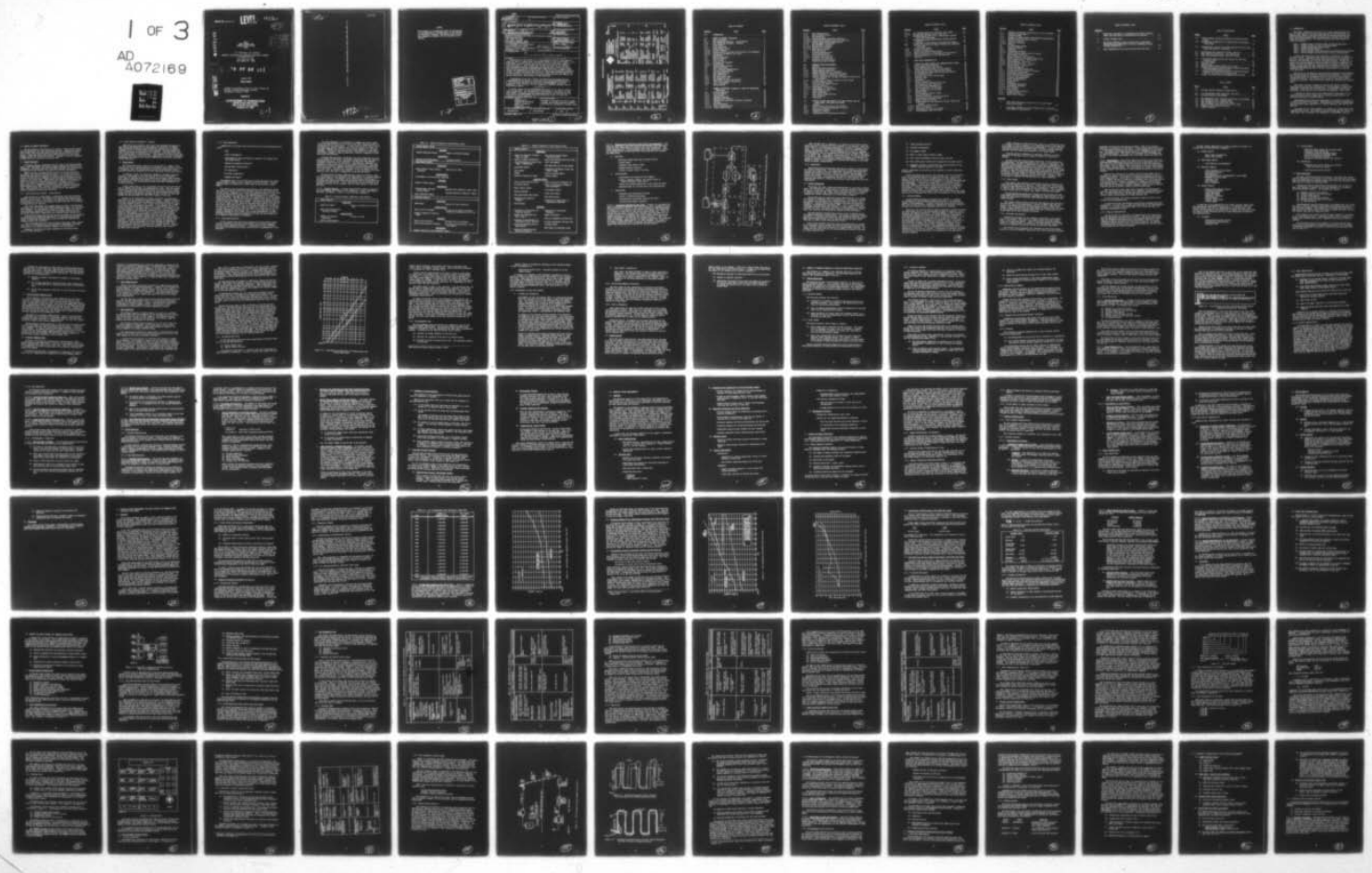
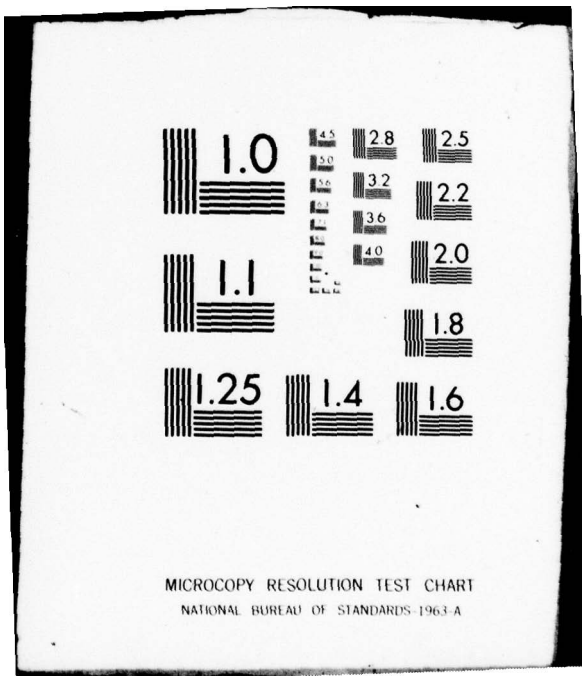
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USCG GROUP CONTROL AND COMMUNICATIONS SYSTEM STUDY

T.P. Ellsworth, W.H. Serstad

Magnavox Government and Industrial Electronics Company
Fort Wayne Division

1313 Production Road
Fort Wayne, IN 46808

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January 1979

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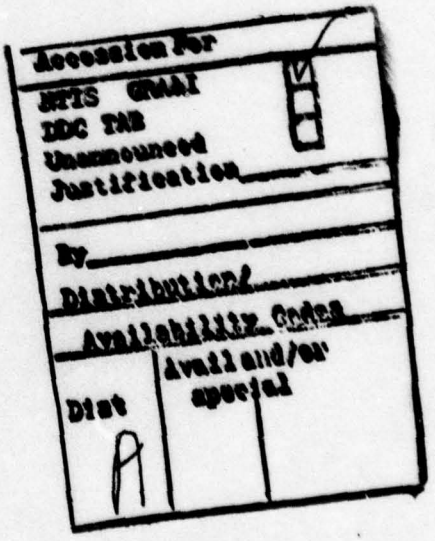
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16. Abstract

Presentation of the results of a study program on Control and Communications for the U.S. Coast Guard, including a survey of the current means ~~utilized~~ used at the Group Office and Station levels for operational communications and control. Also included are current administration and management procedures employed at the Group and Station level. Based upon Study Team observations, it was concluded that a need exists for a computer-based control and communication system capable of storing and processing information related to Search and Rescue (SAR) missions. ~~The study included a~~ projection of SAR workloads in the 1978-86 time period ~~which~~ indicates the need for improving operational effectiveness of SAR operations.

A requirements study for a Control and Communications System was performed ~~and~~ a system concept is presented that involves the development of a real-time Group SAR Data Base that would be ~~utilized~~ used for operational management of SAR resources, and for preparation of record messages and administration reports.

A system concept for Search Planning and Control of 41' and 44' station boats is described. The boat position is monitored by rebroadcast of digitized LORAN-C coordinates to Group Operations Center. The boat position and track history are ~~utilized~~ used by the Group Operations Center to direct the execution of search operations.

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METRIC CONVERSION FACTORS



INTERNATIONAL SYSTEM OF UNITS (SI) CONVERSION FACTORS

Conversion TO Metric Measures

Symbol	Given	Multiply by	To Obtain	Symbol
LENGTH				
in	inches	25.4 *	millimeters	mm
ft	feet	30.48*	centimeters	cm
yd	yards	0.9144*	meters	m
mi	miles (statute)	1.609	kilometers	km
nmi	miles (nautical)	1.852*	kilometers	km
	micron	1.0*	micrometers	μm
Å	angstrom	0.1*	nanometers	nm
AREA				
cmil	circular mils	0.0005067	sq millimeters	mm^2
in^2	square inches	6.452	sq centimeters	cm^2
ft^2	square feet	0.09290	sq meters	m^2
yd^2	square yards	0.8361	sq meters	m^2
mi^2	sq miles (statute)	2.590	sq kilometers	km^2
	acres	0.4047	hectares($10^4 m^2$)	ha
VOLUME				
fl oz	fluid ounces (US)	29.57	cubic cm (milliliters)	cm^3 or ml
gal	gallons (US liq)	3.785	liters	l
gal	gallons (Canada)	4.546	liters	l
in^3	cubic inches	16.39	cu centimeters	cm^3
ft^3	cubic feet	0.02832	cubic meters	m^3
yd^3	cubic yards	0.7646	cubic meters	m^3
bbl	barrels (US petro)	0.1590	cubic meters	m^3
	acre feet	1233.5	cubic meters	m^3
SPEED				
ft/min	feet per minute	5.080*	millimeters per second	mm/s
mi/h	miles per hour	0.4470	meters per sec	m/s
km/h	kilometers per hr	0.2778	meters per sec	m/s
kn	knots	0.5144	meters per sec	m/s
MASS				
oz	ounces (avdp)	28.35	grams	g
lb	pounds (avdp)	0.4536	kilograms	kg
ton	short tons (2000 lbs)	0.9072	metric tons (1000 kg)	t
DENSITY				
lb/ft^3	pounds per cubic foot	16.02	kilograms per cubic meter	kg/m^3

Symbol	To Obtain	Divide by	Given	Symbol

Conversion FROM Metric Measures

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

IEEE Std 268A-1974

Conversion TO Metric Measures

Symbol	Given	Multiply by	To Obtain	Symbol
FORCE				
ozf	ounces-force	0.2780	newtons	N
lbf	pounds-force	4.448	newtons	N
kgf	kilograms-force	9.807	newtons	N
dyn	dynes	10^{-5}*	newtons	N
WORK, ENERGY — POWER				
ft-lbf	foot pounds-force	1.356	joules	J
cal	calorie (thermochem)	4.184*	joules	J
Btu	British thermal units (Intl)	1055.	joules	J
hp	horsepower (elec)	746.*	watts	W
ft-lbf/s	foot pounds-force per second	1.356	watts	W
Btu/h	British thermal units per hour (Intl)	0.2931	watts	W
PRESSURE				
lbf/in^2	pounds-force/$inch^2$	6.895	kilopascals	kPa
lbf/ft^2	pounds-force/$foot^2$	47.88	pascals	Pa
kgf/m^2	kilograms-force/$meter^2$	9.807	pascals	Pa
mb	millibars	100.0*	pascals	Pa
mmHg	millimeters of Hg	133.3	pascals	Pa
inH_2O	inches of water (39°F)	0.2491	kilopascals	kPa
ftH_2O	feet of water	2.989	kilopascals	kPa
LIGHT				
fc	footcandles	10.76	lux	lx
fL	footlamberts	3.426	candelas per sq meter	cd/m^2

Symbol	To Obtain	Divide by	Given	Symbol

Conversion FROM Metric Measures

TEMPERATURE

Symbol	Given	Compute by	To Obtain	Symbol
°F	°Fahrenheit	$(°F-32)\cdot\frac{5}{9}$	°Celsius	°C
°C	°Celsius	$°C\cdot\frac{9}{5}+32$	°Fahrenheit	°F

* Indicates exact value 5 omit when rounding

Extracted from IEEE Stds 268-1973, 280-1968, & 322-1971.



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1.0 INTRODUCTION

This report summarizes the results of a study program performed for the U.S. Coast Guard on functional requirements for a Group Control and Communications System, utilizing modern data and message processing techniques for handling operational and administrative transactions between Group offices and Stations. The tasks performed under the Contract include the following:

Task 1 - Conduct Survey of Current Group and Station Operations
Task 2 - Conduct Forecast of Future SAR Requirements
Task 3 - Perform System Requirements Study
Task 4 - Define Systems Concept
Task 5 - Analyze Current Group Administrative and Management Procedures
Task 6 - Survey Methods for Search Mission Control and Assessment

A study team consisting of four engineers was organized to conduct the Task 1 survey. Designated Coast Guard facilities in the following four Districts were included in the Survey: the First District, the Seventh District, the Ninth District, and the Thirteenth District. Details of the survey sites and the makeup of the Study Team are included in Appendix A. Members of the Survey Team were able to obtain a valuable insight into the current problems faced by Group Commanders and Station OIC's in the performance of SAR operations and in the day-to-day business of operating their facilities.

The results of an analysis of projected SAR workloads for Group Offices and Stations during the 1978-1986 time period are presented. This projection was based upon the recognized factor in the growth of SAR workload - recreational boating. This forecast was included in the Study Program in order to establish a basis for future control and communications requirements.

This report includes a summary of observed and reported problems experienced by Station and Group Offices in the achievement of operational objectives. Based upon the collected data, a requirements analysis was performed, and the results of the analysis are presented in this report.

A forecast of future Control and Communications requirements at the Group and Station level is based upon the projected growth rate of recreational boating in the United States.

Recommendations for near-term improvements in procedures are shown in a separate section of this report. Implementation of these recommendations does not require major expenditures or radical departure from current SAR doctrine.

The output of this study program is a concept for a Group Control and Communications System. The concept presented is based upon the results of study tasks, and is intended to be responsive to requirements analysis.

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2.0 SURVEY OF PRESENT OPERATIONS

The first phase of the Study was to conduct a survey of four designated Group Offices and eight designated Stations. Additional stations were visited, when time and station locations were favorable for such visits. A four-man Survey Team visited USCG facilities in the First, Seventh, Ninth, and Thirteenth Districts. Appendix A shows the schedule of USCG facilities visited by the Survey Team.

2.1 Survey Procedure

The Survey Team was organized along the lines of the Study program tasks. Each Team member was tasked to gather information related to his assignment. Interviews were held with USCG personnel, and the operations of Group Office and Stations were observed by Survey Team members.

Before visiting the Group Offices in each of the four Districts, the Survey Team visited each District Office. At a staff meeting the Survey Team explained the purpose and scope of the survey work, and the officers of the District Commander's Staff presented information of interest to the Survey Team. Appointments were made with individual Staff Officers to cover this USCG activity areas of interest to the Survey Team. The Districts provided documentation, including District Operational Plans, Communications Plans and other reference materials. These documents have been a valuable information source to the Survey Team. Tape recorders and notes were used by Survey Team members to generate memoranda covering the interviews.

2.1.1 Data Gathering Procedure - Group Offices

Upon arrival at a Group Office, a meeting was held with the Group Commander and his Staff. The members of the Survey Team explained the purposes and objectives of the Control and Communications Study Program, and presented an outline of the methods of data collection to be employed at Group Offices and Stations.

Each Study Team member had assigned topics to cover, and individual interviews were set up with Group Office department heads. The interviews were informal - the Team members attempted to gain insight into the day-to-day problems encountered, as well as a functional overview of the particular Group Office organization and structure under consideration.

Particular attention was directed toward the layout and the operation of the Group Office Communications Center. We requested and obtained copies of forms used by Group Offices and Stations for recording and logging requests for assistance.

Tape recordings and notes were utilized by the Survey Team to gather data; later, the information was incorporated in memoranda, recording information on the various subjects covered in the interviews.

