Lead Compounds are not absorbed through the skin.
Skin Absorption: Sulfuric Acid is not readily absorbed through the skin. Lead Compounds are not absorbed through the skin.
Eye Contact: Sulfuric Acid vapors or mist can cause severe irritation, burns, cornea damage and possible blindness. Lead Compounds may cause eye irritation.
Ingestion: Sulfuric Acid may cause severe irritation of mouth, throat, esophagus and stomach. Lead Compounds may cause abdominal pain, nausea, vomiting, diarrhea and severe cramping. Acute ingestion should be treated by physician.

SIGNS AND SYMPTOMS OF OVEREXPOSURE

Acute Effects: Sulfuric Acid may cause severe skin irritation, burns, damage to cornea and possible blindness and upper respiratory irritation. Lead Compounds may cause abdominal pain, nausea, headaches, vomiting, diarrhea, severe cramping and difficulty in sleeping.
Chronic Effects: Sulfuric Acid may lead to scarring of the cornea, inflammation of the nose, throat and bronchial tubes and possible erosion of tooth enamel. Lead Compounds may cause anemia, damage to the kidneys and nervous system. May cause reproductive changes in both males and females.

POTENTIAL TO CAUSE CANCER

Lead has been tested for ability to cause cancer. The results showed that there is insufficient evidence to show that lead can or cannot cause cancer.

EMERGENCY AND FIRST AID PROCEDURES

Inhalation: Sulfuric Acid - Remove to fresh air immediately. If breathing is difficult, give oxygen. Lead Compounds - Remove from exposure; gargle, wash nose and eyes and consult physician.
Skin: Sulfuric Acid - flush with large amounts of water for at least 15 minutes, remove any contaminated clothing and do not wear again until cleaned. If acid is splashed on shoes, remove and discard if they contain leather. Lead Compounds are not absorbed through the skin.
Eyes: Sulfuric Acid - flush immediately with cool water for at least 15 minutes, then consult physician. Lead Compounds - flush immediately with cool water for at least 15 minutes, then consult physician.
Ingestion: Sulfuric Acid - give large quantities of water; DO NOT induce vomiting, then consult physician. Lead Compounds - consult a physician.

V. Fire and Explosion Data

Flash Point: Not applicable.	Flammable Limits: Lower 4.1% (Hydrogen gas) Upper 74.1%
Extinguishing Media: CO_2; foam; dry chemical.	
Special Fire Fighting Procedures: If batteries on charge, turn off power. Use positive pressure, self-contained breathing apparatus. Water applied to electrolyte generates heat and causes it to splatter. Wear acid resistant clothing.	
Unusual Fire and Explosion Hazard: Hydrogen and Oxygen gases are produced in the cells during normal battery operation or when on charge (Hydrogen is highly flammable and Oxygen supports combustion). These gases enter the air through the vent caps. To avoid risk of fire or explosion, keep sparks and other sources of ignition away from the battery. Do not allow metallic material to simultaneously contact both the positive and negative terminal of batteries. Follow manufacturers' instructions for installation.	

VI. Reactivity Data

Stability: ☐ = Unstable ■ = Stable	Conditions to Avoid: Sparks and other sources of ignition. Prolonged over charge.
Incompatibility (Material to Avoid): Combination of sulfuric Acid with combustibles, and organic materials may cause fire and explosion. Also avoid strong reducing agents, most metals, carbides, chlorates, nitrates, picrate. Lead Compound: Potassium, carbides, sulfides, peroxides, phosphorus and sulfur.	
Hazardous Decomposition Products: Sulfuric Acid: Hydrogen sulfur dioxide, sulfur trioxide and sulfuric acid mist.	Hazardous Polymerization: ☐ = May Occur ■ = Will Not Occur

VII: Control Measures

Engineering Controls: Store and handle lead acid batteries in well ventilated areas.
Work Practices: Make certain vent caps are on tightly. Place a minimum of two layers of cardboard between layers of batteries. Do not stack more than three layers high. Do not allow metallic materials to simultaneously contact both the positive and negative terminals of the batteries. Use a battery carrier to lift a battery or place hands at opposite corners to avoid spilling acid through the vents. Avoid contact with internal components of the batteries.

PERSONAL PROTECTIVE EQUIPMENT

Respiratory Protection: None are required under normal conditions. If concentrations of sulfuric acid mist are known to exceed PEL, use NIOSH or MSHA approved respiratory protection.
Eyes and Face: Chemical splash goggles or face shield.
Hands, Arm, Body: Rubber or plastic acid resistant gloves with elbow length gauntlet.
Other Special Clothing and Equipment: Acid resistant apron. Under severe exposure or emergency conditions, wear acid resistant clothing and boots.

VIII. Safe Handling Precautions

Hygiene Practices: Wash hands thoroughly before eating, drinking or smoking after handling batteries.
Protective Measures to be taken during non-routine tasks including equipment maintenance: Not applicable.

SPILL OR LEAK PROCEDURES

Protective measures to be taken if material is released or spilled. Remove combustible materials and all sources of ignition. Stop flow of material and contain spill by diking with soda ash (sodium carbonate) or quick lime (calcium oxide). Carefully neutralize spill with soda ash, etc. Make certain mixture is neutral then collect residue and place in a drum or other suitable container with a label specifying "contains hazardous waste" or (if uncertain call distributor regarding proper labeling procedures). Dispose of as hazardous waste. If battery is leaking, place battery in a heavy duty plastic bag. Wear acid resistant boots, faceshield, chemical splash goggles and acid resistant gloves. DO NOT RELEASE UNNEUTRALIZED ACID.
Waste Disposal Methods: Sulfuric Acid: Neutralize as described above for a spill, collect residue and place in a container labeled as containing hazardous waste. Dispose of as a hazardous waste. If uncertain about labeling procedures, call your local battery distributor or contact listed at beginning.
DO NOT FLUSH LEAD CONTAMINATED ACID TO SEWER.
Batteries: Send to lead smelter following applicable federal, state and local regulations.

IX. Other

REGULATORY INFORMATION: NFPA Hazard rating for Sulfuric Acid: Flammability (Red) = 0 Health (Blue) = 3 Reactivity (Yellow) = 2
US DOT identification and description for batteries and acid is as follows: Batteries, wet, non-spillable, Electric Storage 8, UN 2800, PG III, Label: Corrosive (Exceptions 173.159, paragraph (d), C.F.R. 49) For air shipments, reference International Air Transportation Association (IATA), refer to special provisions A48 and A67.
Sulfuric Acid is water reactive if concentrated. Batteries are regulated under applicable US DOT, RCRA, CERCLA and EPCRA. If you have any questions, please contact the Environmental Assurance Department of GNB Battery Technologies at 612/681-5000 or Richard B. Crowell at 612/681-5281.
The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mist containing sulfuric acid" as a Category 1 carcinogen, a substance that is carcinogenic to humans. This classification does not apply to liquid forms of sulfuric acid or sulfuric acid solutions contained within a battery. Inorganic acid mist (sulfuric acid mist) is not generated under normal use of this product. Misuse of the product, such as overcharging, may however result in the generation of sulfuric acid mist.
A battery is manufactured using lead, CAS No. 7439-92-1 and sulfuric acid, CAS No. 7664-93-9 which are subject to the reporting requirements of EPCRA Section 313 (40 CFR 372).

GNB BATTERY TECHNOLOGIES MATERIAL SAFETY DATA SHEET

I. Product Identification

Chemical/Trade Name (Identity used on label): EVB/CHAMPION LD/ 12-5000 Sealed Lead Acid Battery	Chemical Family/Classification: Electric Storage Battery
Company Name GNB Battery Technologies	Address: 829 Parkview Boulevard Lombard, IL 60148-3249
Division or Department Industrial Battery Company - Stationary Dept.	
Contact	Telephone Number
Questions concerning MSDS Contact Environmental Assurance Department	Day: 612-681-5000 Richard B. Crowell
Transportation Emergencies: CHEMTREC	24 hours: 800-424-9300

II. Hazardous Ingredients

MATERIAL	% by Weight or Volume	CAS NUMBER	Exposure Limits OSHA	Exposure Limits ACGIH
Lead	63-68	7439-92-1	.05 mg/m^3	.15 mg/m^3
Electrolyte: (Sulfuric Acid)	22-23	7664-93-9	1 mg/m^3	1 mg/m^3
Case Material: Polypropylene	6-7	9003-07-0	N/A	N/A
Talc (Non-Asbestos Type)	<1	14807-96-6	2 mg/m^3*	2 mg/m^3*
Separator Material: Glass	2-3	N/A	N/A	N/A
Copper	<1.0	7440-50-8	1 mg/m^3	N/A
Tin	<1.0	N/A	2 mg/m^3	N/A
Antimony	<0.2	7440-36-0	0.05 mg/m^3	0.05 mg/m^3
Cadmium	0.2-0.3	7440-93-9	0.05 mg/m^3	0.05 mg/m^3
			*Respirable Dust	*Respirable Dust

III. Physical Data

Materials (at normal temperatures) Electrolyte	Appearance and Odor Electrolyte is a clear liquid with a sharp, penetrating, pungent odor.
Boiling Point (at 760 MM Hg) 203° F	Melting Point N/A
Specific Gravity (H_2O=1) 1.230-1.350	Vapor Pressure (mm Hg at 20° C) 10
Vapor Density (AIR=1) Greater than 1	Solubility in Water 100%
% Volatiles by Weight N/A	Evaporation Rate (Butyl Acetate=1) Less than 1

IV. Health Hazard Information

ROUTES AND METHODS OF ENTRY

Inhalation: Sulfuric Acid vapors or mist may cause severe respiratory irritation. Lead dust or fumes may cause irritation of upper respiratory tract or lungs.
Skin Contact: Sulfuric Acid may cause severe irritation, burns and ulceration. Lead Compounds are not absorbed through the skin.
Skin Absorption: Sulfuric Acid is not readily absorbed through the skin. Lead Compounds are not absorbed through the skin.
Eye Contact: Sulfuric Acid vapors or mist can cause severe irritation, burns, cornea damage and possible blindness. Lead Compounds may cause eye irritation.
Ingestion: Sulfuric Acid may cause severe irritation of mouth, throat, esophagus and stomach. Lead Compounds may cause abdominal pain, nausea, vomiting, diarrhea and severe cramping. Acute ingestion should be treated by physician.

SIGNS AND SYMPTOMS OF OVEREXPOSURE

Acute Effects: Sulfuric Acid may cause severe skin irritation, burns, damage to cornea and possible blindness and upper respiratory irritation. Lead Compounds may cause abdominal pain, nausea, headaches, vomiting, diarrhea, severe cramping and difficulty in sleeping.
Chronic Effects: Sulfuric Acid may lead to scarring of the cornea, inflammation of the nose, throat and bronchial tubes and possible erosion of tooth enamel. Lead Compounds may cause anemia, damage to the kidneys and nervous system. May cause reproductive changes in both males and females.

POTENTIAL TO CAUSE CANCER

Lead has been tested for ability to cause cancer. The results showed that there is insufficient evidence to show that lead can or cannot cause cancer.

EMERGENCY AND FIRST AID PROCEDURES

Inhalation: Sulfuric Acid - Remove to fresh air immediately. If breathing is difficult, give oxygen. Lead Compounds - Remove from exposure; gargle, wash nose and eyes and consult physician.
Skin: Sulfuric Acid - flush with large amounts of water for at least 15 minutes, remove any contaminated clothing and do not wear again until cleaned. If acid is splashed on shoes, remove and discard if they contain leather. Lead Compounds are not absorbed through the skin.
Eyes: Sulfuric Acid - flush immediately with cool water for at least 15 minutes, then consult physician. Lead Compounds - flush immediately with cool water for at least 15 minutes, then consult physician.
Ingestion: Sulfuric Acid - give large quantities of water; **DO NOT** induce vomiting, then consult physician. Lead Compounds - consult a physician.

V. Fire and Explosion Data

Flash Point: Not applicable.	Flammable Limits: Lower 4.1% (Hydrogen gas) Upper 74.1%
Extinguishing Media: CO_2; foam; dry chemical.	
Special Fire Fighting Procedures: If batteries on charge, turn off power. Use positive pressure, self-contained breathing apparatus. Water applied to electrolyte generates heat and causes it to splatter. Wear acid resistant clothing.	
Unusual Fire and Explosion Hazard: Hydrogen and Oxygen gases are produced in the cells during normal battery operation or when on charge (Hydrogen is highly flammable and Oxygen supports combustion). These gases enter the air through the vent caps. To avoid risk of fire or explosion, keep sparks and other sources of ignition away from the battery. Do not allow metallic material to simultaneously contact both the positive and negative terminal of batteries. Follow manufacturers' instructions for installation.	

VI. Reactivity Data

Stability: ☐ = Unstable ■ = Stable	Conditions to Avoid: Sparks and other sources of ignition. Prolonged over charge.
Incompatibility (Material to Avoid): Combination of sulfuric Acid with combustibles, and organic materials may cause fire and explosion. Also avoid strong reducing agents, most metals, carbides, chlorates, nitrates, picrate. Lead Compound: Potassium, carbides, sulfides, peroxides, phosphorus and sulfur.	
Hazardous Decomposition Products: Sulfuric Acid: Hydrogen sulfur dioxide, sulfur trioxide and sulfuric acid mist.	Hazardous Polymerization: ☐ = May Occur ■ = Will Not Occur

VII: Control Measures

Engineering Controls: Store and handle lead acid batteries in well ventilated areas.
Work Practices: Make certain vent caps are on tightly. Place a minimum of two layers of cardboard between layers of batteries. Do not stack more than three layers high. Do not allow metallic materials to simultaneously contact both the positive and negative terminals of the batteries. Use a battery carrier to lift a battery or place hands at opposite corners to avoid spilling acid through the vents. Avoid contact with internal components of the batteries.

PERSONAL PROTECTIVE EQUIPMENT

Respiratory Protection: None are required under normal conditions. If concentrations of sulfuric acid mist are known to exceed PEL, use NIOSH or MSHA approved respiratory protection.
Eyes and Face: Chemical splash goggles or face shield.
Hands, Arm, Body: Rubber or plastic acid resistant gloves with elbow length gauntlet.
Other Special Clothing and Equipment: Acid resistant apron. Under severe exposure or emergency conditions, wear acid resistant clothing and boots.

VIII. Safe Handling Precautions

Hygiene Practices: Wash hands thoroughly before eating, drinking or smoking after handling batteries.
Protective Measures to be taken during non-routine tasks including equipment maintenance: Not applicable.

SPILL OR LEAK PROCEDURES

Protective measures to be taken if material is released or spilled: Remove combustible materials and all sources of ignition. Stop flow of material and contain spill by diking with soda ash (sodium carbonate) or quick lime (calcium oxide). Carefully neutralize spill with soda ash, etc. Make certain mixture is neutral then collect residue and place in a drum or other suitable container with a label specifying "contains hazardous waste" or (if uncertain call distributor regarding proper labeling procedures). Dispose of as hazardous waste. If battery is leaking, place battery in a heavy duty plastic bag. Wear acid resistant boots, faceshield, chemical splash goggles and acid resistant gloves. DO NOT RELEASE UNNEUTRALIZED ACID.
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A battery is manufactured using lead, CAS No. 7439-92-1 and sulfuric acid, CAS No. 7664-93-9 which are subject to the reporting requirements of EPCRA Section 313 (40 CFR 372).

MATERIAL SAFETY DATA SHEET
EDISON ST-NT PRIMARY BATTERY SERIES

SAB NIFE INC. P.O. Box 5026 Greenville, N.C. 27834 Information Phone # 919-752-8126	For Chemical Emergency Spill, Leak, Fire, Exposure or Accident CALL CHEMTREC - Day or Night 800-424-9300

ST-NT TYPE EP NON-TOXIC BATTERIES PER FEDERAL STANDARD 40 CFR 261.24

HMIS Ratings: 3 Health 1 Flammability 1 Reactivity

1. HEALTH HAZARD INFORMATION

Effects of Overexposure

Eye Effects: Contact with electrolyte solution inside battery causes very rapid, severe damage. Extremely corrosive to eye tissues. May result in permanent blindness.

Skin Effects: Contact with electroylte solution inside battery may cause serious burns to skin tissues.

Ingestion: Ingestion of electrolyte solution causes tissue damage to throat area and gastro/respiratory tract.

Inhalation: During activiation procedures mist generateo may cause varying degrees of irritation of the nasal mucous membranes and respiratory tract tissues. May vary from mild irritation of nasal mucuous membranes to damage of lung tissues proper. (Not applicable to Preactivated Batteries.)

Carcinogenicity: No components of battery have been found to have carcinogenic effects by the NTP, IARC or OSHA.

2. EMERGENCY FIRST AID

Eye Contact: Flush with plenty of water for at least 15 minutes. Get immediate medical attention.

Skin Contact: Remove contaminated clothing and flush affected areas with plenty of water for at least 15 minutes.

Ingestion: Drink large quantities of milk followed by fruit juices or diluted vinegar. Get imediate medical attention. Do not give anything by mouth to an unconscious person.

Inhalation: Remove to fresh air. Give oxygen or artificial respiration if needed. Get immediate medical attention.

3. SPECIAL PROTECTION INFORMATION

Perform activation procedures in a well ventilated area.

Respirator Protection: Use NIOSH approved mist respirator if necessary during activation. None is needed during normal usage.

Eye Protection: Use splash goggles or face shield whenever handling a battery.

Hand Protection: Normally none required. If exposed to electrolyte solution, or dried salts, use any water-insoluble non-permeable glove, i.e., synthethic rubber. Do NOT use leather or wool.

Other Protective Equipment: Rubber boots, rubber apron or rainwear and hard hat if exposed to electrolyte solution.

4. FIRE AND EXPLOSION HAZARDS

Flash Point

Not determined for battery. Lid melts at 210° F. Case decomposes non-violently above 550° F, auto ignition temperature 850° F.

Special Fire Fighting Procedures

Wear protective clothing and equipment to prevent potential body contact with electrolyte solution or mixture of water and solution.

Unusual Fire and Explosion Hazards

Electrolyte solution is corrosive to all human tissues. It will react violently with many organic chemicals, especially nitrocarbons and chlorocarbons. Electrolyte solution reacts with zinc, aluminum, tin and other active materials releasing flamable hydrogen gas.

5. REACTIVITY DATA

Stable under normal conditions.

CAUTION: NEVER ACTIVATE OR TOP OFF WITH ACID.

Incompatabilities: Acids, chlorindated and aromatic hydrocarbons, nitrocarbons, halocarbons or metals mentioned above. Trichlorethylene will react with electrolyte solution to form dichloractylene which is spontaneously combustible.

Note that normal reactions inside batteries utilize oxygen in atmosphere and liberate a small quantity of flamable hydrogen gas. Do not seal battery from atmosphere.

6. HAZARDOUS INGREDIENTS / EXPOSURE LIMITS

Acrylic Polymer Case	None Established - OSHA
Polystryene Lid	None Established - OHSA
Electrolyte Solution	
Potassium Hydroxide Solution	2 mg/m3 ACGIH Ceiling - Air
	None Established - OSHA
Zinc Oxide	10 mg/m3 ACGIH - Nuisance Dust

7. PHYSICAL PROPERTIES

Boiling Point —	Not Applicable	Melting Point —	Not Applicable
Vapor Pressure —	2 mm Hg at 68F	Vapor Density —	Not Applicable
Specific Gravity —	1.29	pH —	14 + (electrolyte solution)
Evaporation Rate —	Not Determined		

Solubility in Water — Completely soluble - electrolyte solution insoluble - remainder

For optimum battery performance do not store above 100° F.

8. SPILL MANAGEMENT PROCEDURES

Electrolyte Solution Spills

Small (up to 5 gallons): Flush with water and neutralize with dilute acid.

Large: Contain material in suitable containers or holding area. Do not allow material to enter sewers, streams or storm conduits. Recover material with vacuum truck and dispose of properly.

Reportable Quantity: 1000 pounds. 40 CFR 117.13.

9. DISPOSABLE INFORMATION

Discharged battery is a hazardous waste under RCRA.

Battery is not EP Toxic. Discharged battery and electrolyte solution are corrosive. Dispose of in accordance with all federal, state and local regulations.

10. PRECAUTIONS AND COMMENTS

For optimum battery performance activate battery as close to installation as possible. If activated battery must be transported long distances utilize Edison preactivated type batteries.

Do not store or utilize battery for prolonged periods tilted more than 30 degrees from vertical, as leakage may result.

Do not transport activated batteries without vent cap in place.

When removing battery from service visually inspect for leakage prior to handling. If leakage has occured follow Spill Management Procedures. For buoy packs, exercise caution as electrolyte may weaken wooden frame and/or nylon rope.

For optimum battery performance do not activate battery with water containing large amounts of iron or copper. Tap water is normally acceptable.

Date Issued: 11-10-86 Last Date Revised 10-01-87

Disclaimer: This information has been compiled from sources considered to be dependable and is, to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty (either express or implied) or guarantee is made to the accuracy, reliability or completeness of the information contained herein. This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. It is the user's responsibility to satisfy himself as to the suitability and completeness of this information for his own particular use. We do not accept liability for any loss or damage that may occur, whether direct, indirect, incidental or consequential, from the use of this information nor do we offer warranty against patent infringement. Additional information is available by calling the telephone number above designated for this purpose.

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: McGraw-Edison Co., Power Systems Group	EMERGENCY TELEPHONE NO.: (201) 751-3700
ADDRESS (Number, Street, City, State, and ZIP Code): P. O. Box 28, Bloomfield, N. J. 07003	
CHEMICAL NAME AND SYNONYMS: "Carbonaire Battery - ST"	TRADE NAME AND SYNONYMS: "Edison" "Carbonaire"
CHEMICAL FAMILY: Alkali/Metallic/Carbon	FORMULA: $KOH+Zn+C+H_2O$

SECTION II - HAZARDOUS INGREDIENTS (Per Cell Basis)

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE N/A			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS Mercury (metallic) in cast	0.3	
OTHERS			Bichloride Mercury (surface)	0.25	

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Potassium Hydroxide Solution	11.7	
(24% Strength, ph14)		

SECTION III - PHYSICAL DATA

24% KOH Solution= 228°

BOILING POINT (°F.) Anhydrous KOH = (as mfg'd)	2420°	SPECIFIC GRAVITY (H_2O=1)	1.325
VAPOR PRESSURE (mm Hg.) KOH 1.26 x	10^{-17}	PERCENT, VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1) of H_2	0.0899	EVAPORATION RATE (Butyl Acetate=1)	
SOLUBILITY IN WATER @20°C. KOH	H20 112g/100g		
APPEARANCE AND ODOR Slightly opaque liquid. Odor negligible.			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	LEL	UEL
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES No fire expected.			
UNUSUAL FIRE AND EXPLOSION HAZARDS None			

(Continued on reverse side)

SECTION V · HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

EFFECTS OF OVEREXPOSURE

Strong alkali (KOH) may cause first degree burns of skin areas if not washed off with water or neutralized with viengar.

EMERGENCY AND FIRST AID PROCEDURES

See above.

SECTION VI · REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE		N/A

INCOMPATABILITY (Materials to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR		

SECTION VII · SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Flush with large quantities of water, or neutralize with acetic acid or vinegar.

WASTE DISPOSAL METHOD

Sanitary land fill

SECTION VIII · SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) N/A

VENTILATION				
	LOCAL EXHAUST	N/A	SPECIAL	N/A
	MECHANICAL (General)	N/A	OTHER	N/A

PROTECTIVE GLOVES	when disposing	EYE PROTECTION	when disposing

OTHER PROTECTIVE EQUIPMENT None

SECTION IX · SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Mark and label "Corrosive Liquid". Use protective equipment when handling.

OTHER PRECAUTIONS None.

GENERAL MOTORS CORPORATION
MATERIAL SAFETY DATA SHEET

SECTION I

PRODUCT NAME OR NUMBER (as it appears on label) All models of Delco batteries	GM COMMON CODE
MANUFACTURER'S NAME Delco Remy Division, GMC - Anderson Operations	EMERGENCY TELEPHONE NO. (313)556-1597 or 6200
ADDRESS (Number, Street, City, State and Zip Code) 2401 Columbus Avenue, Anderson, IN 46018	MANUFACTURER'S D-U-N-S NO. 00-003-5001
HAZARDOUS MATERIAL DESCRIPTION, PROPER SHIPPING NAME, HAZARD CLASS, HAZARD ID NO. (49 CFR 172.101) Battery, Electric Storage, Wet, Filled with Acid - Corrosive, Class 8 - UN2794	
ADDITIONAL HAZARD CLASSES (as applicable)	
CHEMICAL FAMILY Liquid content - Sulfuric acid	FORMULA Liquid content - H_2SO_4

SECTION II — INGREDIENTS
(list all ingredients)

CAS REGISTRY NO.	%W	%V	CHEMICAL NAME(S)	Listed as a Carcinogen in NTP, IARC or OSHA 1910(z) (specify)
7664939		37	Sulfuric acid	IARC
7732185		Bal	Water	N/A
7439921		>90	Lead	N/A
			Separator: Polyethylene	
			Case and Cover: Polypropylene (Plastic)	

SECTION III — PHYSICAL DATA

BOILING POINT 233 °F ___ °C		SPECIFIC GRAVITY (H_2O = 1) Varies with battery size		Average 1.280 +/- .01	
VAPOR PRESSURE @ 77 °F 25 °C 2.730 ☐ mm Hg ☐ psi		PERCENT VOLATILE BY VOLUME (%)	N/A	PERCENT SOLID BY WEIGHT (%)	N/A
VAPOR DENSITY (AIR = 1)	N/A	EVAPORATION RATE (= 1)	N/A		
SOLUBILITY IN WATER Miscible		pH =	<1.0		
APPEARANCE AND ODOR				IS MATERIAL: (LIQUID) (SOLID) GAS PASTE POWDER	

SECTION IV — FIRE AND EXPLOSION HAZARD DATA

FLASH POINT N/A ___ °F ___ °C method used	FLAMMABLE LIMITS	LEL N/A	UEL N/A

EXTINGUISHING MEDIA

SPECIAL FIRE FIGHTING PROCEDURES
Recommended self-contained breathing apparatus if batteries are involved in fire. Toxic fumes from burning plastic, acid fumes and vapors can occur.

UNUSUAL FIRE AND EXPLOSION HAZARDS
While batteries are being charged, hydrogen gas is generated. Avoid open flame, sparks or

SECTION V-HEALTH HAZARD DATA

Sulfuric acid

EFFECTS OF OVEREXPOSURE — Conditi to Avoid Contact with sulfuric acid results in rapid destruction of body tissue (burns). According to the International Agency for Research on Cancer (IARC), occupational exposure to strong inorganic acid mists containing sulfuric acid is carcinogenic to humans.	THRESHOLD LIMIT VALUE [X] 1mg/m3 PERMISSIBLE EXPOSURE LIMIT [X] 1mg/m3 OTHER LIMIT [ ]
PRIMARY ROUTES OF ENTRY Inhalation [X] Skin Contact [X] Other (specify) Ingestion	
EMERGENCY AND FIRST AID PROCEDURES INHALATION: Do not exceed 1 mg/m3 TWA. Remove to fresh air. Get medical attention. INGESTION: Do not induce vomiting. Give milk mixed with egg whites, if conscious. Get medical attention. EYE OR SKIN CONTACT: Flush with large volumes of water. Get medical attention.	

SECTION VI-REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	x	
INCOMPATIBILITY (materials to avoid) Oxidizing or reducing materials			
HAZARDOUS DECOMPOSITION PRODUCTS: When heated, can emit highly toxic fumes.			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	x	

SECTION VII-SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Lime or soda-type compounds may be used to neutralize and/or flush with large volumes of water. Contain spill.	
WASTE DISPOSAL METHOD According to local, state and federal regulations for lead scrap or acid	
CERCLA (Superfund) REPORTABLE QUANTITY (in lbs) 1000 lbs.	
RCRA HAZARDOUS WASTE NO. (40 CFR 261.33) D002	
VOLATILE ORGANIC COMPOUND (VOC) (as packaged, minus water) N/A	
[X] Theoretical 4 lb/gal	[ ] Analytical N/A lb/gal

SECTION VIII-SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type) Use NIOSH approved respiratory protection if 1 mg/m3 TWA is exceeded (acid)			
VENTILATION	LOCAL EXHAUST (Specify Rate) Yes, at charging stations	SPECIAL N/A	
	MECHANICAL (General) (Specify Rate) N/A	OTHER N/A	
PROTECTIVE GLOVES (specify type) Rubber		EYE PROTECTION (specify type) Splash-proof safety goggles	
OTHER PROTECTIVE EQUIPMENT Use rubber boots and acid-proof clothing for major spills.			