Appendix B contains trip report summaries of the Survey Team's visits to USCG facilities.

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2.1.2 Data Gathering Procedure - Stations

Upon arrival at a Station, the Survey Team explained the purpose of the Control and Communication Study program to the Officer in Charge. Then the Officer in Charge would describe the operation of his Station. Although we did not utilize formal questionnaires, the Team members were aware of the types of information to be acquired. Individual interviews were conducted with Station personnel. Tape recorders and notes were used to record information, which was later transcribed in the form of memoranda. Photographs were taken of the Station Communication facilities, and other Station facilities.

2.2 Group Office

Each Coast Guard Group consists of a Group office, a number of SAR stations and other elements which may include WPB's, Buoy Tenders, an Aids to Navigation team, and engineering facilities for maintenance support. Each SAR station has resources of its own consisting of boats and vehicles.

In addition to SAR, the Group must respond to incidents involving pollution, enforcement of laws and treaties and aids to navigation. Other types of problems may also be handled by the Group, such as shore-based medical emergencies and support of military communications for near-by installations. The information-handling system must accommodate all of these activities.

A Coast Guard Group is the link between the District and the Station, both in command relationship and communications links. When the circumstances of a particular SAR incident causes the control of the incident to be transferred from Station to Group, the Group Communications Center becomes the hub of information exchange for that case and the Group OOD becomes the decision maker for most major aspects of the case.

Because of the collocation of various activites, variations were observed in the way different Group offices operate. Among the observed activities collocated with Group offices are industrial bases, air stations and lifeboat stations. Any of these activities may have an impact on the facilities and personnel available. As an example, one of the reasons that Group North Bend seems to be an efficient operation is that the Group office is collocated with an Air Station. This situation permits the sharing of both personnel and better facilities than were observed at other groups. To say that air stations and Group offices should be collocated whenever possible would be a mistake, however, since the resulting efficiency depends more upon how the people adapt to the organization and their missions than it does upon the facilities available. In cases where a Station and a Group are collocated, the functions of Station watchstander and Group radioman are combined in the radioman, and the Group OOD acts also as the Station OOD. This situation usually results in personnel with a higher level of training and experience in the information handling functions than would be the case at most stations.

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2.2.1 Group Operations

Operations at the Group level may involve any of the following mission areas:

- SAR
- Aids to Navigation
- Enforcement of Laws and Treaties, primarily for fishing laws and drugs control
- Marine Environmental Protection
- Recreational Boating Safety
- Ice Operations
- Military Preparedness
- Command and Support

The emphasis here is on the SAR mission using resources of a collocated Station or those of other stations in multi-unit cases. The predominant aspect of operations in these cases is the control of small boats.

The center of decision-making and planning is the Operations Center. This room is variously called the "OD Shack", the RCC (as a District) or the Ops Center. Whatever it is called, the Operations Center is the focus of activity during SAR missions. The Communications Center is always located adjacent to the Ops Center for best accessibility to latest information by the OOD. The OOD and others in the Ops Center use all available information in determining how to dispatch, monitor, and direct the activities of SAR forces under their control. The monitoring function extends not only to cases in which the Group has operational control, but also to other cases with lower priorities, so that the Group OOD can be ready at any time to assume control in case of a change in conditions. The extent to which this is done varies, but some OOD's try to keep up with all the incident information they possibly can. It is never possible to have complete information on all cases, but the more comprehensive the OOD's knowledge of things occurring throughout the Group, the more capable he is of handling "unexpected" circumstances.

2.2.2 Group Administration

In this section the present-day procedures for Group Office administrative responsibilities will be described, with particular emphasis directed to the reporting functions. A description of the accounting data flow from Stations and Groups, and Districts to Headquarters is also presented.

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The Group Commander is responsible for command and overall supervision and administration of all Stations and other resources under the jurisdiction of the Group Office. In some cases the Group Office may be collocated with another command, such as an Air Station or a Base, and the Group Commander may also be the Air Station Commander or the Base Commander. The Survey Team observed that collocation of a Group Office with another command is usually beneficial, from the standpoint of both facilities and personnel.

Although some procedural differences were noted among the four Districts covered in the Survey, the general organization and the reporting procedures were found to be essentially the same for Group Offices surveyed in each of the four Districts. Consolidation, summation, and generation of top-level reports are performed at Districts. Data-entry operations involved in keypunch operations, including verification and error correction. One method of verification was to keypunch the data two times; then the entries were compared. If the two cards do not carry identical data, the card is flagged for review and correction.

The Group Office provides administrative support to Stations under its jurisdiction by the preparation and submission of the reports required by District Offices. The purpose of the Administrative Survey was to determine what types of periodic Administrative reports are prepared and processed by Group Offices. Later, consideration can be directed to the possible inclusion of the necessary data for these reports in the Group Data Base.

2.2.2.1 Periodic Reports. - Periodic administrative reports prepared by the Group Offices are divided in four categories: Annual, Semi-Annual, Quarterly, and Monthly. Table 2-1 lists the four categories.

Table 2-1. Periodic Reports Prepared by Group Offices

Annual Reports	
OPERATIONS	
Ammunition Report	Report of Inspection of Private Aid
Small Arms Training and Completion Reports	
FINANCE/SUPPLY	
Summary of Financial Operations	Release of Funds
Lube Oil Requirements	

(12)

(13)

Table 2-1. Reports Prepared by Group Offices (Cont)

Annual Reports (Cont)	
PERSONNEL	
Officer Education Record	Report of Records Holdings
ENGINEERING	
Heating Plant Maintenance	Equipment Record
Semi-Annual Reports	
OPERATIONS	
Public Affairs Video Library Inventory	SAR Facility Index
FINANCE/SUPPLY	
Procurement by Civilian Exec. Agencies	
PERSONNEL	
Officer Fitness Report	
ENGINEERING	
Outboard Motor and Boat Trailer Report	Heating Plant Commercial Insp. Form
	Heating Inspection Completion Report
Boat Inspection Report	
Quarterly Reports	
OPERATIONS	
BAMS Report	Abstract of Boat Operations
FINANCE/SUPPLY	
Mess Activity Statement	Military Civil Rights and Human Relations Affirmative Action Plan
Deposit Program for Minority Banks	
PERSONNEL	
Medical Care Abstract	Exchange Activity Statement
Moral Fund Financial Statement	Photo-Copy and Duplication Production Report
ENGINEERING	
Energy Conservation and Management Report	

(14)

(14)

Table 2-1. Reports Prepared by Group Offices (Cont)

Monthly Reports	
OPERATIONS	
Report of Violation of Radio Reqs. or Comm.	SAR Incident Report Folder (Filed Locally)
Report of Radio Interference	Master SAR Planning Check-off Sheet
Loss and Recovery of Small Arms Ammo. or Explosives	Daily SAR Summary
Assistance Record	SMC Check-Off List for SAR Phases
Boat Record	Geographical Reference Points and Alter - Names
SITREP	Vehicle Accident Report
Record of Inspection, ATON	Casualty Report
FINANCIAL/SUPPLY	
Stores Account Balance Sheet	Add-On Listing for Shopping List
Allocation Record	Report of Non-Receipt Damage or Non-conformance
Optar Control Record	Procurement Request
Stores Statement	Travel Cost Report
Cash Subsistence Mess Report	Fund Modification
Abandoned and Forfeited Property	Estimate for Change Order or Supplemental Agreement
GTR Worksheet	
PERSONNEL	
Preparation of Personnel for Overseas Transfer	Disposition of Drug Abuse Offenders
Request for Negotiation of Gov't Lease	Report of Casualty
Inventory of and Receipt for Furniture in Gov't Quarters	Officer Assignment and Data Form
Controlled Substance Discrepancy Report	Enlisted Assignment and Data Form
Impatient Hospitalization/ Physician Facility	Accident Report
	PMIS Family of Personnel Forms

(15)

(15)

2.2.2.2 Administrative Functional Staff Records and Management. - The Group has three major functional organization elements that are responsible for Group administrative functions and report preparation: Personnel Administration, Financial/Supply Office and Engineering. Reporting responsibilities of each functional Group Administration elements are shown below:

a. Personnel

- Maintains Formal Hard Copy Personnel Records
- Issues Orders
- Prepares Input Forms to PMIS
- Manages Housing Situation
- General Clerical Center for Group

b. Finance/Supply

- Consolidates and Supervises Unit Budgets
- Checks, Prepares, Submits, and Tracks Status of Special Purchases (Form 1155's)
- Checks and Forwards SURF Cards or New Orders for Units
- Maintains GSA, CG, and FSN Parts Files (Microfische)

c. Engineering

- Maintains Boat Maintenance Records
- Assist in Housing Maintenance
- Provides Parts Assistance (Sources and "ETC")
- Provide Major Repair Assistance

2.2.2.3 Accounting Information Flow Chart. - Figure 2-1 illustrates the flow of accounting information from the Station level, through the Group Office and District, and on to the central computer at USCG Headquarters. A transaction is initiated at the Station; for example, the Station OIC may initiate an order for an item on the Federal Stock List. Since the Station does not have a Federal Stock Catalog, the Group Office is requested to assist in determining the correct Federal Stock No. and the proper nomenclature, as required, for placing an order. A SURF card order is prepared. After the item is properly identified, the accounting data must be added (appropriation, FY, fund breakdown, cost center to be charged, and object class) to indicate the nature of expenditure. Again, the accounting data is handled by the Group Office.

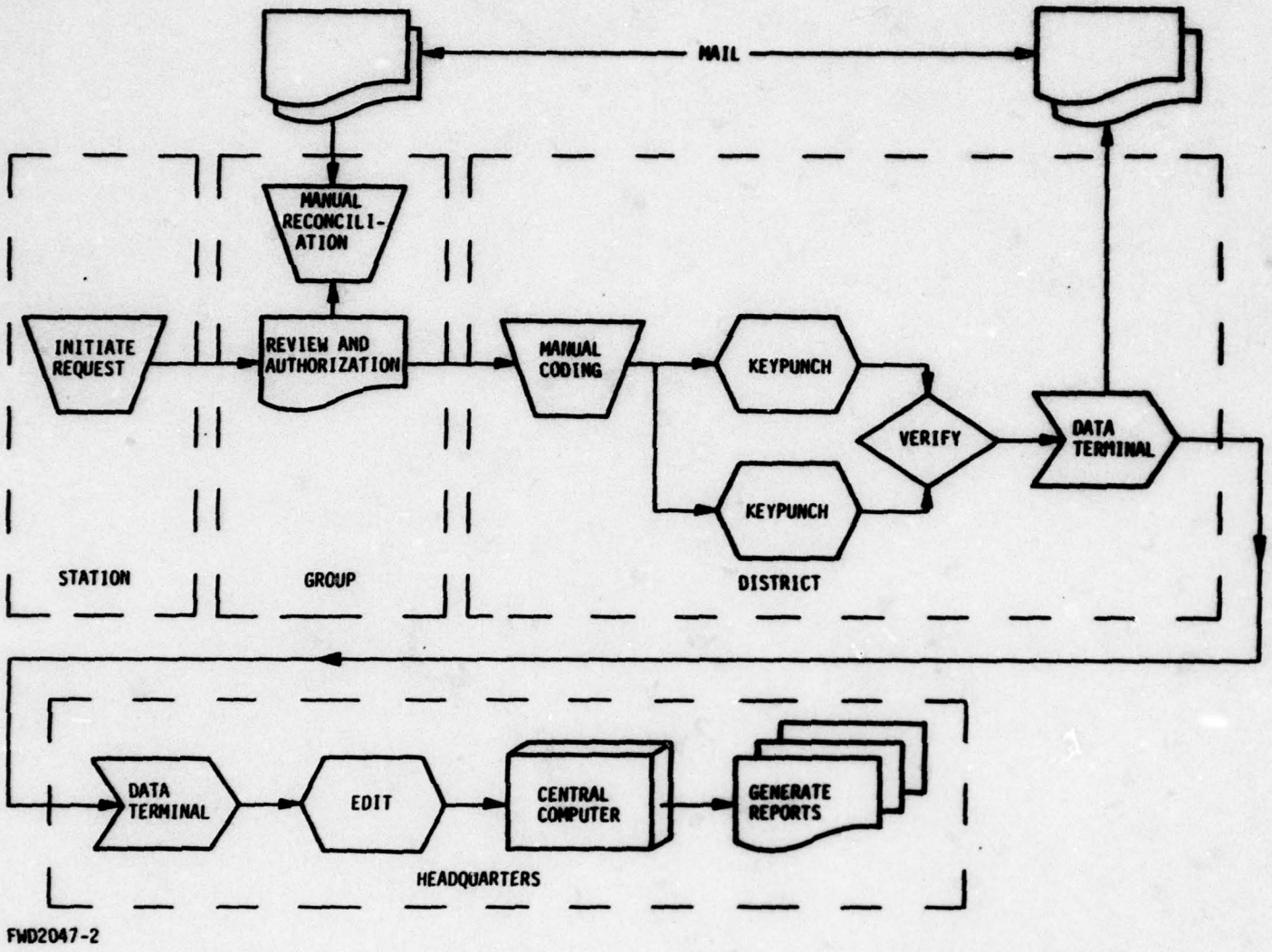


Figure 2-1. Typical Present Accounting Transaction Processing Flow Chart

When the SURF card is completed, it is mailed to the District Office. Supporting detail documents are also forwarded to the District. When viewed at District, the accounting information is recorded on standard coding forms. The resulting transferred information is not in usable form for computer processing or edit. Further manipulation of data is necessary - the alphanumerics must be transferred from the source document (SURF card) to the coding form. After manual coding tabs place, the data is keypunched and verified. After keypunching, the accounting data is transmitted via a Data 100 terminal to the Central computer at Headquarters. At this time hardcopy printout of the transaction is printed and returned to the Group Office for manual reconciliation.

2.2.3 Engineering

Engineering provides maintenance and facility support to Group Office and Station installations. The responsibilities of the Engineering group includes such items as facility inspections, maintenance and repair of heating and ventilating systems, electrical systems, shop machinery, maintenance and overhaul. Each of the Group offices visited had different kinds of facilities; the engineering sections for these offices were organized and staffed to satisfy the particular requirements for the local Group Office.

2.3 Station Operations

The Groups that were visited contained between six and twelve stations each. The Stations are involved mostly in SAR and recreational boat safety, but may be called upon to support other Coast Guard missions. The Officer in Charge is usually a BMC. Each station operates four to eight boats, ranging from 16-foot trailerables to 44-foot motor lifeboats.

The present mode of conducting Station SAR operations is to assign each Station a designated zone of responsibility. The Station receives all requests for assistance that originate within the Station's zone boundaries. Station resources are assigned to provide the required assistance, as determined by the Station OOD. If it is determined that additional resources from other Stations, or other support, is required to handle the case, the Station calls upon the Group Operations center. Under this condition the Group OOD may become the SAR coordinator.

The peak periods of Station SAR activity occur on weekends during the summer recreational boating season. The average workweek for station personnel is in excess of 100 hours per week during the peak SAR season. Many stations made extensive use of the services of the Coast Guard Auxiliary in order to cope with peak SAR activity.

Most of the incidents receiving Coast Guard assistance are handled by an individual Station without the need for additional help from the Group. However, under some conditions the Group becomes involved. The conditions that cause this may vary among different districts, and some of these conditions are:

(1) Search planning required

(2) Crossing of boundaries

(3) Air support needed

(4) WPB's or other group resources needed

(5) Units from two different stations become involved

(6) Two or more units involved even though from the same station

(7) Judgement of Group or Station OD that the seriousness of the incident warrants control by the Group

(Similar conditions are involved in the transfer of control from Group to District).

Station SAR Operations involve two different roles for the Station. First, the station may control all aspects of the case. Such cases usually involve the use of only one small boat as a SAR vehicle. The Group may or may not be advised of the progress of the case depending upon its seriousness. If the case is "minor SAR", it is reported in the daily SAR summary. Second, the station may be acting as an element of the Group, with Station resources being controlled by the Group Operations Center. At any one time, a Station may be involved in both of the above types of cases. The information inputs required at the station are similar for both types of case, but for the latter type there must also be a continuous and timely flow of information to the Group OOD.

2.3.1 Decision-Making

Decision-making regarding the appropriate response to a request for assistance or other reported distress situation is an important element in SAR management. In order to make the right decision the OOD must have the best possible information regarding the distress situation. He must also be aware of the readiness status of his resources.

When calls are received from the public reporting a possible distress, the interviewing skill of the Watchstander may play an essential role in obtaining the needed information. The Watchstander is often required to exercise good judgement in extracting needed information from panicky individuals reporting what may or may not be a real SAR incident. It is up to the Watchstander receiving the call to gather all the facts he can which might help in determining the course of action. This must be done carefully, trying to get the most essential information first in case of a loss of contact, but without interrupting a person in the process of supplying information. The information-gathering process requires skill and tact. If the Watchstander fails to obtain an accurate description of the distress location, a description of the boat involved, and the severity of the situation, the prosecution of the case may be seriously hampered.

Timely termination of SAR activities, when it is verified that there is no danger to life or property, is an important factor in the effective utilization of resources and prevents wasted effort. In many cases the Coast Guard Station is not notified that a distress situation had been resolved, and that Coast Guard assistance is no longer needed.

Accurate position information is sometimes difficult to obtain, especially if the boat is out of sight of land or if visibility is limited.

For SAR cases that require search operations, an area search plan is established. The search platform may be a boat or a helicopter. The designated search pattern is based upon the particular parameters of the SAR case, and the proper execution of the search plan should provide a high probability-of-detection of the distress case. Thus, the OOD should be able to rely upon the navigational accuracy of execution of the search pattern in order to provide the desired high probability-of-detection. At present, this goal cannot be achieved because there exists no means of monitoring the search platform's position and track. Therefore, there is no basis to evaluate the effectiveness of a search operation.

2.3.2 False Alarms

False alarms (the reporting of nonexistent distress situations) may reduce the SAR readiness of a Station. A false alarm that occurs during a period of peak SAR activity may result in diversion of resources needed to service cases involving hazards to life and property. Also, responding to false alarms results in wasted time, effort, and operating expense.

The discrimination between false alarms and real distress may sometimes depend upon the Watchstander's knowledge of recent patterns in false alarms and high ability to ask the right questions when talking with the reporting party.

The largest source of false alarms has been from CB radio wherever it has been used as a monitoring device. The use of REACT teams and state police as an adjunct to Coast Guard monitoring results in fewer false alarms. This is primarily due to their method of tracking down the source of false alarms and the screening effect that their activity has in reducing reporting of false distress situations.

2.3.3 Personnel and Training

Shortage of personnel is very seasonal at Stations in the northern half of the country. Most OIC's will mention among their most urgent needs "a few more good people". Since the present information-handling system is a manual system, its capability for handling peak loads is very sensitive to manpower availability during the peak work load period.

The turnover rate associated with transfers and end-of-enlistments reduces the level of personnel familiarity with local conditions including

geographic peculiarities and boating clientele. Some of the desired continuity is provided by the Auxiliary. Turnover also causes the Station to be continually breaking in new people in the fundamentals of watchstanding. The Communications Watchstander position is demanding enough, even for experienced people. This task is also difficult for individuals who are new to the Station and perhaps new to the whole subject of search and rescue.

2.3.3.1 Watchstander. - Even if the turnover rate were so low that every Communications Watchstander had more than a year of experience at his location, the skill level would be far below that for other jobs within the Coast Guard. This is because there is presently no rate for watchstanding and no formal training school. Any skills gained in typing, radio communicating, telephone interviewing or record keeping are gained by on-the-job training.

Consider the situation of a recently enlisted young Seaman that is assigned to a station. He has had no training or experience in typing or radio communications. Since there is no established Watchstander's rate (and no channel for him to strike for a radioman's rate), he is automatically in an "on-the-job training" situation with respect to qualifying for watchstanding duties. Since watchstanding is considered only an added duty, and not his specialty or primary interest, there is little personal incentive for him to become a highly qualified watchstander.

Some Station OIC's have taken steps to upgrade the Watchstander's position, and assure that the watch is not manned by inexperienced personnel. At Station Belle Isle, the men that take the watch receive extra liberty; hence, watchstanding has become desirable duty.

At Station Cortez, all station personnel (except the Chief) are in rotation for watchstanding duty.

At Station Coos Bay, Watchstander qualification standards have been established. A written test is used to qualify men for the Watchstander's position. At the time of the Study Team's visit there were only five qualified Watchstanders aboard.

2.3.4 Station Administration

The Station OIC is responsible for administrative work associated with the day-to-day operation of his facility. The Survey Team learned that the preparation and processing of the numerous periodical reports requires as much as 80 percent of the Station OIC's time, as well as substantial efforts from his First Class Petty Officers. The demands of administrative workload limits the time available for the OIC to provide training for his Station personnel.

Periodic formal administrative reports prepared by Stations are divided into the following four categories:

(1) Annual Reports

- Small Arms Accountability
- Small Arms Training

(2) Semi-Annual Reports

- Cost Reduction and Management

(3) Quarterly Reports

- Coast Guardsman of the Quarter
- Long Range Training
- Housing Report
- Boat Administration and Management System (BAMS)
- PSS/MEP Activities Report
- Financial Plan
- Boat Abstracts
- Fuel Consumption

(4) Monthly Reports

- Safety Board Meeting (Letter)
- Telephone Statements
- Ratio Memorandum
- Commissary Report
- Commissary Contracts
- Vehicle Report
- Weather Bureau Forms
- Target Ledger

In addition to the preparation of the formal periodic reports that are prepared and submitted by the Station, it is necessary that each Station perform a set of local administrative staff functions; local records are maintained by the Station OIC to support his functional needs. The types of staff functions and local records maintained at Stations are presented below:

(1) Personnel

- Abbreviated Personnel Records
- Training and Qualifications
- Emergency Data

(2) Finance/Supply

- Maintains Target Ledger for Allocated Funds
- Commissary Stock and Records
- Inventory of Station Personal Property
- Milstrip Requisitions and SURF Cards
- SF-44's for Special Purchases
- Maintains Local Parts Control and Inventory

(3) Engineering

- Maintains Local Parts Control and Inventory (Boat and Electrical Spares)

- Local Boat Maintenance Records

2.4 Radio Monitoring

The radio monitoring functions discussed in this subsection include distress monitoring by the Station on 156.8 MHz, 2182 kHz, and on Citizen's Band, and communications exchanges between the Station and the public which take place as a result of such monitoring.

Although the Station Communications Watchstander does not have as many radio speakers to monitor as the Group radioman, he is currently monitoring multiple channels. The channels may include:

(1) Channel 16 on low-level antenna
(2) Working channel on low-level antenna
(3) Citizen's Band monitor
(4) Channel 16 on high-level antenna
(5) Working channel on high-level antenna
(6) HF 2182-kHz monitor

The Watchstander does not usually have a "radioman's ear" for filtering certain types of information from among many simultaneous acoustic inputs from many speakers. This capability is becoming more important as more stations get VHF-FM radios with Channel 16 guard receivers, Citizen's Band radios, and access to high-level sites.

The volume of voice traffic on each of these channels is increasing as the user population grows. Congestion already exists on Channel 16. During times of heavy SAR activity, congestion also occurs on working channels.

The monitoring of CB has the potential to increase the SAR false alarm rate as large numbers on land mobile users with little investment in equipment and perhaps no operators license find that the Coast Guard "has its ears on."

Although the installation of VHF direction-finding antenna arrays (VHF-DF) had not been authorized, some Stations have installed and are operating such arrays. The Survey Team visited a Station that reported successful utilization of their VHF/DF installations. The Station OIC reported the following benefits:

(1) Reduced co-channel interference on Channel 16 and Working Channels.

(2) Use of radio bearings on distressed boats radio transmission as a navigational aid to locating the position of the Distress Case.

(3) Use of radio bearings on USCG boat to track and guide the boat's course.

2.5 Voice Landline Communications

Voice Landline is the Station's main communications link ashore. The dial-up telephone provides communication with the public, with agencies that become involved in SAR, and with other Coast Guard facilities. In addition to dial-up lines, the Station can communicate with the Group Communications Center through an intercom tie line when the Station and Group have access to the same high-level VHF antenna. Communications between Group and Station over voice landline is used during prosecution of a case as the real-time link; the teletype line is used as an after-the-fact information and documentation link.

Reliability of telephone communications is poor in some locations. In Group Woods Hole and Group St. Petersburg, comments were made that although the phone situation is slowing improving, the noise and dropouts during wet weather cause erratic communications.

During marginal weather conditions in the SAR season the Watchstander is often overloaded with weather inquiries from the public. Some stations (example: Coos Bay) are using taped weather messages to alleviate this situation. At Station Belle Isle the volume of such calls has declined since the Station began supplying marine weather reports to a local AM radio station for broadcast, and the National Weather Service at Detroit Metro Airport initiated a 24-hour weather line.

2.6 Teletype Communications

Teletype is utilized for transmission of record message traffic between Stations and Group Offices. Stations are connected to the Group Office Communications Center via a "Pony Loop". When one teletype machine is transmitting, all other teletype units on the loop are receiving the transmitted message.

The Station Watchstander is responsible for operating the teletypewriter and for composition and transmission of record message traffic.

Typically, the Watchstander has no previous experience in typing and has received no training in communications. The Watchstander's limited skill level, combined with limitations imposed by the Pony Loop, results in long delays in preparation and transmission of record message traffic. Each message must be composed on line by one Station at a time, while the other Stations await their turn to transmit. The result of slow typing rate and the serial nature of message transmissions between Station and Group is that, after a busy day, it requires many hours to handle the backlog of message traffic.

2.7 Boat Communications

VHF-FM voice radio circuits are utilized for communications between Station boats and the Station Watchstander. Channel 16, the distress and calling Channel, is normally used for initial call-up, then a shift is made to a Station's assigned working channel. The Station has the option of utilizing its low-level local antenna for short-range communications, or the Station may utilize a remote high-level VHF facility for longer-range communications.

The VHF high-level antenna arrays provide seaward-looking directivity patterns, and the antenna height (100 ft. or more) provides off-shore ranges out to 20 miles or more. Access to the high-level transceivers is provided by leased telephone circuits. Utilization of these installations is controlled by the Group Communication Center.

2.8 Boat Operations

The principal mission of Station boats is to serve as a platform for SAR missions within the boundaries of the assigned zone of a Station. The Station zones may vary in size; normally, the offshore operating range is 20 miles. However in some districts, the offshore range for Station boats has been extended to 125 miles.

The onboard navigation devices aboard 41-ft. and 44-ft. boats are the marine compass, a fathometer, and on some boats, a marine radar. These instruments are useful for approximate navigation purposes, but are not adequate for accurate position fixing.

The operational environment of a small boat is characterized by the capability of the boat crew, the platform characteristics, and the conditions imposed by sea state and weather conditions.

A typical boat crew consists of three men: the coxswain, a seaman and an engineer. The coxswain is usually the best qualified navigator aboard. To qualify as coxswain he must have some knowledge of navigation, boat handling and rules of the road, SAR procedures, and local knowledge of the coastal waters. The other two crew members usually have limited navigation experience. The engineer is responsible for the engine room, and the seaman is the lookout and may handle voice radio communications.

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When a boat is under way on a SAR mission, the crew is fully occupied with the tasks of operating the boat; little time or opportunity exists for making navigational plots on a chart. Although small boats may carry navigational charts, space for adequate chart tables and instruments is not available. Thus, navigational facilities and the opportunity for on-board position plotting and navigation are not available for small Coast Guard boats.

The SAR operational environment is affected by weather and sea conditions. High winds, foul weather, and poor visibility pose severe challenges to all aspects of small-boat operations. Under conditions of reduced visibility, and when shore check points or aids to navigation cannot be used, the coxswain must rely on his "seaman's eye" and his compass as his principal means of navigation.

An experienced coxswain who has a good local knowledge of shore check points and aids to navigation can navigate the inshore coastal waters; and this is the zone wherein most SAR operations occur. As shown in figure 2-2, 90 percent of recreational boating occurs within 5 miles of shore, which is well within the navigational capability zone for small boats.

During the Survey Team's visits to Stations in the 7th and 13th Districts, it was observed that the policy has been established for assigning small boats for offshore SAR cases out to 125 miles from shore, weather conditions permitting. Two conditions exist that influence the decision to employ small boats for the longer-range offshore missions. First, the increased utilization of WPB's for ELT missions limit their availability for offshore SAR missions. Second, we were informed by Headquarters OSR staff members that a boat utilization analysis has been recently completed. This analysis indicates that in many instances, a mismatch exists between resource capability and the requirement of the SAR mission - in many cases "too much boat" for the case requirement, and poor cost effectiveness is the result. At present, small boats are principally used for inshore SAR; this policy will be revised to permit the assignment of small boats to SAR cases that occur farther off-shore and within the boats designated operating range. The Survey Team observed instructions that authorized the employment of the 41-boat for cases out to an offshore range of 125 nmi, weather permitting.