SECTION IX-SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Avoid skin contact when charging batteries. Avoid placing in areas where hydrogen gas can build up. Do not place near open flames, sparks or lighted matches.
OTHER PRECAUTIONS Pay attention to labels on battery and cartons containing batteries. Listed as a carcinogen : NTP, IARC or OSHA: Sulfuric acid = IARC

Seller agrees not to assert any claim (other than a claim for a patent infringement) against General Motors Corporation for any use or disclosure of any technical data or information disclosed in connection with this questionnaire.

PLEASE COMPLETE QUESTIONNAIRE AND RETURN TO:	Name (print) Richard Gallagher
	Signature Richard Gallagher
	Title Battery MSDS Administrator

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: SAFT	EMERGENCY TELEPHONE NO.
ADDRESS (Number, Street, City, State, and ZIP Code)	
CHEMICAL NAME AND SYNONYMS: Primary Battery, Gelled Electrolyte	TRADE NAME AND SYNONYMS: Solid Power; SP-1200
CHEMICAL FAMILY: Air Depolarized Zinc Cell	FORMULA: N/A

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS		%	TLV (Units)	ALLOYS AND METALLIC COATINGS		%	TLV (Units)
PIGMENTS	NA			BASE METAL	NA		
CATALYST	NA			ALLOYS	NA		
VEHICLE	NA			METALLIC COATINGS	NA		
SOLVENTS	NA			FILLER METAL PLUS COATING OR CORE FLUX	NA		
ADDITIVES	NA			OTHERS	NA		
OTHERS	NA						

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Gelled Potassium Hydroxide Electrolyte		*
Mercury/Zinc Amalgam/Gelled Electrolyte		*

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	NA		SPECIFIC GRAVITY (H_2O=1)	NA	
VAPOR PRESSURE (mm Hg.)	NA		PERCENT, VOLATILE BY VOLUME (%)	NA	
VAPOR DENSITY (AIR=1)	NA		EVAPORATION RATE (_____ =1)	NA	
SOLUBILITY IN WATER	NA			NA	
APPEARANCE AND ODOR					

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	NA	FLAMMABLE LIMITS	NA	Lel / Uel
EXTINGUISHING MEDIA	NA			
SPECIAL FIRE FIGHTING PROCEDURES	NA			
UNUSUAL FIRE AND EXPLOSION HAZARDS	NA			

(Continued on reverse side)

(*) SEE PAGE 3

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
(1)Mercury in Air: 0.05 mg/m^3 (2) Caustic Material

EFFECTS OF OVEREXPOSURE
(1) Minor; limited EXPOSURE possible only if battery broken open

EMERGENCY AND FIRST AID PROCEDURES
(1) Provide good ventilation during clean up.
(2) Wash thoroughly with water

SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE		

INCOMPATABILITY *(Materials to avoid)*

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR		

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
If Battery Case Broken Open: (a) Provide good ventilation. (b) Wear eye protection & rubber gloves. Avoid skin contact. (c) Seal materials in plastic bag.

WASTE DISPOSAL METHOD
Meets EPA Requirements 40CFR Parts 261.22; 261.23 & 261.24 for Non Hazardous Material. Landfill Disposal IN ACCORDANCE WITH USER AGENCY OR COMPANY STANDARD PRACTICE.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*

VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL *(General)*	OTHER

PROTECTIVE GLOVES | EYE PROTECTION

OTHER PROTECTIVE EQUIPMENT

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Avoid Breakage of Battery Case. In case of breakage see above.

OTHER PRECAUTIONS
Do Not Incinerate.

(*)

	NEW BATTERY	EXHAUSTED BATTERY
GELLED - KOH Electrolyte	≈ 40.7%	≈ 37.4%
KOH (as 100%)	≈ 10.2%	≈ 9.5%
Total Mercury	≈ 0.29%**	≈ 0.26%
Elemental Mercury	l.t. 0.003%	≈ 0.24%

(**) Mostly as Zinc Amalgam

ATTACHMENT 7: PPE ENSEMBLE DESCRIPTIONS .13
PAGE 1 LEVEL D ENSEMBLE 4/93

OPERATION FOR WHICH THIS LEVEL D ENSEMBLE APPLIES: All operations with air "normal" air contaminate levels. Air contaminates below permissible exposure limits.

___ cloth coveralls
OPTION: ___long/___short sleeved coveralls
OPTION: street clothing may be worn by personnel not exposed to splashing liquids or oily equipment.

___ chemical resistant coveralls (Tyvek/rain suits)

___ resistant (see note 2) steel toe/shank safety boots with textured bottoms
OPTION: hip high boots (e.g., designated snake areas)
OPTION: deck shoes with textured soles (e.g., boat ops)

___ resistant gloves
OPTION: leather gloves (if no contact with oil)

___ hard hat (when objects are handled overhead. All personnel in designated areas)

___ safety glasses (as required by Site Safety Officer)
OPTION: with tinted lenses (as required for sunlight)

___ PFD (all personnel on or near water)
___ Chest or Knee Waders (as needed)
___ hearing protection (in noisy areas)
___ insect repellant (in designated mosquito/tick areas)
___ sunscreen (as needed for sunlight)
___ whistle (in designated areas)

NOTES:

1) "AS NEEDED" means to use when and in such a way so as to prevent significant skin contact with oil.

2) "RUBBER"/"RESISTANT" means chemical resistant material which resists oil penetrating to the skin or cloth garments underneath. Neoprene is a common material which is resistant to many oils.

3) Respiratory protection is used in this ensemble as a safe work practice while working around carcinogens in order to keep low exposures as low as reasonably attainable. For spill response involving oils that may still contain benzene in particular this may be used while working in close proximity to spilled product until benzene has weathered away (typically the first day).

EQUIPMENT NEEDED (LEVEL D)

STATION 1: EQUIPMENT DROP / OUTER, RAIN GEAR, GLOVES, AND KNEE WADERS WASH & RINSE:

___ chem wipes, spray bottle, paper towels (equipment DECON, at equipment drop)

STATION 2: PROTECTIVE SUIT WASH/RINSE:

___ garden hose/spray apparatus capable of spraying contaminated areas if suit is to be used more than once

___ garbage bag for one use suits

STATION 3: OUTER BOOT/GLOVE REMOVAL:

___ garbage bag

STATION 4: GLOVE/BOOT/BOOTIE REMOVAL:

___ garbage bag

STATION 5: RESPIRATOR STATION: (as needed)

___ wash with cleaner/sanitizing solution

___ plastic carrying bag

STATION 6: MEDICAL MONITORING STATION: (as needed)

___ stool or seat

___ medical monitoring equipment

___ 1st AID KIT

First CG District ATON Battery Recovery Site Safety Plan

ATTACHMENT 9: SANITATION REQUIREMENTS

A. Potable water. An adequate supply of potable water, or other drinking fluids, shall be maintained at all times throughout the site. Containers for drinking fluids shall be capable of being tightly closed, and equipped with a tap. These containers must also be labeled in such a manner that the contents are not accidentally used for other purposes. Where single service cups are supplied, the unused cups shall be maintained in a sanitary containers; and a separate disposal container provided for used cups.

B. Non-potable water. Water intended for uses other than drinking or washing shall be identified in a way that it is not accidentally used for drinking, washing, or cooking. There shall be no cross-connection of potable and non-potable water supplies.

C. Toilet facilities. When activities will be prolonged (over 2.5 hours) toilet facilities shall be provided at a minimum in accordance with Table H-120.2 (Toilet Facilities) of 29 CFR 1910.120(n). For 20 or fewer people 1 facility (porta-potty) is required

E. Washing Facilities. Washing facilities shall be readily accessible by all employees. In addition to sanitary cleaning, these facilities shall be so equipped that they can be used to remove oily residues from the skin. Washing facilities shall be maintained free of contaminants above exposure limits, and as free as practical from oily residues.

First CG District ATON Battery Recovery Site Safety Plan

I. POISONOUS\INFECTIOUS INSECTS. The primary concern here is ticks carrying Lymes disease, poisonous spiders, bee stings, allergic sensitivities, and for certain response operations mosquitoes that may be carriers of infectious diseases.

A. PREVENTION.

1. During morning safety briefings, provide information on the location of hazards and how to deal with problems.

2. Personnel should be provided with long sleeved clothing and insect repellant in designated areas.

3. Personnel should inspect each other for ticks and signs of infected bites during breaks when working in designated areas.

4. Personnel with allergies to bee stings or insect bites may suffer a medical emergency if bitten. Supervisors on site should be prepared to deal with these medical emergencies.

5. Personnel with severe allergies must work in areas away from known/suspected bee hazards.

B. BEE STINGS. When a bee stings it may leave a stinger in the wound which will continue to inject venom. Wasps, hornets, and ants do not have this type of stinger, but they can produce multiple bites.

1. The following signs or symptoms may indicate an allergic reaction:

- swollen throat, difficulty breathing, or noisy breathing;

- sudden pain, severe itching, hives (or itching over the body), headache, acute redness and/or swelling of the wound;

- a white, firm swelling in the skin with itching;

- reduced consciousness, or shock.

2. FIRST AID.

a. Wash the wound with soap and water.

b. If symptoms of allergic reaction are present REQUEST MEDICAL ASSISTANCE and treat for shock.

ATTACHMENT 10: BITES, STINGS, AND POISONOUS PLANTS .23
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Personnel briefed on first aid procedures must understand that "FIRST" aid implies that further treatment will probably be needed from trained/qualified medical personnel.

See the American Red Cross- Standard First Aid Training Manual or the American Academy of Orthopedic Surgeons' "Emergency Care and Transportation of the Sick and Injured" for additional information and updated procedures.

INDEX:

I. POISONOUS\INFECTIOUS INSECTS

A. PREVENTION

B. BEE STINGS

C. POISONOUS SPIDERS
1. The BLACK WIDOW
2. The BROWN RECLUSE

D. TICKS

II. ANIMAL BITES

A. GENERAL

B. ANIMAL BITES AND RABIES
1. PREVENTION
2. FIRST AID FOR ANIMAL BITES/RABIES

III. POISONOUS PLANTS

A. GENERAL INFORMATION/PREVENTION

B. FIRST AID FOR POISONOUS PLANTS

salivation, nausea, and/or vomiting;

- profuse sweating, or swollen eyelids.

d. FIRST AID.

(1) Wash the wound with soap and water.

(2) Request medical assistance to address symptoms. The person usually recovers after several days of illness.

(3) If symptoms of allergic reaction are present treat for shock.

(4) A cold pack may be helpful if the bite is quickly recognized.

2. The BROWN RECLUSE.

a. The brown recluse has a brown body about 1/8 inch long and about 1/2 inch long including the legs. It has a characteristic fiddle shape on the back.

b. The brown recluse does not build webs but may be encountered indoors in hiding locations. For this reason these spiders rarely bother humans, but some bites occur in the areas around Texas, Oklahoma, Kansas, and Missouri.

c. The most serious symptoms of the brown recluse bite are local effects. There may be no noticeable effect from this bite. In severe cases a red area appears around the bite. A crust may develop and fall off while the area of redness grows deeper. These bites may take several months to heal.

d. FIRST AID.

(1) Wash the wound with soap and water.

(2) If symptoms of allergic reaction are present REQUEST MEDICAL ASSISTANCE and treat for shock.

(3) There is no good first aid for spider bites other than cleaning the wound if it can be found. A cold pack may be helpful if the bite is quickly recognized. A physician can address symptoms and the person usually recovers after several days of illness. In

c. If stinger remains embedded, try to remove it WITHOUT SQUEEZING IT (this may inject more poison into the wound). Avoid using a tweezers since it may squeeze the stinger. Scrape the stinger out with a plastic card (e.g., credit card or drivers license).

d. Persons with severe allergy to bee stings may carry an emergency treatment kit.

e. Use a cold pack to reduce/limit swelling. DO NOT PLACE A COLD PACK DIRECTLY ON THE SKIN! Place gauze pad or clean cloth on the skin to prevent direct skin contact with the pack.

f. Keep the wounded area below the level of the heart to slow the venom's spread.

g. DO NOT administer aspirin or alcohol since this will dilate blood vessels enhancing spread of poison.

C. POISONOUS SPIDERS.

1. The BLACK WIDOW.

a. The black widow has a glossy black body that is about 1/2 inch long, and is almost an inch long when including the legs. The body is bulbous in shape with a characteristic red hour glass shape on the bottom side of the abdomen (it is not easily seen from above).

b. The black widow is a web building spider found in most parts of the U.S. and even into Canada, but generally prefers warm climates.

c. The most serious symptoms of a black widow bite are those of systemic poisoning. Initially the bite may produce no pain, and may not swell or cause local symptoms. As systemic symptoms develop they may initially appear similar to a severe case of the flu, but can develop into other more severe symptoms. Signs and symptoms can include:

- severe abdominal pain (similar to appendicitis), rigidity, pain/cramps in the muscles, and/or tightness in the chest and difficulty breathing;

- pain in the soles of the feet;

- alternating dry mouth and heavy

particular the local tissue damage from a brown recluse bite may develop gangrene.

D. TICKS.

1. Ticks are about 1/4 inch long. They attempt to bury their heads and crab-like pincers beneath the skin leaving only their bodies exposed above the skin.

2. Ticks carry infectious diseases (rocky mountain spotted fever or Lymes disease) in this way into your blood. In most cases disease will not result, but flu like symptoms may develop several days later including:

- fever,

- rash,

- joint pain, or

- headaches.

3. FIRST AID FOR POISONOUS\INFECTIOUS INSECTS.

a. Wash the wound with soap and water.

b. If symptoms of allergic reaction are present REQUEST MEDICAL ASSISTANCE and treat for shock.

c. Try using alcohol, oils, or a heated paper clip to encourage the tick to release it's grip. Grasp the tick and remove it quickly when it shows signs of letting go (the tick may wiggle its legs in an attempt to withdraw from the skin). If the head remains under the skin, soak the area several times daily and use a tweezers to attempt to remove.

d. If fever, rash, or headaches develop within several weeks contact medical personnel.

II. POISONOUS SNAKES, ANIMAL BITES, AND MARINE ANIMAL PUNCTURES.

A. GENERAL.

1. In addition to animal bites (including bites by humans) and snake bites; stings from jellyfish, Portuguese man-o-war, anemones, corals, and hydras may be painful or cause allergic reactions. Similarly urchins, cone shells, stingrays, spiny

fish (e.g., catfish, certain toads, or oyster fish) can cause allergic reactions or infection.

2. Personnel should also be briefed on procedures to follow in the event of a bite, and known or suspected locations where problems may occur.

3. All personnel working in designated areas should be provided with snake leggings or hip high boots. Appropriate work clothing will also help prevent many other bite related problems.

4. If personnel notice potentially infected animals on site they should notify their supervisor immediately, EVEN IF NO ONE HAS BEEN BITTEN. Other personnel must be kept away from potentially infected animals until animal control authorities take appropriate action.

B. ANIMAL BITES AND RABIES.

1. PREVENTION.

a. The following signs/symptoms may indicate infected ANIMAL BITES in unreported cases (infection can develop within hours of a bite):

- pain or tenderness of a wound
- redness, heat, or swelling around the wound
- pus under the skin or in the wound
- red streaks trailing from the wound
- swollen lymph nodes in arm pits/groin/neck.

b. RABIES is a serious infection typically passed to humans by the saliva of diseased animal carriers such as those listed below.

(1) It is generally recognized that rabid animals may drool or act irritable, but any strange/abnormal behavior can also indicate infected animals. Infected animals may also act strangely quiet, partially paralyzed, or unafraid of humans.

(2) Some common animal sources of rabies include:

- skunks,
- prairie dogs,
- foxes,
- bats,
- dogs,

- cats,
- raccoons, and even
- cows.

c. If personnel notice potentially infected animals on site they should notify their supervisor immediately, EVEN IF NO ONE HAS BEEN BITTEN. Other personnel must be kept away from potentially infected animals until animal control authorities take appropriate action.

2. FIRST AID FOR ANIMAL BITES/RABIES.

a. Get medical attention ASAP to address infection hazards and/or poisoning.

b. Determine when person last had tetanus immunization (contact unit holding medical records for assistance).

c. Interview victims and witnesses to attempt to identify the specific type of animal that gave a bite and/or unusual behaviors.

d. GENERAL first aid for animal bites:

(1) Control serious bleeding. Apply pressure using a gauze pad. Use of tourniquets IS NOT advised unless absolutely necessary.

(2) WASH YOUR HANDS before touching a wound. Personnel should also wear RUBBER GLOVES and FACE SHIELD for working around human blood.

(3) Wash wounds that are not bleeding heavily. Use plain soapy water. Trained medical personnel must clean serious wounds.

(4) Cover with clean dressing and bandage.

e. RABIES treatment must be administered by medical personnel. Prompt treatment is essential since there is no cure for rabies if it is allowed to develop in a wound. Rabies shots must be started quickly in order to prevent infection by building up immunity.

III. POISONOUS PLANTS.

A. GENERAL INFORMATION/PREVENTION.

1. Personnel should be informed of known and suspected locations where these plants may be contacted.

2. Personnel should also be briefed on procedures to follow in the event of contact.

3. Long sleeved clothing should be worn in areas designated to contain these plants.

4. Signs and symptoms of skin contact with poisonous plants:

   - itching,
   - burning, and
   - blister formation.

B. FIRST AID FOR POISONOUS PLANTS.

1. DO NOT SCRATCH. Scratching will only spread the poison and work it into the skin.

2. If these plants are accidentally touched, the plant sap should be washed off of the affected area with soapy water immediately.

3. Medical attention may be needed if prolonged or serious conditions result.

ATTACHMENT (11) AFTER ACTION REPORT

S A M P L E

From: Unit
To: Commanding Officer, Civil Engineering Unit Providence

Subj: BATTERY RECOVERY AFTER ACTION REPORT

Ref: (a) ATONORD 01-XXX-94

1. Per reference (a), ANT Saugerties was directed to conduct battery recovery operations on the following sites:

a. Upper Hudson River LT 83
b. Turkey Point Buoy Depot (abandoned 1965)

2. Site survey conducted on 31 Aug 94 by unit personnel as part of the First District ATON battery recovery training program. The site safety plan, photo documentation and soil samples are enclosed.

3. The clean up of the site was completed on 31 AUG 94, utilizing D1 trained recovery personnel. Following an extensive "site reconnaissance", the team recovered approximately 15 Edison Carbonaire carcasses from an the site. The following resource hours were utilized:

a.	Small Boats	2 Hours
b.	Vehicles	7 Hours
c.	Site Survey	14 Man Hours
d.	Procurement and Gear Preparation	1 Man Hour
e.	Brushing Access to site	4 Man Hours
f.	Clean Up Site	14 Man Hours

4. Expenses were as follows:

a.	PPE	75.00
b.	Film	10.00
c.	Bags/Buckets/Drums	20.00
d.	Labels	4.00
e.	Other (paper, sprayer)	42.00

5. The following lessons learned, comments and recommendations are provided:

a. Need rakes for small pieces.
b. Use Video to critique cleanup.

6. Batteries are currently stored at ANT Saugerties, awaiting final disposition. Documentation of final disposition will be forwarded separately upon completion.

First CG District ATON Battery Recovery Site Safety Plan

7. Additional comments:

OINC/CO

Encl: (1) Site Plan (original)
(2) Photo/Video documentation
(3) Soil Samples w/ DD1149
(4) Disposal documentation (if applicable)

Copy: CCGDONE (oan) with encl (1) only
CG GP New York

ATTACHMENT [12] ADDITIONAL FIRST AID KIT ITEMS

Medical Instrument and Supply Kit Field Casualty Treatment

FSN 6545-00-935-7093

Insect Repellent

FSN 6505-01-137-8456

Sun Screen Lotion

FSN 6505-01-121-2336

Blanket (any kind)

Eye Wash Bottle (Available through commercial supplier like Lab Safety Corp.)

Instructor Notes	Instructor Activity

PRESENTING THE INFORMATION

(LT Bills)

1. Show COMDTNOTE Training Tape
2. Review Types Of Batteries (TECHMAN)
   - -Slides
   - -Discussion

Hazard Communication

(LCDR Danielczyk)

1. The Standard
2. Hazard Communication [1901.1200] vs Hazwoper [1910.120]
3. Batteries are Articles
4. Identification and Labels
5. MSDS Location on-site
6. Chemical, Physical and Health Hazards
7. How to detect presence of materials in work area
8. Individual protection methods and equipment

Material Handling, Segregation, Packaging & Disposal

(Mr. Georges Bockstael)

1. MSDS
2. Site Work Plan
   - -Site Reconnaissance
   - -Site Safety Plan
   - -Site Preparation and Use Of PPE
   - -Field Testing And Segregation
   - -Recovery Of Batteries And Parts
   - -Packaging Of Components
   - -Hazardous Waste Rules
   - -Labels On Containers
   - -Decontamination

Instructor Notes	Instructor Activity

OPENING ACTIONS

Introduction

(All)

1. INTRODUCE MEMBERS OF THE TRAINING TEAM.

Gaining Attention

(LT Bills)

1. Introduction to current nation-wide battery situation.

   -Prior to 1986, most aids were powered by batteries.
   -since no laws were in place prior to 1973, batteries were sometimes released into the envonment
   -As many as 1600 sites could be affected.

2. Show CRUSADERS clip, recovering "Coast Guard" batteries from Tampa Bay.

   -FFCA made Govt agencies liable to states.
   -Battery recovery/disposal limited to EC&R
   -Most/all funding west to d7/d8 for remediation

Stating The Objectives Of The Course

(LT Bills)

1. To expedite recovery and disposal of ATON batteries discovered at terrestrial sites. Utilized existing AFC-30 disposal contracts.

2. Aquatic sites will be addressed once Volpe study is completed

   -Indications are from MIT study that batteries do not pose a threat to the environment. (Quote study) Passout copies of press release.

3. Focused HAZWOPER: Meet the requirements of CFR, while providing comprehensive training, focusing on ATON batteries.

4. Every ANT/WYTL will be sufficiently trained to safely recover and dispose of discarded batteries.

5. Provide copies of ATONORD/SSP

Recalling Prerequisites

(LCDR Danielczyk/LT Bills)

1. Discuss Background and Gverning Laws.

Instructor Notes	Instructor Activity

Environmental Monitoring

(Mr. Georges Bockstael)

1. Chain Of Cutody

2. Standard Sampling
   -Equipment needed
   -Documentation of Sample Location
      *The Geographical Center
      *The Perimeter
      *The Perimeter Plus One
      *Site And Sample Map

3. Archiving Samples

Enhancing Retention and Transfer

(All)

1. LAB
   -Create Terrestrial Site Mock-Up for Practice Recovery

Actual Recovery Exercise (When Available)

(All)

1. Recover Batteries From Reported Terrestrial Site

CLOSING ACTIONS

(LT Bills)

1. After Action Reports
   -Provide Sample AAR from D7
   -Discuss Prob;ems Encountered

2. Prevention Methods
   -Battery Box Seccuring Method
   -ID, Labeling and Tracking

3. Reporting Released Batteries
   -Provide Format

Assessing Performance

1. Students are evaluated with a written test.

CRITIQUE COURSE

1. Provide Critique
   -Verbal Feedback

Instructor Notes	Instructor Activity
	(Provide Handout) - CRCLA/RCRA - COMDTINST - D1 Guidance

REMEDIAL ACTION PLAN

BATTERY CLEANUP SITE OPERATIONS

MATERIAL HANDLING, SEGREGATION, PACKAGING AND DISPOSAL

A. SCOPE AND RATIONAL

A.1 Coast Guard units that are assigned to remove batteries from ATON sites must follow this protocol to ensure that batteries are handled properly. Proper handling will ensure that personnel safety, environmental safety and regulatory compliance are accomplished. Handling of batteries will be conducted in a uniform manner under a standard operating procedure (SOP). Since differences in site conditions will dictate the site specific approach to be taken, there must be flexibility to the site operations plans.

A.2 Survey, remove and dispose of abandoned aids to navigation (ATON) batteries. The driving force behind the battery cleanup operations is the perception that the batteries are causing harm to the environment, and therefore the Coast Guard is causing environmental harm. The disposal of batteries in the coastal environment is an illegal activity, and because the batteries do not decompose it appears that the Coast Guard is engaged in illegal action.

A.3 Recovery of spent batteries at ATON sites is a current obligation of the ANT teams. The recovery of discarded batteries is also a logical extension of ANT duties. The ANT teams are trained in the handling of live batteries (which are potentially more hazardous than the spent or discarded batteries). With additional training the ANT's will be able to safely, legally and successfully acomplish this mission.

B. INITIAL SITE RECONNAISSANCE

B.1 Upon arrival at the site take a few minutes to orient yourself and get a feel for the lay of the land. Using a standard Site Plan 1" = 20', draw in the relative position of the shoreline and the position of the aid.

B.2 All members of recovery team meet to determine who will go where and where the stage-out area will be set up along with position of safety equipment, "tailgate site safety plan" will be developed. Search zones will be established.

B.3 Personal protective equipment (tyveks and boots) is donned, pH paper, a Site Plan 1" = 20' and a supply of flags taken into the search zone.

B.4 Upon discovery of a battery note it's position on the Site Plan, identify it's type (L = Lead Acid, Z = Zinc Air), condition (intact or ruptured), test the battery casing with ph paper (H = "hot = Corrosive), flag the battery and continue outward.

B.5 Return to stage-out area. Determine number of buckets, bags, tape, barrels, and labels that will be required. If the scope of the recovery is within the capability of the recovery team's ability and equipment, proceed to the recovery phase.

C. BATTERY RECOVERY

C.1 Don appropriate personal protective equipment (may also include safety glasses and gloves).

C.2 All batteries and battery pieces will be placed in plastic bags, one battery per bag. The bags will be taped closed and placed in transportation buckets. Intact batteries may be handled in the same way that spent batteries taken directly from the aid during normal replacement are handled. Leaking batteries must be handled as hazardous waste (leaking batteries are batteries that have "hot" corrosive fluid from the battery interior located on the outside of the battery as measured by pH paper wipe test). Discovery of a leaking battery should be an uncommon event. Leaking batteries should be double bagged, placed into a transportation bucket and the bucket should be labeled HAZARDOUS WASTE, CORROSIVE. The transportation bucket lid should be screwed on and the bucket isolated from the other batteries. Should contact with any corrosive material be made, it will be necessary to immediately decontaminate the affected area/s (Wash off).

C.3 Broken or ruptured batteries should also be double bagged (bag, tape and bag, tape) to prevent battery casings from tearing their bags. There may be value in using an outer burlap bag for support and strength. Bring battery back to the servicing vessel for transportation to the Unit.

C.4 Information necessary for transportation.

a. <u>Zinc Air Primary Batteries</u>

1) The air-depolarized batteries consist of an inert plastic or hard rubber case, potassium hydroxide liquid electrolyte, zinc-mercury alloy anode, carbon cathode, and an insoluble residue or lime bed. The SAFT batteries will also contain a starch based electrolyte gelling agent. The pH of the electrolyte is close to 14. The EPA Hazardous Waste Identification Number for these batteries should be D002 (corrosivity). You may note that under COMDTINST M 16478.1B they are also identified as waste code D009 (toxicity characteristic for mercury). Actual TCLP analysis for mercury indicates that the D009 is not necessary, see Figure C.2.a for TCLP analysis results. Also, if the batteries have been broken open and the electrolyte has been diluted/neutralized by contact with sea water or the pH otherwise cannot be measured

as 12.5 or more, the battery carcass does not meet the definition of a hazardous waste, and should be disposed as a solid waste.