2.8.1 SAR Operational Goals

Two SAR Operational goals have been established by the Coast Guard for all maritime SAR operations:

(1) Reduce Transit Time
(2) Improve Search Execution

Achievement of these goals is limited by the lack of accurate on-board navigation information. In order to reduce the transit time and

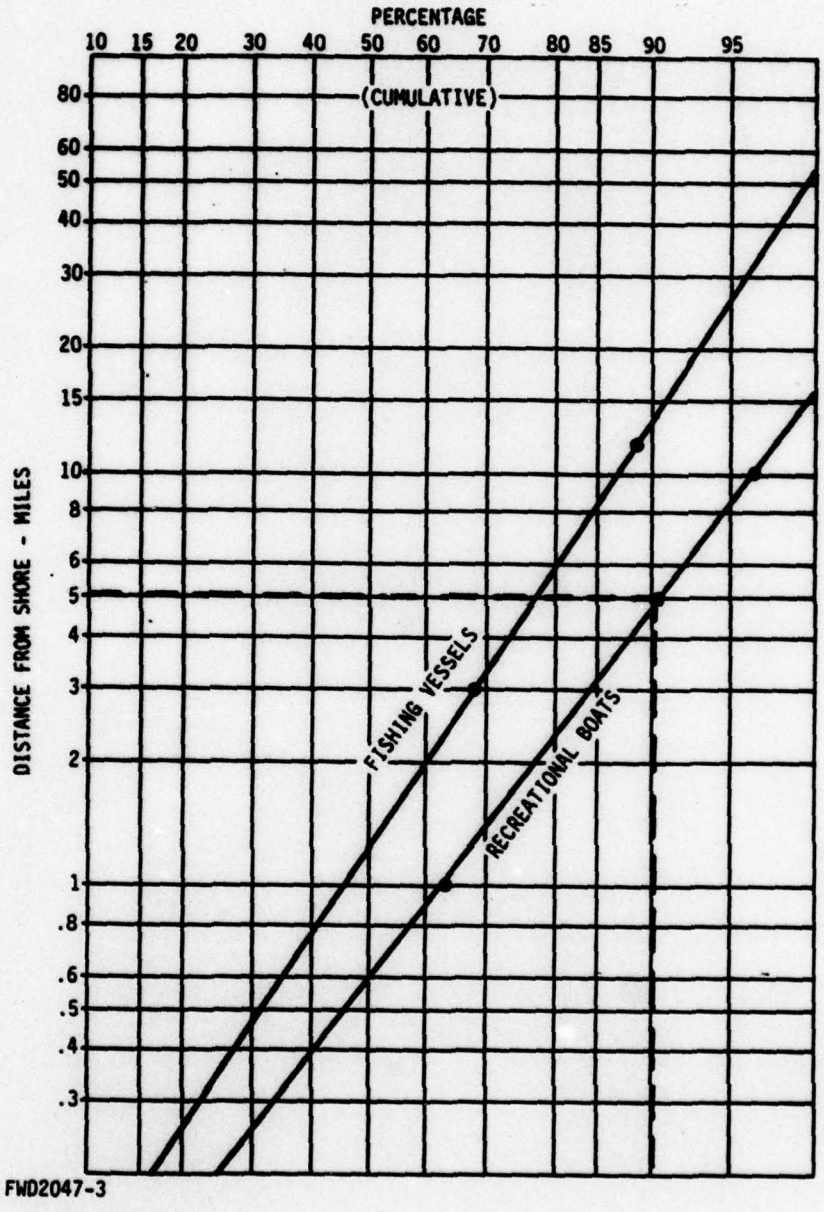


Figure 2-2. Distribution of Operation of Fishing Vessels and Recreational Boats

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improve search execution, the coxswain must hold to the most direct course, and at the highest possible speed. Under unfavorable conditions it is difficult to steer a straight course.

Transit time has been defined as the time it takes to reach datum. For short runs, in a straight line, the present seaman's eye navigation is adequate. To extend the distance a small boat can go offshore, however, the present seaman's eye approach will not suffice for holding transit times to a minimum. It was stated to the Survey Team that arrival at an offshore datum under present conditions, is a combination of skill and luck, under the best conditions.

The Search aspect in SAR is very important -- the distressed boat (or person) must be located before assistance can be rendered. On the average, 23 percent of SAR cases involve search operations. When a search operation is conducted by a Coast Guard boat, the boat is directed to a designated search point. Then, the coxswain will be directed to execute a designated search pattern.

In order to correctly execute the designated search pattern, the coxswain should be guided by an accurate navigation reference so that the legs of the search pattern can be executed with a high degree of confidence. Since the coxswain does not have an accurate navigational system, the search pattern cannot be executed with a known confidence level. Thus, neither the search planner at the Station or Group nor the coxswain has knowledge of how well the search pattern is being executed. If the distress case is not located within the predicted search area, the Coast Guard does not have the information to evaluate how well the search area was covered. In the event it becomes necessary to repeat the search pattern, the Coast Guard cannot verify that the search pattern was repeated.

2.8.2 SAR Management Data

The SAR management data base derives its information from the SAR Assistance Report, RCS-SR-2000. The Assistance Report provides three elements of information that are affected by the small boat's navigational accuracy. Tolerances as set forth by CG-397* are as follows:

(1) Distance (of datum) Offshore (B 05) ±1/10 nmi.

(2) Latitude and Longitude (B 06 and B 07) nearest minute.

(3) Distance to Scene of Search Area (C 06) - the indicated accuracy is ±1/10 nmi.

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*USCG Search and Rescue Reports Manual, CG-397.

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Another element of information appearing on the Assistance Report related to navigation is:

> Date/time on scene (C 05) - Indicated accuracy is to the nearest minute.

At present, all elements on SAR management information, with the possible exception of date/time on scene, are products of the coxswain's best guess. Many times the date/time on scene is also a guess because that element of information was not written down at the time. During the Survey Team's interviews with boat crews, it was observed that the Assistance Report is usually written at the end of the day's mission, and that the recorded navigational data, time annotations etc., are usually estimates.

2.8.3 Enforcement of Laws and Treaties

a. Fishing Zone Boundaries

Enforcement of Laws and Treaties (ELT) is a Coast Guard mission area that occupies an increasing share of small-boat operating time. For the most part, it was discovered that ELT navigational requirements are related to marine boundary definition. Boundary definition may be defined as the capability to accurately establish the locations of prescribed legal boundary lines. The purpose of boundary definitions is to determine whether or not a vessel is operating in accordance with laws and regulations within a zone defined by the boundary lines.

An example of the need for accurate boundary line definition was observed in the 13th Coast Guard District. The Coast Guard is tasked with the enforcement of commercial fishing regulations in the Puget Sound area. Puget Sound is divided into a number of fishing zones, defined on a chart by marine boundary lines. The fishing regulations designate certain fishing zones wherein fishing is prohibited during specified periods, but the abstention from fishing is not imposed for all zones at the same time. In some cases, the fishing regulations for various zones may be changed on a daily basis.

Recent U.S. dealings with Canada concerning reciprocal fishing rights in Canadian and U.S. boundary waters brought to light another potential boundary definition problem. At one point during the episode it appeared that the Coast Guard might be called upon to enforce the right of the U.S. to exclude Canadian recreational fishermen from U.S. waters in the Great Lakes. This would have posed a formidable enforcement problem for the small boats in the Ninth District.

b. Drug Traffic Interdiction

Small boats are being assigned to assist in drug interdiction operations. Off the East coast of Florida small boats have to determine the location of the boundary of Bahamian waters. The lack of an accurate indication of this boundary limits the capability of the Coast Guard boat to investigate suspect vessels.

2.8.4 Marine Environmental Protection

The Coast Guard has the responsibility for Marine Environmental Protection in harbors and within the Coastal Confluence zone; this task involves monitoring and enforcement of regulations regarding the use of authorized dumping zones, and location of pollution incidents and spills. These are examples of the need for an accurate onboard navigation system. In order to legally establish and document the locating of a violation incident, knowledge of the coordinates of the spill incident is needed. Currently, small boats lack the necessary navigational capability to satisfy this requirement.

2.8.5 Aids to Navigation

Coast Guard boats are used for non-SAR tasks that involve navigation and position fixing. ATON teams are responsible for installation and maintenance of Aids to Navigation, but other USCG boats report ATON deficiencies whenever observed. Navigational aids (buoys, markers) must be accurately maintained in the position shown on navigation charts, since all mariners rely on these aids as reference points.

During the Survey, the members of the Survey Team discussed the current means employed to position aids, and the shortcomings of these methods. At present, marine aids must be positioned by measuring angles to shore reference points and manuevering the boat into the designated position for installing the aid. This can be a tedious process, and the position location accuracy of the aid may be questionable. A similar kind of uncertainty exists for accuracy of checks on the position of deployed aids.

2.9 Questionnaires

Since the survey task covered a time frame which did not coincide with the SAR season, operations were not observed when peak loads were occurring. This had the advantage of permitting more time for briefings and discussions with operating personnel in Station, Group, and District offices. However, since there are no records of actual message traffic except the teletype message files, there is no way of obtaining quanitative information on what the watchstanders, radiomen, and OOD's are doing during their busiest times. A questionnaire was, therefore, made up after the survey to tabulate the opinions and recollections of the

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people closest to the problem. Separate but similar forms were made up for each Group Office and Station visited. A sample set of these forms and copies of the responses are included in Appendix C.

The information obtained in these questionnaires was of two types:

(1) Answers to specific questions

(2) Tabulations of percent of time spent and number of occurances for various tasks under each of the following conditions: a) during the busiest day of the season, and b) during the busiest hour.

3.0 SUMMARY OF OBSERVED PROBLEMS IN ACHIEVING OPERATIONAL OBJECTIVES

This section is a summary of the problems observed by the Study Team during the survey of operations. The following subsections are keyed to the observations made in section 2.

3.1 Station Operations

The principal mission of the Stations visited is to carry out the Search and Rescue mission. It was observed that many of the problems encountered are similar, but the priorities associated with the problems (as seen by a Station OIC) are varible among Stations. This subsection summarizes the observed and reported problems associated with Station operations.

3.1.1 Decision Making

The following problems were observed:

(1) Incomplete or inadequate information gathering of facts on a distress situation - this relates to the experience and skill level of the Station Watchstander.

(2) Lack of accurate navigational position information for distress case, and for deployed Station boats.

(3) Under conditions of intense radio and telephone traffic it is difficult for the busy Watchstander to fully inform the OOD of the status of SAR cases.

3.1.2 False Alarms

The problem caused by false alarms is twofold:

(1) False alarms cause a diversion of SAR resources. This diversion of resources can cause a unit to be unable to respond to a real distress situation in a timely way, resulting in loss of life and property damage.

(2) Under some circumstances the incidence of false alarms may obstruct timely decision making. For example: a search effort may be terminated if the conditions of the case appear to be similar to those encountered in prior false-alarm cases.

Dealing with false alarms and making the correct disposition of false-alarm incidents is an added burden for Watchstanders and OOD's.

3.1.3 Personnel Problems

The Station manpower is usually made up of a Boatswain's Mate, seamen, engineers, and cooks. SAR missions are carried out by three-man boat crews, and a Station may have a complement of 30 men. The OIC has no men trained in such specialties as yeoman, radioman, and storekeeper.

The OIC is faced with a personnel management problem: he has personnel that have narrow fields of training to cover a wide spectrum of skills necessary to perform the required missions. The only way for the OIC to close the gap between skilled job requirements and manpower availability is by "on-the-job training".

One of the problems encountered in using on-the-job training is the aptitude, skill level, and motivation of the young seaman trainees. The Survey Team observed that some of the trainees do not have the aptitude or interest to become a well-qualified watchstander.

Each Station maintains a radio watch, at least during daylight hours. The Watchstander is tasked to monitor Channel 16, CB, and Coast Guard working channels. He is also tasked to receive and record requests for assistance via radio and telephone. He also maintains contact with station boats during SAR operations. The Watchstander is responsible for preparation and transmission of formal record messages via a Pony Loop Teletype circuit to Group Headquarters. The Watchstander may also be responsible for performing PRECOM and EXCOM.

During the Survey it was observed that SAR information handling at the Station and Group levels are almost entirely based upon manual techniques. Message transmissions may utilize telephone or teletype circuits, as well as radio circuits. The priority, or urgency of the message determines the selected message transmission mode.

Papers by Cassis and Dorrian describe some of the problems faced by the Coast Guard in SAR information handling. Some of the difficulties pointed out in their papers have been alleviated, primarily in the area of radio monitoring.

Based upon the Survey Team's observations, and upon the responses to the Questionnaire Survey, (Appendix C), the principal problems in current SAR communications appear to be:

(1) Slow SAR message composition and handling, due to Station Watchstander's inexperience or lack of typing and language skills.

(2) Delay in handling record message traffic. Peak weekend SAR workloads during summer months requires extended work hours, causing Watchstander's fatigue.

(3) Lack of a standard file format for recording Requests for Assistance.

(4) Delays in processing SAR messages due to heavy radio traffic.

(5) Noisy working environment in some Group Communication rooms, due to location of teletype printers adjacent to the Communications Console.

3.1.4 Administrative Support

Operating a Station involves all the administrative aspects of running a small business. The OIC's administrative tasks include budgeting and finance, requisitioning and purchase of supplies and materials, maintenance of station property, commissary management, boat maintenance, and local community relations.

Perhaps the most time-consuming administrative job is paperwork - the preparation of an array of periodic reports, as shown in table 2-1 of section 2. Typically, the Station OIC must spend up to 80 percent of his time on administrative tasks. Obviously, the burden of administrative workload means that he cannot spend that time on personnel training and upgrading the SAR effectiveness of his unit. Clerical and administrative support to the Station OIC, by the assignment of yeoman rates to a Station, would relieve a part of the problem.

3.1.5 Requests for Local Marine Weather Conditions

Fisherman and recreational boat owners call the local Coast Guard Station for local marine weather information. Answering these calls is usually a Station Watchstander's responsbility. The time required to read the local forecast to the caller diverts the Watchstander from his main tasks.

3.1.6 Teletype

The problems in teletype communications at most Stations revolve around two circumstances:

(1) The Watchstander at the Station has no training as a communicator.

(2) The teletype network connecting Stations to the Group is a Pony Loop with no offline message composition capability at Stations.

The Watchstander normally has no formal training in communication skills, and his typing is strictly "hunt and peck". His knowledge of communications protocol and formal message formats is, for the most part, learned by trial and error. It sometimes takes a Watchstander more than an hour or two to compose a long message. The transmission of a message takes place only as fast as the Watchstander can type.

The teletype network linking the Stations and the Group connects all the terminals to the line without provision for any of the Station terminals to go off line, compose a message on paper tape, and then transmit the precomposed message. (A few of the largest Stations now have this capability).

The result of the slow typing and the serial nature of transmissions within the Group is that after a busy day it may take several hours to handle the message traffic backlog.

From the viewpoint of a Group radioman the main problem is the inexperience and lack of skill of the Station Watchstander. However, from the viewpoint of the Station Watchstander, the main problem is usually stated in terms of some radiomen being "more interested in perfect message format than they are in information content of the message".

3.1.7 Radio Monitoring

3.1.7.1 Station Communications. - Although the Station Communications Watchstander does not have the large number of radio speakers to monitor that a Group radioman has, he nevertheless is now monitoring more than one channel at a time. The channels may include:

(1) Channel 16 on low-level antenna
(2) Working channel on low-level antenna
(3) Citizen's Band monitor
(4) Channel 16 on high-level antenna
(5) Working channel on VHF high-level antenna
(6) HF 2182-kHz monitor

The Station Watchstander is not usually trained to develop a "radioman's ear" for picking out certain types of information from among many simultaneous acoustic inputs. This capability is becoming more important as more Stations become equipped with VHF-FM radios having Channel 16 guard receivers, Citizen's Band radios, and access to VHF high-level sites.

The volume of voice traffic on each of these monitored channels is increasing with increases in the user population, and congestion already exists on Channel 16 during times of heavy SAR activity on working channels.