2) **LABELING:** A battery which contains electrolyte (intact) or a broken battery which fails the field pH test, must be handled as a hazardous waste. Transportation of these batteries requires the following information:

* Proper Shipping Name = Waste Battery, electric storage, wet, filled with alkali
* Hazard Class = Corrosive material
* Identification Number UN2795
* Label = CORROSIVE
* EPA Hazardous Waste Number D002

3) **PACKAGING:** Batteries shall be double-wrapped in plastic bags, palletized, and banded. Batteries will be placed upright with layers separated by plywood or cardboard. The total pallet is not to exceed 4 layers in height. Onboard the recovery vessel the batteries can be double-wrapped and placed into a drum with absorbent material filling the voids. Any battery which is determined to be currently leaking electrolyte must be packed into an individual container and isolated. Upon return to the unit, batteries will be off-loaded and handled according to the same procedures used for spent batteries being returned from ATON servicing. If primary batteries are not recycled, they must be included in the unit calculation of hazardous waste generated per month.

b. Lead-Acid Batteries

1) Lead-acid batteries are wet, rechargable, and usually six-celled. Each cell consists of a lead (anode) and lead dioxide (cathode) plates totally immersed in sulfuric acid electrolyte. The EPA Hazardous Waste Identification Numbers are D002 (corrosivity) and D008 (toxicity characteristic for lead). Intact, non-leaking lead acid batteries which are recycled do not need to be disposed of as hazardous waste. Pieces of lead acid battery cases which do not fail the field pH screening, are solid waste (debris) and should be recovered, returned to the unit and disposed of as landfill waste. The lead plates from these batteries should be collected in plastic bags (using PPE), returned to the unit and boxed for recycling.

2) On return to the unit lead acid batteries should be handled according to standard operating procedures established in COMDTINST M 16478.1B.

3) **LABELING:** A leaking lead acid battery will require the following information to meet transportation rules:

* Proper Shipping Name = Waste battery, Electric Storage, wet, filled with acid

* Hazard Class = Corrosive material

* Identification Number UN2794

* Label = CORROSIVE

* EPA Hazardous Waste Numbers D002 and D008

4) **PACKAGING:** Batteries shall be double-wrapped in plastic bags, palletized, and banded. Batteries will be placed upright with layers separated by a plywood or cardboard. Onboard the recovery vessel the batteries can be placed in a drum. Leaking batteries must be packed into individual containers with absorbent material and isolated.

5) The primary concern when handling the lead acid batteries is the sulfuric acid electrolyte, the lead and the toxicity of the lead is a secondary issue. Unlike the primary batteries the pH of the lead acid batteries is more difficult to characterize and will be found to cover a wide range of values. Any leaking lead acid battery which field pH test at a value of 2 or less is a hazardous waste.

6) Leaking lead acid batteries and primary batteries which fail the field pH test are both hazardous waste. They must be individually packaged, labeled, and stored separately. As hazardous waste they will have to be disposed of under a Hazardous Waste Manifest, using the unit's EPA ID Number or a temporary ID Number will need to be assigned by the state.

Batteries and battery pieces which are determined not to be hazardous waste may be shipped under a bill of lading.

D. ENVIRONMENTAL MONITORING

D.1 Environmental monitoring serves three main functions;

a. It provides the documentation necessary to show that the site has been cleared of spent batteries.
b. Soil samples taken can be used to assess potential environmental impact of batteries in the environment, and to determine if there is a need for additional site remediation.
c. Monitoring can be use to show that potential environmental impacts from the clean-up actions have been minimized, and that a Quality Assurance Plan (QAP) has been followed resulting in valid documentation/sample collection.

D.2 On the site plan, identify the aid name, aid number, number of batteries, location of batteries, battery type(s) and condition. A standard 50 foot radius scale is provided on the site plan form. Generally, the entire terrestrial area within the 50 foot radius will be searched for batteries. If batteries

are found outside the 50 foot radius from the aid, adjust the scale to fit the site (ie. 1" = 50'). The distance from the aid to the last battery found will be considered one (1) SITE RADIUS. The search for batteries should be extended outward for one additional SITE RADIUS. For example, if the last battery found is 40' from the aid, the search pattern should be out to a minimal distance of 80' from the aid. Take up to four (4) photos of each site.

Using the site plan drawing determine the area which represents the greatest concentration of batteries. From the center of the area with the greatest number of batteries you will take soil sample #1. Soil sample #2 will be taken out at 1 SITE RADIUS within three feet of the position of the outermost battery. Soil sample #3 should be taken out at SITE RADIUS 2. Soil sample #3 will be used as a background sample.

D.3 SOIL SAMPLE COLLECTION

Sampling devices shall be decontaminated between individual soil samples. The following steps shall be followed, for decontamination of sampling devices:

a. Remove all bulk solids.

b. Scrub with detergent and potable water solution.

c. Rinse with isopropyl alcohol, and

d. Rinse with deionized water.

The recovery team shall collect one soil sample from each of the three indicated areas at each aid. A stainless steel sampling tool shall be used to collect soil samples.

Each soil sample shall be placed in clean, plastic containers. A two inch diameter by four inch deep soil sample should be taken from the surface at each of the three locations. As each sample is packaged, a chain of custody form shall be retained by the sampling personnel. A copy of the chain of Custody form shall be mailed to CEU Providence along with the soil samples.

Secure a sample label to each soil sample conatiner collected in the field. The sample label shall contain the following data:

a. Aid name and number
b. Sample number
c. Distance and direction from aid
d. Date
e. Time
f. Initials of sampling personnel

E. RECORD KEEPING

Record keeping serves several important functions including regulatory, operations, environmental and planning. The most important records are the site plan, the photographs, the chain of custody/sample documentation and the bill of lading/waste manifest.

Hazardous Waste Operations and Emergency Response (HAZWOPER)

Scope and Application
Training Requirements
Training Content
Written Safety & Health Programs
Site Specific Safety & Health Plan Contents
Site Charicteriztions, Analysis and Control

<u>References</u>
29CFR 1910.120

<u>First District SEOH Points of Contact</u>
D1(mseh): 617-223-8593/8436
MLCA (kse): 212-668-7155/6/7

HAZWOPER Scope & Application

"Applies unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards"

Government Mandated or Recommended Cleanups and Site Investigations

RCRA Cleanup & Corrective Actions

RCRA Transportation, Storage & Disposal (TSD) Activities

Emergency Response Operations for Releases or Substantial Threats of Releases, Regardless of Location

Encl. (4) to COMDTINST 16478.12

HAZWOPER Training Requirements

Based on Job Function, Hazards expected, Time of Work

Emergency Response

- First Responder Awareness Level (knowledge)
  Sufficient Training/Experience
- First Responder Operations Level (defensive)
  8 hours training/experience
- Hazmat Technician (stop release/aggressive)
- Hazmat Specialist (direct or specific knowledge)
  24 hours & proven experience
- On-scene Incident Commander (in charge)
  24 hours & proven experience

Post-Emergency Response

- General Site Workers
  40 hours off site, 24 hours field
- Minimal Hazard/Non-Routine Site Employees
  24 hours off site, 8 hours field
- Management/Supervisory Training
  Trained to Employee Level
  8 hours hazwaste operations

Annual Refresher Training

Application of Past OJT

HAZWOPER Training Content

Names of Personnel Responsible for Safety & Health

Safety, Health and Other Hazards On-Site

Personal Protective Equipment Required

Work Practices to Minimize Risk

Safe Use of Equipment

Medical Surveillance

Decontamination

Drum/Waste Handling

Sanitation, Illumination Requirements

HAZWOPER Written Safety & Health Program

Need not repeat employers Standing Operating Procedures

ID, evaluate, control safety and health hazards & provide for emergency response for hazwaste operations

Organizational Structure

- Site Supervisor
- Site Safety and Health Officer
- On-Scene Representatives
  - supervisor representatives
  - Site Safety Supervisor

Work Plan

Site Specific Safety & Health Plan

Training Program

Medical Surveillance

HAZWOPER Site Specific Site Safety Plan

Drafted before site work begins

Needs to address:

- Health risks/hazard analysis for each task
- Employee training requirements
- PPE requirements for each task
- Medical Surveillance Requirements
- Types & Frequency of Air Monitoring/Environmental Sampling
- Site Control Measures
- Decontamination Required
- Emergency Response Plan

Encl. (4) to COMDTINST 16478.12

Site Characterization / Analysis & Control

<u>Site Characterization</u>

Preliminary Assessment

Hazard ID including items that pose skin absorption or inhalation hazards

- IDLH atmospheres
- Death/Serious Harm

<u>Site Control</u>

Site Maps

Site Work Zones

Buddy System

Communications

- locating/calling hospitals/emergency response
- locating Incident Command & Safety Personnel

Encl. (4) to CONDTINST M164/8.12

HAZARD COMMUNICATION

Training Requirements

Labeling Requirements

Material Safety Data Sheets
- File Requirement
- Content Requirement

Written Program

Coast Guard HazCom

References

- 29CFR 1910.1200
- COMDTINST 6260.21

First District SEOH Points of Contact

D1(mseh): 617-223-8593/8436

MLCA (kse): 212-668-7155/6/7

Written Program/ Training Requirements

Written Program Requirements

"Inventory" of all Hazardous Substances in Workplace

How Training will be Provided

Handling Routine and "Non-Routine" Tasks

Hazardous Material Coordinator Designated

Training Requirements

OSHA:
- New Chemical introduced in workplace
- New Worker comes aboard

USCG:
- In addition to OSHA: Annual Training

Familiarity with MSDS

Where to find "Right to Know" info

Chemical Release detection

PPE requirements

Encl. (4) to COMDTINST 11548.12

Non-original Container Labeling Requirements

Chemical Identity
Name/CAS Number

Hazard Warning
(corrosive, oxidizer, etc.)

Written in English

Excludes Daily Use and 1 Person use

Recommend : Manufacturer, Fed. Stock Number, Target Organ

Material Safety Data Sheets (MSDS) Files

Must be readily available when chemical is used

No organization requirement

MSOs: bulk & frequently encountered with emphasis on carcinogens, highly toxic (TLV <100 PPM)

Annual Review

COMDT requires HAZMAT manager sign all HazMat PR prior to purchase
- PPE requirements
- substitutes
- quantity ordered/inventory

HAZMAT IN ----> HAZWASTE OUT

<u>Recommendations</u>
- Master File
- One person receive, check-in hazmat & maintain complete file
- Facility/Shop Area/Use specific (not numerical or alphabetical)
- Highlight Product Name

MSDS Requirements
Obtaining MSDS

8 sections (can vary in placement)

Written by Manufacturer/Importer

- Confusing/Legal Language
- Trade Secrets
  - immediate access for medical purpose,
  - Safety and Health Evaluation
  - statement of confidentiality

Not Required For:

- Articles
- Pesticides (EPA regulated)
- Food Additives/Cosmetics (FDA)
- Alcohol
- Prescription Drugs (FDA)
- Home Use Items

Obtaining MSDS

- Manufacturer/Importer
- Place of Purchase
- HMIS for Federal Stock Numbered Items
  - MLCA(kse)
  - D1 (mseh)
  - Groups

OTHER USCG
HAZCOM ITEMS

Driving

Hearing Conservation

- >84 dBA - single hearing protection
- >104 dBA - double hearing protection

Slip, Trip, Falls

Heat & Cold Safety

Benzene

Asbestos

Hydrogen Sulfide

Welding Fumes

Sand Blasting

Confined Space Entry

Fire & Explosion Hazards

Water Safety

MSO Access Control

- vessels
- shipyards
- confined spaces
- dry docks
- spill response zones

MSDS NOTES

1: MFG NAME, Address, Phone number

2: Hazardous Ingredients (above 5%), % of total mixture, PELs/TLVs

- not required to list inert/non-hazardous ingredients
-

3: Physical Characteristics

- Boiling Point: Temp at which begins to boil (watch low ones)
- Vapor Pressure: Temp Dependent, concentration of vapor above liquid
- Vapor Density: Air (=1) as reference - whether substance vapor will sink or rise. Accumulation points
- Solubility : Will substance dissolve /mix in water
- Appearance /Odor
- Specific Gravity: Water (=1) as reference - whether liquid/solid form of substance will sink or rise. Accumulation points.
- Melting Point: Temp at which solid goes to liquid
- Evaporation Rate: How fast will substance evaporate over time (component specific)

MSDS NOTES

4: Fire & Explosion Data

- Flash Point: Temp at which substance gives off enough vapors that if spark is introduced substance can ignite
- Auto-Ignition Temperature: Temp at which substance gives off enough vapors that it can ignite on own
- Flammable Limits: Lower/Upper Explosive Limits - Lean or Rich
- Extinguishing Media: CO_2, Water, Foam, etc.
- Special Procedures: clothing type, unusual qualities when on fire

5: Reactivity Data

- What this stuff doesn't mix with (oxidizer/ corrosive - HCn/Acids)
- What remains after it burns off - is residual hazardous
- Substances/Areas to avoid: Sodium & water Heat build-up

Encl. [illegible] to COMDTINST [illegible]

MSDS N[redacted]

6: Health Hazard Data

- Entry Routes (skin, respiratory, ingestion)
- Acute & Chronic Health Effects
- Is it formally recognized as a carcinogen (human or animal)
- Symptoms of exposure
- Medical Conditions aggravated by exposure
- Emergency First Aid Procedures : To vomit or not to vomit Antidotes

7: Precautions for Safe Handling and Use

- Spill Instructions
- Waste Disposal
- Handling and Storage

8: Control Measures

- PPE requirements
- Mechanical Controls
- Work Practices (avoid skin contact)

Please initiate the below page seven entry for the following individuals for training conducted on 20-21 SEP 94:

QM2 Steven A. Rogers 007 54 0350, USCG	ANT NY
CWO2 Lloyd F. Kelleher 149 48 6881, USCG	GRU NY
MK3 Christopher J. Vecchio 039 42 2715, USCG	ANT NY
BM2 Albert J. Washington Jr. 560 17 5323, USCG	ANT NY
EM1 James H. Hickey, 125 36 6185, USCG	ANT NY
MK2 Craig W, Thorngren 575 21 1002, USCG	HAWSER
MK3 Kenneth C. Gardner 554 85 8088, USCG	ANT NY
BM1 Jeff Wheeler 519 98 6946, USCG	ANT NY
FN Melvin A. Watson, 258 41 4644, USCG	ANT NY
MK2 Ronald Friedman, 117 58 8434, USCG	ANT NY
EM2 Thomar R. Ruegamer 449 53 8426, USCG	ANT NY
MK1 Marson Kay 264 19 2361, USCG	ANT NY

QUOTE

COMPLETED 2 DAY FOCUSED HAZARDOUS WASTE OPERATIONS (HAZWOPER) TRAINING COVERING SAFETY, HEALTH AND ENVIRONMENTAL ASPECTS OF ATON BATTERY RECOVERY OPERATIONS WHICH INCLUDED THE FOLLOWING TOPICS:

HAZARD COMMUNICATION (HAZCOM): 29 CFR 1910.1200, MATERIALS SUBSTANCE DATA SHEET (MSDS) OF MERCURY, LEAD, POTASSIUM HYDROXIDE, SULFURIC ACID, NICKEL-CADMIUM AND THOSE OF GENERIC BATTERIES.

HAZARDOUS WASTE OPERATIONS (HAZWOPER): 29 CFR 1910.120 SITE WORK/SAFETY PLANS, DESIGNATED INDIVIDUALS, HAZARD EVALUATION AND COMMUNICATION REQUIREMENTS. RECOVERY TRAINING AND FIELD OPERATIONS LIMITED TO PPE LEVEL "D" (NO RESPIRATORS, TYVEK/SPLASH PROTECTION ONLY).

BATTERY RECOGNITION: TYPES OF PRIMARY AND SECONDARY BATTERIES USED ON ATON.

MATERIAL HANDLING, SEGREGATION, PACKAGING AND DISPOSAL; SITE RECONNAISSANCE, DETECTION, SITE SAFETY PLAN, PERSONAL PROTECTIVE EQUIPMENT, FIELD TESTING AND SEGREGATION, RECOVERY AND PACKAGING PROCEDURES LABELING AND CHAIN OF CUSTODY, ENVIRONMENTAL MONITORING SOIL SAMPLES AND ARCHIVING.

HANDS ON LAB; MOCK UP RECOVERY EXERCISE, ACTUAL RECOVERY/DISPOSAL EVOLUTION AND PREVENTATIVE MEASURES.

UNQUOTE

LT Keith Bills (617) 223-8385

Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 26

MERCURY
(Revision C)
Issued: September 1981
Revised: August 1988

SECTION 1: MATERIAL IDENTIFICATION

26

Material Name: MERCURY

Description (Origin/Uses): Used in barometers, thermometers, hydrometers, and pyrometers; in mercury arc lamps producing ultraviolet rays; in switches and fluorescent lamps; as a catalyst in oxidations of organic compounds; in alloys; in explosives; and for extracting gold and silver from ore.

Other Designations: Colloidal Mercury; Metallic Mercury; Quicksilver; Hg; Hydrargyrum;

CAS No. 7439-97-6

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

Comments: Inorganic and organic mercury compounds are highly toxic, as is pure mercury.

Genium

HMIS
H 3
F 0
R 0
PPG*
*See sect. 8

R 1
I 4
S 1
K 0

SECTION 2: INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Mercury, CAS No. 7439-97-6	Ca 100	OSHA PEL Ceiling: 1 mg per 10 m³ ACGIH TLV (Skin*), 1987-88 TLV-TWA: 0.05 mg/m³ as Hg (Mercury Vapor) Toxicity Data** Rabbit, Inhalation, LC_{50}: 29 mg/m³ (30 Hrs)

*Mercury can be absorbed through intact skin, which contributes to overall exposure.

**See NIOSH, *RTECS* (OV4550000), for additional data with references to reproductive, mutagenic, and tumorigenic effects.

SECTION 3: PHYSICAL DATA

Boiling Point: 673°F (357°C)
Specific Gravity (H_2O = 1): 13.546 at 68°F (20°C)
Vapor Pressure: 0.0018 Torr at 77°F (25°C)
Water Solubility (%): Insoluble
Molecular Weight: 201 Grams/Mole
Melting Point: -37.93°F (-38.85°C)

Appearance and Odor: A silver, heavy liquid; odorless. **Danger:** Mercury vapor has no warning properties.

SECTION 4: FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER

Extinguishing Media: *Mercury does not burn. Use extinguishing agents that will put out the surrounding fire.

Unusual Fire or Explosion Hazards: When exposed to the high temperatures that occur during a fire, mercury can vaporize to form extremely toxic fumes.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5: REACTIVITY DATA

Mercury is stable in closed containers at room temperature under normal storage and handling conditions. It cannot undergo hazardous polymerization.

Chemical Incompatibilities: Hazardous reactions involving mercury and acetylene, ammonia, boron phosphodiiodide, chlorine, chlorine dioxide, methyl azide, sodium carbide, nitric acid, oleum, and sulfuric acid are reported (Genium ref. 84).

Conditions to Avoid: Do not expose mercury to incompatible chemicals.

Hazardous Products of Decomposition: Extremely toxic mercury metal fumes are likely to be produced during fires.

SECTION 6. HEALTH HAZARD INFORMATION

Mercury is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: Mercury is very toxic due to its liquid and fat solubility, lack of charge, and membrane permeability. It is a slowly cumulative poison that concentrates in the brain, kidneys, and liver. It is very hazardous when spilled or heated. Mercury and its vapor are rapidly absorbed by the membranes lining the respiratory tract, the gastrointestinal (GI) tract, and the skin. Mercury is a teratogen (causes physical defects in embryos). **Medical Conditions Aggravated by Long-Term Exposure:** Preexisting problems of the target organs can be worsened. Provide preplacement and periodic medical exams emphasizing the target organs. **Target Organs:** Skin, eyes, respiratory system, central nervous system (CNS), kidneys. **Primary Entry:** Skin absorption/contact, inhalation. **Acute Effects:** Erosion of the respiratory/GI tracts, causes vomiting, bloody diarrhea, shock, headache, metallic taste. Inhalation of high concentrations for short periods can cause pneumonitis, chest pain, dyspnea, coughing, stomatitis, gingivitis, and salivation. **Chronic Effects:** Tremors, emotional problems, loss of concentration, depression, drowsiness, fatigue, insomnia, loss of memory, kidney problems, eye lesions, vision disturbances, sore mouth and throat, problems with the sense of taste or smell, nosebleeds, nasal inflammation, loss of weight or appetite, poor hand-eye coordination, awkwardness, and unsteadiness, as well as dermatitis. **FIRST AID: Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin.** Immediately wash the affected area with soap and water because of the increased exposure from skin absorption. **Inhalation.** Remove exposed person to fresh air; restore and/or support his or her breathing as needed. Have medical personnel administer oxygen to treat the chemical pneumonitis that may develop. **Ingestion.** Never give anything by mouth to someone who is unconscious or convulsing. Note to physician: If indicated by degree of ingestion, saline cathartics and charcoal should be used. Chelation therapy with d-penicillamine may also be indicated.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. **Seek prompt medical assistance for further treatment, observation, and support after first aid. Treatment of chronic mercury poisoning requires expert medical care. At the first signs, immediately remove the exposed person from further exposure and have him or her examined and treated by a physician trained in occupational mercury poisoning.**

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, restrict access to the spill area to necessary personnel, and provide adequate ventilation. Clean up spills promptly. Specialized equipment and/or techniques may be required to safely deal with large mercury spills; if large quantities of mercury are used in the workplace, detailed, prior spill-management planning is recommended. Collect spilled mercury by using a suction pump and an aspirator bottle with a long capillary tube. For finely divided mercury in inaccessible cracks, corners, etc., treatment with calcium polysulfide and excess sulfur is recommended to convert the mercury globules into mercury sulfide. Vacuum cleaners may be used if they are equipped with specially designed mercury-absorbent exhaust filters. Collect the mercury into tightly sealed containers for later disposal or reclamation. Cleanup personnel must use the recommended personal protective equipment (see sect. 8).

Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Do not pour mercury down a drain. Mercury is very harmful to the environment. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Air Contaminant (29 CFR 19010.1000 Subpart Z)

EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste No. U151
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg)*

*Per the Clean Water Act, § 407 (a); Clean Air Act, § 112; and Resource Conservation and Recovery Act, § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of mercury may occur, wear a full face shield or splash guard. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent any contact with mercury and the skin.
Ventilation: Install and operate general and local ventilation systems powerful enough to continuously maintain airborne levels of mercury below the OSHA PEL standard cited in section 2.
Safety Stations: Make emergency eyewash stations, washing facilities, and safety/quick-drench showers available in work areas.
Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean mercury from shoes and equipment. Separate work and street clothes; store work clothes in special lockers and always shower before changing to street clothes.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store mercury in a cool, dry, well-ventilated area in tightly closed unbreakable polyethylene containers. Protect these containers from physical damage.
Special Handling/Storage: Construct storage areas to have smooth, hard, nonporous floors with no cracks or spaces so that spilled mercury globules do not form in inaccessible areas.
Comments: Mercury evaporates slowly, but if it is spilled it can form many tiny globules that evaporate much faster than a single pool of it will. In an unventilated area, significant concentration of mercury vapor can develop from this enhanced evaporation effect. This poisonous vapor is particularly hazardous if breathed over a long period of time, so spills or releases of mercury require very meticulous cleaning procedures.

Transportation Data (49 CFR 172.101-2)
DOT Shipping Name: Mercury, Metal
DOT Hazard Class: ORM-B

DOT Label: None
DOT ID No. NA2809

IMO Class: 8
IMO Label: Corrosive

References: 1, 2, 8, 26, 38, 84-94, 100.

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Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: MJ Hardies, MD

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CONSENSUS REPORTS: Reported in EPA TSCA Inventory.

SAFETY PROFILE: Mildly toxic by ingestion. A skin irritant. When heated to decomposition it emits acrid smoke and irritating fumes. See also 3,7-DIMETHYL-1,6-OCTADIEN-3-OL ACETATE.

LCE000 CAS:64083-05-2 *HR: 3*
LD-813

PROP: Commercial mixture of aromatic amines containing approx 40% MOCA.

TOXICITY DATA with REFERENCE
orl-rat TDLo:37 g/kg/2Y-C:CAR TXAPA9 31,159,75

SAFETY PROFILE: Questionable carcinogen with experimental carcinogenic data. When heated to decomposition it emits toxic fumes of NO_x. See also AROMATIC AMINES.

LCF000 CAS:7439-92-1 *HR: 3*
LEAD
af: Pb aw: 207.19

PROP: Bluish-gray, soft metal. Mp: 327.43°, bp: 1740°, d: 11.34 @ 20°/4°. vap press: 1 mm @ 973°.

SYNS: C.I. 77575 ◇ C.I. PIGMENT METAL 4 ◇ GLOVER ◇ LEAD FLAKE ◇ LEAD S2 ◇ OLOW (POLISH) ◇ OMAHA ◇ OMAHA & GRANT ◇ SI ◇ SO
etc.

TOXICITY DATA with REFERENCE
cyt-hmn-unr 50 μg/m³ MUREAV 147,301,85
cyt-rat-ihl 23 μg/m³/16W GTPZAB 26(10),38,82
cyt-mky-orl 42 mg/kg/30W TOLEDS 8,165,81
orl-dom TDLo:662 mg/kg (female 1-21W post):REP TXAPA9 25,466,73
orl-mus TDLo:4800 mg/kg (female 1-16D post):TER BECTA6 18,271,77
orl-wmn TDLo:450 mg/kg/6Y:PNS:CNS JAMAAP 237,2627,77
ihl-hmn TCLo:10 μg/m³:GIT:LIV VRDEAS (5),107,81
ipr-rat LDLo:1000 mg/kg EQSSDX 1,1,75
orl-pgn LDLo:160 mg/kg HBAMAK 4,1289,35

CONSENSUS REPORTS: IARC Cancer Review: Group 2B IMEMDT 7,230,87; Animal Inadequate Evidence IMEMDT 23,325,80. Lead and its compounds are on the Community Right-To-Know List. Reported in EPA TSCA Inventory. EPA Genetic Toxicology Program.

OSHA PEL: TWA 0.05 mg(Pb)/m³
ACGIH TLV: TWA 0.15 mg(Pb)/m³; BEI: 50 μg(lead)/L in blood; 150 μg(lead)/g creatinine in urine.
DFG MAK: 0.1 mg/m³; BAT: 70 μg(lead)/L in blood, 30 μg(lead)/L in blood of women less than 45 years old.
NIOSH REL: TWA (Inorganic Lead) 0.10 mg(Pb)/m³

SAFETY PROFILE: Suspected carcinogen. Poison by ingestion. Moderately toxic by intraperitoneal route. Human systemic effects by ingestion and inhalation: loss of appetite, anemia, malaise, insomnia, headache, irritability, muscle and joint pains, tremors, flaccid paralysis without anesthesia, hallucinations and distorted perceptions, muscle weakness, gastritis and liver changes. The major organ systems affected are the nervous system, blood system, and kidneys. Lead encephalopathy is accompanied by severe cerebral edema, increase in cerebral spinal fluid pressure, proliferation and swelling of endothelial cells in capillaries and arterioles, proliferation of glial cells, neuronal degeneration and areas of focal cortical necrosis in fatal cases. Experimental evidence now suggests that blood levels of lead below 10 μg/dl can have the effect of diminishing the IQ scores of children. Low levels of lead impair neurotransmission and immune system function and may increase systolic blood pressure. Reversible kidney damage can occur from acute exposure. Chronic exposure can lead to irreversible vascular schlerosis, tubular cell atrophy, interstitial fibrosis, and glomerular sclerosis. Severe toxicity can cause sterility, abortion and neonatal mortality and morbidity. An experimental teratogen. Experimental reproductive effects. Human mutation data reported. Very heavy intoxication can sometimes be detected by formation of a dark line on the gum margins, the so-called "lead line."

When lead is ingested, much of it passes through the body unabsorbed, and is eliminated in the feces. The greater portion of the lead that is absorbed is caught by the liver and excreted, in part, in the bile. For this reason, larger amounts of lead are necessary to cause toxic effects by this route, and a longer period of exposure is usually necessary to produce symptoms. On the other hand, upon inhalation, absorption takes place easily from the respiratory tract and symptoms tend to develop more quickly. For industry, inhalation is much more important than is ingestion. For the general population, exposure to lead occurs from inhaled air, dust of various types, and food and water with an approximate 50/50 division between inhalation and ingestion routes. Lead occurs in water in either dissolved or particulate form. At low pH, lead is more easily dissolved. Chemical treatment to soften water increases the solubility of lead. Adults absorb about 5-15% of ingested lead and retain less than 5%. Children absorb about 50% and retain about 30%.

Lead produces a brittleness of the red blood cells so that they hemolyze with but slight trauma; the hemoglo-

bin is not affected. Due to their increased fragility, the red cells are destroyed more rapidly in the body than is normal, producing an anemia which is rarely severe. The loss of circulating red cells stimulates the production of new young cells which, on entering the blood stream, are acted upon by the circulating lead, with resultant coagulation of their basophilic material. These cells after suitable staining, are recognized as "stippled cells." There is no uniformity of opinion regarding the effect of lead on the white blood cells.

In addition to its effect on the red blood cells, lead produces a damaging effect on the organs or tissues with which it comes in contact. No specific or characteristic lesion is produced. Autopsies in deaths attributed to lead poisoning and experimental work on animals have shown pathological lesions of the kidneys, liver, male gonads, nervous system, blood vessels and other tissues. None of these changes, however, has been found consistently. In cases of severe lead poisoning, the amount of lead found in the blood is frequently in excess of 0.07 mg per 100 cc of whole blood. The urinary lead excretion generally exceeds 0.1 mg per liter of urine.

Flammable in the form of dust when exposed to heat or flame. Moderately explosive in the form of dust when exposed to heat or flame. Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Rubber gloves containing lead may ignite in nitric acid. Violent reaction on ignition with chlorine trifluoride; concentrated hydrogen peroxide; ammonium nitrate (below 200° with powdered lead); sodium acetylide (with powdered lead). Incompatible with NaN_3; Zr; disodium acetylide; oxidants. Can react vigorously with oxidizing materials. A common air contaminant. When heated to decomposition it emits highly toxic fumes of Pb. See also LEAD COMPOUNDS.

LCG000 CAS:15347-57-6 *HR: D*
LEAD ACETATE
mf: $C_2H_4O_2 \cdot xPb$ mw: 1510.39

SYN: ACETIC ACID, LEAD SALT

TOXICITY DATA with REFERENCE
cyt-hmn:lyms 1 umol/L TBCSDY 8,39,84
cyt-hmn:leu 10 umol/L EXPEAM 30,1696,74
orl-rat TDLo:18900 µg/kg (male 9W pre):REP ANDRDQ 21,161,89

SAFETY PROFILE: Experimental reproductive effects. Mutation data reported. When heated to decomposition it emits toxic fumes of Pb.

LCG500 *HR: 3*
LEAD(IV) ACETATE AZIDE
mf: $C_4H_9N_3O_4Pb$ mw: 426.35

$Pb(OOCCH_3)_3N_3$

CONSENSUS REPORTS: Lead and its compounds are on the Community Right-To-Know List.

SAFETY PROFILE: Above 0°C it decomposes to nitrogen and the explosive lead(II) azide. When heated to decomposition it emits toxic fumes of NO_x. See also LEAD COMPOUNDS and AZIDES.

LCH000 CAS:1335-32-6 *HR: 3*
LEAD ACETATE, BASIC
mf: $C_4H_{10}O_8Pb_3$ mw: 807.71

PROP: White powder.

SYNS: BASIC LEAD ACETATE ◇ BIS(ACETO)DIHYDROXYTRILEAD ◇ BIS(ACETATO)TETRAHYDROXYTRILEAD ◇ BLA ◇ LEAD MONOSUBACETATE ◇ LEAD SUBACETATE ◇ MONOBASIC LEAD ACETATE ◇ RCRA WASTE NUMBER U146 ◇ SUBACETATE LEAD

TOXICITY DATA with REFERENCE
mmo-sat 250 mg/L ENMUDM 2,234,80
orl-mus TDLo:258 g/kg (28D male):REP EXPEAM 30,486,74
orl-rat TDLo:350 g/kg/90W-C:CAR BJCAAI 16,289,62
orl-mus TDLo:90 g/kg/2Y-C:ETA BJCAAI 23,765,69
ipr-mus TDLo:38 mg/kg/6W-I:NEO TXAPA9 82,19,86

CONSENSUS REPORTS: IARC Cancer Review: Group 3 IMEMDT 7,230,87; Animal Sufficient Evidence IMEMDT 23,325,80; IMEMDT 1,40,72; Human Limited Evidence IMEMDT 23,325,80. Lead and its compounds are on the Community Right-To-Know List. Reported in EPA TSCA Inventory. EPA Genetic Toxicology Program.

SAFETY PROFILE: Experimental reproductive effects. Questionable carcinogen with experimental carcinogenic, neoplastigenic, and tumorigenic data. Mutation data reported. When heated to decomposition it emits toxic fumes of Pb. See also LEAD and LEAD COMPOUNDS.

LCI000 *HR: 3*
LEAD ACETATE BROMATE
mf: $C_2H_3BrO_5Pb$ mw: 394.15

CONSENSUS REPORTS: Lead and its compounds are on the Community Right-To-Know List.

SAFETY PROFILE: A poison. A very friction-sensitive explosive. Upon decomposition it emits toxic fumes of Pb and Br^-. See also LEAD COMPOUNDS and BROMATES.

LCI600 *HR: 3*
LEAD ACETATE-LEAD BROMITE
mf: $C_4H_6O_4Pb \cdot Br_2O_6Pb$ mw: 788.29

$Pb(OOCCH_3)_2 \cdot Pb(BrO_3)_2$

Material Safety Data Sheet

GNB Industrial Battery Company
Woodlake Corporate Park
829 Parkview Boulevard
Lombard, IL 60148-3249

Electrolyte (Sulfuric Acid

Identity (Trade Name As Used On Label)

C04SA

MSDS Number*

7664-93-9

CAS Number*

April 13, 1987

Date Prepared

James B. Doe, P.E.

Prepared By*

(708) 691-7886
Phone Number (For Information)

(800) 424-9300
Emergency Phone Number

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

SECTION 1 - MATERIAL IDENTIFICATION AND INFORMATION

COMPONENTS — Chemical Name & Common Names (Hazardous Components 1% or greater; Carcinogens 0.1% or greater)	% (Wt.)	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
		mg/m^3	mg/m^3	
Sulfuric Acid Solution - Electrolyte	20-40	1	1	
Non-Hazardous Ingredients	60-80			
TOTAL	100			

TRANSPORTATION INFORMATION:

SECTION 2 - PHYSICAL / CHEMICAL CHARACTERISTICS

Boiling Point: 219°F to 237°F

Specific Gravity (H_2O=1): 1.140 to 1.300

Vapor Pressure (mm Hg and Temperature): 20.8 to 48.6 @ 77°F

Melting Point Point: 7.7°F to -40.0°F

Vapor Density (Air = 1): 3.4

Evaporation Rate (Butyl Acetate = 1): Less that 1

Solubility in Water: Infinite

Water Reactive: Exothermic - Always add acid to water

Appearance and Odor: clear liquid with sharp, penetrating pungent odor

SECTION 3 - FIRE AND EXPLOSION HAZARD DATA

Flash Point and Method Used	Auto-Ignition Temperature	Flammability Limits in Air % by Volume	LEL	UEL
n/a	n/a	n/a	n/a	

Extinguisher Media: n/a

Special Fire Fighting Procedures: Move electrolyte containers from fire area if possible. Cool these containers exposed to flames from side until well after fire is out.

Use respirator as protection against electrolyte mist

Unusual Fire & Explosion Hazards: Do not use water directly on electrolyte. If large amounts of combustible materials are involved, use water spray or fog in flooding amounts. Use water spray to absorb corrosive vapors. Refer to Section 7 for procedures in handling electrolyte.

Material Safety Data Sheet For: Page 2 of 2 Electrolyte MSDS (cont.)

SECTION 4 - REACTIVITY HAZARD DATA

STABILITY ☒ Stable ☐ Unstable	Conditions To Avoid: Violent exothermic reaction with water and organic materials. May ignite finely divided combustible materials on contact. Runoff to sewer may create fire or explosion hazard.
Incompatability (Materials to Avoid)	Iron, powdered metals, zinc and steel react with sulfuric acid and release flammable hydrogen gas.
Hazardous Decomposition Products	Thermal decomposition products include highly toxic fumes of sulfuric oxides (SOx).
HAZARDOUS POLYMERIZATION ☐ May Occur ☒ Will Not Occur	Conditions To Avoid: N/A

SECTION 5-HEALTH HAZARD DATA

PRIMARY ROUTES OF ENTRY	☒ Inhalation ☒ Skin Absorption	☒ Ingestion ☐ Not Hazardous	CARCINOGEN LISTED IN	☐ NTP ☐ IARC Monograph	☐ OSHA ☒ Not Listed

HEALTH HAZARDS	Acute: Nose, eye and throat irritation
	Chronic: Repeated exposure to mist or liquid causes respiratory dermatitis, conjunctivitis and lacrimation.
Signs and Symptoms of Exposure	Stinging and burning sensation to skin and eyes.
Medical Conditions Generally Aggravated by Exposure	Exposure to acid mist can aggravate pulmonary conditions.

EMERGENCY FIRST AID PROCEDURES — Seek medical assistance for further treatment, observation and support if necessary.

Eye Contact: If electrolyte contacts the eye, immediately wash the eye with large amounts of water and continue flushing for 15 minutes. Get medical attention promptly.

Skin Contact: If electrolyte contacts the skin, promptly wash the skin with soap and water. Get medical attention promptly.

Inhalation: If electrolyte is inhaled, remove person to fresh air. If breathing has stopped, perform artificial respiration. Get medical attention.

Ingestion: If electrolyte has been swallowed, get medical attention immediately. Give large quantities of water until medical help arrives.

SECTION 6-CONTROL AND PROTECTIVE MEASURES

Respiratory Protection (Specify Type): Self-contained breathing apparatus if fumes or mist are present.

Protective Gloves: Rubber	Eye Protection: Goggles or face shield.

VENTILATION TO BE USED			
	☒ Local Exhaust: To outside air	☒ Mechanical (general): To outside air	☐ Special
	☐ Other (specify)		

Other Protective Clothing and Equipment: Rubber boots, rubber apron and polyester clothing.

Hygienic Work Practices: Wash hands and protective equipment with water after use.

SECTION 7-PRECAUTIONS FOR SAFE HANDLING AND USE/LEAK PROCEDURES

Steps to be Taken If Material is Spilled Or Released: Contain spill with absorbant dike. Apply baking soda, soda ash, caustic soda or equivalent to neutralize the electrolyte.

Waste Disposal Methods: Neutralized electrolyte may be disposed in sewer system if local regulations permit. Any dike material should be disposed in accordance with local regulations.

Precautions to be Taken in Handling and Storage: Avoid electrolyte contact with eyes, skin or clothing. Avoid breathing electrolyte vapor. No smoking regulations if possibility of hydrogen evolution.

Other Precautions and/or Special Hazards: Store electrolyte only in approved containers.

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP

NO 2

POTASSIUM HYDROXIDE
Revision B

DATE February 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME POTASSIUM HYDROXIDE
OTHER DESIGNATIONS: Caustic Potash, Potash Lye, KOH, GE Material D4B11, CAS #001 310 583
MANUFACTURER: Available from many suppliers, including:

Hooker Chemicals & Plastics Corp.
Industrial Chemicals Group
Niagara Falls, NY 14303
Tel: (716) 278-7777

Allied Chemical
P.O. Box 1139R
Morristown, NJ 07960 Tel: (201) 455-4157
Emerg Tel: (201) 455-2000

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Typical content:		
Potassium Hydroxide (KOH)	>83	Ceiling Level 2 mg/m^3 (KOH)*
Water	<13	
Potassium Carbonate (K_2CO_3)	<3.5	Human, Skin 50 mg/24H Severe Irritation
*ACGIH (1983) TLV.		Rat, Oral LD_{50} 365 mg/kg

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F ---- 2400
Vapor pressure, 719 C, mm Hg ---- 1.0
Volatility @ R.T. --------- Negligible
Solubility in water, %, at 0 C - 49
20 C - 52
100 C - 64

Specific gravity, 20/4C ---------- 2.044
Melting point, deg C ---------- ~360
(if anhydrous - 380C)
pH (0.1 M solution) ---------- 13.5
Molecular weight ---------- 56.1

Appearance & Odor: Off-white, hygroscopic solid; no odor. (Irritancy of KOH dust may become noticeable at 2 mg/m^3.)

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
None-Not combustible	N/A	N/A	N/A	N/A

Although it is not combustible and does not support combustion, it can be hazardous if present in a fire area. The following should be known for fire fighting: (1) It can melt and flow when heated (m.p. about 360 C). (2) Hot or molten material can react violently with small amounts of water (splattering, misting). (3) Can react with certain metals, such as aluminum, to generate flammable hydrogen gas. (4) Reacts with CO_2.
Firefighters should use self-contained respirator and full protective clothing.

SECTION V. REACTIVITY DATA

It is a stable material in closed containers under normal conditions of storage and handling. It does not polymerize. It is hygroscopic. It reacts with carbon dioxide from the air to form potassium carbonate.
Potassium hydroxide can react violently with strong acids and with many organic chemicals especially with nitrocarbons and chlorocarbons. (Reacts with trichloroethylene to form spontaneously flammable dichloroacetylene.) It generates much heat when it dissolves in water.
Avoid contact with leather and wool (hydrolysis). It is corrosive to aluminum, tin, zinc, and alloys which contain these metals (liberates hydrogen).

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NO 2

SECTION VI HEALTH HAZARD INFORMATION

TLV (Ceiling) 2 mg/m3

Strongly alkaline! Solid or its Conc. solutions can be rapidly corrosive to human tissue, producing severe burns and severe to permanent eye injury. Dust/mist inhalation can injure the entire respiratory tract. Ingestion causes burns, extreme pain and esophageal stricture. Estimated adult LD_{50} is 5g.

FIRST AID:

Eye Contact: Immediately flush with running water for 15 min., including under eyelids. (Speed in rinsing may save eyesight!) Contact physician! Continue gentle flushing 30 minutes or more or until medical help obtained.

Skin Contact: Flush with running water, under safety shower while removing clothing for gross contact. Continue flushing up to an hour for serious cases until medical help obtained.

Inhalation: Safely remove to fresh air. Contact physician. Have trained person administer oxygen for respiratory distress.

Ingestion: Immediately give 2-3 glasses of milk or water to drink; then citrus juice or diluted vinegar to neturalize. Contact physician. Vomiting may occur spontaneously, but do not induce it. Repeat giving liquid if vomiting occurs.

Get medical help for treatment, observation and support after first aid.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of large spills. Institute prior plan. Provide ventilation (explosion-proof where H_2 can be generated). Clean-up personnel need protection against inhalation of mists or dusts and skin or eye contact.

Promptly shovel or sweep up dry material and place in appropriate container for use or disposal. (Delayed clean-up will allow pick up of moisture, increasing clean-up task.) CAUTION! Avoid dusting conditions. Wet trace residues with water and neutralize with dilute acetic acid. (Sodium bicarbonate may be used to partially neutralize.) Flush with much water. Do not flush waste caustic directly to sewer or surface waters.

DISPOSAL: Carefully dissolve in water and neutralize with dilute acetic acid. Flush to sewer with lots of water, regulations permitting. Or dispose of through a licensed contractor. Consider use of waste caustic for neutralizing plant acid wastes.

Follow Federal, State and Local regulations.

AQUATIC TOXICITY TLm 96: 100-10ppm EPA (CWA) RQ is 1000 lbs. (40CFR 117)

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general ventilation, and also local exhaust ventilation (with filtration to remove KOH from exhausted air) to meet TLV requirements, especially where dusting or misting occurs. For exposures to 100 mg/m3 use high efficiency particulate respirator or a self-contained respirator; full facepiece. Wear chemical safety goggles and/or full faceshield where dusting or splashing is possible. Use neoprene or rubber gloves and appropriate protective clothing (apron, boots, etc.) where needed to prevent contact, especially when solutions are prepared. Soiled clothing to be removed promptly and laundered before reuse.

Eyewash fountains, washing facilities and safety showers should be immediately accessible in areas of use and handling.

Provide employee training for those working with KOH; until trained, workers should not work with this material.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a dry, well-ventilated area separate from acids, peroxides, easily ignitible materials and other incompatibles. Protect containers from physical damage. Have abundant water supply available where stored or used. Drainage systems for storage or use areas need retention basins for pH adjustment and dilution of spills prior to discharge.

To prepare solutions add caustic potash slowly to water while stirring to avoid rapid heat build up. Avoid breathing dusts or mists. Avoid contact with skin, eyes and clothing. Wash thoroughly after handling. Wear protective clothing when handling material.

DOT Classification: CORROSIVE MATERIAL I.D. No. UN1813 (Dry Solid) Label: CORROSIVE

DATA SOURCE(S) CODE: 1-11,14,25,26,37,39,43,47-49

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APPROVALS: MIS/CRD J. M. Nielsen

INDUST. HYGIENE/SAFETY 2-6 84

MEDICAL REVIEW: FEB 13 1984

Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 38
LEAD MONOXIDE
(Revision B)
Issued: November 1979
Revised: February 1986

SECTION 1. MATERIAL IDENTIFICATION

19

MATERIAL NAME: LEAD MONOXIDE

OTHER DESIGNATIONS: Lead (II) Oxide, Plumbous Oxide, Litharge, Massicot, PbO, CAS # 1317-36-8

MANUFACTURER/SUPPLIERS: Available from several suppliers, including:
NL Baroid, Inc., PO Box 1675, Houston, TX 77251; Telephone: (713) 527-1100
Eagle-Picher Industries, Inc., Chemicals Division, 580 Walnut Street, Cincinnati, OH 45202; Telephone: (513) 721-7010

HMIS	Not Found
H. 2	
F. 0	R 0
R. 0	I 4
PPE *	S 0
* See Sect. 8	K 0

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
LEAD MONOXIDE, PbO	>99	ACGIH TLV*: 8-hr TWA: 0.15 mg/m^3
* Current (1985-86) ACGIH TLV, as Pb		OSHA PEL**: 8-hr TWA: 0.05 mg/m^3
** Current OSHA PEL (as Pb) with an action level of 0.03 mg/m^3 (29 CFR 1910.1025)		Rat, Intraperitoneal, LDLo: 430 mg/kg
		Dog, Oral, LDLo: 1400 mg/kg

SECTION 3. PHYSICAL DATA

Melting Point ... 1646.6°F(897°C) (Begins to Sublime before Melting)
Boiling Point ... 2681.6°F(1472°C) (Decomposes)
Molecular Weight ... 223.2

	Litharge	Massicot
Density	9.53 g/cc	9.6 g/cc
Solubility in Water (@ 25°C)	0.0504 g/L	0.1065 g/L

Appearance and odor: Lead monoxide exists in two crystalline forms: litharge and massicot. The reddish litharge transforms to yellow massicot at 912.2°F(489°C). Lead monoxide is odorless.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
NA	NA	NA		

This material is nonflammable. Use whatever extinguishing agents are appropriate for the surrounding fire.

When hot, lead monoxide can act as an oxidizing agent and may intensify combustion.

Toxic dust and fumes may be generated in a fire situation. Fire fighters should wear self-contained breathing apparatus and full protective gear.

SECTION 5. REACTIVITY DATA

Lead monoxide is stable at room temperature. It does not polymerize. When heated and cooled in air it can undergo transitions between crystalline and oxide forms.

Mixtures of lead oxide and chlorinated rubber may react violently when heated. A lead oxide-glycerol mixture (used as cement/jointing compound) can ignite when exposed to fluorine gas and may explode after exposure to perchloric acid fumes. Violent reactions can occur when lead monoxide is heated with aluminum, sodium, zirconium, titanium, boron, or silicon. Other incompatibles include hydrogen trisulfide, metal acetylides, and peroxyformic acid.

Toxic lead fumes can form at high temperatures.

No. 38 2 80 LEAD MONOXIDE (Rev. B)

SECTION 6. HEALTH HAZARD INFORMATION | TLV

Lead compounds are toxic when inhaled or ingested. Lead is a cumulative poison. The chief effects of excessive lead intake are anemia, neurological disorders, and kidney damage. Symptoms of the neurological effects may include irritability, headaches, insomnia, delirium, convulsions, muscular tremors, and palsy of the extremities. Excessive lead exposure may also have adverse effects on human reproduction. Symptoms of acute lead poisoning by ingestion include headache; abdominal pain; nausea, vomiting; diarrhea; and, in severe cases, coma and death.
The IARC concludes that the evidence for carcinogenicity of lead and lead compounds to humans is inadequate. The NTP does not list lead monoxide in its third annual report on carcinogens.

FIRST AID: Any worker who experiences symptoms of lead poisoning should be removed from exposure and receive prompt medical care. EYE CONTACT: Flush eyes (including under the eyelids) with running water for at least 15 minutes. Obtain medical attention. SKIN CONTACT: Flush affected area with plenty of water. If irritation persists, seek medical attention. INHALATION: Remove victim from exposure. Get medical attention for treatment of symptoms. INGESTION: If person is conscious, give another plenty of milk or water to drink. Induce vomiting. Keep victim warm and at rest. Get medical assistance immediately.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety/environmental personnel of large spills. Ventilate spill area. Cleanup personnel should wear respiratory protection, gloves, and protective clothing. Carefully vacuum up spilled material. Place collected material in a suitable container that can be tightly sealed for reclaim or disposal. Avoid dusting conditions at all stages of handling.

DISPOSAL: Salvage material when possible. PbO requires disposal as a hazardous waste. Contact supplier or a licensed chemical waste disposal contractor for treatment, packaging, and disposal requirements. Follow Federal, state, and local regulations.

EPA Hazardous Waste No.: D008 (EP TOXIC; 40 CFR 261.24)

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide local exhaust ventilation and/or other engineering controls to meet the PEL requirement. NIOSH-approved respirators should be worn where engineering controls and work practices do not reduce exposures to or below the PEL. Half-mask air-purifying respirators with high efficiency filters are acceptable for concentrations up to 0.5 mg/m^3 (2.5 mg/m^3 with full facepiece). Protective clothing and equipment such as coveralls, gloves, hats, and shoes should be worn when exposures exceed the PEL or where the possibility of skin and eye contact exist. Provide clean body-covering work clothing weekly to workers exposed to above the PEL (daily if exposed above 0.2 mg/m^3) and arrange for special handling and laundering of contaminated clothing. Changing rooms (with separate storage facilities for street and work clothing) and showers are required for employees exposed to above the PEL. Prevent dust from being transported to lunchroom by way of the ventilation system or contaminated clothing. Consult the OSHA lead standard (29 CFR 1910.1025) for detailed requirements.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in tightly closed containers away from incompatibles. Protect containers from physical damage. Keep away from food or feed. Use good housekeeping procedures (vacuuming and/or wet cleanup) to prevent accumulation of dust. DO NOT use compressed air for cleaning surfaces or clothing (use vacuum). Follow good personal hygiene practice. Wash face and hands thoroughly after handling and before eating, drinking, or smoking. Do not eat, drink, or use tobacco in areas where this material is used.
Exposure monitoring, biological monitoring, and medical surveillance should be provided in accordance with the OSHA Lead Standard (29 CFR 1910.1025).
Prevent dust generation. Use with adequate ventilation. Avoid inhalation and contact. Do not ingest.

DOT Classification: Not listed in Hazardous Materials Table, 49 CFR 172.101.
Data Source(s) Code: 2, 4, 5, 12, 14, 25, 55, 57, 58, 61, 62, 82, 84. CV

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Approvals	
Indust. Hygiene/Safety	6/86
Medical Review	

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Schenectady, NY 12304-4690 USA
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Section 1. Material Identification

41

Cadmium Metal/Powder (Cd) Description: Occurs naturally in the mineral greenockite (cadmium sulfide). This form is rare and most cadmium is obtained by extraction from other ores containing it as a mineral (lead, copper, and zinc). Zinc sulfide ores are the main source; by direct distillation or recovery from the electrolytic process. Used in electroplating other metals, fire protection systems, nickel-cadmium storage batteries, power transmission wire, TV phosphors, pigments for ceramic glazes, machinery enamels, baking enamels, photography and lithography, selenium rectifiers, electrodes for cadmium-vapor lamps, and photoelectric cells; as a fungicide and a Weston standard cell control of atomic fission in nuclear reactors.

Other Designations: CAS No. 7440-43-9, colloidal cadmium.

Manufacturer: Contact your supplier/distributor. Consult latest *Chemical Week Buyers' Guide*[73] for suppliers list.

Cautions: Cadmium is a highly toxic metal. Symptoms may be delayed several hours and include pulmonary edema (fluid in lungs) which can be fatal. Chronic effects include kidney damage. Cd is considered a carcinogen by several government agencies. The powder is pyrophoric and presents a significant fire/explosion hazard.

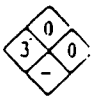
Powder

HMIS		R	
H	3*	I	4
F	1	S	2
R	3	K	3

Genium

Solid

HMIS		R	
H	3*	I	4
F	0	S	2
R	0	K	1



*Chronic effects PPE-Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Cadmium, ca 100%

1992 OSHA PEL
8-hr TWA: 5 $\mu g/m^3$

1992 OSHA SECAL*
TWA: 15 or 50 $\mu g/m^3$

1990 IDLH Level
50 mg/m^3

1993-94 ACGIH TLVs
TWA: 0.01 mg/m^3 (total dust), Class A2 carcinogen
TWA: 0.002 mg/m^3 (respirable fraction)

1991 DFG (Germany) MAK
None established

1992 NIOSH REL
Carcinogen, keep as low as possible

1992 Toxicity Data†
Human, inhalation, LC_{Lo}: 39 mg/m^3/20 min caused cardiac changes, thrombosis, and respiratory depression.
Rat, oral, LD_{50}: 225 mg/kg; details not reported.
Woman, inhalation, LC_{Lo}: 129 $\mu g/m^3$ for 20 continuous years produced lung tumors.
Man, TC_{Lo}: 88 $\mu g/m^3$/8.6 years caused kidney and urinary toxicity with protein in the urine.

* Separate engineering control limit: to be achieved in processes and work places where it is not possible to achieve the PEL through engineering and work practices alone. The SECAL for Cd is 15 or 50 $\mu g/m^3$ depending on the processes involved. See Federal Register 57 (178): 42222, Table VIII-B1, 9/14/92.
†See NIOSH, *RTECS* (EU9800000), for additional mutation, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 1409 °F (765 °C)
Melting Point: 610 °F (321 °C)
Vapor Pressure: 0.095 mm Hg at 609.6 °F (320.9 °C)
Refraction Index: 1.13
Mohs Hardness: 2.0
Molecular Weight: 112.4
Density: 8.642
Water Solubility: Insoluble
Other Solubilities: Soluble in nitric (rapidly), hydrochloric (slowly), and other acids. The solid is soluble in ammonium nitrate solution, but the powdered form undergoes an explosive reaction.

Appearance and Odor: Silver-white, blue-tinged, lustrous, odorless, soft metal that is easily cut with a knife. The powder is grayish-white.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: The solid metal is not flammable, but the finely divided powder is pyrophoric. As a rule, the more finely divided the powder is, the greater the potential for explosion. Use carbon dioxide, dry chemical, or sand. **Unusual Fire or Explosion Hazards:** Processes that create cadmium dust such as cutting, grinding, or welding present a serious explosion hazard in presence of ignition sources. Avoid creation of cadmium dust clouds. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Do not release runoff from fire control methods to sewers or waterways; dike for proper disposal.