The monitoring of CB will probably increase the SAR false-alarm rate as large numbers of land mobile users having little investment in equipment and with perhaps no operators license find that the Coast Guard "has its ears on."

3.1.7.2 Group Communications. - The Group Radioman has a large number of radio speakers to monitor. These radio speakers in combination with the teletype printers create a noisy working environment in the communications center. In the COMMCEN's at both Woods Hole and Detroit there are thirteen speakers being monitored simultaneously.

Most of the speakers monitored at the Group are for remote VHF radio receivers at high-level sites. The coverage obtained by high-level sites fills in the coverage gaps experienced by Watchstanders at the individual stations using low-level antennas. Figure 3-1 illustrates the kind of assistance that the Group COMMCEN can give to Station Watchstanders. This teletype exchange took place between a radioman at Group St. Petersburg and the Watchstander at Station Clearwater. The Station was unable to communicate with a 41-foot boat just a few hundred yards from the Station, and the Group radioman was able to talk with the boat via a high-level VHF transceiver.

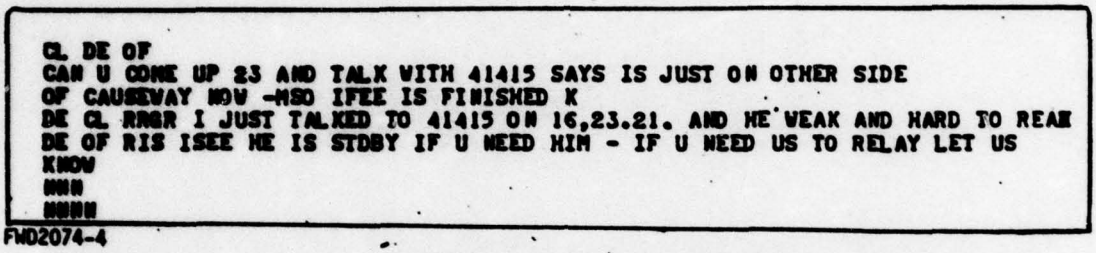


Figure 3-1. Conversational Teletype Interchange Between Station Clearwater and Group St. Petersburg

When the Watchstander is busy with other tasks it may take a few seconds to acknowledge a call, or he may miss the call entirely and the coxswain must repeat it until it is acknowledged; then the information can be passed. The same thing can happen with calls from the Watchstander to the boat, especially if the boat is conducting activities that require the coxswain to be away from the wheel. When large volumes of voice traffic are required, these delays and recalls degrade the information-carrying ability of the channel.

Acoustic noise levels both in the radio room and on the boat reduce the intelligibility of transmissions and make it necessary to repeat messages when they are not clearly understood.

Gaps in coverage were noted in the area of Cape Code Canal, Cortez Station, and Clearwater Beach Station. These coverage gaps result in loss of contact with boats, even though the boats may be within line-of-sight distance of the shore antenna. Among the most common explanations for these gaps are notches in antenna patterns and RF shadowing due to structures and terrain.

During the Survey it was learned that some SAR missions involve sending small boats out to ranges beyond the VHF communications range. This situation was observed at Ft. Lauderdale and Coos Bay; some SAR missions involved offshore ranges of 50 or more miles. In some cases, the operating range for 41-foot and 44-foot boats has been extended out to 125 miles. Since HF transceivers have been removed from most Station boats, the boat will be out of radio communications range of shore stations for extended offshore missions.

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3.1.8 Boat Communications

Communications between Stations and their own boats may become difficult during times of busy SAR activity, influenced by the following:

(1) Congestion on the working channel, especially if nearby high-level VHF transmissions are using the same frequency for other communications.

(2) Crews and/or Watchstanders become involved with other tasks. (This causes delay in establishing contact.)

Other factors that are not as sensitive to SAR activity level are:

(1) Noise level in radio room, mostly from radio monitoring speakers or teletype machines

(2) Noise level on boat

(3) Gaps in coverage, especially in intra-coastal waterway

(4) Range limitation when boats must work beyond line of sight distance

Congestion on the working channel is a function of the level of SAR activity at the Station and the amount of activity on the channel that is introduced into the Station-boat links from other sources such as high-level antennas with over-lapping coverage. Only at times of intense activity does this become a problem.

3.1.9 Station Administration

The Group Office is tasked to provide administrative and logistic support to Stations within the Group. However, the Survey Team learned that a very significant administrative workload, consisting of an array of periodic reports and Station functional tasks, falls squarely upon the Station OIC. This observation was made in light of the fact that stations have no yeomen rates to assist in handling both the preparation of periodic reports and the paperwork details of Station administration. From the viewpoint of the Station OIC, he does not receive the degree of administrative support that he needs to most effectively perform his mission. In discussions with Station OIC's regarding the proportion of their time that they must devote to the "paperwork" aspects of managing their station, we learned that a typical response was "80 percent of my time must be spent at my desk." The administrative workload is such as to not leave enough time for the OIC to perform other important aspects of his job--such as training his boat crews for improved SAR mission effectiveness.

3.1.10 Boat Operations

The principal operational problem areas observed during the Survey relate to communications and navigation. A summary of these problems are presented in this subsection.

3.1.10.1 Limited On-board Navigation Capability. - Boats are equipped with a marine compass and a marine radar set. Although boats may carry navigational charts, facilities and opportunity for on-board position and track plotting are not available. Thus, the boat cannot accurately determine his position when beyond the range of visual checkpoints ashore.

3.1.10.2 Limited Search Pattern Execution Capability. - Although a search planner can designate a search area and a search pattern, neither the coxswain or the OOD ashore has the means to monitor the execution of the pattern. Thus, actual search effectiveness is unknown; this hampers effective decision making.

3.1.10.3 Limited Range VHF/FM Communications. - The goal of the Coast Guards' VHF/FM radio coverage is to provide voice radio communications for the coastal confluence areas and waterways of the CONUS. This goal is not realized, because of shadow zones and areas of poor radio propagation.

Line-of-sight radio range limitation is a problem for offshore missions (beyond 20 miles) because the boat does not have radio communications with the shore stations. The lack of radio communications between the boat and Station results in loss of coordination and control.

3.1.11 SAR Management Information

3.1.11.1 SAR Data Entry Problems. - The following problems were observed in connection with SAR case data entry and summarization:

(1) The means of recording data is manpower-intensive and error-prone, since each data element is written twice - initially entries on the local form and later transcribed to CG-3272.

(2) Since the on-scene sortie and case events are not recorded as they happen, the accuracy and completeness of the entries (made several hours after the incident) are questionable.

(3) Errors in time annotation of sortie events are common.

(4) Transcription errors are introduced by the transfer of data from the local form to the Assistance Report form.

(5) Position estimates and distance estimates may be inaccurate due to lack of an accurate navigational reference for the boat.

3.1.11.2 SAR Data Base Problems. - Several criticisms have been made of the Coast Guard's SAR Data Base. These characteristics were discussed with members of the Survey Team during conferences with USCG Headquarters staff members:

(1) The SAR Data Base is inflexible, and cannot generate special or interim reports for management use.

(2) The collection and processing of SAR data is cumbersome and expensive. It is estimated that the cost exceeds $500,000.00 annually.

(3) Data is not available from the SAR Data Base to provide measurement of On-Scene effectiveness.

(4) Timely management reports are not available because of the time required to collect, edit, enter and process data.

3.1.11.3 Boat Administration and Management System (BAMS) Report Problems. - The BAMS reports are also prepared by station personnel, and sortie operating data is derived from the local case forms. The problems encountered in preparation of BAMS reports are similar to those listed for the Assistance Report.

3.2 Group Operations

3.2.1 Teletype Communications

The problems associated with the Teletype Pony Loop operation is discussed in section 3.1.6 of this report. The Pony Loop is a communications bottleneck for record message traffic between Stations and the Group Communications Center.

In some locations, handling and relaying of teletype messages occupies a significant part of the Group Radioman's time. Relaying incoming messages is usually accomplished by tearing a punched tape from an incoming circuit, determining the addresses, and transmitting the message on another teletype machine.

3.2.2 Group Administration

3.2.2.1 Personnel Administration. - One of the important management applications of personnel records is to quickly locate a man having a particular qualification or rating; the man with the right qualification may qualify for promotion, and may also fill a critical need.

Although the personnel records are intended to be an accurate and complete source of data on the background and qualification of every enlisted man, it was learned that some serious deficiencies exist insofar as specialty qualifications, records of service schools attended, etc.

At present, there is no mechanism for a complete review and update of personnel records. Personnel records are maintained at the Group level, and not at the Station level. Thus, the Officer in Charge at the Station may not be aware of deficiencies in his men's personnel records.

A new computerized Personnel Management Information System (PMIS) is being introduced. The intent of PMIS is to mechanize and improve the Coast Guard's personnel management information availability.

3.2.2.2 Accounting and Logistics. - The members of the Survey Team talked to the Supply Officers at District Headquarters and Group Offices, and several problem areas in the field accounting system were discussed. The principal areas of concern are summarized below:

a. Lack of Uniformity in Accounting Systems. - The basic accounting concepts being used in the eleven Coast Guard Districts is based upon EAM; EAM represents the best accounting concepts in the early 1960's. These concepts were published as a part of CG-330 in 1965, and were adapted to computer mechanization and introduced in the early 1970's as the District Accounting System (DIAS) for some Districts. Other Districts utilize other systems:

- 14th & 17th Districts: Converted to DIAS in 1977
- 1st District: Uses older accounting system pre-CG-330.

Thus, among Districts there exists widely varying procedures to maintain administrative supporting records, basic filing standard and review procedures, flow of documents, and other financial information.

Because of a lack of standardization among Districts, newly assigned personnel to District or Group Offices must have extensive retraining and reorientation. Examples of non-informity among Districts include:

(1) Document Numbering
(2) Reconciliation Procedures
(3) Point Accounting
(4) Object Class Meanings
(5) Document Flow and Batching

Highly trained and qualified personnel may find it difficult to convert from an advanced system to a less satisfactory system. This situation leads to problems involving morale and job satisfaction.

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b. Necessity for Maintenance of Duplicate Accounting Records. - The Survey Team was informed that some Groups maintain two sets of accounting records: - Input Data to the District Computer, and local "On the Cuff" local Manual Accounting Records.

c. Manual Versus Computer Records and Reports. - The manual records are maintained because the District computerized system does not produce the required accounting information in a timely manner. Thus, the Group accounting staff is always in the position of reconciling accounting reports to a more reliable (manual) bookkeeping source when the turn-around time required for the reports from the District Computer is too long.

An example of the shortcomings of current accounting reports is shown in a recent report on an inspection conducted in the Seventh District. The subject of this inspection report is the utility of the Allotment Account Report (F102 DM). The report states that the Allotment Report is of little or no value to field operating managers for managing the obligation of their funds. Managers normally dedicate one man-year per year to the maintenance of manual records and their reconciliation with the Allotment Account Reports. Three principal shortcomings of the Allotment Accounting Report were listed:

(1) No continuing ledger value, since only instanteous transactions are printed.

(2) No allowance for administrative reservations as opposed to legal obligations.

(3) Not timely enough to use for day to day business.

d. Labor-Intensive, Outmoded Data Entry. - At present, the mail service is used to collect accounting data from field units, with the result that the information is old at the time of data entry. Before accounting data can be entered in the District Computer, several labor-intensive steps are necessary, causing futher delays. If it is determined that verification of the entries is required prior to keypunching, its accuracy must be verified manually. For example, the requesting Station submits a Procurement Request, which is mailed to the District. The request is keypunched, the keypunched data is verified, and the data entered to the Headquarters Coast Guard computer via a Data 100 Terminal. If an item is questioned by the District, the Group Office or Station may not have the supporting detail available because of the lapsed time.

Delays in processing the data entry contribute to the delay in generating timely management reports. Very often, the results in a report output that is of little value to the Group Office.

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3.3 Responses to Questionnaires

The responses to the questionnaires received from Groups and Stations are presented in Appendix C.

Some of the conclusions that can be drawn from the responses to the questionnaire are:

(1) In all Groups there are times when the radioman is so overwhelmed by the workload that he falls behind.

(2) At all stations there are times when the Watchstander falls behind.

(The methods of dealing with this range from calling in members of the liberty crew for help to just doing the best possible while the backlog builds up until traffic slows down.)

(3) The absence of skilled communicators at Stations, and circuit outages are the most serious problems in Group teletype loops.

(4) In Group communication centers the largest and most time-consuming component of formal message traffic is the relaying of message between other facilities.

(5) During busy boating-season days, 50 to 100 weather request calls from the public is not unusual at lifeboat stations.

(6) Group personnel spend a greater portion of their time looking up information in references than do Station personnel. (This may be because of a greater need or because the Group usually has more information available in reference documents.)

3.4 Peak SAR Workload Problems

The peak SAR workload periods coincide with the peak periods of recreational boating. These periods occur during the summer weekends in June, July, and August. In addition to the SAR workload, Coast Guard station personnel are called upon to support local special marine events, such as regattas, water carnivals, boat races, etc.

All of the problems listed in this subsection are intensified by the stress of an increased number of SAR cases and by the work involved in special marine events. Based upon interviews with Station personnel, the following SAR workload problems were identified:

(1) Communications Delays, SAR Message Traffic

With a sharply increased SAR case load, the Station Watchstander is unable to keep current in teletyping record messages. Thus, processing SAR messages may be delayed for several hours, creating difficulties for group OOD's.

(2) Watchstander Fatigue

An experienced Watchstander may be able to cope with the problems associated with heavy radio and message traffic. The burden of heavy workload is more difficult for the less experienced Watchstander. Although it is not easy to measure the effects of fatigue on watchstander performance, the efficiency of the Watchstander probably decreases under high traffic conditions.

(3) Internal Communications Problems

When the radio Watchstander is working at saturation, fully occupied with handling radio and teletype traffic, an internal communications problem can develop. The Watchstander may become too busy to communicate important SAR information to the OOD. This means that the OOD is not in a position to make the best decisions regarding resource allocations, and other vital SAR procedures.

(4) Communications, Radio Traffic

During peak periods of SAR activity, several Station boats are assigned to SAR missions at the same time. This situation causes a sharp increase in voice message traffic on working channels, and causes heavy traffic on Channel 16, the calling and distress channel. Some station Watchstanders reported that Channel 16 becomes unusable for communications during the peak periods of SAR activity.

Some Group Communication Centers are taking steps to cope with the overload problem by providing auxiliary positions at the communication console - to accommodate the assignment of extra Watchstanders. However, most Station communication rooms do not have provisions for extra positions at the Station communications console.

4.0 OBSERVED SYSTEM REQUIREMENTS

4.1 Approach

The principal objective of the Group Control and Communications System Study is to arrive at a set of functional requirements for a control system that will facilitate the performance of missions performed by Coast Guard Groups and Stations.

The approach to the problems of defining overall system requirements was to carefully review the various needs that exist to support the principal mission areas. Also, consideration was given to the need to provide important support functions that directly affect the capability of a Station to perform its assigned missions. Consideration of these items was based upon studies and observations of the Survey Team. A candidate list of needs was narrowed down to selected functions that are believed to provide substantially improved operational performance, and could be justified by a savings in money and man-hours. Unfortunately, it is not possible to justify the selected functions on the basis of Cost/Benefit analyses, because the necessary statistical data are not available from the Coast Guard. In addition, it would be difficult to estimate the entire cost of implementation of a system embodying the selected characteristics.