Section 5. Reactivity Data

Stability/Polymerization: Cadmium easily tarnishes in moist air as it is oxidized to cadmium oxide. The solid is stable in dry air. The powder is pyrophoric. Cd becomes brittle at 176 °F (80 °C). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include ammonium nitrate (powdered Cd), hydrazoic acid, tellurium, zinc, ammonia, sulfur, selenium, nitryl fluoride, and oxidizing agents. **Conditions to Avoid:** Creation of Cd dust clouds, exposure to heat and ignition sources, and contact with incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of Cd can produce toxic cadmium oxide (CdO) fumes.

Section 6. Health Hazard Data

Carcinogenicity: The following agencies list Cd as a carcinogen: IARC Class 2A (probably carcinogenic in humans),[183] NTP Class 2 (reasonably anticipated to be a carcinogen),[169] and NIOSH Class X (carcinogen defined without further categorization),[183] ACGIH TLV-A2 (suspected human carcinogen),[183] EPA-B1 (Probable human carcinogen) and DFG MAK-A2 (unmistakably carcinogenic in animal experimentation only).[183]
Summary of Risks: Dust or fume inhalation generally results in acute symptoms delayed up to 24 hr. Effects include a flu-like syndrome similar to metal fume fever with chills, fever, and muscle pain in the back and limbs. Pulmonary edema (fluid in lungs) can develop after severe exposure and may result in death. If victim recovers, residual changes may include lung fibrosis (thickening) and vascular changes. Long-term exposure to Cd damages the liver and kidneys (accumulates, half-life = 7 to 30 yr). Proteinuria (protein in urine) of low molecular weight is the first sign of tubular dysfunction. Excess urinary glucose is also seen. Bone demineralization similar to osteoporosis (decreased bone density)...

Continue on next page

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Section 6. Health Hazard Data, *continued*

occurs *not* as a direct effect of Cd exposure, but indirectly by altering kidney regulation of calcium and phosphorus which are needed for strong, healthy bones. Some studies show a correlation between anemia (low hemoglobin in blood) and high Cd levels. Selenium (Se) and zinc (Zn) appear to suppress Cd toxicity; Se binds up Cd, preventing it from entering body tissue and Zn may compete for the same metabolic site. **Medical Conditions Aggravated by Long-Term Exposure:** Kidney, blood, or respiratory disorders. **Target Organs:** Blood, kidney, liver, respiratory system. **Primary Entry Routes:** Inhalation, ingestion. **Acute Effects:** Inhalation may cause irritation of the eyes, nose, and throat, nausea and vomiting, abdominal colic, diarrhea, chest tightness, cough, headache, and weakness. Pulmonary edema could develop up to 24 hr post exposure. Kidney damage may occur after acute exposures, but is more likely with chronic exposure. **Chronic Effects:** Symptoms may be delayed several years after last exposure and include perforation of the nasal septum (tissue between the nostrils), loss of smell, chronic bronchitis, severe progressive emphysema, anorexia, insomnia, fatigue, pallor, anemia, kidney damage, bone demineralization, lung fibrosis and possible cancer of the respiratory tract.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Wash exposed area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of cadmium's irritating nature.

Note to Physicians: β-2 microglobulin excretion of > 200 µg/g creatinine indicates kidney dysfunction as does a renal cortex [Cd] of 180 to 220 µg/g of wet kidney cortex. Blood Cd levels are *not* indicative of exposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against inhalation. Carefully scoop up small spills and place in sealed impermeable containers. *Do not* disperse dust by sweeping. Remember that Cd powder can be pyrophoric and must be handled carefully. Prevent entry into sewers, drains, and waterways. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.24): D006, Characteristic of Toxicity; regulatory level = 1.0 mg/L

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 10 lb (4.54 kg)† [* per CWA, Sec. 307(a)]

SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1027)

No reporting of releases of this substance is required if the diameter of the pieces of the solid metal is equal to or exceeds 100 µm (0.004 in.)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For any detectable concentration, use a SCBA or supplied air respirator (with auxiliary SCBA) with a full facepiece operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear gloves, boots, aprons, and gauntlets to prevent Cd dust from contacting skin. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL or SECAL (Sec. 2). Lunchroom facilities should not have concentrations above 2.5 µg/m³ at any time. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(NIOSH) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes; launder before reuse. Remove Cd from shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using Cd, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage/Handling Requirements: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles. Do not allow cadmium dust to build up in storage areas.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and maintain concentrations at the lowest practical level.

Administrative Controls: Prohibit workers from removing Cd from protective clothing and equipment by blowing, shaking, or any other means that disperses Cd into the air. Employees must not enter eating facilities while wearing PPE unless it is vacuumed with a HEPA. Consider preplacement and periodic medical exams of exposed workers emphasizing the blood, kidneys, liver, and respiratory system. Educate workers on cadmium's carcinogenicity.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Poisonous solids, n.o.s.*, Pyrophoric metals, n.o.s.†
DOT Hazard Class: 6.1*, 4.2†
ID No.: UN2811*, UN1383†
DOT Packing Group: III*, I†
DOT Label: Keep away from food*, Spontaneously Combustible†
Special Provisions (172.102): —*, B11†

Packaging Authorizations
a) **Exceptions:** 173.153*, None†
b) **Non-bulk Packaging:** 173.213*, .187†
c) **Bulk Packaging:** 173.240*, .242†

Quantity Limitations
a) **Passenger Aircraft or Railcar:** 100 kg*, Forbidden†
b) **Cargo Aircraft Only:** 200 kg*, Forbidden†

Vessel Stowage Requirements
a) **Vessel Stowage:** A*, D†
b) **Other:** –

Solid metal, † Powder

(SDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 148, 159, 167, 169, 183, 185, 186
Prepared by: M Gannon, BA; Industrial Hygiene Review: PA Roy, MPH, CIH; Medical Review: TW Thoburn, MPH, MD

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PERCENT WEIGHT OF MATERIAL
BASED ON THE TOTAL WEIGHT OF
THE BATTERY

ST-2

McGinn -

DISCH

Carbon:	5.76%	
Zinc:	22.5%	
Zinc Strap + 4 Screws =	0.61%	
Potassium Hydroxide:	10.92%	
Lid:		
Lid (Top) + Shields + Rope =		
2 Caps =	2.1%	
Pitch Seal:	1.0%	
MP-20 Glue:	0.22%	(Including White Epoxy)
Case:	6.81%	
Lime:	15.1%	(Including 2.4% Ca cl_2)
Lime Canisters:	0.90%	
Zinc Oxide:	0.91%	
Water:	31.85%	
Mercury:	0.067%	
Terminal Hardware:	0.7%	
Bichloride of Mercury:		
(Surface Amalgamation)	0.056%	

Total Hg .123

PERCENT WEIGHT OF MATERIALS BASED ON THE TOTAL WEIGHT OF THE BATTERY.

ST-3

Carbon:	5.8%	
Zinc:	22.6%	
Zinc Straps	0.62%	
Lid:		
Lid (Top) + Shields + Rope	=	
2 Caps	= 2.0%	
Pitch Seal:	1.0%	
MP-20 Glue:	0.22%	(Including White Epoxy)
Case:	6.86%	
Lime:	15.2%	(Including 2.4% Ca Cl_2)
Lime Canisters:	0.90%	
Potassium Hydroxide:	11.0%	
Zinc Oxide:	0.92%	
Water:	32.1%	
Mercury:	0.0679%	
Terminal Hardware:	0.655%	
Bichloride of Mercury:		
(Surface Amalgamation)	0.0566%	.0677 + .0566 = .1245

ATTACHMENT TO FORM OSHA-20

McGraw-Edison Co., Power Systems Group
P. O. Box 28, Bloomfield, N. J. 07003

S20. 4.1.7. Federal Stock Number (FSN):

S20. 4.1.8. Gross Weight:

S20. 4.1.9. Outside Package Dimensions:

Length -
Height -
Width -

S20. 4.1.10. National Fire Protection Assn. Std. 704M. Signal:

Flammability - 1
Health - 2
Reactivity - 0
Specific Hazard - Strong Alkali

S20. 4.10 Section X - Transportation Data

Proper Shipping (Article) Name:

Batteries, Electric, Storage, Wet.

DOT Classification: Corrosive

DOT Label: Corrosive

DOT Marking: NA #2794

DOT Placard: Corrosive

Precautions To Be Taken In Transportation:

Shipping cartons comply with DOT requirements in CFR-49 #100-199.

ATTACHMENT 7: PPE ENSEMBLE DESCRIPTIONS .13
PAGE 1 LEVEL D ENSEMBLE 4/93

OPERATION FOR WHICH THIS LEVEL D ENSEMBLE APPLIES: All operations with air "normal" air contaminate levels. Air contaminates below permissible exposure limits.

___ cloth coveralls
OPTION: ___long/___short sleeved coveralls
OPTION: street clothing may be worn by personnel not exposed to splashing liquids or oily equipment.

___ chemical resistant coveralls (Tyvek/rain suits)

___ resistant (see note 2) steel toe/shank safety boots with textured bottoms
OPTION: hip high boots (e.g., designated snake areas)
OPTION: deck shoes with textured soles (e.g., boat ops)

___ resistant gloves
OPTION: leather gloves (if no contact with oil)

___ hard hat (when objects are handled overhead. All personnel in designated areas)

___ safety glasses (as required by Site Safety Officer)
OPTION: with tinted lenses (as required for sunlight)

___ PFD (all personnel on or near water)
___ Chest or Knee Waders (as needed)
___ hearing protection (in noisy areas)
___ insect repellant (in designated mosquito/tick areas)
___ sunscreen (as needed for sunlight)
___ whistle (in designated areas)

NOTES:

1) "AS NEEDED" means to use when and in such a way so as to prevent significant skin contact with oil.
2) "RUBBER"/"RESISTANT" means chemical resistant material which resists oil penetrating to the skin or cloth garments underneath. Neoprene is a common material which is resistant to many oils.
3) Respiratory protection is used in this ensemble as a safe work practice while working around carcinogens in order to keep low exposures as low as reasonably attainable. For spill response involving oils that may still contain benzene in particular this may be used while working in close proximity to spilled product until benzene has weathered away (typically the first day).

ATTACHMENT 8: DECON LAYOUT .11A
PAGE 1 4/93

EQUIPMENT NEEDED (LEVEL D)

STATION 1: EQUIPMENT DROP / OUTER, RAIN GEAR, GLOVES, AND KNEE WADERS WASH & RINSE:

___ chem wipes, spray bottle, paper towels (equipment DECON, at equipment drop)

STATION 2: PROTECTIVE SUIT WASH/RINSE:

___ garden hose/spray apparatus capable of spraying contaminated areas if suit is to be used more than once

___ garbage bag for one use suits

STATION 3: OUTER BOOT/GLOVE REMOVAL:

___ garbage bag

STATION 4: GLOVE/BOOT/BOOTIE REMOVAL:

___ garbage bag

STATION 5: RESPIRATOR STATION: (as needed)

___ wash with cleaner/sanitizing solution

___ plastic carrying bag

STATION 6: MEDICAL MONITORING STATION: (as needed)

___ stool or seat

___ medical monitoring equipment

___ 1st AID KIT

First CG District ATON Battery Recovery Site Safety Plan

ATTACHMENT 9: SANITATION REQUIREMENTS

A. Potable water. An adequate supply of potable water, or other drinking fluids, shall be maintained at all times throughout the site. Containers for drinking fluids shall be capable of being tightly closed, and equipped with a tap. These containers must also be labeled in such a manner that the contents are not accidentally used for other purposes. Where single service cups are supplied, the unused cups shall be maintained in a sanitary containers; and a separate disposal container provided for used cups.

B. Non-potable water. Water intended for uses other than drinking or washing shall be identified in a way that it is not accidentally used for drinking, washing, or cooking. There shall be no cross-connection of potable and non-potable water supplies.

C. Toilet facilities. When activities will be prolonged (over 2.5 hours) toilet facilities shall be provided at a minimum in accordance with Table H-120.2 (Toilet Facilities) of 29 CFR 1910.120(n). For 20 or fewer people 1 facility (porta-potty) is required

E. Washing Facilities. Washing facilities shall be readily accessible by all employees. In addition to sanitary cleaning, these facilities shall be so equipped that they can be used to remove oily residues from the skin. Washing facilities shall be maintained free of contaminants above exposure limits, and as free as practical from oily residues.

First CG District ATON Battery Recovery Site Safety Plan

I. POISONOUS\INFECTIOUS INSECTS. The primary concern here is ticks carrying Lymes disease, poisonous spiders, bee stings, allergic sensitivities, and for certain response operations mosquitoes that may be carriers of infectious diseases.

A. PREVENTION.

1. During morning safety briefings, provide information on the location of hazards and how to deal with problems.

2. Personnel should be provided with long sleeved clothing and insect repellant in designated areas.

3. Personnel should inspect each other for ticks and signs of infected bites during breaks when working in designated areas.

4. Personnel with allergies to bee stings or insect bites may suffer a medical emergency if bitten. Supervisors on site should be prepared to deal with these medical emergencies.

5. Personnel with severe allergies must work in areas away from known/suspected bee hazards.

B. BEE STINGS. When a bee stings it may leave a stinger in the wound which will continue to inject venom. Wasps, hornets, and ants do not have this type of stinger, but they can produce multiple bites.

1. The following signs or symptoms may indicate an allergic reaction:

- swollen throat, difficulty breathing, or noisy breathing;

- sudden pain, severe itching, hives (or itching over the body), headache, acute redness and/or swelling of the wound;

- a white, firm swelling in the skin with itching;

- reduced consciousness, or shock.

2. FIRST AID.

a. Wash the wound with soap and water.

b. If symptoms of allergic reaction are present REQUEST MEDICAL ASSISTANCE and treat for shock.

ATTACHMENT 10: BITES, STINGS, AND POISONOUS PLANTS .23
PAGE 1 4/93

Personnel briefed on first aid procedures must understand that "FIRST" aid implies that further treatment will probably be needed from trained/qualified medical personnel.

See the American Red Cross- Standard First Aid Training Manual or the American Academy of Orthopedic Surgeons' "Emergency Care and Transportation of the Sick and Injured" for additional information and updated procedures.

INDEX:

I. POISONOUS\INFECTIOUS INSECTS

A. PREVENTION

B. BEE STINGS

C. POISONOUS SPIDERS
1. The BLACK WIDOW
2. The BROWN RECLUSE

D. TICKS

II. ANIMAL BITES

A. GENERAL

B. ANIMAL BITES AND RABIES
1. PREVENTION
2. FIRST AID FOR ANIMAL BITES/RABIES

III. POISONOUS PLANTS

A. GENERAL INFORMATION/PREVENTION

B. FIRST AID FOR POISONOUS PLANTS

salivation, nausea, and/or vomiting;

- profuse sweating, or swollen eyelids.

d. FIRST AID.

(1) Wash the wound with soap and water.

(2) Request medical assistance to address symptoms. The person usually recovers after several days of illness.

(3) If symptoms of allergic reaction are present treat for shock.

(4) A cold pack may be helpful if the bite is quickly recognized.

2. The BROWN RECLUSE.

a. The brown recluse has a brown body about 1/8 inch long and about 1/2 inch long including the legs. It has a characteristic fiddle shape on the back.

b. The brown recluse does not build webs but may be encountered indoors in hiding locations. For this reason these spiders rarely bother humans, but some bites occur in the areas around Texas, Oklahoma, Kansas, and Missouri.

c. The most serious symptoms of the brown recluse bite are local effects. There may be no noticeable effect from this bite. In severe cases a red area appears around the bite. A crust may develop and fall off while the area of redness grows deeper. These bites may take several months to heal.

d. FIRST AID.

(1) Wash the wound with soap and water.

(2) If symptoms of allergic reaction are present REQUEST MEDICAL ASSISTANCE and treat for shock.

(3) There is no good first aid for spider bites other than cleaning the wound if it can be found. A cold pack may be helpful if the bite is quickly recognized. A physician can address symptoms and the person usually recovers after several days of illness. In

c. If stinger remains embedded, try to remove it WITHOUT SQUEEZING IT (this may inject more poison into the wound). Avoid using a tweezers since it may squeeze the stinger. Scrape the stinger out with a plastic card (e.g., credit card or drivers license).

d. Persons with severe allergy to bee stings may carry an emergency treatment kit.

e. Use a cold pack to reduce/limit swelling. DO NOT PLACE A COLD PACK DIRECTLY ON THE SKIN! Place gauze pad or clean cloth on the skin to prevent direct skin contact with the pack.

f. Keep the wounded area below the level of the heart to slow the venom's spread.

g. DO NOT administer aspirin or alcohol since this will dilate blood vessels enhancing spread of poison.

C. POISONOUS SPIDERS.

1. The BLACK WIDOW.

a. The black widow has a glossy black body that is about 1/2 inch long, and is almost an inch long when including the legs. The body is bulbous in shape with a characteristic red hour glass shape on the bottom side of the abdomen (it is not easily seen from above).

b. The black widow is a web building spider found in most parts of the U.S. and even into Canada, but generally prefers warm climates.

c. The most serious symptoms of a black widow bite are those of systemic poisoning. Initially the bite may produce no pain, and may not swell or cause local symptoms. As systemic symptoms develop they may initially appear similar to a severe case of the flu, but can develop into other more severe symptoms. Signs and symptoms can include:

- severe abdominal pain (similar to appendicitis), rigidity, pain/cramps in the muscles, and/or tightness in the chest and difficulty breathing;

- pain in the soles of the feet;

- alternating dry mouth and heavy

particular the local tissue damage from a brown recluse bite may develop gangrene.

D. TICKS.

1. Ticks are about 1/4 inch long. They attempt to bury their heads and crab-like pincers beneath the skin leaving only their bodies exposed above the skin.

2. Ticks carry infectious diseases (rocky mountain spotted fever or Lymes disease) in this way into your blood. In most cases disease will not result, but flu like symptoms may develop several days later including:

- fever,
- rash,
- joint pain, or
- headaches.

3. FIRST AID FOR POISONOUS\INFECTIOUS INSECTS.

a. Wash the wound with soap and water.

b. If symptoms of allergic reaction are present REQUEST MEDICAL ASSISTANCE and treat for shock.

c. Try using alcohol, oils, or a heated paper clip to encourage the tick to release it's grip. Grasp the tick and remove it quickly when it shows signs of letting go (the tick may wiggle its legs in an attempt to withdraw from the skin). If the head remains under the skin, soak the area several times daily and use a tweezers to attempt to remove.

d. If fever, rash, or headaches develop within several weeks contact medical personnel.

II. POISONOUS SNAKES, ANIMAL BITES, AND MARINE ANIMAL PUNCTURES.

A. GENERAL.

1. In addition to animal bites (including bites by humans) and snake bites; stings from jellyfish, Portuguese man-o-war, anemones, corals, and hydras may be painful or cause allergic reactions. Similarly urchins, cone shells, stingrays, spiny

fish (e.g., catfish, certain toads, or oyster fish) can cause allergic reactions or infection.

2. Personnel should also be briefed on procedures to follow in the event of a bite, and known or suspected locations where problems may occur.

3. All personnel working in designated areas should be provided with snake leggings or hip high boots. Appropriate work clothing will also help prevent many other bite related problems.

4. If personnel notice potentially infected animals on site they should notify their supervisor immediately, EVEN IF NO ONE HAS BEEN BITTEN. Other personnel must be kept away from potentially infected animals until animal control authorities take appropriate action.

B. ANIMAL BITES AND RABIES.

1. PREVENTION.

a. The following signs/symptoms may indicate infected ANIMAL BITES in unreported cases (infection can develop within hours of a bite):

- pain or tenderness of a wound
- redness, heat, or swelling around the wound
- pus under the skin or in the wound
- red streaks trailing from the wound
- swollen lymph nodes in arm pits/groin/neck.

b. RABIES is a serious infection typically passed to humans by the saliva of diseased animal carriers such as those listed below.

(1) It is generally recognized that rabid animals may drool or act irritable, but any strange/abnormal behavior can also indicate infected animals. Infected animals may also act strangely quiet, partially paralyzed, or unafraid of humans.

(2) Some common animal sources of rabies include:

- skunks,
- prairie dogs,
- foxes,
- bats,
- dogs,

- cats,
- raccoons, and even
- cows.

c. If personnel notice potentially infected animals on site they should notify their supervisor immediately, EVEN IF NO ONE HAS BEEN BITTEN. Other personnel must be kept away from potentially infected animals until animal control authorities take appropriate action.

2. FIRST AID FOR ANIMAL BITES/RABIES.

a. Get medical attention ASAP to address infection hazards and/or poisoning.

b. Determine when person last had tetanus immunization (contact unit holding medical records for assistance).

c. Interview victims and witnesses to attempt to identify the specific type of animal that gave a bite and/or unusual behaviors.

d. GENERAL first aid for animal bites:

(1) Control serious bleeding. Apply pressure using a gauze pad. Use of tourniquets IS NOT advised unless absolutely necessary.

(2) WASH YOUR HANDS before touching a wound. Personnel should also wear RUBBER GLOVES and FACE SHIELD for working around human blood.

(3) Wash wounds that are not bleeding heavily. Use plain soapy water. Trained medical personnel must clean serious wounds.

(4) Cover with clean dressing and bandage.

e. RABIES treatment must be administered by medical personnel. Prompt treatment is essential since there is no cure for rabies if it is allowed to develop in a wound. Rabies shots must be started quickly in order to prevent infection by building up immunity.

III. POISONOUS PLANTS.

A. GENERAL INFORMATION/PREVENTION.

1. Personnel should be informed of known and suspected locations where these plants may be contacted.

2. Personnel should also be briefed on procedures to follow in the event of contact.

3. Long sleeved clothing should be worn in areas designated to contain these plants.

4. Signs and symptoms of skin contact with poisonous plants:

   - itching,
   - burning, and
   - blister formation.

B. FIRST AID FOR POISONOUS PLANTS.

1. DO NOT SCRATCH. Scratching will only spread the poison and work it into the skin.

2. If these plants are accidentally touched, the plant sap should be washed off of the affected area with soapy water immediately.

3. Medical attention may be needed if prolonged or serious conditions result.

ATTACHMENT (11) AFTER ACTION REPORT

S A M P L E

From: Unit
To: Commanding Officer, Civil Engineering Unit Providence

Subj: BATTERY RECOVERY AFTER ACTION REPORT

Ref: (a) ATONORD 01-XXX-94

1. Per reference (a), ANT Saugerties was directed to conduct battery recovery operations on the following sites:

a. Upper Hudson River LT 83
b. Turkey Point Buoy Depot (abandoned 1965)

2. Site survey conducted on 31 Aug 94 by unit personnel as part of the First District ATON battery recovery training program. The site safety plan, photo documentation and soil samples are enclosed.

3. The clean up of the site was completed on 31 AUG 94, utilizing D1 trained recovery personnel. Following an extensive "site reconnaissance", the team recovered approximately 15 Edison Carbonaire carcasses from an the site. The following resource hours were utilized:

a.	Small Boats	2 Hours
b.	Vehicles	7 Hours
c.	Site Survey	14 Man Hours
d.	Procurement and Gear Preparation	1 Man Hour
e.	Brushing Access to site	4 Man Hours
f.	Clean Up Site	14 Man Hours

4. Expenses were as follows:

a.	PPE	75.00
b.	Film	10.00
c.	Bags/Buckets/Drums	20.00
d.	Labels	4.00
e.	Other (paper, sprayer)	42.00

5. The following lessons learned, comments and recommendations are provided:

a. Need rakes for small pieces.
b. Use Video to critique cleanup.

6. Batteries are currently stored at ANT Saugerties, awaiting final disposition. Documentation of final disposition will be forwarded separately upon completion.

First CG District ATON Battery Recovery Site Safety Plan

7. Additional comments:

OINC/CO

Encl: (1) Site Plan (original)
(2) Photo/Video documentation
(3) Soil Samples w/ DD1149
(4) Disposal documentation (if applicable)

Copy: CCGDONE (oan) with encl (1) only
CG GP New York

ATTACHMENT [12] **ADDITIONAL FIRST AID KIT ITEMS**

Medical Instrument and Supply Kit Field Casualty Treatment

FSN 6545-00-935-7093

Insect Repellent

FSN 6505-01-137-8456

Sun Screen Lotion

FSN 6505-01-121-2336

Blanket (any kind)

Eye Wash Bottle (Available through commercial supplier like Lab Safety Corp.)

Instructor Notes	Instructor Activity

PRESENTING THE INFORMATION

(LT Bills)

1. Show COMDTNOTE Training Tape
2. Review Types Of Batteries (TECHMAN)
   - -Slides
   - -Discussion

Hazard Communication

(LCDR Danielczyk)

1. The Standard
2. Hazard Communication [1901.1200] vs Hazwoper [1910.120]
3. Batteries are Articles
4. Identification and Labels
5. MSDS Location on-site
6. Chemical, Physical and Health Hazards
7. How to detect presence of materials in work area
8. Individual protection methods and equipment

Material Handling, Segregation, Packaging & Disposal

(Mr. Georges Bockstael)

1. MSDS
2. Site Work Plan
   - -Site Reconnaissance
   - -Site Safety Plan
   - -Site Preparation and Use Of PPE
   - -Field Testing And Segregation
   - -Recovery Of Batteries And Parts
   - -Packaging Of Components
   - -Hazardous Waste Rules
   - -Labels On Containers
   - -Decontamination

Instructor Notes	Instructor Activity

OPENING ACTIONS

Introduction

(All)

1. INTRODUCE MEMBERS OF THE TRAINING TEAM.

Gaining Attention

(LT Bills)

1. Introduction to current nation-wide battery situation.

   -Prior to 1986, most aids were powered by batteries.
   -since no laws were in place prior to 1973, batteries were sometimes released into the envonment
   -As many as 1600 sites could be affected.

2. Show CRUSADERS clip, recovering "Coast Guard" batteries from Tampa Bay.

   -FFCA made Govt agencies liable to states.
   -Battery recovery/disposal limited to EC&R
   -Most/all funding west to d7/d8 for remediation

Stating The Objectives Of The Course

(LT Bills)

1. To expedite recovery and disposal of ATON batteries discovered at terrestrial sites. Utilized existing AFC-30 disposal contracts.

2. Aquatic sites will be addressed once Volpe study is completed

   -Indications are from MIT study that batteries do not pose a threat to the environment. (Quote study) Passout copies of press release.

3. Focused HAZWOPER: Meet the requirements of CFR, while providing comprehensive training, focusing on ATON batteries.

4. Every ANT/WYTL will be sufficiently trained to safely recover and dispose of discarded batteries.

5. Provide copies of ATONORD/SSP

Recalling Prerequisites

(LCDR Danielczyk/LT Bills)

1. Discuss Background and Gverning Laws.

Instructor Notes	Instructor Activity

Environmental Monitoring

(Mr. Georges Bockstael)

1. Chain Of Cutody

2. Standard Sampling
   -Equipment needed
   -Documentation of Sample Location
     *The Geographical Center
     *The Perimeter
     *The Perimeter Plus One
     *Site And Sample Map

3. Archiving Samples

Enhancing Retention and Transfer

(All)

1. LAB
   -Create Terrestrial Site Mock-Up for Practice Recovery

Actual Recovery Exercise (When Available)

(All)

1. Recover Batteries From Reported Terrestrial Site

CLOSING ACTIONS

(LT Bills)

1. After Action Reports
   -Provide Sample AAR from D7
   -Discuss Prob;ems Encountered

2. Prevention Methods
   -Battery Box Seccuring Method
   -ID, Labeling and Tracking

3. Reporting Released Batteries
   -Provide Format

Assessing Performance

1. Students are evaluated with a written test.

CRITIQUE COURSE

1. Provide Critique
   -Verbal Feedback

Instructor Notes	Instructor Activity
	(Provide Handout) - CRCLA/RCRA - COMDTINST - D1 Guidance

REMEDIAL ACTION PLAN

BATTERY CLEANUP SITE OPERATIONS

MATERIAL HANDLING, SEGREGATION, PACKAGING AND DISPOSAL

A. SCOPE AND RATIONAL

A.1 Coast Guard units that are assigned to remove batteries from ATON sites must follow this protocol to ensure that batteries are handled properly. Proper handling will ensure that personnel safety, environmental safety and regulatory compliance are accomplished. Handling of batteries will be conducted in a uniform manner under a standard operating procedure (SOP). Since differences in site conditions will dictate the site specific approach to be taken, there must be flexibility to the site operations plans.

A.2 Survey, remove and dispose of abandoned aids to navigation (ATON) batteries. The driving force behind the battery cleanup operations is the perception that the batteries are causing harm to the environment, and therefore the Coast Guard is causing environmental harm. The disposal of batteries in the coastal environment is an illegal activity, and because the batteries do not decompose it appears that the Coast Guard is engaged in illegal action.

A.3 Recovery of spent batteries at ATON sites is a current obligation of the ANT teams. The recovery of discarded batteries is also a logical extension of ANT duties. The ANT teams are trained in the handling of live batteries (which are potentially more hazardous than the spent or discarded batteries). With additional training the ANT's will be able to safely, legally and successfully acomplish this mission.

B. INITIAL SITE RECONNAISSANCE

B.1 Upon arrival at the site take a few minutes to orient yourself and get a feel for the lay of the land. Using a standard Site Plan 1" = 20', draw in the relative position of the shoreline and the position of the aid.

B.2 All members of recovery team meet to determine who will go where and where the stage-out area will be set up along with position of safety equipment, "tailgate site safety plan" will be developed. Search zones will be established.

B.3 Personal protective equipment (tyveks and boots) is donned, pH paper, a Site Plan 1" = 20' and a supply of flags taken into the search zone.

B.4 Upon discovery of a battery note it's position on the Site Plan, identify it's type (L = Lead Acid, Z = Zinc Air), condition (intact or ruptured), test the battery casing with ph paper (H = "hot = Corrosive), flag the battery and continue outward.

B.5 Return to stage-out area. Determine number of buckets, bags, tape, barrels, and labels that will be required. If the scope of the recovery is within the capability of the recovery team's ability and equipment, proceed to the recovery phase.

C. BATTERY RECOVERY

C.1 Don appropriate personal protective equipment (may also include safety glasses and gloves).

C.2 All batteries and battery pieces will be placed in plastic bags, one battery per bag. The bags will be taped closed and placed in transportation buckets. Intact batteries may be handled in the same way that spent batteries taken directly from the aid during normal replacement are handled. Leaking batteries must be handled as hazardous waste (leaking batteries are batteries that have "hot" corrosive fluid from the battery interior located on the outside of the battery as measured by pH paper wipe test). Discovery of a leaking battery should be an uncommon event. Leaking batteries should be double bagged, placed into a transportation bucket and the bucket should be labeled HAZARDOUS WASTE, CORROSIVE. The transportation bucket lid should be screwed on and the bucket isolated from the other batteries. Should contact with any corrosive material be made, it will be necessary to immediately decontaminate the affected area/s (Wash off).

C.3 Broken or ruptured batteries should also be double bagged (bag, tape and bag, tape) to prevent battery casings from tearing their bags. There may be value in using an outer burlap bag for support and strength. Bring battery back to the servicing vessel for transportation to the Unit.

C.4 Information necessary for transportation.

a. <u>Zinc Air Primary Batteries</u>

1) The air-depolarized batteries consist of an inert plastic or hard rubber case, potassium hydroxide liquid electrolyte, zinc-mercury alloy anode, carbon cathode, and an insoluble residue or lime bed. The SAFT batteries will also contain a starch based electrolyte gelling agent. The pH of the electrolyte is close to 14. The EPA Hazardous Waste Identification Number for these batteries should be D002 (corrosivity). You may note that under COMDTINST M 16478.1B they are also identified as waste code D009 (toxicity characteristic for mercury). Actual TCLP analysis for mercury indicates that the D009 is not necessary, see Figure C.2.a for TCLP analysis results. Also, if the batteries have been broken open and the electrolyte has been diluted/neutralized by contact with sea water or the pH otherwise cannot be measured

as 12.5 or more, the battery carcass does not meet the definition of a hazardous waste, and should be disposed as a solid waste.

2) **LABELING:** A battery which contains electrolyte (intact) or a broken battery which fails the field pH test, must be handled as a hazardous waste. Transportation of these batteries requires the following information:

* Proper Shipping Name = Waste Battery, electric storage, wet, filled with alkali
* Hazard Class = Corrosive material
* Identification Number UN2795
* Label = CORROSIVE
* EPA Hazardous Waste Number D002

3) **PACKAGING:** Batteries shall be double-wrapped in plastic bags, palletized, and banded. Batteries will be placed upright with layers separated by plywood or cardboard. The total pallet is not to exceed 4 layers in height. Onboard the recovery vessel the batteries can be double-wrapped and placed into a drum with absorbent material filling the voids. Any battery which is determined to be currently leaking electrolyte must be packed into an individual container and isolated. Upon return to the unit, batteries will be off-loaded and handled according to the same procedures used for spent batteries being returned from ATON servicing. If primary batteries are not recycled, they must be included in the unit calculation of hazardous waste generated per month.

b. **Lead-Acid Batteries**

1) Lead-acid batteries are wet, rechargable, and usually six-celled. Each cell consists of a lead (anode) and lead dioxide (cathode) plates totally immersed in sulfuric acid electrolyte. The EPA Hazardous Waste Identification Numbers are D002 (corrosivity) and D008 (toxicity characteristic for lead). Intact, non-leaking lead acid batteries which are recycled do not need to be disposed of as hazardous waste. Pieces of lead acid battery cases which do not fail the field pH screening, are solid waste (debris) and should be recovered, returned to the unit and disposed of as landfill waste. The lead plates from these batteries should be collected in plastic bags (using PPE), returned to the unit and boxed for recycling.

2) On return to the unit lead acid batteries should be handled according to standard operating procedures established in COMDTINST M 16478.1B.

3) **LABELING:** A leaking lead acid battery will require the following information to meet transportation rules:

* Proper Shipping Name = Waste battery, Electric Storage, wet, filled with acid

* Hazard Class = Corrosive material

* Identification Number UN2794

* Label = CORROSIVE

* EPA Hazardous Waste Numbers D002 and D008

4) **PACKAGING:** Batteries shall be double-wrapped in plastic bags, palletized, and banded. Batteries will be placed upright with layers separated by a plywood or cardboard. Onboard the recovery vessel the batteries can be placed in a drum. Leaking batteries must be packed into individual containers with absorbent material and isolated.

5) The primary concern when handling the lead acid batteries is the sulfuric acid electrolyte, the lead and the toxicity of the lead is a secondary issue. Unlike the primary batteries the pH of the lead acid batteries is more difficult to characterize and will be found to cover a wide range of values. Any leaking lead acid battery which field pH test at a value of 2 or less is a hazardous waste.

6) Leaking lead acid batteries and primary batteries which fail the field pH test are both hazardous waste. They must be individually packaged, labeled, and stored separately. As hazardous waste they will have to be disposed of under a Hazardous Waste Manifest, using the unit's EPA ID Number or a temporary ID Number will need to be assigned by the state.

Batteries and battery pieces which are determined not to be hazardous waste may be shipped under a bill of lading.

D. ENVIRONMENTAL MONITORING

D.1 Environmental monitoring serves three main functions;

a. It provides the documentation necessary to show that the site has been cleared of spent batteries.
b. Soil samples taken can be used to assess potential environmental impact of batteries in the environment, and to determine if there is a need for additional site remediation.
c. Monitoring can be use to show that potential environmental impacts from the clean-up actions have been minimized, and that a Quality Assurance Plan (QAP) has been followed resulting in valid documentation/sample collection.

D.2 On the site plan, identify the aid name, aid number, number of batteries, location of batteries, battery type(s) and condition. A standard 50 foot radius scale is provided on the site plan form. Generally, the entire terrestrial area within the 50 foot radius will be searched for batteries. If batterie

are found outside the 50 foot radius from the aid, adjust the scale to fit the site (ie. 1" = 50'). The distance from the aid to the last battery found will be considered one (1) SITE RADIUS. The search for batteries should be extended outward for one additional SITE RADIUS. For example, if the last battery found is 40' from the aid, the search pattern should be out to a minimal distance of 80' from the aid. Take up to four (4) photos of each site.

Using the site plan drawing determine the area which represents the greatest concentration of batteries. From the center of the area with the greatest number of batteries you will take soil sample #1. Soil sample #2 will be taken out at 1 SITE RADIUS within three feet of the position of the outermost battery. Soil sample #3 should be taken out at SITE RADIUS 2. Soil sample #3 will be used as a background sample.

D.3 SOIL SAMPLE COLLECTION

Sampling devices shall be decontaminated between individual soil samples. The following steps shall be followed, for decontamination of sampling devices:

a. Remove all bulk solids.

b. Scrub with detergent and potable water solution.

c. Rinse with isopropyl alcohol, and

d. Rinse with deionized water.

The recovery team shall collect one soil sample from each of the three indicated areas at each aid. A stainless steel sampling tool shall be used to collect soil samples.

Each soil sample shall be placed in clean, plastic containers. A two inch diameter by four inch deep soil sample should be taken from the surface at each of the three locations. As each sample is packaged, a chain of custody form shall be retained by the sampling personnel. A copy of the chain of Custody form shall be mailed to CEU Providence along with the soil samples.

Secure a sample label to each soil sample conatiner collected in the field. The sample label shall contain the following data:

a. Aid name and number
b. Sample number
c. Distance and direction from aid
d. Date
e. Time
f. Initials of sampling personnel

E. RECORD KEEPING

Record keeping serves several important functions including regulatory, operations, environmental and planning. The most important records are the site plan, the photographs, the chain of custody/sample documentation and the bill of lading/waste manifest.

Hazardous Waste Operations and Emergency Response (HAZWOPER)

Scope and Application
Training Requirements
Training Content
Written Safety & Health Programs
Site Specific Safety & Health Plan Contents
Site Charicteriztions, Analysis and Control

References
29CFR 1910.120

First District SEOH Points of Contact
D1(mseh): 617-223-8593/8436
MLCA (kse): 212-668-7155/6/7

HAZWOPER Scope & Application

"Applies unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards"

Government Mandated or Recommended Cleanups and Site Investigations

RCRA Cleanup & Corrective Actions

RCRA Transportation, Storage & Disposal (TSD) Activities

Emergency Response Operations for Releases or Substantial Threats of Releases, Regardless of Location

Encl. (4) to COMDTINST 16478.12

HAZWOPER Training Requirements

Based on Job Function, Hazards expected, Time of Work

Emergency Response

- First Responder Awareness Level (knowledge)
  Sufficient Training/Experience
- First Responder Operations Level (defensive)
  8 hours training/experience
- Hazmat Technician (stop release/aggressive)
- Hazmat Specialist (direct or specific knowledge)
  24 hours & proven experience
- On-scene Incident Commander (in charge)
  24 hours & proven experience

Post-Emergency Response

- General Site Workers
  40 hours off site, 24 hours field
- Minimal Hazard/Non-Routine Site Employees
  24 hours off site, 8 hours field
- Management/Supervisory Training
  Trained to Employee Level
  8 hours hazwaste operations

Annual Refresher Training

Application of Past OJT

HAZWOPER Training Content

Names of Personnel Responsible for Safety & Health

Safety, Health and Other Hazards On-Site

Personal Protective Equipment Required

Work Practices to Minimize Risk

Safe Use of Equipment

Medical Surveillance

Decontamination

Drum/Waste Handling

Sanitation, Illumination Requirements

HAZWOPER Written Safety & Health Program

Need not repeat employers Standing Operating Procedures

ID, evaluate, control safety and health hazards & provide for emergency response for hazwaste operations

Organizational Structure

- Site Supervisor
- Site Safety and Health Officer
- On-Scene Representatives
  - supervisor representatives
  - Site Safety Supervisor

Work Plan

Site Specific Safety & Health Plan

Training Program

Medical Surveillance

HAZWOPER Site Specific Site Safety Plan

Drafted before site work begins

Needs to address:

- Health risks/hazard analysis for each task
- Employee training requirements
- PPE requirements for each task
- Medical Surveillance Requirements
- Types & Frequency of Air Monitoring/Environmental Sampling
- Site Control Measures
- Decontamination Required
- Emergency Response Plan

Site Characterization / Analysis & Control

<u>Site Characterization</u>

Preliminary Assessment

Hazard ID including items that pose skin absorption or inhalation hazards

- IDLH atmospheres
- Death/Serious Harm

<u>Site Control</u>

Site Maps

Site Work Zones

Buddy System

Communications

- locating/calling hospitals/emergency response
- locating Incident Command & Safety Personnel

HAZARD COMMUNICATION

Training Requirements

Labeling Requirements

Material Safety Data Sheets
- File Requirement
- Content Requirement

Written Program

Coast Guard HazCom

References
- 29CFR 1910.1200
- COMDTINST 6260.21

First District SEOH Points of Contact

D1(mseh): 617-223-8593/8436

MLCA (kse): 212-668-7155/6/7

Written Program/ Training Requirements

Written Program Requirements

"Inventory" of all Hazardous Substances in Workplace

How Training will be Provided

Handling Routine and "Non-Routine" Tasks

Hazardous Material Coordinator Designated

Training Requirements

OSHA:
- New Chemical introduced in workplace
- New Worker comes aboard

USCG:
- In addition to OSHA: Annual Training

Familiarity with MSDS

Where to find "Right to Know" info

Chemical Release detection

PPE requirements

Non-original Container Labeling Requirements

Chemical Identity
Name/CAS Number

Hazard Warning
(corrosive, oxidizer, etc.)

Written in English

Excludes Daily Use and 1 Person use

Recommend : Manufacturer, Fed. Stock Number, Target Organ

Material Safety Data Sheets (MSDS) Files

Must be readily available when chemical is used

No organization requirement

MSOs: bulk & frequently encountered with emphasis on carcinogens, highly toxic (TLV <100 PPM)

Annual Review

COMDT requires HAZMAT manager sign all HazMat PR prior to purchase
- PPE requirements
- substitutes
- quantity ordered/inventory

HAZMAT IN ----> HAZWASTE OUT

<u>Recommendations</u>
- Master File
- One person receive, check-in hazmat & maintain complete file
- Facility/Shop Area/Use specific (not numerical or alphabetical)
- Highlight Product Name

MSDS Requirements
Obtaining MSDS

8 sections (can vary in placement)

Written by Manufacturer/Importer

- Confusing/Legal Language
- Trade Secrets
  - immediate access for medical purpose,
  - Safety and Health Evaluation
  - statement of confidentiality

Not Required For:

- Articles
- Pesticides (EPA regulated)
- Food Additives/Cosmetics (FDA)
- Alcohol
- Prescription Drugs (FDA)
- Home Use Items

Obtaining MSDS

- Manufacturer/Importer
- Place of Purchase
- HMIS for Federal Stock Numbered Items
  - MLCA(kse)
  - D1 (mseh)
  - Groups

OTHER USCG
HAZCOM ITEMS

Driving

Hearing Conservation

- >84 dBA - single hearing protection
- >104 dBA - double hearing protection

Slip, Trip, Falls

Heat & Cold Safety

Benzene

Asbestos

Hydrogen Sulfide

Welding Fumes

Sand Blasting

Confined Space Entry

Fire & Explosion Hazards

Water Safety

MSO Access Control

- vessels
- shipyards
- confined spaces
- dry docks
- spill response zones

MSDS NOTES

1: MFG NAME, Address, Phone number

2: Hazardous Ingredients (above 5%), % of total mixture, PELs/TLVs

- not required to list inert/non-hazardous ingredients
-

3: Physical Characteristics

- Boiling Point: Temp at which begins to boil (watch low ones)
- Vapor Pressure: Temp Dependent, concentration of vapor above liquid
- Vapor Density: Air (=1) as reference - whether substance vapor will sink or rise. Accumulation points
- Solubility : Will substance dissolve /mix in water
- Appearance /Odor
- Specific Gravity: Water (=1) as reference - whether liquid/solid form of substance will sink or rise. Accumulation points.
- Melting Point: Temp at which solid goes to liquid
- Evaporation Rate: How fast will substance evaporate over time (component specific)

MSDS NOTES

4: Fire & Explosion Data

- Flash Point: Temp at which substance gives off enough vapors that if spark is introduced substance can ignite
- Auto-Ignition Temperature: Temp at which substance gives off enough vapors that it can ignite on own
- Flammable Limits: Lower/Upper Explosive Limits - Lean or Rich
- Extinguishing Media: CO_2, Water, Foam, etc.
- Special Procedures: clothing type, unusual qualities when on fire

5: Reactivity Data

- What this stuff doesn't mix with (oxidizer/ corrosive - HCn/Acids)
- What remains after it burns off - is residual hazardous
- Substances/Areas to avoid: Sodium & water Heat build-up

MSDS N[redacted]

6: Health Hazard Data

- Entry Routes (skin, respiratory, ingestion)
- Acute & Chronic Health Effects
- Is it formally recognized as a carcinogen (human or animal)
- Symptoms of exposure
- Medical Conditions aggravated by exposure
- Emergency First Aid Procedures : To vomit or not to vomit Antidotes

7: Precautions for Safe Handling and Use

- Spill Instructions
- Waste Disposal
- Handling and Storage

8: Control Measures

- PPE requirements
- Mechanical Controls
- Work Practices (avoid skin contact)

Please initiate the below page seven entry for the following individuals for training conducted on 20-21 SEP 94:

QM2 Steven A. Rogers 007 54 0350, USCG	ANT NY
CWO2 Lloyd F. Kelleher 149 48 6881, USCG	GRU NY
MK3 Christopher J. Vecchio 039 42 2715, USCG	ANT NY
BM2 Albert J. Washington Jr. 560 17 5323, USCG	ANT NY
EM1 James H. Hickey, 125 36 6185, USCG	ANT NY
MK2 Craig W, Thorngren 575 21 1002, USCG	HAWSER
MK3 Kenneth C. Gardner 554 85 8088, USCG	ANT NY
BM1 Jeff Wheeler 519 98 6946, USCG	ANT NY
FN Melvin A. Watson, 258 41 4644, USCG	ANT NY
MK2 Ronald Friedman, 117 58 8434, USCG	ANT NY
EM2 Thomar R. Ruegamer 449 53 8426, USCG	ANT NY
MK1 Marson Kay 264 19 2361, USCG	ANT NY

QUOTE

COMPLETED 2 DAY FOCUSED HAZARDOUS WASTE OPERATIONS (HAZWOPER) TRAINING COVERING SAFETY, HEALTH AND ENVIRONMENTAL ASPECTS OF ATON BATTERY RECOVERY OPERATIONS WHICH INCLUDED THE FOLLOWING TOPICS:

HAZARD COMMUNICATION (HAZCOM): 29 CFR 1910.1200, MATERIALS SUBSTANCE DATA SHEET (MSDS) OF MERCURY, LEAD, POTASSIUM HYDROXIDE, SULFURIC ACID, NICKEL-CADMIUM AND THOSE OF GENERIC BATTERIES.

HAZARDOUS WASTE OPERATIONS (HAZWOPER): 29 CFR 1910.120 SITE WORK/SAFETY PLANS, DESIGNATED INDIVIDUALS, HAZARD EVALUATION AND COMMUNICATION REQUIREMENTS. RECOVERY TRAINING AND FIELD OPERATIONS LIMITED TO PPE LEVEL "D" (NO RESPIRATORS, TYVEK/SPLASH PROTECTION ONLY).

BATTERY RECOGNITION: TYPES OF PRIMARY AND SECONDARY BATTERIES USED ON ATON.

MATERIAL HANDLING, SEGREGATION, PACKAGING AND DISPOSAL; SITE RECONNAISSANCE, DETECTION, SITE SAFETY PLAN, PERSONAL PROTECTIVE EQUIPMENT, FIELD TESTING AND SEGREGATION, RECOVERY AND PACKAGING PROCEDURES, LABELING AND CHAIN OF CUSTODY, ENVIRONMENTAL MONITORING, SOIL SAMPLES AND ARCHIVING.

HANDS ON LAB: MOCK UP RECOVERY EXERCISE, ACTUAL RECOVERY/DISPOSAL EVOLUTION AND PREVENTATIVE MEASURES.

UNQUOTE

LT Keith Bills (617) 223-8385

SAMPLE SEMI ANNUAL PROGRESS REPORT FORMAT*

From: Commander, _____ Coast Guard District (oan)
To: Commandant (G-NSR-1)

Subj: ATON BATTERY RECOVERY PROGRESS REPORT AS OF _____

Total EC&R funds allocated for FY __: $

Total obligations, FY to date: $

Unobligated balance remaining: $

Period and Fiscal Year Progress Statistics

	This Period	FY to Date
Terrestrial sites surveyed:		
Number found with/without batteries:	/	/
Number of batteries found/recovered:	/	/
Aquatic sites surveyed:		
Number found with/without batteries:	/	/
Number of batteries found/recovered:	/	/

Period and FY EC&R Cost Summary:

Total battery disposal costs:	$	$
Total travel/per diem costs:	$	$
Total misc. supplies cost:	$	$
Total other costs (list):	$	$
Total EC&R funds obligated:	$	$

Pounds of batteries awaiting disposal (beginning of period):
+ pounds of batteries recovered this period :
- pounds of batteries disposed of this period:
= pounds awaiting disposal (end of period) :

Total EC&R funds remaining, ATON Battery Project: $

Cumulative Summary:

Total terrestrial/aquatic fixed lighted ATON sites in District: /
Total number terrestrial/aquatic sites surveyed for batteries: /
Total terrestrial sites found with/without batteries: /
Total aquatic sites found with/without batteries: /
Total terrestrial/aquatic sites with recoveries completed: /
Est. sites/pounds of batteries remaining to be recovered: /

COMMENTS:

Copy: COMDT (G-ECV-1)

* Do not include "new" losses/recoveries of secondary batteries from knockdowns, storms, etc. in this report.

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

References:
(a) 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response.
(b) 29 CFR 1910 Subpart I, Personal Protective Equipment.
(c) 33 CFR 159, Marine Sanitation Devices.
(d) 40 CFR 311, Worker Protection.
(e) COMDTINST M6000.1 (series)
(f) COMDTINST M6260.17

A. SCOPE AND APPLICATION.

A.1. This Site Specific Safety and Health plan addresses health and safety issues for U. S. Government response and contract personnel conducting operations to recover Aid To Navigation (AtoN) batteries at fixed aquatic sites. Only properly equipped, trained and certified personnel are permitted to enter the controlled areas of these sites.

A.2. All U. S. Government and contract personnel assigned to this project shall review this Site Specific Safety and Health Plan and abide by its contents. All U. S. Government and contract personnel shall sign and date this plan, indicating agreement to and understanding of all information contained herein.

B. SITE DESCRIPTION.

B.1. GENERAL SITE DESCRIPTION: Batteries have been lost into the water from Coast Guard controlled AtoN through accidents and acts of nature. The AtoN battery response project has been created by the Coast Guard to remove these potential threats to the environment.

Each site at which batteries may have been lost can be described as falling into one of three categories:

(a) Fixed Aids. Those aids which are currently located at a fixed, known locations, designated on nautical charts and light lists, by latitude and longitude, and are attached to the bottom with piles or other construction.

(b) Floating Aids. Those aids which are currently located at a known location, designated on nautical charts and light lists, by latitude and longitude, and are anchored in place by a mooring system.

(c) Historic Aids. Fixed or floating aids that have been discontinued.

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

B.2. PHYSICAL LOCATION:

LLNR:_____ LAT/LONG:_____
Aid Description: _____
Radius centered at aid:_____
Geographic
Description: ----------

The site includes the bottom, beach, water column and the diving platform within the boundaries of the above radius.

B.3. SITE CHARACTERISTICS:

Water depth (MLW); Min: _____Ft., Max: _____Ft.

Tide:	High/Low	Height	Time
	H/L	_____	_____
	H/L	_____	_____

Currents;	Speed(kts)/Direction(M/T)°	Time
Continuous:	_____/_____°	_____
Tidal:	_____/_____°	_____
	_____/_____°	_____
	_____/_____	_____

Bottom type:

_____
_____

Platform:

_____
_____

This information will be used in the local diving safety plan, ATTACHMENT (11).

B.4. Historical information for Coast Guard AtoN batteries indicates that the following hazardous or potentially hazardous materials may be present at the site as a result of the presence of AtoN batteries:

1) Mercury (Hg)
0.035 to 0.15 Lbs/battery for primary batteries. For intact battery casings this material will be expected to be contained within the battery case.
2) Potasium Hydroxide (KOH)
Less than 10.5 Lbs per battery for primary batteries.
3) Lead Sulfate ($PbSO_4$)
12.60 to 20.60 lbs for secondary (lead acid) batteries.

4) Sulfuric Acid (H_2SO_4)
10 - 18 Lbs per battery for secondary (lead acid) batteries.
5) Nickel Hydroxide ($NiOH_2$)
Small quantities associated with some types of batteries.
6) Lead (Pb)
Component of plates in secondary (lead acid) batteries.
7) Nickel Cadmium (NiCd)
Constituent of some types of batteries. Unable to estimate quantities.
8) Methyl Mercury (CH_3Hg)
By-product of elemental mercury exposed to the environment. Unable to estimate quantities.
9) Hydrogen Sulfide (H_2S)
By-product of decaying vegetation that may be naturally occurring at underwater work sites. Unable to estimate quantities.

Mercury (UN2809), Potasium Hydroxide (UN1814), Lead Sulfate, Lead, Sulfuric Acid (UN1830) and Nickel Hydroxide are Hazardous Substances as defined under Section 101(14) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended.

Methyl Mercury (CAS:22967-92-6) may or may not be listed as Hazardous Substances under Section 101(14), depending on the specific compound involved.

C. WORK PLAN AND ENTRY OBJECTIVE: Government response personnel will conduct site surveys and battery recovery. Site surveys will consist of site identification, mapping, and may include sampling. Recovery work will consist of transporting batteries from the bottom to the diving platform. The only U. S. Coast Guard personnel authorized to conduct operations within exclusion or decontamination areas on this hazardous material site are those who have completed the appropriate training as designated later in this document. All work shall be conducted in accordance with procedures established during pre-entry briefings and daily work plans for the site.

C.1. ACTIVITIES. Recovery operations include:

C.1.a. All operations will be under the direction and supervision of the Site Coordinator.

C.1.b. Up to a 1000 yard safety area centered on the site may be established and enforced by the Coast Guard. During operations, the platform will be moored within the safety area.

C.1.c. The dive platform will moor as close to the center of the site as reasonable and safe. If safe to do so, one point of the moor may be an Aid to Navigation piling. To the extent circumstances permit the platform shall be moored such that motion of the platform due to the effects of waves, seas, current, winds and other conditions is at a minimum.

C.1.d. Prior to commencing diving, the Site Coordinator shall determine the number of recovered batteries that can safely be transported on the platform.

C.1.e. The divers will enter the water and search the bottom out to a radius of at least 50 feet around the center of the site. When a battery or batteries are located the divers will inform the topside supervisor of the battery location, type and condition. The divers shall move each battery to the underwater collection point (normally the base of AtoN). Where a large concentration of batteries is found at a location within the site, the topside supervisor may elect to have the divers move those batteries after they complete the search/mapping of the entire site.

C.1.f. Only batteries that are on the surface or partially uncovered shall be recovered. Any batteries that are entirely below the surface of the bottom, so that the divers must dig to touch them shall not be moved or uncovered since doing so may release contamination into the environment. If the divers suspect that a buried battery is present they shall report it to the topside supervisor who shall insure that it is plotted on the site map as a possible buried battery.

C.1.g. At the conclusion of the search/mapping phase of the dive operation, when batteries are found, the topside supervisor shall decide whether or not to proceed to the recovery phase of the operation. At a minimum, factors to be considered in this decision are a) the number of batteries that can be safely transported by the platform (see C.1.d. above), b) the time required to complete the recovery operation with due regard given to remaining daylight and diving air supply and, c) specific guidance given by the Site

Coordinator in regard to battery recovery. If the topside supervisor decides to designate the site for battery recovery at a later date, the Site Coordinator shall be so informed and the day's diving operations concluded for that site.

C.1.h. If the topside supervisor (with the concurrence of the Site Coordinator) decides to proceed with the recovery phase of the operation the divers shall return to any known batteries that have not been brought to the collection point and collect them.