A system with the following capabilities will support a substantial improvement in operational effectiveness:

(1) Radio Communications

- The VHF/FM network, supplemented by HF radio communications circuits, to provide full coverage of a coastal maritime zone 0 to 125 nmi offshore.
- Digital Data Communications via radio circuits should be implemented

(2) SAR Data Entry

- Request for assistance received, processed, and entered into group data bank
- Radio-Watch and requests for assistance processed by rated Group Watchstanders
- Real-time data entry a design goal
- Simplified data entry
  - Prompting
  - Sequence
  - Under operator's control

(3) Preparation and Transmission of Record Message Traffic

- Provide capability for composition of Record Messages by radiomen at Group Communications Center.
- Volume of record messages traffic reduced--fewer SITREPS needed because of immediate access to case data from Group Data Bank.
- Computer-driven display used to format record messages, utilizing SAR case data in data bank.

(4) Small-Boat Navigation and Status Reporting

- Provide automatic means of periodically determining boat's position coordinates.
- Provide means of automatically plotting and display of position of all Station boats under way.
- Situation displays for Station Watchstander and Station OOD.
- Situation displays for Group Watchstander and Group OOD
- Simplified course-to-steer display for boat coxswain.
- Consider simplified status reporting panel aboard UTB's.

(5) Resource Status

- Status of Station and Group resources maintained in Group Data Bank.
- Resource status display available to Watchstanders and ODD's.

(6) General Requirements

- Flexibility
  - Capability to exercise operational control at either Station or Group level
  - Non-volatile operating program and stored data
- Adaptable
  - Modular software adaptable to local station and group requirements
  - Local data items may be entered and stored.

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- Simplicity in Operation

  - Straightforward system operation, with "Menu-Select" functions under operator control

- Case History Information Storage

  - SAR case data to be stored, so that case can be reconstructed

  - Storage medium to be low cost and convenient to store

(7) Man/Machine Interface

- Planned for Watchstander's skill level

- Should aid, not impede Watchstander's operation.

  - Easy and rapid SAR data entry under operator's control

  - No interference with information gathering

  - Storage and retrieval operations convenient as flip-file.

4.2 Search and Rescue Operations

The requirements discussed in the following subsection are derived from problems observed during the Survey phase as discussed in subsection 2.2.1 - Group Operations and subsection 2.3 - Station Operations.

4.2.1 Reduce Manpower Dependence

The information-handling capacity of any given Station or Group Office is dependent upon the following factors:

(1) The number of people available for information handling tasks

(2) Training and experience level of the people

(3) Motivation of the people

(4) Physical facilities - layout, space

(5) Equipment available for information handling tasks, such as radios and teletype terminals

(6) Interface between the people and the equipment

The factor which is most often viewed as a variable for coping with peaks in SAR activity is the first one, number of people.

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The statistics that describe the monthly, daily, and hourly variations in caseload are quite stable. That is, the relative peaks and valleys appear to be a repeatable pattern superimposed on a long-term rising curve of caseloads. This can be seen by an examination of the USCG "SAR Statistics" publication for any number of recent years. Using the present Coast Guard communications and control system, an obvious way to accommodate the information-handling requirements during peak periods would be to add additional people. However, the Coast Guard does not have the luxury of being able to hire and lay off people in adjusting to its activity cycles. Any new system therefore should be adaptable to extreme fluctuations in demand and should provide for expansion in capabilities over the long term.

The flow of information is proportional to the number of people only to the extent that you can add one or two Watchstanders, and then the space and equipment factors become a limitation. Therefore, even if the manpower problem were solved by obtaining great numbers of highly trained and motivated people, this would only increase the capacity of the system to another level where equipment limitations cause another bottleneck. This in no way reduces the urgency of reducing the dependence upon manpower. It does, however, indicate that any new system should contribute both to reducing the number of people needed and to increasing the potential of the equipment for handling larger volumes of information in the future.

4.2.2 Augment Watchstander's Performance

Hardware assistance for the Watchstander is required. Such assists include fast storage and recall of case information; prompting, editing and addressee generation during record message composition; and simplified communications with SAR resources using digital transmission of standard messages with transmissions initiated by a single key entry, and receptions printed out on a display.

4.2.3 Decrease Burden of Administrative Tasks

Release of the Station OIC and his top Non-Comms from most of the present paperwork burden, which is the main limiting factor in their participation in SAR Operations and training, is a requirement of any new system whether it is electronics based or not.

4.2.4 Improve Information Gathering Capability

Increased accuracy with which datum is known is a requirement that could greatly reduce search time for SAR resources. It is primarily the skill and local knowledge of the Watchstander which determines how well the distress position is identified. Prompting of the Watchstander and immediate access to local knowledge files during information gathering would increase the probability of an accurate datum, especially for Watchstanders who do not have long experience at the particular location.

4.2.5 Improve Frequency and Accuracy of Resource Position and Status Reports

A method is required for the Watchstander and/or Radiomen to obtain updated position and activity reports quickly from small boats whenever required by the OOD so that decision-making function is not hampered by incomplete knowledge of where is boats are and what they are doing.

4.2.6 Provide Means to Reduce Incidence of False Alarms

False Alarms that must be pursued because of an absence of identication of the real source and location are a serious problem. A means of identifying and verifying a higher percentage of distress reports is required in order to reduce the wasted effort associated with false alarms.

4.3 Landline Communications

4.3.1 Voice Landline Communications

The only problem with voice landline that would generate a requirement is the complaint in all Districts surveyed, except the Thirteenth, that the reliability of the phone service was poor at times. This unreliability is weather related. In both the First and Ninth Districts, however, the phone service is improving.

Voice landline changes are, therefore, not considered in this study.

4.3.2 Teletype Landline

4.3.2.1 Requirements at Station. -

a. Accurately Transmit Record Traffic. - This requirement relates to the record message composition aspect of augmenting the Watchstander's performance. It primarily consists of help for the Watchstander by some of the following methods:

(1) Prompting - time suggestions as to format and required paragraph content for messages requiring specific formats and content.

(2) Editing - A method for accomplishing corrections, deletions and insertions of any part of the text as it is being typed. The Watchstander can transmit any block of the message as he composes it or can examine the whole message after it is composed before transmitting it.

(3) Addressee Generation - Writing of a complete addressee title or of an entire group of addressees accomplished with a single keystroke with special labeling on such keys.

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(4) Training - Provisions for typing practice at times when the Watchstander is not busy, with an interrupt for incoming messages.

b. Clear the Record Message Channel. - This requirement, if satisfied, will permit each Station to send or receive a message at any time with, at most, a few minutes delay.

4.3.2.2 Requirements at Group Office. -

a. Clear the Record Message Channel. - This requirement was stated previously for the Station. It may be even more essential for the Group COMMCEN, since the most serious delays and overloads caused by TTY Pony Loops are presently at the COMMCEN.

b. Automatic Message Relaying. - The torn-tape relay method must be replaced by automatic switching. A drastic reduction in required radioman activity will be achieved.

c. Quieting of Printers. - The noise associated with the present TTY printers is a distraction which radiomen learn to overcome by concentration. This noise degrades the listening capability of even the best radiomen when they are monitoring a number of radio channels in the Communications Center.

d. Provide Message Traffic Count. - It was found to be very difficult to obtain information on traffic volume. Generation of this kind of information, although not a prime function of a COMMCEN, is required for decision-making about future alternatives. The fact that this information is not available now does not invalidate suggestions for improvement of the networks, but as the communications system begins to approach optimization, detailed quantitative data will be necessary for planning purposes.

4.4 Radio Communications

4.4.1 Radio Monitoring

The basic methods of monitoring distress channels would not lend themselves to modification unless there were changes in the transmitters used by the boating population. In all cases, except possibly the new type of EPIRB, this would presently be impractical as a requirement. A more realistic approach is to require that the monitoring by Station Watchstander or Group Radioman be made more effective by removing some of the distracting influences. This includes:

(1) Reduction in the amount of conversation required on the Coast Guard working channels

(2) Obtaining the assistance of civilian and police organizations in monitoring Citizens' Band radio so that it doesn't have to be monitored directly by Station Watchstanders.

(3) In the case of the Group Communications Center, quieting of the radio monitoring area.

In addition to the above, VHF-FM direction-finding is required on high-level antenna sites for a line-of-bearing on emissions being monitored. This will reduce the amount of discussion between the party in distress and the Watchstander or Radioman monitoring the channel regarding the location of the distress. Direction-finding will also provide a means of recognizing hoax calls that are transmitted from shore points.

4.4.2 Boat Control Communications

Communications requirements for control of small boat resources include:

(1) Elimination of Working Channel Congestion. - Elimination of congestion on working channels during period-of heavy SAR activity is the goal. Sharing of one or two working channels by all resources of a Station, sometimes with overlapping traffic from high-level antenna sites on the same frequency, dictates that messages be separated from one another either by time, frequency or code separation. Time separation by the use of short digital messages is the method recommended and discussed.

(2) Provide Message Persistence. - Because of the difficulty of establishing contact when the other party is occupied away from the radio, it is required that a message transmitted be stored at the receive end and held until it can be acknowledged. This could be as simple as the lighting of a lamp at the receive end by the decoding of a digital address for that particular receiver.

(3) Provide Clarity of Message Content. - For those messages with meanings essential to the operation, the probability of correct reception must be improved. Preferably, the interpretation of such messages should be independent of the acoustic noise environment at the receiver.

(4) Eliminate RF Coverage Gaps. - This must be done without a change in frequency band used for control. The combination of high-level and local VHF-FM antenna sites satisfies the area coverage needs. The integration of these different types of antenna site location into a real-time control network is, therefore, the logical step in achieving small-boat control without coverage gaps.

4.5 Boat Navigation

The problems and shortcomings of the currently used navigational instruments and methods employed aboard Coast Guard boats were discussed in paragraph 3.1.10. Based upon consideration of both SAR and other mission requirements for accurate navigation and position fixing, the following functional requirements were established for an onboard navigation system:

(1) Coverage

(a) Coverage should extend to the offshore operation zones for a small boat that is from 0 to 125 nmi along the coastal confluence zones of the continental U.S., Alaska, Hawaii, and the Great Lakes.

(2) Accuracy

(a) Maximum accuracy requirement appears to be ± 1/10 nmi (Ref: Sections 6-B-05 and 7-C-06 of the SAR Reports Manual (CG-397).

(b) Minimum requirements, such as off-shore navigation, can be adequately satisfied by ± 1/4 nmi accuracy.

(3) System Features

(a) Computation and display of the navigational information needed by the Coxswain to accurately traverse the planned track and the legs of a search pattern. (An optimum Coxswain's display configuration will require additional study; however, it is apparent that the Coxswain could utilize the following:

- Course-to-Steer
- Distance-to-go to Waypoint or Datum
- Distance off Intended Track

(b) Storage of track information for use in evaluating search effectiveness

(c) Storage of date/time annotated selected positions for use in SAR data base

(4) Onboard Equipment

(a) Should be small in size to accommodate the limited available space.

(b) Should be able to stand up to the exposed environment of a 30-foot, 41-foot, or 44-foot Coast Guard boat.

(c) Should be capable of operation with minimum crew attention.

(d) Should provide continuous, automatic readout of navigation information that is accessible and usable.

4.6 Conclusion

As a result of the field surveys, consideration of future growth, together with technology assessment, it was concluded that a computer-based *Group Command and Control System* should be implemented.

(52)

(52)

5.0 FORECAST FUTURE REQUIREMENTS FOR GROUP CONTROL AND COMMUNICATIONS, (1978-1986 Time Frame)

5.1 Approach

This section addresses the impact of boat population growth on the overall SAR workload. This approach appears to be a reasonable way to satisfy the objective of this Study Task. Since the principal mission of Stations and Group offices is perceived to be Search and Rescue, the forecast effort concentrates on SAR, but other Station/Group missions are also considered.

It is a well established fact that the growth trend in the need for SAR services is principally determined by the rate of increase in the number of recreational boats. Recreational boats represent the largest group of clients for SAR services (76 percent of the USCG's SAR response workload). Statistically, the number of registered boats in the U.S., and projections based upon the growth rate, represent the best predictor to forecast future SAR activity levels. Considerable publicity is given to the U.S. population migration to the "Sun Belt". There is another similar, but less-publicized, migration of the U.S. population to locations near the water: the coastal areas, inland lakes and waterways. This migration, coupled with the growing societal affluence will result in substantial growth in recreational boating. Population migration trends indicate that, by 1985, nearly 60 percent of the U.S. population will live within 50 miles of our lakeshores and sea coasts. Projections indicate that over 55 million boat operators and over 23 million boats will cruise our coastal and inland waters. These demographic changes provide the challenge--how will the U.S. Coast Guard provide the needed SAR services to this large and growing boating-oriented segment of our society?

During the survey phase of the Study Program, we had the opportunity to observe some of the factors affecting the present problems and future challenges facing the Coast Guard. The following paragraphs embody the operational philosophy and outlook of some USCG District and Headquarters Staff members.

The U.S. Coast Guard is, and will continue to be, the SAR Coordinator for both public and private SAR efforts in the maritime zones. In order to cope with the continuing expansion of demand for SAR services, every effort should be made to fully utilize the U.S. Coast Guard Reserve and the U.S. Coast Guard Auxiliary to relieve the burden of peak SAR workloads. Also, the SAR resources of local municipal, private salvage and emergency service companies will probably be utilized to help accommodate the growing workload.

Of all SAR cases, 7 percent involve assistance to personnel only, 8 percent involve property only, and 85 percent represent assistance rendered to personnel and property. A substantial percentage of the SAR cases involving recreational boats (over 80 percent) is considered

to be "convenience SAR". An example of the high incidence of "convenience SAR" was observed by members of the Survey Team during our visit to the Miami Group Office. An examiniation of the SAR case log for 10 days indicated that approximately 86 percent of those cases represent "out of fuel", or "battery failure". If some way can be devised to effect even a modest reduction in the workloads attributible to convenience SAR, the overall workload could be significantly reduced.

5.1.1 Future Growth and Resource Requirements

Based upon evaluation of U.S. Coast Guard reports and upon conversations with U.S. Coast Guard staff members, it appears that future requirements for USCG SAR resources and personnel will be determined by three principal factors:

(1) Growth in recreational boating

(2) Increased needs in other mission areas (ELT, Boating Safety, etc.)

(3) Increased effectiveness and better utilization of resources

We are able to utilize statistical regression analysis to make some SAR growth forecasts. However, data is not readily available for evaluating growth in the other mission areas that affect station workloads. Also, it is not possible to estimate the impact of improvements that can be realized through improved operational effectiveness. Therefore, the analytical statistical forecasts presented in this section are limited to growth in the boat population and SAR projections.

The projected growth patterns for SAR (and the other missions) performed by Stations establish the groundwork for an approach to forecasting future requirements in the 1978 to 1986 time frame.