C.1.i. Topside personnel will then lower a basket or other suitable retrieval device to the divers. The divers will place batteries into the retrieval device and topside personnel will bring the batteries to the surface. In cases where the batteries will be raised by hand, no more than two batteries shall be raised in the retrieval device at any one lift. This cycle will continue until all batteries have been retrieved.

C.1.j. The batteries will be brought aboard the platform through the contamination reduction area. While in the contamination reduction area each battery will be placed in a plastic bag. Prior to being moved into the cold or clean area each battery will be placed in a second plastic bag.

C.1.k. Any testing or sampling of a battery or its contents shall take place in the contamination reduction area prior to placing the battery in the second bag.

C.1.l. Once on board the platform and in the clean area, each battery will be logged, packed in DOT approved packaging, appropriately marked and staged for transportation to an approved shore side disposal facility.

C.1.m. When all of the batteries have been recovered the divers shall recover their tools and return to the surface.

C.1.n. In most instances, the ascent through the water column will be adequate decontamination for the divers and equipment. If, in the topside supervisor's judgement, the divers and their hand carried equipment do not need further decontamination, they shall be

brought out of the water through a route that does not take them through the platform portion of the contamination reduction area. This will prevent them from becoming recontaminated by substances left where the batteries have been sampled and bagged. If further decontamination of the divers or their hand carried equipment is deemed necessary, they/it shall be brought out of the water and through the platform portion of the contamination reduction area for decontamination.

C.1.o. Following the completed recovery of - or determination of nonexistence of - batteries, the site will be closed.

C.1.p. Site sampling in addition to that in paragraph C.1.k. above may be required. This additional sampling may include bottom sediment core samples, ambient water sampling, battery content sampling or biota sampling. The sampling may be required during any phase of the battery removal process. Specific protocols for site sampling, if required will be provided.

C.1.q. To accomplish this operation, most of the following job tasks will be required:

1) Drum and Container Handling
2) Battery handling
3) Manual Lifting
4) Helicopter Operations
5) Small Boat Operations
6) Motor Vehicle Operations
7) Crane Operations
8) Diving Operations
9) Subsurface Moving and Lifting
10) Bottom to Surface Lifting

D. SITE ORGANIZATION:

D.1. DEFINITIONS AND KEY PERSONNEL. The command and control structure for this response is discussed in the basic instruction. The dive team shall continuously coordinate with the supporting AtoN unit. Both report to the appropriate Group AtoN Officer who reports to the District office (Site Coordinator).

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

D.1.a. The Site Coordinator (SC) is the pre-designated federal official responsible for incident management. The Site Coordinator for this incident is:

CAPT _. _.
Commander, __th Coast Guard District(oan)

Phone: (___) ___-

The Site Coordinator (SC) may, at his discretion, appoint one or more representatives to serve as Site Supervisor(s).

D.1.b. The Site Safety and Health Officer (SSHO), often referred to as the Site Safety Officer (SSO), is the single individual responsible for developing and implementing the Site Coordinator's Site Specific Safety and Health Plan, in accordance with 29 CFR 1910.120. The SSHO for this incident is:

MLC___[LANT/PAC] Environmental Health Officer
Commander (kse)
Maintenance and Logistics Command,

Phone: (___) ___-
FAX: -

D.1.c. Site Safety and Health Supervisors (SSHPs), often referred to simply as Site Safety Supervisors, are the individuals in the field responsible for enforcing the SSHO's Site Specific Safety and Health Plan. Either the SSHO or a designated SSHP must be on-site at all times. In instances where more than one individual is designated to act as SSHP, a single individual must be designated as the senior or lead SSHP. A list of SSHPs for this incident will be maintained on-site and is included as appendix B.

SSHPs must be properly equipped, trained, and certified to conduct hot area operations. Further, they must be properly equipped and trained to conduct environmental sampling if required.

D.1.d. Diving/topside supervisor. This individual is responsible for all aspects of the diving operation. The duties of this position are detailed in the appropriate sections of the Navy Diving Manual. The diving safety plan, Attachment (11) should list this person by name and give duties specific to this site. In most operations the Diving Supervisor will also act as Site Supervisor.

D.2. In addition to the above listed individuals, the following personnel assignments have been identified:

Public Affairs Officer:

_____
Public Affairs Officer
Commander, __th Coast Guard District(dpa)
_____
_____
_____

Phone: (___) ___-____

Scientific Support Coordinator:

National Oceanic and Atmospheric Administration.
c/o Commander (m)
_____th Coast Guard District
_____

Phone (___) ___-____

US Environmental Protection Office - Regional Office (_____,___):

Phone: (___) ___-____

_____[State] Marine Patrol [local] Office:

Phone: (___) ___-____
(___) ___-____

U. S. Navy Supervisor of Salvage (SUPSALV)

Mr. E. L. WOLFORD
Director of Ocean Engineering
Naval Sea Systems Command (OOC)
Washington, DC 20362-5101
Phone: (703) 607-2758

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

E. SITE CONTROL.

E.1. Overall site security shall consist of up to a 1000 yard safety area centered on the site. When needed it shall be established and enforced by the Coast Guard.

E.2. Anyone entering or departing the work area or associated control areas, shall be approved by the Site Safety Supervisor and Site Supervisor.

E.3. No person is allowed to enter the work area without subscribing to this (or an equivalent Site Coordinator reviewed) Site Safety and Health plan. All personnel entering the site shall have received the proper training and be fully informed as to applicable hazards and procedures on site.

E.4. No divers may work on the site for more than 30 days without receiving an entry examination for occupational medical monitoring in accordance with 29 CFR 1910.120. Maintenance and Logistics Command, _____ [Atlantic/Pacific] will designate active duty Coast Guard personnel in this operation who must be entered into the Coast Guard Occupational Medical Monitoring Program (OMMP) per COMDTINST M6000.1 (series).

E.5. Site Boundaries. See Para B.2 above. Up to a 1000 yard safety area on the surface centered on the aid and the diving platform, used as an operations and recovery platform.

E.5.a. EXCLUSION/HOT AREAS: This includes: The sea bottom within the site boundaries and the following portions of the dive platform:

_____
_____
_____
_____
_____

E.5.b. CONTAMINATION REDUCTION/WARM AREAS: These includes: The water column and the following portions of the diving platform:

_____
_____
_____
_____
_____.

These areas will be established and maintained by the Site Safety and Health Supervisor(s). Changes in the areas will be based on the most recent site characterization and monitoring information. These areas shall provide adequate room for

prescribed decontamination and a buffer between the support area and hot area for reduction of airborne, solid and liquid contaminants.

E.5.c. SUPPORT/COLD area: The remainder of the diving platform and the 1000 yard exclusion area shall serve as the support/cold area.

1) This area will include a safe egress from the hot and warm areas for evacuation from the work vessel.

2) This area will include a safe observation area for supervisory and support personnel.

3) This area will be maintained as a clean, uncontaminated area with no measurable or observable airborne hazards, dust, or liquid chemical hazards.

E.5.d. The above areas shall be marked as needed to control traffic and enforce contamination avoidance and decontamination procedures. The Coast Guard Site Safety and Health Officer and/or Site Safety Supervisor(s) shall periodically inspect work areas to ensure the effectiveness of boundaries.

E.6. A site map for the diving platform, including contamination control areas and emergency egress routes, will be provided as Attachment (3).

E.7. TRAINING: In general all personnel on site must have adequate training to do their jobs safely. This includes the fundamentals of site safety and safety conscious operational training. An ongoing training program to reinforce and build upon previous training is also required (i.e., annual refresher training).

E.7.a. REGULATORY REQUIREMENTS: Barring on site emergencies, this project is classified as a post-emergency response operation. General requirements are described in 29 CFR 1910.120.

E.7.b. INITIAL TRAINING: General site workers including Coast Guard divers and topside personnel who handle recovered batteries must have the Hazard Communication (HAZCOM) or higher training. The AtoN Battery Remediation Project Training Course conducted by the CG Liaison to the Naval Diving and Salvage Training Center fills this requirement for CG divers.

E.7.c. MANAGEMENT/SUPERVISORY TRAINING. On-site managers and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall have at least the same initial training as the personnel they supervise.

E.7.d. The possibility of an on site emergency involving release of hazardous waste is remote for this operation. If probability of such emergencies occurring increases, this section should be expanded to include information on the following training levels per 29 CFR 1910.120(q)(4), (5) and (6).

E.7.e. SITE SAFETY TRAINING: Prior to conducting operations on site, involved personnel shall be trained in site safety operations and this site specific site safety plan, in accordance with 29 CFR 1910.120. Attendance at the site safety briefing for this site meets this requirement.

E.7.f. INITIAL AND PERIODIC TRAINING BRIEFS: Prior to conducting operations, involved personnel shall be briefed (at a minimum) on the following:

1) Air/surface evacuation procedures,
2) Thermal stress concerns,
3) Basic water/vessel/vehicle safety concerns,
4) Specific work plans/practices.

F. HAZARD EVALUATION:

F.1. The following potential hazards have been identified for assessment. Each general category has been assigned a probability ranging from very low to high.

1)	Chemical hazards	Medium
2)	Noise hazards	Medium
3)	Pressure (hyperbarism):	Medium
4)	Sunburn/sun exposure	High

5)	Physical hazards	Medium to high
6)	Explosive hazards	Very low
7)	Thermal hazards	Medium
8)	Motion Sickness	Medium
9)	Oxygen Imbalance	Low
10)	Biological hazards	Low to high
11)	Radiation hazards	Very low
12)	Heat/cold stress	Medium to high

F.2. CHEMICAL HAZARDS: Nine possible chemical hazards have been identified. Each hazard has been assigned a hazard rating based on its projected fate and potential toxicity ranging from low to high. The primary reference source for the following information is the chemical information database TOMES (Micromedex, Inc.). Generic hazardous substance information sheets, MSDS's, and TOMES data sheets are attached as Attachment (4) to this safety plan.

1)	Mercury	High
2)	Potassium Hydroxide	Low
3)	Lead Sulfate	Medium
4)	Sulfuric Acid	Low
5)	Nickel Hydroxide	Low
6)	Lead	High
7)	Nickel Cadmium	Low
8)	Methyl Mercury	High
9)	Hydrogen Sulfide	Low

F.2.a. MERCURY: Mercury (Hg; CHRIS Code: MCR; UN 2809, CAS 7439-97-6) is the primary chemical hazard anticipated on scene. Levels of mercury at each site will vary in accordance with several factors including number of batteries at the site, condition of the batteries, and terrain of the site. The following primary batteries which contain mercury may be potentially recovered during this operation: Edison/NIFE/Saft-NIFE, Saft America, CEGASA/AMCEL, and Union Carbide. According to manufacturer's information, total amount of mercury in the batteries ranges from 0.035 to 0.150 lbs.

GENERAL DESCRIPTION: Mercury is a silvery-white heavy, liquid metal. It is highly mobile and has a tendency to disperse, forming alloys. It is corrosive to most alloys with the exception of iron or steel.

ACUTE TOXICITY TO HUMANS: Mercury is a corrosive chemical and is readily absorbed via the respiratory tract (elemental mercury vapor, mercury compound dusts), intact skin, and gastrointestinal tract. Occasional incidental swallowing of metallic mercury is generally without harm, as Mercury in its elemental form is usually non-toxic unless a GI fistula or other GI inflammatory disease is present or the mercury is retained for a prolonged period in the GI tract. Mercury vapor will cause severe pulmonary damage if inhaled, as well as central nervous system damage. Soluble salts of Mercury have a violent corrosive effect on skin and mucous membranes. Acute exposures may result in severe nausea, vomiting, abdominal pain, bloody diarrhea, and kidney damage. In severe exposures, death may result within 10 days.

CHRONIC TOXICITY TO HUMANS: Chronic toxicity is likely to follow repeated exposures with conditions manifesting themselves over long periods of time. Conditions resulting from chronic exposures to mercury have included inflammation of mouth and gums, excessive salivation, loosening of the teeth, kidney damage, muscle tremors, jerky gait, spasms of the extremities, personality changes, depression, irritability and nervousness.

EXPOSURE LIMITS: Exposure limits are based on requirements for elemental Mercury.

ACGIH TLV:	0.05 mg/cu m.
ACGIH STEL:	None (Elemental, non-vapor).
OSHA PEL:	None.
OSHA CEILING:	0.1 mg/cu m.
NIOSH REL:	0.05 mg/cu m.
IDLH:	28 mg/cu m.

F.2.b. POTASSIUM HYDROXIDE: Potassium hydroxide (KOH; CHRIS Code: PTH; UN1814; CAS 1310-58-3) is an electrolyte in primary batteries. Since potassium hydroxide is in solution in primary batteries, the presence of this chemical at the site will depend upon the condition and water-tight integrity of the batteries.

GENERAL DESCRIPTION: Potassium hydroxide is a white odorless and nonvolatile solid which

can be dissolved in water as a colorless solution. In the primary batteries, potassium hydroxide is in solution. In solution, potassium hydroxide is corrosive and may potentially generate explosive hydrogen gas upon contact with aluminum, tin, lead, or zinc. Density of this material in solution is 12.8 pounds per gallon.

TOXICITY TO HUMANS: Potassium hydroxide is corrosive to bodily tissues by all routes of exposure. Contact with concentrated solution may result in severe burns of the skin or eyes. Breathing concentrated mists in air from a potassium hydroxide solution may result in irritation of the upper respiratory tract, inflammation of the lungs, and possibly pneumonitis.

EXPOSURE LIMITS: The exposure levels are as follows:

ACGIH TLV:	2.0 mg/cu m
ACGIH STEL:	None

F.2.c. LEAD SULFATE: Lead Sulfate ($PbSO_4$; CHRIS Code: LSF; CAS 7446-14-2) is a constituent of secondary (lead acid) batteries. During the operation of secondary batteries, the lead plates in these batteries react with sulfuric acid to produce lead sulfate as a by-product. Lead sulfate may be present in each secondary battery and may, depending upon the condition and structural integrity of the batteries, be present on the exterior of the batteries.

GENERAL DESCRIPTION: Lead sulfate appears as white crystals in solid form. It is practically insoluble in water, but is soluble in acid.

HEALTH HAZARDS: Lead sulfate is a corrosive irritant to the skin, eyes, and mucous membranes. It is moderately toxic by ingestion. Ingestion of lead sulfate may result in abdominal pain, diarrhea, constipation, loss of appetite, muscular weakness, headache, blue line on gums, metallic taste, nausea, and vomiting.

EXPOSURE LIMITS: The exposure levels to lead sulfate are as follows:

ACGIH TLV:	0.15 mg/cu m.
ACGIH STEL:	None
OSHA PEL:	0.05 mg/cu m.
OSHA CEILING:	none.
NIOSH REL:	0.10 mg/cu m.
IDLH:	none.

F.2.d. SULFURIC ACID: Sulfuric acid (H_2SO_4; CHRIS Code: SFA; UN1830; CAS 7664-93-9) is a constituent of secondary (lead acid) batteries. The presence and concentration of this material in the secondary batteries will depend upon the condition and the water-tight integrity of the batteries.

GENERAL DESCRIPTION: Sulfuric acid is a colorless to dark brown oily liquid that is odorless when cool but may evolve choking vapors when hot. This material is highly corrosive to bodily tissues, many metals, and is reactive with a wide variety of chemicals and substances. Concentrated sulfuric acid reacts violently with water.

HEALTH HAZARDS: Contact with sulfuric acid may cause severe burns to the skin or eyes. Inhalation of sulfuric acid mist can cause severe irritation and inflammation of the upper respiratory tract.

EXPOSURE LIMITS: Exposure limits for sulfuric acid are as follows:

ACGIH TLV:	1 mg/cu m.
ACGIH STEL:	none
OSHA TWA:	1 mg/cu m
NIOSH REL:	1 mg/cu. m.
IDLH:	none.

F.2.e. NICKEL HYDROXIDE: Nickel Hydroxide ($NiOH_2$; CAS 12054-48-7) is a constituent of nickel-cadmium batteries.

GENERAL DESCRIPTION: Nickel hydroxide in solid form is a light green crystal.

HEALTH HAZARDS: Nickel hydroxide is a confirmed carcinogen.

EXPOSURE LIMITS: Exposure limits for nickel hydroxide are as follows:

ACGIH TLV:	1 mg/cu m.
ACGIH STEL:	none
OSHA TWA:	1 mg/cu m
NIOSH REL:	1 mg/cu m.
IDLH:	none.

F.2.f. LEAD: Lead (Pb; CAS 7439-92-1) is a constituent of secondary (lead acid) batteries. During the operation of secondary batteries, the lead plates in these batteries react with sulfuric acid to produce lead sulfate as a by-product (see earlier description of lead sulfate). Lead will be present in each secondary battery and may, depending upon the condition and structural integrity of the batteries, be present on the exterior of the batteries.

GENERAL DESCRIPTION: Lead is a bluish-gray soft metal.

HEALTH HAZARDS: Lead is a suspected human carcinogen and may be poisonous if ingested. Short-term systemic effects following ingestion include: loss of appetite, anemia, malaise, insomnia, headache, irritability, muscle and joint pains, and tremors. Major organ systems affected are the nervous system, blood system, and kidneys. Chronic or long-term exposure to lead may result in severe kidney damage.

EXPOSURE LIMITS: The exposure levels to lead are as follows:

ACGIH TLV:	0.15 mg/cu m.
ACGIH STEL:	None
ACGIH Biological Exposure Indices (BEI):	50 micrograms (lead) per liter in blood; 150 micrograms (lead) per gram creatine in urine
OSHA PEL:	0.05 mg/cu m.
OSHA CEILING:	none.
NIOSH REL:	0.10 mg/cu m.
IDLH:	none.

F.2.g. CADMIUM: Cadmium (Cd; CAS 7440-43-9) is a constituent in batteries which have been used in lighthouses such as: Nickel-Cadmium HED and ED Series, Exide EI and FHGS Series, and GNB Absolyte-II Series. Since these batteries were used at lighthouses, the likelihood of release of these batteries into the aquatic environments around aids to navigation is minimal.

GENERAL DESCRIPTION: Cadmium is a silver-white, malleable metal.

HEALTH HAZARDS: Cadmium is a confirmed human lung carcinogen. Inhalation is the primary route of exposure. Acute exposure to cadmium dust may result in pulmonary irritation. Repeated exposure to lower levels of airborne cadmium may result in chronic poisoning characterized by irreversible lung injury. Short term symptoms of airborne cadmium exposure include anemia, eosinophilia, yellow discoloration of the teeth, and rhinitis.

EXPOSURE LIMITS:

ACGIH TLV:	0.05 mg/cu m.
ACGIH Biological Exposure Indices (BEI):	10 micrograms per liter in blood; 10 micrograms per gram creatine in urine
OSHA PEL:	0.2 mg/cu m (as a dust)
OSHA CEILING:	0.6 mg/cu m.
NIOSH REL:	0.10 mg/cu m.
IDLH:	none.

F.2.h. METHYL MERCURY: Methyl mercury (CH3Hg; CAS: 22967-92-6) may be present at primary battery sites. The mercury present in primary batteries may react with the surrounding aquatic environment to produce methyl mercury.

GENERAL DESCRIPTION: Methyl mercury is a colorless liquid.

HEALTH HAZARDS: Methyl mercury is a poison of the central nervous system. Primary routes of exposure are skin absorption, inhalation, and ingestion. Symptoms of poisoning include numbness and tingling of the lips, hands, and feet as well as dizziness, emotional disturbances, and jerking movements of the limbs, head, or shoulders. There may be a delay in the onset of symtpoms (latency period) for a single toxic dose from one to several weeks. Biological half-life for methyl mercury (the time needed to eliminate it from the body) is about 70 days with a considerable risk of accumulation of mercury to toxic levels. Methyl mercury can cause irritation of the skin, eyes, mucous membranes.

EXPOSURE LIMITS:

ACGIH TLV:	0.01 mg/cu m
OSHA PEL:	none.
OSHA CEILING:	none.
IDLH:	none.

F.2.i. HYDROGEN SULFIDE: Hydrogen sulfide (H_2S; UN1053; CAS 7783-06-4) is a by-product of decaying organic material (such as rotting vegetation) that may be naturally occurring at underwater work sites.

GENERAL DESCRIPTION: Hydrogen sulfide is colorless, flammable gas with an offensive odor (i.e., smells like "rotten eggs").

HEALTH HAZARDS: Hydrogen sulfide is an acute poison by inhalation. Low airborne concentrations can cause irritation of the eyes and upper respiratory tract. Acute exposure to higher concentrations may result in coma or chronic pulmonary edema. Hydrogen sulfide is a "chemical asphyxiant" which means that it acts as a poison by paralyzing the respiratory center of the body. It is an insidious poison since a person's sense of smell may become fatigued to the "rotten egg" smell of hydrogen sulfide. The odor and irritating effects do not offer a dependable warning to workers who may be exposed to gradually increasing amounts and therefore become used to it. Hydrogen sulfide is a dangerous fire hazard when exposed to heat, flame, or oxidizers.

F.3. SAFETY/PHYSICAL HAZARDS:

F.3.a PRESSURE HAZARDS (DYSBARISM): Descending to work on the bottom will expose dive personnel to the hazards associated with diving.

Only currently military certified Coast Guard dive personnel or contract personnel with suitable certification will dive during this operation.

Descending and ascending within the water column while following a dive profile exposes the diver to changes in the volume of gases in the body. During descent, this pressure increases and the volume decreases causing squeezes. During ascent the pressure outside of the body decreases and the volume of gases within the body increases leading of over pressure unless compensated for or vented. In any case, the diver must be in constant pressure equilibrium or suffer from the effects of dysbarism. An example of a squeeze not compensated for is an ear squeeze which may lead of tympanic membrane rupture. An example of an over pressure situation not compensated for would be PULMONARY OVER INFLATION SYNDROME leading to ARTERIAL GAS EMBOLISM.

Additionally inert gas absorption takes place during diving at a rate and quantity greater than that for a human on the surface. Due to laws of physics, NITROGEN (79% of AIR) is absorbed into tissues readily during descent with pressure increases over that of the surface. During ascent, this NITROGEN is off gassed normally as the pressure reduces, freeing more of the absorbed gas from solution. The lungs act as a filter here to slowly release the gas from the tissues during the ascent phase. However, if the depth and duration of the dive are such that an amount of gas exceeds the limits of the ability of the lungs to exchange the gas, or the rate of ascent so rapid as to defeat the lungs ability to filter, than the NITROGEN will come out of solution in the tissues and not be allow to be off gassed as part of respiration. In this case bubbles will be formed in the tissues and DECOMPRESSION SICKNESS in some form is created.

Diving supervisors and Diving Medical Technicians are trained in the recognition and management of diving related casualties.

Prior to the commencing diving operations the following shall be accomplished:

- All Coast Guard divers shall have a current approved dive physical.

- All divers shall be examined by either the DIVING SUPERVISOR or DIVE MEDICAL TECHNICIAN prior to and immediately after each dive to determine fitness.

- The diving safety plan, Attachment 11, shall be completed to include having prearranged access and contact with the nearest HYPERBARIC CHAMBER. Telephone numbers, radio frequencies and points of contact for the chamber(s) and evacuation facilities the this shall be posted on the site. All divers shall be briefed on the diving accident evacuation plan.

- At a minimum, the following emergency medical equipment and personnel trained to manage it shall be on hand:

  a. Standard Oxygen Kit
  b. Coast Guard Standard EMT Kit

Specific dive safety information is included in the Navy Diving Manual which shall be available on site for all operations.

F.3.b. NOISE HAZARDS: Noise may be present aboard the recovery vessel from cranes, compressors, generators and ROV operations. Noise underwater may result from passing vessels, through water communications gear and diving platform machinery. COMDTINST M5100.47 defines hazardous noise as noise which exceeds 84 decibels, A scale (dBA). Hearing protection must be worn if the noise levels exceeds 84 dBA. If measuring equipment such as noise meters are not available to determine the noise levels, the following "rule of thumb" should be used: If you are standing an arm's length away from someone

and you need to SHOUT in order to converse, the noise level is most likely at or above 84 dBA and hearing protection is needed.

F.3.c. UV LIGHT EXPOSURE: Sunburn and sun exposure are expected to be a problem for personnel working on the water. Preventive measures such as the use of sunblock with an SPF of 15 or higher and sunglasses with UV protection are highly encouraged. Dive Site Supervisors shall ensure personnel on station are not over exposed to the sun.

F.3.d. BACK INJURY HAZARDS: Work on this site will require much manual lifting of heavy objects to position equipment. Many batteries may be packed in one drum, presenting a significant back injury or drop hazard that is to be avoided. Site Safety Officers shall ensure body mechanics are addressed to all personnel involved with manual labor.

F.3.e. HEAT STRESS: If the standby diver is dressed out but not in the water, evaluation of this hazard and adjustments to work/rest schedules may become necessary with excessive heat. Heat stress monitoring shall be the responsibility of the Diving Supervisor and the Site Safety Supervisor. Exposure limits for personnel are based upon the PHYSIOLOGICAL HEAT EXPOSURE LIMIT (PHEL) Chart (available in reference (f)). The Dive Supervisor shall ensure minimum risk for all personnel on station. Frequent rests and adequate hydration for all personnel exposed to temperatures greater than 90 degrees (F). In addition, care must be taken to ensure topside personnel, particularly the standby diver, have shade during hot sunny periods.

F.3.f. COLD STRESS: Depending on seasonal water temperatures, a man-overboard could present the problem of hypothermia. Cold stress may also be an issue for divers.

F.3.g. OXYGEN IMBALANCE: The standard sea-level oxygen content for air is 20.9% O2.

F.3.h. BIOLOGICAL HAZARDS: The primary biological hazards anticipated with this site are from unfriendly marine life and insects. For operations on the shore associated with this site, toxic or thorny plants may be a factor. These hazards are not expected to be

significant in the project. Divers are protected from the elements through dive suits which include gloves and boots. Topside personnel should use appropriate personal protective equipment and insect repellent.

In certain areas, some marine life can present a hazard. The SITE SAFETY SUPERVISOR should contact local area authorities to determine which (if any) of the below are known to exist in the area and what measures are recommended prior to the commencement of diving operations:

ALLIGATORS
POISONOUS SNAKES*
CORAL

*Access to local 911 or MEDICAL PERSONNEL ON HAND with antivenom is recommended when operating in areas infested with poisonous snakes.

CORAL/BARNACLES: All divers and personnel handling material brought over the side must wear sturdy gloves, steel toed boots etc. to avoid direct contact with the marine growth that may be attached. Coral and barnacle cuts bleed easily and freely and heal poorly. All cuts must be cleansed well and prompt medical attention sought. The best management is to avoid direct contact.

CARNIVOROUS/OMNIVOROUS ANIMALS: Divers must be reminded that some of these creatures may be very aggressive. Alligators have little fear of man and pose a real risk for all inland waterway dives. Poisonous snakes are also very common. Snake anti venom is strongly recommended if EMTs or medical personnel are onsite.

The following specific types of biological hazards may be associated with this site :

_____
_____
_____
_____
_____
_____
_____
_____
_____

F.3.i. MOTION SICKNESS: Personnel working on any vessel involved with the search and recovery operation may be exposed to motions that could trigger motion sickness. Motion sickness however, is not expected to be a significant factor in this operation. The use of motion sickness medication is not encouraged as it has a tendency to mask symptoms relating to chemical exposures. Additionally, no diving may be allowed for a diver either taking motion sickness medication or that is motion sick.

F.3.j. RADIATION HAZARDS: No radiation hazards are anticipated during this operation.

F.3.k. Compressed air cylinders will be maintained on site for respiratory protection and divers air supply. All such supplies shall be certified as Grade "D" or better breathing quality air.

F.3.l. Falling objects are a potential hazard during lifting operations. Extreme caution shall be used when conducting battery lifts while divers are in the water.

F.3.m. Slips, trips and falls are a potential hazard on a diving site. There will be a significant amount of equipment on the deck. Cautious movement is recommended.

F.3.n. Man overboard drowning hazards exist during operations near water. The DIVE/SAFETY SUPERVISOR shall ensure that personnel take adequate precautions working around water and that EMT or other medical personnel are available for emergency need.

F.4. Monitoring reports for additional on-scene hazard assessments shall be maintained and included as amendments to this plan.

F.5. ENVIRONMENTAL MONITORING: Environmental monitoring for Mercury or other contaminants shall be conducted at the discretion of and under the direction of the SSO or his representative. Monitoring shall be done in accordance with 29 CFR 1910.120, using properly calibrated instrumentation. If in the course of operations additional hazards are identified, further environmental monitoring protocols shall be established, this site safety plan amended, and all site personnel briefed on the change.

ROUTINE MONITORING: Unless directed by the SSO or otherwise indicated, routine monitoring for Mercury or other contaminants will not be conducted. If required, protocols for the routine monitoring will be included as an appendix to this plan.

F.6 SAFE WORK PRACTICES: The following safe work practices shall be adhered to while on site. During pre shift briefings, information on the location of hazards and methods of control are to be discussed.

F.6.a. HEAT STRESS. Site safety personnel shall generally be guided by the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines in determining work/rest periods. Fluids shall be available at all times and encouraged during rest periods. Heat stress guidelines are attached as Attachment (5).

F.6.b. COLD STRESS. Personnel shall be provided with adequate warm clothing to prevent cold stress. Site safety personnel shall generally be guided by the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines in determining rest/warm-up periods. Warming shelters shall be provided for rest periods. Warm and/or sweet fluids (such as soups, cocoa, cider, or sweetened -- low caffeine -- hot teas) shall also be available during rest periods. Drinking coffee is not encouraged. Exposure suits shall be worn by personnel working and or traveling in small boats or aircraft over water. Cold stress guidelines on are attached as Attachment (6).

F.6.c. ACCESS. Access to the work area shall be limited in accordance with access control requirements described above.

F.6.d. LIGHTING. Sufficient illumination shall be provided at a minimum to meet the requirements of TABLE H-120.1 (Minimum Illumination Intensities) of 29 CFR 1910.120(m). (Note: This paragraph does not apply to underwater work sites)

F.6.e. HARD HATS. Hard hats are to be worn throughout the work area wherever overhead hazards exist. Personnel shall not be allowed under drum or container lifts. All hard hats shall meet American National Standards Institute safety guidelines.

F.6.f. SAFETY SHOES. Safety shoes or boots are to be worn in topside work areas. Safety shoes or boots shall be steel toed and steel shanked and meet American National Standards Institute safety guidelines.

F.6.g. HIGH NOISE AREAS. Hearing protection is required in high noise areas (exceeding 84 dBA, or as designated by site safety personnel). Locations likely to exceed this level generally include those where noise levels require personnel to raise their voices to be heard.

F.6.h. CONTAMINATION AVOIDANCE. All surfaces shall be maintained as free as practicable of accumulations of bottom sediment, run off or other debris brought out of the hot area. Compressed air SHALL NOT be used to clean contaminated surfaces.

F.6.i. LIFTING. All heavy loads shall be moved to the extent possible by mechanical means or with mechanical assistance. Safe lifting practices shall be observed for all heavy manual lifting.

F.6.j. COMPRESSED GAS CYLINDERS. Compressed gas cylinders will be firmly secured when not in use.

F.6.k. HAND PROTECTION. Outer protective gloves will be used to prevent hand injuries. This will include the prevention of punctures on chemical protective gloves where appropriate. Contaminated gloves will be properly disposed of as they become soiled.

F.6.l. LOOSE OR EASILY MOVABLE GEAR, including disposal drums, will be staged and secured to prevent rolling.

F.6.m. DRUM HANDLING. Detailed regulations regarding drum handling and spill containment can be found in 29 CFR 1910.120(j). In general:

1) Drums shall be inspected prior to being moved.

2) Movement of filled drums must be kept to a minimum.

3) To the greatest extent possible, filled drums shall not be moved by unaided manual methods.

4) Prior to shipment, each filled drum must be in good condition (or overpacked) and properly labeled in accordance with 49 CFR requirements.

5) When filled drums are moved from their original locations to a work area or staging area, a spill containment area must be constructed for those locations. The containment should be able to contain the maximum loss from any of the containers in the area.

F.6.n HELICOPTER OPERATIONS. Helicopter operations are not anticipated. If required, helicopter operations will be accomplished in accordance with the Coast Guard Boat Crew Seamanship Manual; COMDTINST M16114.5(series).

G. PERSONAL PROTECTIVE EQUIPMENT (PPE). All recovery and on-site support personnel should have and use the personal protective equipment required for safe handling of AtoN batteries given in COMDTINST M 16500.3A, ATON TECHNICAL MANUAL. All chemical protective clothing (CPC) shall be constructed of materials suitable for use with Mercury. Examples of such materials include, but are not limited to: Viton, PVC, nitrile, neoprene, butyl, natural rubber, or composite-laminate materials.

G.1. Divers shall use the following PPE ensemble (this is in conjunction with equipment required to conduct a scuba dive per VOL 1 of the USN Dive Manual):

a) MK 20 (AGA) diving system in SCUBA mode (positive pressure full face mask),
b) Diving dry suit with attached boots, gloves and hood,
c) Inner CPC gloves,
d) Outer "reef gloves" or equivalent for chafe protection of CPC gloves.
e) Tending lines and buddy lines as conditions dictate.

** The topside supervisor may authorize relaxation PPE for the standby diver if:

a) there is minimal likelihood that the standby, if used, will come in contact with contaminants and,
b) the heat stress problems a standby diver faces

when fully dressed out in CPC are significant concerns.

G.2. On-site personnel shall observe specified decontamination procedures.

G.3. Contaminated CPC must be decontaminated in accordance with the specified decontamination procedures contained in this plan. All CPC and equipment that has been in the warm or hot areas (regardless of known or suspected contamination) must be decontaminated.

H. DECONTAMINATION PROCEDURES:

H.1. GENERAL. All personnel and equipment leaving the Exclusion/Hot area will be thoroughly decontaminated before passing through to the Support/Cold area.

H.2. CONTAINMENT. A continuous system of containment shall be established and maintained at all times during operations.

The containment system should be established to physically separate each area. Separation is intended to prevent liquid or solid movement from one area to the next and to prevent spillage onto uncontaminated deck space.

Containment is to be established in such a way as to ensure that water spillage along the lift path would be routed over the side without entering the personnel decontamination area, the deck storage area, or any non-controlled, uncontaminated area.

H.3. DECONTAMINATION PROCEDURES:

H.3.a. Decon solutions will be potable or sea water.

H.3.b. DECON STEPS:

1) WATER WASH/DELUGE:
The water column shall be considered a water wash/deluge system and the first step of the decontamination procedure. On reaching the surface, unless otherwise indicated, the divers shall be considered decontaminated and shall exit the water without going through the platform portion of the contamination reduction area. Any outer clothing or equipment that shows bottom sediment shall be removed and decontaminated through the platform portion of the contamination reduction area.

2) SEGREGATED EQUIPMENT DROP: All equipment to remain in the hot area for further operations shall be segregated from equipment requiring decontamination.

3) OUTER TYVEK/SARANEX SUIT REMOVAL (if worn) Outer Tyvek/saranex suits are removed and discarded in an appropriate disposal container.

4) RESPIRATOR/MK20 DIVING SYSTEM REMOVAL: Respirator/SCUBA tank/AGA mask removed, cleaned, and disinfected.

5) DRYSUIT SECONDARY WASH/RINSE: (If necessary) rinse drysuit with water.

H.4. Containers for contaminated items shall be labeled or tagged to identify their contents, as required by current OSHA regulations. In no case shall used chemical protective clothing or contaminated materials or equipment be stored without undergoing prescribed decontamination procedures.

H.5. In addition to the decon above, all on-site personnel must shower at the end of each work shift. All personnel shall wash their hands prior to eating, drinking or smoking.

I. SANITATION. Potable water, nonpotable water, toilets and personal hygiene facilities shall be readily available.

I.1. Potable water. An adequate supply of potable water, or other drinking fluids, shall be maintained. Containers for drinking fluids shall be capable of being tightly closed, and equipped with a tap. These containers must also be labeled in such a manner that the contents are not accidentally used for other purposes. Where single service cups are supplied, the unused cups shall be maintained in sanitary containers; and a separate disposal container provided for used cups.

I.2. Nonpotable water. Water intended for uses other than drinking, washing, or cooking shall be identified in such a way that it is not accidentally used for drinking, washing, or cooking. There shall be no cross-connection of potable and nonpotable water supplies.

I.3. On-site personnel shall wash their hands and faces prior to eating, drinking, dipping, smoking and/or applying cosmetics. No smoking is permitted in

controlled areas except at established smoking areas in the cold/support area

J. OTHER SITE SAFETY ITEMS REQUIRED:

J.1. A Coast Guard Emergency Medical Technician (EMT)/Diver or Diving Medical Technician should be on hand or available for consultation via radio.

J.2. Hand held air horns or bull horns.

J.3. A MILLER Board litter (or equivalent). Standard Coast Guard Oxygen delivery and EMT kit.

J.4. Eye wash stations as appropriate.

J.5. Test paper for decon wash water pH and battery content sampling if required.

K. EMERGENCY PROCEDURES:

K.1. General Shipboard Emergency Procedures:

K.1.a. Follow Shipboard Watch, Quarter and Station bill as designated by the CO, OinC or Coxswain/Boat Officer of the vessel.

K.1.b. Observe buddy system; and avoid panic.

K.1.c. STOP WORK immediately. Secure all drums, containers, or other loads to prevent further hazards where such action does not place personnel in jeopardy.

K.1.d. Take necessary steps to remove hazards and avoid secondary injury.

K.1.e. Assemble at appropriate muster point, as designated in Shipboard Watch, Quarter and Station Bill, as designated by the CO, OinC or Coxswain/Boat Officer of the vessel.

K.1.f. Conduct emergency decontamination as outlined below if necessary.

K.2. EMERGENCY MEDICAL PROCEDURES:

K.2.a. Use portable air horn, whistle, hands-on-head, or other immediately available means to call for assistance.

K.2.b. Do not leave injured personnel unattended.

K.2.c. Call for the EMT or Medical Representative. Activate local 911 or EMS jurisdiction for assistance and request medical direction as needed. In the case of a diving related casualty limit all unnecessary movement and place the diver on oxygen or as directed by the EMT or Diving Medical Technician.

K.2.d. Provided there are not life threatening or overriding safety concerns, do not attempt to move injured personnel without competent medical assistance.

K.2.e. In instances where overriding safety concerns exist and movement of injured personnel is immediately necessary, utilize available means, such as a litter, to move the injured person only as far as absolutely necessary to an area of safety.

K.3. EMERGENCY DECON PROCEDURES:

K.3.a. EVACUATION OF HOT AREA OR WORK AREA:

1) Skip water wash and abbreviate decontamination procedures as needed. Make every effort to remove gross contamination through removal of chemical protective clothing where such removal does not delay evacuation.

2) Primary evacuation route is through the decon area.

3) To the extent possible, deposit all contaminated articles prior to exiting decon area.

4) Muster at site designated by the Master of vessel in Shipboard Watch, Quarter, and Station Bill

K.3.b. MEDICAL REMOVAL -- WITH CONTAMINATION:

1) Call EMT.

2) EMT is authorized to abbreviate decon procedures as necessary to prevent further injury.

K.4. EMERGENCY FIRE PROCEDURES:

K.4.a Call for help. Ensure that alarm is passed to supervisors and vessel operator.

K.4.b. Do not attempt to fight fires other than small fires. A small fire is generally one that can be extinguished with equipment and personnel immediately at hand, requiring no more than a few minutes time.

K.4.c. Do not take extraordinary measures to fight fires unless there is a serious risk of loss of life.

K.4.d. Upon hearing fire alarm, proceed to assembly point as assigned in Shipboard Watch, Quarter, and Station Bill for head count and further instruction.

L. COMMUNICATIONS:

L.1. GENERAL SIGNALS:

L.1.a. A whistle or air horn shall be treated as a need for assistance or notification of an emergency.

L.1.b. Standard diving signals per the Navy Diving Manual shall be used.

L.1.c. Repeated long horn blasts from the tending vessel, or hand held horns shall be taken as an evacuation call for personnel in the hot area. All personnel are to assemble in accordance with the Shipboard Watch, Quarter, and Station Bill.

L.2. RADIO COMMUNICATIONS:

L.2.a. CALL SIGNS:

1) Platform: _____.

2) OSC REPRESENTATIVE: _____.

3) Platform mobile units (Small boats etc.)
_____:_____
_____:_____
_____:_____
_____:_____

4) COAST GUARD OPERATIONAL ASSETS
Boats, cutters, and aircraft will use standard nomenclature (hull numbers, aircraft numbers, etc. using standard procedures).

5) The term "RESCUE" shall only be employed by those assets actually engaged in search and rescue operations.

L.2.b. VHF Channel 21A (157.05 MHz) has been designated as the primary working frequency for field communications.

L.2.c. VHF Channel 06 (156.03 MHz) has been designated as the secondary working frequency for field communications.

L.2.d. HF Frequency _____ (_____) MHz upper side band has been designated as the primary HF frequency for field to Site Coordinator.

(HF frequencies shown in parenthesis are window/dial settings.)

L.2.e. HF Frequency _____ (_____) MHz upper side band has been designated as the secondary HF frequency for field to base communications.

(HF frequencies shown in parenthesis are window/dial settings.)

L.2.f. VHF Channel 16 is designated for site emergencies.

L.3. Local Public Affairs - _____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

L.4. USCG District _____ Operations Centers

PHONES; ___-___-____ (voice)
___-___-____
___-___-____ (facsimile)

L.5. USCG Air Station:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

L.6. USCG platform OPCON:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

L.7 Other USCG Command/support functions: _____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

L.8. HOSPITALS CAPABLE OF TREATING MERCURY/MERCURY VAPOR EXPOSURES AND/OR PROVIDING DIVER RECOMPRESSION FOR AGE OR DCS.

Hospital: _____
Address: _____
_____
LAT/LONG: _____/_____
Communications; Phones: _____
_____
Freqs: _____PRI.
_____SEC.

Hospital: _____
Address: _____
_____
LAT/LONG: _____/_____
Communications; Phones: _____
_____
Freqs: _____PRI.
_____SEC.

HELIPORT: _____
Heliport frequencies: _____ and _____

ENSURE THOROUGH WATER WASH DECON PRIOR TO TRANSPORTING VICTIMS PRIOR TO AIR EVAC. CONTACT ATSDR (listed below) A.S.A.P.

L.9. Agency for Toxic Substance and Disease Registry (ATSDR)

24 Hour emergency contact (404)639-0615
(Will provide consultation and/or medical specialists to local medical facilities treating patients.)

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

L.10. Other phone numbers:

DAN	Dive Accident Network	(919) 684-8111
EDU	Experimental Dive Unit	(904) 234-4351
NAMRI	Naval Medical Research Institute	(301) 295-1839

HELIPORT: _____
Heliport frequencies: ___.___ and ___.___

L.11. Other phone numbers:

_____
_____
_____
_____
_____
_____
_____
_____

M. SITE SAFETY BRIEFINGS/MEETINGS.

M.1. All personnel shall receive an initial site safety briefing to communicate the nature, level and degree of hazards expected on site.

M.2. Site safety meetings shall be held before each operation or shift is commenced and when significant changes are made in work procedures or safety plans. The procedure will be discussed by all participants to ensure that all personnel understand their assignment. Safety procedures and any changes or modifications to this plan or normal routine shall be discussed at these meetings or as outlined elsewhere in this plan.

N. AUTHORIZATIONS:

SITE SAFETY OFFICER:

_____ DATE: _____
Print Name:
Diving Officer
Aton Battery Response Dive TEAM A/B/C

SITE COORDINATOR:

_____ DATE: _____
CAPT
Commander, _____th Coast Guard District (oan)
_____, __

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

APPENDICES

APPENDIX A	List of On Site Coordinator/Representatives
APPENDIX B	List of Site Safety and Health Supervisors

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

RECOMMENDED ATTACHMENTS

ATTACHMENT (1)	Platform AtoN battery capacity.
ATTACHMENT (2)	Signature page for personnel on this project
ATTACHMENT (3)	Site map for platform
ATTACHMENT (4)	Hazardous substance information
ATTACHMENT (5)	Heat Stress guidelines
ATTACHMENT (6)	Cold Stress guidelines
ATTACHMENT (7)	Small Boat Operations guidelines
ATTACHMENT (8)	A guide to safe work practices for lifting
ATTACHMENT (9)	Decontamination diagram
ATTACHMENT (10)	Site sampling protocols (if required)
ATTACHMENT (11)	Diving Safety Plan

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

APPENDIX **A** **List of On Site Coordinator/Representatives**
(In order of seniority)

SC REPRESENTATIVE - On scene:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

SC REPRESENTATIVE - On scene:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

SC REPRESENTATIVE - On scene:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

SC REPRESENTATIVE - On scene:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

USCG SITE SAFETY PLAN/ATON BATTERY RESPONSE PROJECT

APPENDIX B **List of Site Safety and Health Supervisors**
(In order of seniority)

Site Safety and Health Supervisor:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

Site Safety and Health Supervisor:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

Site Safety and Health Supervisor:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

Site Safety and Health Supervisor:_____:

PHONES; ___-___-____ (voice)
___-___-____ (voice)
___-___-____ (facsimile)

UNITED STATES COAST GUARD
Headquarters Public Affairs

MEDIA ADVISORY DATE: MARCH 22, 1994

CONTACTS:

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RESEARCH FINDINGS INDICATE COAST GUARD AID TO NAVIGATION (AToN) BATTERIES NOT HAZARDOUS TO MARINE ENVIRONMENT

MIT RESEARCH FINDINGS

The Volpe National Transportation Systems Center in Cambridge, MA released initial research findings today concluding that the mercury and alkaline solution contained in spent Coast Guard AToN batteries are unlikely to harm the marine environment or enter the food chain.

The study, performed by Massachusetts Institute of Technology (MIT) researchers Professor Francois Morel and Dr. Robert Mason, examined whether mercury, small amounts of which coated zinc plates inside the batteries, was or could be absorbed into the aquatic food chain. Mercury can enter the food chain when it is in a methylated (methyl mercury) or oxidized (ionic mercury) form. Mercury in its elemental form dissolves very slowly in water (30 to 100 years) and is not absorbed by aquatic organisms. Once dissolved, elemental mercury enters a natural cycle where it is volatilized into the atmosphere.

Professor Morel and Dr. Mason concluded that "it is expected that none of (the mercury) should be oxidized or methylated or become accumulated by the planktonic biota" and that they "expect to see no measurable biological effects due to the AToNs [batteries], either in the local sediments or in the water column." The alkaline (electrolyte) solution in the batteries is immediately neutralized in water and causes no harm.

The MIT findings were based on laboratory analyses and field studies conducted in the Chesapeake Bay. Significant findings:

> On a regional and global scale, the amount of mercury in AToN batteries is insignificant. Mercury is found in all waters and its concentration fluctuates over time.

Typical used AToN batteries were found, after their normal service life, to only contain a fraction of their original mercury content. The mercury remaining in the batteries is in an elemental form that is not absorbed by biological organisms, even if the batteries are not completely intact.

Well over half (60%) of the discarded batteries recovered to date were fully intact. Intact batteries were found not to leak measurable amounts of mercury.

COAST GUARD REACTION

Rear Admiral Peter A. Bunch, USCG, Chief of the Office of Engineering, Logistics and Development at Coast Guard Headquarters in Washington, DC characterized the research findings as positive:

> "The Coast Guard has been working closely with the Volpe National Transportation Systems Center to determine the environmental effects of discarded AToN batteries. These findings do nothing to relieve us of our responsibility to remedy the problem in accordance with federal and state requirements, but it is good to have solid scientific evidence that discarded AToN batteries are limited to a waste problem, and not a health or environmental hazard."

ADDITIONAL BACKGROUND

The U.S. Coast Guard operates approximately 16,500 lighted aids to navigation (AToN) consisting primarily of fixed navigational lights and buoys. AToN are located throughout the country on navigable waterways and in U.S. territorial waters in other parts of the world. Before the 1980's, lighted AToN were powered by various types and sizes of "one time use" wet cell/gel cell batteries. In the mid-1980's, the Coast Guard began converting most of its lighted AToN to solar power, substantially reducing its reliance on expendable batteries.

Prior to the 1970's, the Coast Guard, like the rest of the nation, did not have the environmental awareness that exists today. Although before 1973 there were no directives that said what to do with used batteries, it was never Coast Guard policy to dispose of them in the water. In 1973, the Coast Guard issued instructions that set procedures for battery recycling and proper disposal.

A small number of AToN batteries continue to get into the water when lighted AToN are hit by vessels, destroyed by bad weather or vandalized. It is Coast Guard policy to immediately report accidental battery losses to federal, state and local environmental authorities and to recover the batteries whenever safely possible. The Coast Guard is developing methods for

better attachment of batteries to lighted aids to prevent future losses and facilitate retrieval.

Since 1984, the Coast Guard has been picking up AToN batteries from various sites. Site surveys are being conducted in locations across the country. The Coast Guard, through the John A. Volpe National Transportation Systems Center, is conducting an analysis of known sites and is investigating the most effective site assessment, removal and remediation techniques.

An issue of concern is that greater damage not be done to the marine environment by removing batteries that may be covered over with natural growth (i.e. corals, algae, sponges) and used as "homes" by aquatic creatures. Additional study and consultation with regulatory and environmental agencies may be necessary to determine if removing the batteries is the best course of action.

The Coast Guard is working cooperatively with the U.S. Environmental Protection Agency Office of Federal Facilities Enforcement (OFFE) and affected state environmental agencies to develop a national remediation plan. Technical assistance is being provided by the U.S. Navy Supervisor of Salvage (SUPSALV), the National Oceanographic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency's National Estuarine Program. Recovery operations currently underway in Florida will provide information necessary to develop the national plan. The Coast Guard anticipates completion of an initial draft of the plan in the summer of 1994.

UNITED STATES COAST GUARD
Headquarters Public Affairs

MEDIA ADVISORY DATE: MAY 11, 1994

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COAST GUARD REMOVES AIDS TO NAVIGATION (ATON) BATTERIES FROM TAMPA BAY

On April 8, 1994, the Coast Guard completed an initial effort to clean up ATON batteries at aquatic lighted ATON sites in Tampa Bay, FL. The clean up was coordinated by the Coast Guard Civil Engineering Unit, Miami, the Aids to Navigation Branch of the Seventh Coast Guard District in Miami, Coast Guard Group, St. Petersburg, FL and the John A. Volpe National Transportation Systems Center (Volpe Center) in Cambridge, MA.

In total, Coast Guard divers and Volpe Center researchers surveyed 100 aquatic lighted ATON sites in Tampa Bay, and removed approximately 1,700 ATON batteries from 49 of the sites. There were no batteries detected at 51 of the sites.

All but 12 of the recovered batteries were of the pre-1980's "primary" type. Ten of the 12 "secondary" batteries (i.e. lead-acid automotive-type batteries used in solar-powered ATON) were positively traced back to "knockdowns" (i.e. vessel collisions with lighted ATON) or incidents of vandalism/theft that occurred between 1989 and 1992. The two remaining secondary batteries are thought to have entered the water due to similar causes.

In January 1994, Volpe Center researchers worked from the Coast Guard Cutter VISE to survey ten aquatic ATON sites, collect soil and battery samples and evaluate diver safety procedures and different methods of removing batteries. In conjunction with the research, batteries were removed from a number of previously surveyed sites.

In February and March 1994 Coast Guard dive teams utilized small boats and crews from Coast Guard Group, St. Petersburg, FL to survey sites and remove batteries when they were discovered.

Additionally, on April 21, 1994, the Coast Guard finished a clean up of the former Anclote Key Light, removing approximately 180 primary batteries from the land site near Tampa. The clean up was conducted with concurrence from Anclote Key State Park officials.

All of the recovered batteries are being recycled or properly disposed of through a contract with the Defense Reutilization and Marketing Service.

The Coast Guard is working cooperatively with officials of the Florida Department of Environmental Protection and is keeping state officials appraised of survey findings and battery removals.

With the assistance of the Volpe Center, the Coast Guard is developing a national response plan for ATON batteries. Data collected from this study will be analyzed and used to develop standard procedures for battery recovery and site safety. In addition, evaluations will be made to determine the most efficient and cost effective methods for ATON battery recovery.

ADDITIONAL BACKGROUND

The U.S. Coast Guard operates approximately 16,500 lighted aids to navigation (ATON) consisting primarily of fixed navigational lights and buoys. ATON are located throughout the country on navigable waterways and in U.S. territorial waters in other parts of the world. Before the 1980's, lighted ATON were powered by various types and sizes of "one time use" wet cell/gel cell "primary" batteries. In the mid-1980's, the Coast Guard began converting most of its lighted ATON to solar power, substantially reducing its reliance on expendable batteries.

Prior to the 1970's, the Coast Guard, like the rest of the nation, did not have the environmental awareness that exists today. Although before 1973 there were no directives that said what to do with used batteries, it was never Coast Guard policy to dispose of them in the water. In 1973, the Coast Guard issued instructions that set procedures for battery recycling and proper disposal.

A small number of ATON batteries continue to get into the water when lighted ATON are hit by vessels, destroyed by bad weather or vandalized. It is Coast Guard policy to immediately report accidental battery losses to federal, state and local environmental authorities when required and to recover the batteries whenever safely possible. The Coast Guard is developing methods to better attach batteries to lighted aids to prevent future losses and facilitate retrieval.

Since 1984, the Coast Guard has been picking up ATON batteries from various sites. Site surveys are being conducted in locations across the country. The Coast Guard, through the Volpe Center, is conducting an analysis of known sites and is investigating the most effective site assessment, removal and remediation techniques. Site survey and clean up operations nationwide are anticipated to be spread over several years.

An issue of concern is that greater damage not be done to the marine environment by removing batteries that may be covered over with natural growth (i.e. corals, algae, sponges) and used as "homes" by aquatic creatures. Additional study and consultation with regulatory and environmental agencies may be necessary to determine if removing the batteries is the best course of action.

The Coast Guard is advising the U.S. Environmental Protection Agency Office of Enforcement and Compliance Assurance (formerly the Office Federal Facilities Enforcement) and affected state environmental agencies on development of the national clean up plan. Technical assistance is being provided by the U.S. Navy Supervisor of Salvage (SUPSALV), the National Oceanographic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency's National Estuarine Program. The Coast Guard anticipates completion of an initial draft of the plan in the summer of 1994.

MEDIA ADVISORY DATE: JUNE 24, 1994

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COAST GUARD DISTRIBUTES TRAINING VIDEO ON PREVENTING IMPROPER DISPOSAL OF AIDS TO NAVIGATION (ATON) BATTERIES

On June 24, 1994 Coast Guard Headquarters began distributing an internal training video reiterating proper procedures for handling and disposing of used batteries from lighted aids to navigation (ATON). The video is targeted at all personnel involved in the servicing and support of ATON and is being sent to over 500 Coast Guard units nationwide.

The 13 minute video titled ATON Battery Awareness, reviews past practices and restates the Coast Guard's long standing policy that spent ATON batteries are to be recycled or otherwise properly disposed of. Field personnel demonstrate correct methods, equipment and safety practices for changing out, packaging and handling ATON batteries.

The video goes on to review current hazardous waste laws and Coast Guard procedures to account for every single battery. Personnel are told what steps to take if they discover that ATON batteries have been lost or improperly stored. Personnel are warned to never allow batteries to enter the water.

The video is a joint production effort of the Maintenance and Logistics Command, Atlantic at Governor's Island, NY, the Office of Engineering, Logistics and Development and the Public Affairs Staff at Coast Guard Headquarters.

COAST GUARD REACTION

Rear Admiral Peter A. Bunch, Chief of the Office of Engineering, Logistics and Development at Coast Guard Headquarters expressed satisfaction with the training initiative:

> We want to correct any misperception that the Coast Guard condones or tolerates improper disposal practices. The Coast Guard is committed to an aggressive internal environmental compliance program. Only by ensuring our own house and actions are in order will we continue to receive the full support of the American public and Congress in carrying out our missions. Although we don't believe that our people have contributed to this problem for many years, we want to remind them of their individual roles as environmental guardians.