In order to project total SAR workload for the period 1978-1986, a basis for forecasting the magnitude of the task must be considered. If it is assumed that current operational procedures and Communication and Control methods for SAR will be applied during the 1977-1986 epoch, regression analysis can be utilized to project SAR manning levels, facility and OE budgets.

5.2 Analysis of Boating Population in the U.S.

5.2.1 Recreational Boating

Recreational boating is acknowledged to be the major factor in determining SAR workload; requests for assistance that occur as a result of recreational boating currently accounts for 82 percent of the total SAR response workload. Correlation analysis show that recreational boating activity, as measured by the number of registered recreational boats, is the driving factor that determines SAR workloads. This information was derived from interviews at USCG Headquarters. Forecasting

the number of registered recreational boats is considered to be the best reliable predictor of future SAR workload growth. It is estimated that the population of registered recreational boats will increase from 7.7 million in 1976 to 9.9 million in 1981. Thus, it is expected that the growth in SAR workload will follow the same overall growth pattern. Thus, it is estimated that the overall SAR caseload will be 85,000 in 1981, with 65,000 SAR incidents involving recreational boats.

5.2.2 Commercial Fishing

Commercial fishing vessels account for 13 percent of the SAR workload. It is expected that little growth will be experienced by the commercial fishing industry from 1977 to 1981, and the requirement for SAR will be stable. An estimated 9000 SAR cases are predicted for 1981.

5.2.3 Concentrations of Recreational Boating

Although the growth analysis indicates an average 6 percent national average annual SAR growth rate due to a similar national growth pattern for recreational boating, it should be recognized that 6 percent is an average predicted growth rate, and that the growth rate can be significantly higher in locations that experience high concentrations of recreational boating. During the Survey it was learned that some lifeboat stations located near the recreational boating centers experienced an accelerated SAR caseload growth during the past two years; for example, the 9th Coast Guard District experienced a SAR caseload growth of 24 percent in 1976.

Thus, future planning to accommodate the SAR growth rate must consider not only average national growth rate, but must also consider those recreational boating-intensive areas, wherein the growth rate greatly exceeds the national average.

5.2.4 U.S. Boating Statistics (1964-1977 Time Frame)

There are two types of recreational boats: numbered and unnumbered boats. With the exception of Alaska, New Hampshire, and Washington, all states now have a USCG-approved registration and numbering system for all boats. Boat registration is a state responsibility, and registry requirements are not entirely uniform; in many states, only motor boats and sailboats over twelve feet in length must be registered. The source of the numbered boat data presented in this report is CG-357, "Boating Statistics" for the years 1964 to 1977.

Unnumbered boats include small sailboats and non-powered watercraft of all types. No reliable count is available for unnumbered/unregistered boats in the U.S. However, the USCG Office of Boating Safety published listings of numbered boats and estimated totals in CG-357. Table 5-1 lists the recreational boat population for the time period of 1961 through 1976.

Table 5-1. U.S. Recreational Boat Population (1961-1977)

Year	Number of Numbered Boats	Est. Total Boats
1961	3,100,000	5,850,000
1962	3,500,000	5,950,000
1963	3,500,000	6,050,000
1964	3,800,000	6,200,000
1965	4,138,140	6,350,000
1966	4,067,371	6,500,000
1967	4,458,893	6,650,000
1968	4,742,871	6,850,000
1969	4,864,074	7,100,000
1970	5,128,345	7,400,000
1971	5,510,092	7,850,000
1972	5,910,794	8,500,000
1973	6,339,678	9,600,000
1974	6,830,456	10,750,000
1975	7,303,286	11,800,000
1976	7,671,213	12,750,000
1977	8,000,000	13,600,000

NOTE: (Statistical data provided by Ken Freund of the USCG Program Development & Analysis Branch, Office of Boating Safety.)

5.2.4.1 Recreational Boating Growth (1961-1977). - Table 5-1 summarizes statistical data abstracted from CG-357 and supplemented by information and statistical projections provided by the Office of Boating Safety. The table presents data on numbered bosts and estimates of population of non-numbered boats. Figure 5-1 shows the same data graphically. The lower curve shows the total recreational boat population, including both numbered and estimated unnumbered boats. The current registered recreational boat population numbers about 8,000,000.

(56)

(56)

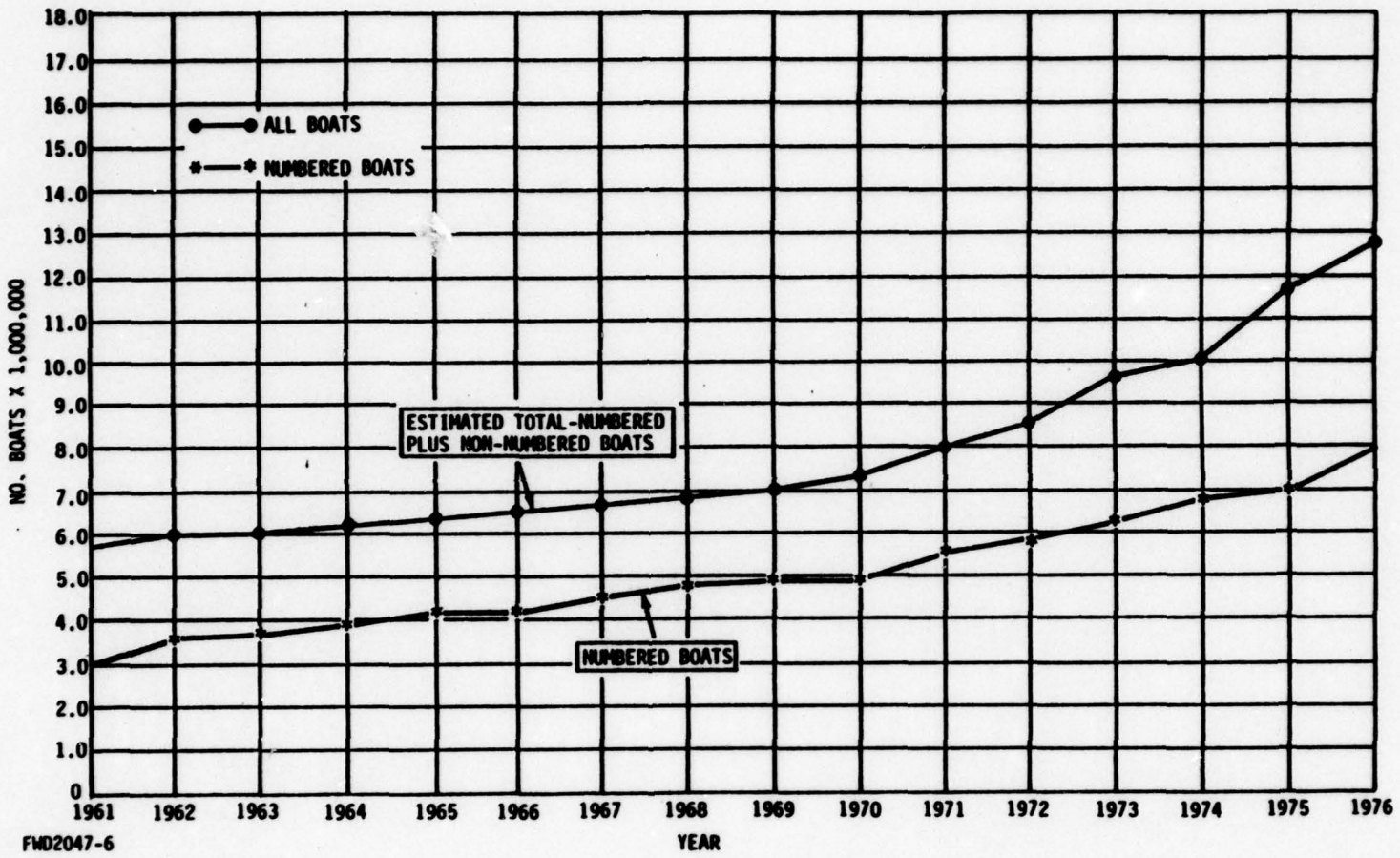


Figure 5-1. Recreational Boat Population Growth, 1961-1977

During the 1961-1970 epoch, the average rate in the registered boat population was very nearly constant--about 200,000 units/year. Starting in 1970-1971, the average growth rate increased sharply to approximately 428,500 units/year. This latter sharply accelerated growth rate appears to also be a linear-slope curve.

5.3 Projected Growth in U.S. Recreational Boating (1977-1986 Time Frame)

A projection of the growth of total recreational boat population for the years 1977 to 1986 is shown in figure 5-2. The growth projection is based upon statistical data from the Program Development and Analysis Branch of the Office of Boating Safety. These projections consider additions to the boat population reported from new boat sales, and decreases caused by calculated boat attrition rates.* This projection results in an estimated increase in the recreational boat population to 19,600,000 boats by 1986, an increase of nearly 50 percent (6,000,000) over the 1978 population. It should be noted that this growth estimate is far more conservative than would result from simple linear regression, based upon the 1973-1977 epoch. Based upon the latter linear regression analysis for the 1973-1977 period, the 1986 recreational boat population would increase to 22.7 million units, an increase of 67 percent over 1978. Both growth projected curves are shown in figure 5-2. The 50-percent growth rate figure is currently being used for planning purposes.

5.4 Relationship Between Recreational Boating and SAR Workload

Studies of the incidence of SAR cases and boating population statistics indicate a direct relationship between the size of the recreational boating population in the U.S. and the number of SAR cases. This relationship is evident from current statistical data on SAR:

- 94 percent of SAR cases involve vessels
- 82 percent of vessel cases involve recreational boats.

These statistics clearly indicate that maritime SAR case workload is driven by recreational boating (.94 x .82 = .78), because recreational boating constitutes the principal source of requests for assistance to the Coast Guard. Recreational boating accounts for approximately 78 percent of the total SAR case workload.

Thus, growth in the number of SAR cases per year increases directly with growth in the size of the population of recreational boats. This relationship can be readily demonstrated by comparing trend curves of the number or recreational boats and curves of SAR statistics over a period of years. This relationship is evident from a comparison of the growth curves shown in figure 5-1 (Recreational Boat Population 1961-1977) and figure 5-3 (Total SAR Assistance Cases 1961-1977).

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*"Boat Attrition Rates" - Ken Freund, Office of Boating Safety, 1 March 1978.

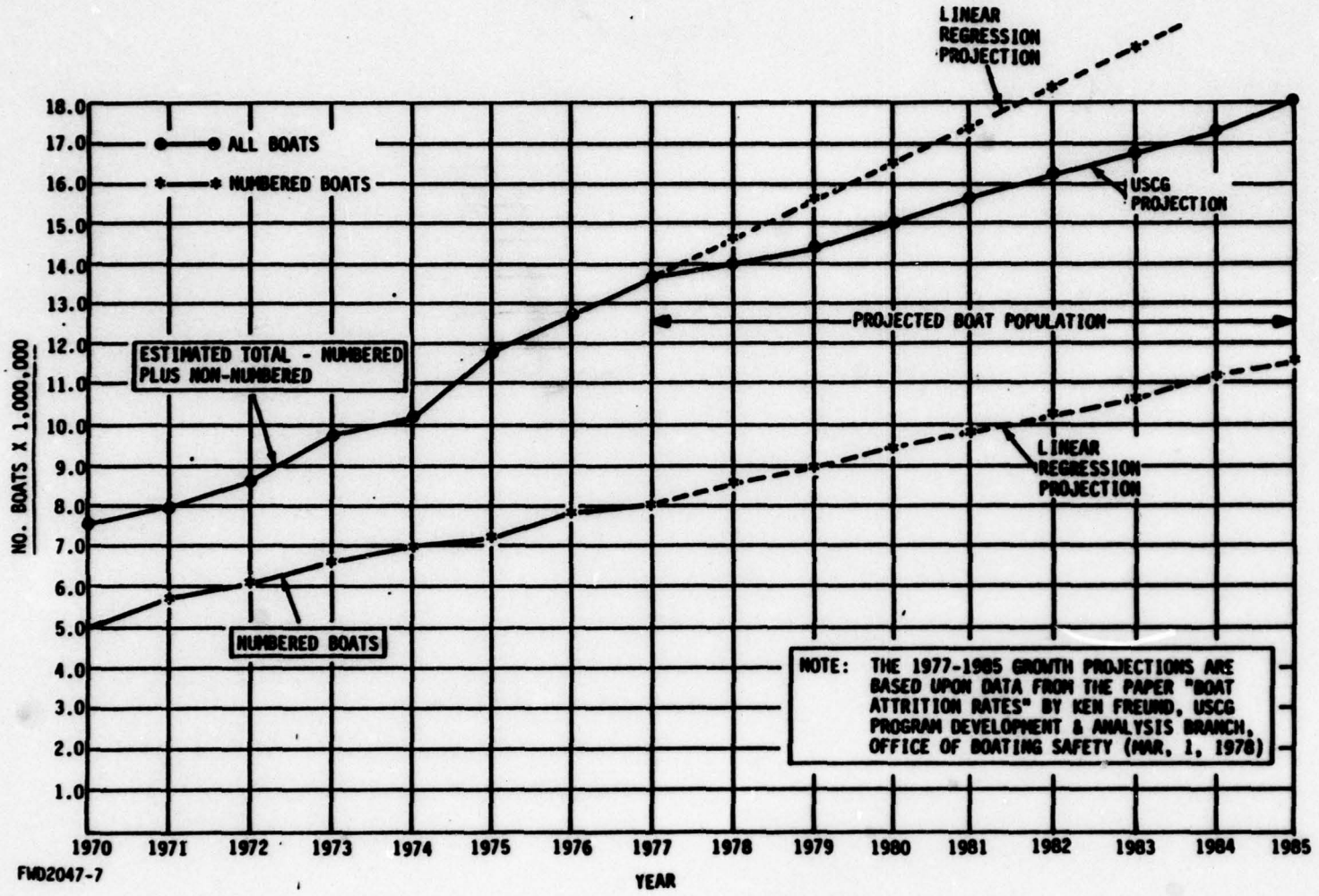


Figure 5-2. Boat Population Projections 1977-1985 Period

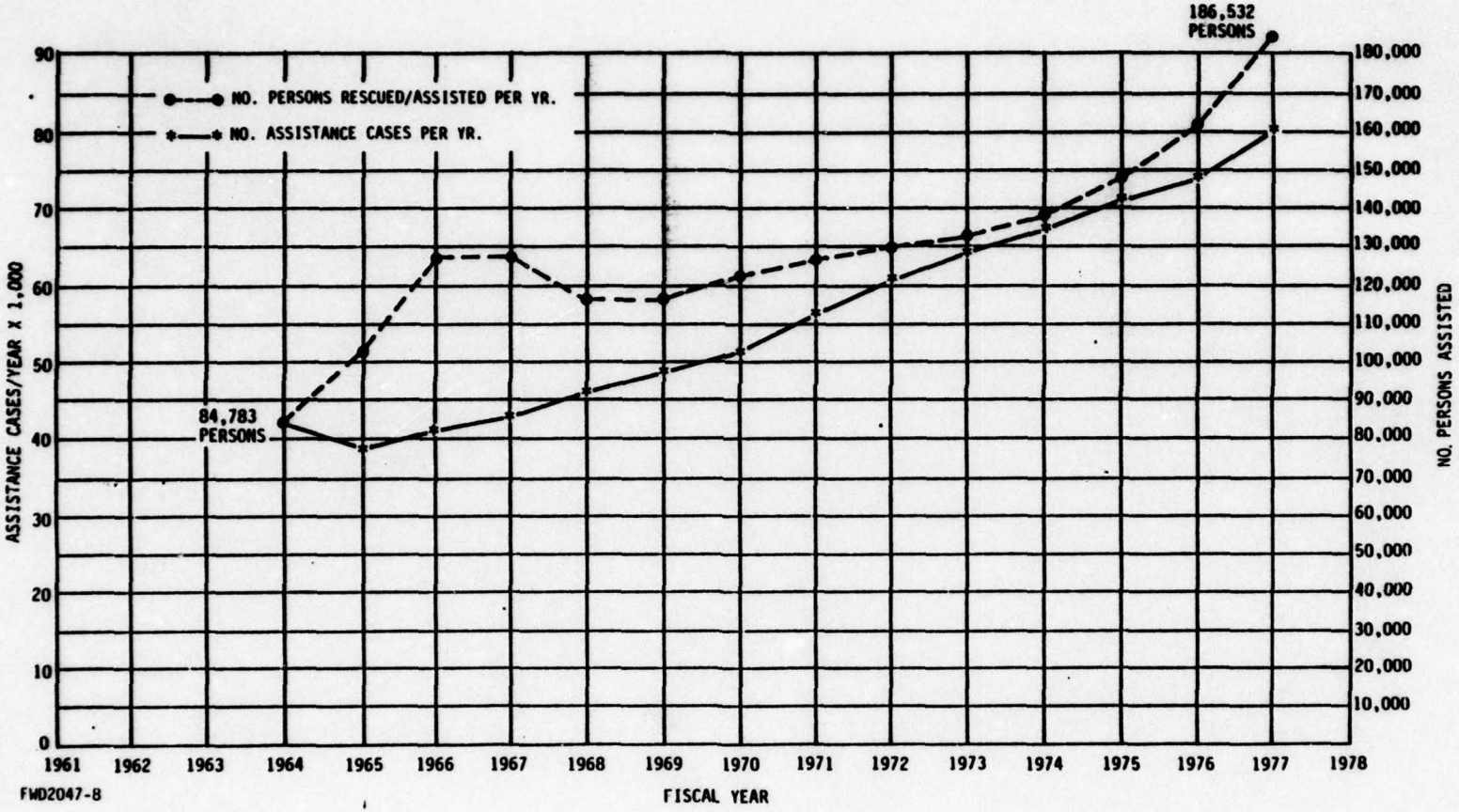


Figure 5-3. Total SAR Assistance Cases, 1961-1977 Period

5.5 Projections of SAR Workload (1978-1986 Time Frame)

The U.S. Coast Guard's current workload in Maritime SAR has increased to an annual level of 88,000 sorties (2061 SAR cases). Three thousand lives per year are saved, and assistance is rendered to more than 160,000 persons per year in distress situations.

Using simple linear projections, based upon the SAR assistance case growth rate shown in figure 5-3, the following predictions can be made:

1977	1986
82,061 cases	119,360 cases,

an increase of 37,299 cases. This represents a net increase of 45 percent in SAR case load.

Based upon the SAR workload projections, it appears that a substantial increase in SAR workload will be borne by Stations during the next several years. If an efficient digital data communications and control system were employed to link Group Offices to their Stations, it would also provide the necessary means for the Group Offices to supply the needed administrative support to Stations. Centralized Group Office support will increase the Station's operating effectiveness, because Station personnel can dedicate their total efforts to training and SAR operational readiness instead of spending time on reports and paperwork.

5.6 SAR Staff and Facility Support Projections (1978-1986 Time Frame)

The Study Team is aware that a simple projection of manning level requirements, based upon present-day facilities and resources and upon current Station and Group Office manning levels, would not be entirely adequate, or sufficiently accurate for planning purposes. However, such a projection will be useful in evaluating cost-effective alternatives that are open to the USCG in planning for the future.

5.6.1 Projected SAR Growth

In subsection 5.5 of this report, an increase of 45 percent for SAR case workload was calculated on the basis of a simple linear projecting to 1986. Based upon this prediction, it will be necessary to increase the Coast Guards manning level to accommodate the increased workload.

In addition to personnel increase projections, substantial capital expenditures would also be required for new Station and Group shore facilities, boats, overhaul and maintenance facilities, wireline and radio communications, and other fixed assets.

If we assume that the current ratio of SAR personnel to the number of SAR cases is constant, then this ratio could be applied to prediction of future SAR manning levels.

For 1977, approximately 13,141 USCG billets were charged to SAR tasks, and 82,000 SAR assistance cases were served. Linear projections for the year 1986 indicate growth to 119,360 assistance cases, with a corresponding increase in SAR manning level requirements:

$$\frac{119,360}{75,069} \times 13,141 = 20,894 \text{ SAR personnel}$$

Table 5-2 shows projected current and projected SAR resource levels for the years 1977 and 1990.

Table 5-2. Projected Resource Requirements

	Current (1977)	Projected (1990)
Cutter Days	271	478
WPB Days	2,491	3,514
Fixed Wing A/C Hours	8,358	17,879
Rotary Wing A/C Hours	14,248	32,279
Boat Hours	124,574	226,068
Manyears	13,141	26,830
OE Funds	$250 M	$1.4 Billion (1990$)

The projections shown in Table 5-2 illustrate the problem faced by the Coast Guard. OE funds to provided SAR services is forecast to increase from $250 M (1977) to $1.4 Billion (1990 dollars). SAR manning level is forecast to increase from 13,141 (1976) to 26,830 by 1990.

5.6.2 Planning Alternatives

The results of these projections clearly indicate that the Coast Guard should consider some planning alternatives in order to substantially reduce projected SAR personnel and resource requirements and to avoid substantial budget expansion. Interviews with Headquarters personnel indicate that the Coast Guard is considering the following alternatives:

(1) Improve operational effectiveness.

(2) Impose constraints on USCG capacity to provide SAR services (to the public).

(3) Transfer responsibility for SAR operations to other agencies.

5.6.2.1 Improve Operational Effectiveness. - Studies of current SAR operations show the following work distribution for the 96,000 SAR sorties for 1977:

FACILITY	SORTIES WORKLOAD
SAR Stations	65 percent
Air Station	22 percent
Cutters	5 percent
Other Resources	19 percent

The above table shows that SAR stations handle 65 percent of the SAR workload. If the same distribution of workload exists in the future, this table indicates that, in order to realize significant improvement in SAR operational efficiency, efforts should be directed toward improving SAR station operations.

The following quotation from SAR STATISTICS, 1977 (CG 489) states three areas of concern: ALERTING, LOCATING, and ON-SCENE EFFECTIVENESS.

> "Alerting, locating, and on-scene effectiveness remain the major issue in the SAR problem. Case studies indicate nearly half of the lives lost (9445) were considered not savable at the time of Coast Guard notification. On the average, 14 percent of our cases involve searching, and we find the distressed unit in about half (54 percent) of the search sorties. Over 43,000 sorties hours, (45 percent of total) are spent conducting search operations. Advances in such areas as computerized search planning, emergency position indicating radio beacons (EPIRB's), VHF-FM communications/DF nets, and emergency medical care have significantly contributed to SAR effectiveness."

In addressing these major concerns, the Coast Guard has established the following objectives:

(1) Initiate Proper Response. - One of the Coast Guard's SAR objectives is to initiate an appropriate response to a request for assistance within five minutes of initial notification of a distress incident.

(2) Minimize Time to Arrive on Scene. - Another objective is to minimize the time for a SAR unit to arrive at the scene of a distress incident, with the USCG rescue unit arriving at the scene within one hour of the dispatch of the USCG rescue unit.

Although on-scene effectiveness is a concern, it was stated that there is presently no way of evaluating it. In addition, it was learned that overall program evaluation is hampered by the inadequacy of the present SAR data base. One area where the data base is deficient is

that there is as much as a 40-percent discrepancy in resource utilization when SAR assistance reports are reconciled against the ABSTRACT of OPERATIONS.

5.6.2.2 Impose Constraints on Performance of SAR Services. - One of the alternatives would be to limit the expansion of USCG facilities and manpower to a prescribed limit, and to transfer the responsibility for handling the "overflow" to other agencies. Since the principal problem is to handle the peak SAR workloads that occur during the summer recreational boating season and on weekends, part-time employees of municipalities and the use of private marine service and salvage firms could be instituted.

Another way to reduce workload is to limit the demands on the USCG for Convenience SAR (free towing and fuel delivery) by charging a fee for this convenience SAR service.

5.6.2.3 Transfer Responsibility for SAR Operations. - During a meeting with USCG Headquarters personnel, we learned that a proposal is under consideration to transfer some of the SAR workload to other government and private agencies. Some municipalities have harbor police and emergency marine rescue units that are capable of providing SAR services. Also, private salvage and towing firms could be more extensively used in SAR operations.

An extreme position would be for the Coast Guard to surrender all SAR resource capability to conduct SAR operations, but to retain its role as overall marine SAR coordinator.

5.7 Conclusion

It is commonly believed among Headquarters personnel that the Coast Guard will have extreme difficulty in expanding its budget to accommodate the projected resource requirements shown in table 5-2. It was also stated that both imposing constraints on SAR services and transferring responsibility for SAR operations would be both a difficult and lengthy legal procedure. This leaves the most obvious avenue for addressing the problem of the growing SAR workload, that is, improve SAR operational effectiveness.

6.0 SHORT-TERM RECOMMENDATIONS

The following is a list of short-term recommendations, some of which are already in use at certain Stations:

(1) A separate phone number for weather requests by public, preferably answered by a non-Coast Guard agency like the National Weather Service

(2) Lacking this, use recorded weather messages

(3) Tape recorder for making NOTMAR announcements

(4) Selective call on TTY where possible, or at least split pony loops

(5) TTY tape perforator and line switch as a means of providing composition in an off-line condition

(6) VHF-DF on station antenna tower

(7) Utilization of REACT teams for CB monitoring

(8) The provisions of a publication in which Station Chiefs can exchange ideas on equipment and operations without going through Group or District information chains

(9) Some discretionary money for each Station for equipment that the OIC can buy and justify afterwards

(10) Auto-dial telephone with the numbers to be called in PRECOM's and EXCOM's preset for single-button selection

(11) Assistance in gathering information on SAR incidents and recording it for use in prosecution of the case.

7.0 CONCEPT FOR GROUP CONTROL AND COMMUNICATIONS SYSTEM

A concept for a Group Control and Communications System is presented in this section of the report. The system concept presented is based upon the observations made by the Magnavox Study Team, and the analysis of the present and projected future needs for an improved means for control and communications for Group and Station Search and Rescue operations. The intent of the planned Control and Communications System is to achieve:

(1) Improved SAR efficiency and readiness of Station personnel

(2) Overall coordination of SAR Operations by Group Control Center

(3) Timely preparation of accurate Management Reports at a reduced cost

(4) Simplified and reduced paperwork burden of Station OIC's

(5) Centralized processing of Requests for Assistance by Group Communications Center.

7.1 System Design Considerations

The system design concepts set forth in this section of the report are responsive to the present and future needs as observed and projected during the performance of this Study program. These system design concepts utilize engineering disciplines of several key technical areas:

(1) Navigation Systems
(2) Computer Systems and Peripherals
(3) Display Terminals - CRT and Plasma
(4) Human Factors, Man-Machine Interface
(5) Digital Message Processing and Transmission
(6) VHF/FM Voice and Data Communications
(7) HF Propagation and Modems
(8) Systems Engineering.

These engineering disciplines, applied to the set of requirements developed for the Control and Communications System, form the technical basis for the planned system.

7.2 Group Communications and Control

The planned organization of the Group Control and Communications system will support either Station-centered operations or the Group-centered structure set forth in COMDINST 2300.3A. Under COMDINST 2300.3A, the Group Communications Center is to serve as the communications hub for all radio, teletype and telephone communications for Stations within the Group. This concept is illustrated in figure 7-1.

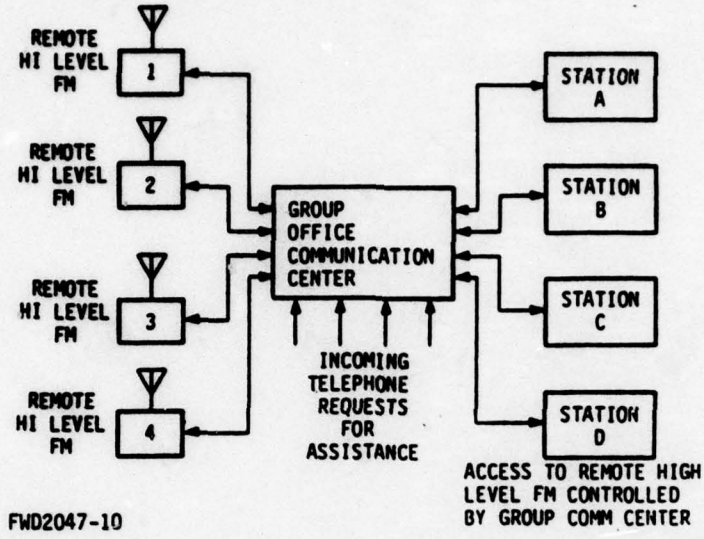


Figure 7-1. Group Office Communications Hub Concept for VHF Voice Communications

A further step in implementation of the Group Communications hub concept is to assign to the Group Communications Center the responsibility for receiving and processing all Requests for Assistance from the boating public, and other information relating to emergency situations.

7.2.1 Group SAR Functions Under the Hub Concept

The Group Watchstander and Group OOD will be responsible for overall management of all Search and Rescue operations within their assigned zone of responsibility. Initial communications relating to possible distress situations will be handled by the Group Communications Center. The Group OOD will decide whether or not Coast Guard resources will be committed, and he will assign a case to the appropriate USCG resource (cutter or station) or will request air support from the District Operations Center.

Upon assignment of a SAR case to a Station, the Group OOD will transfer responsibility for servicing the SAR case to the designated Station. This transition can be readily accomplished, since all information relating to the SAR case (up to the time of assignment to the Station) is in the Group SAR Data Bank. The Group and Station OOD can jointly review the available data on their respective display terminals, and the Station Watchstander can assume the responsibility for direct radio communications with the distressed boat; the Station Watchstander will also handle all communications with his own Coast Guard rescue unit.

In accordance with this doctrine, the Group Communications and Operations Center of the future will perform the following major SAR functions:

(1) Maintain radio watch

(2) Receive, process, and record Requests for Assistance received via VHF/FM circuits

(3) Determine degree of severity

(4) Assign SAR case to SAR unit

(5) Search planning

(6) Monitor progress of case via information from SAR Data Bank

(7) Coordinate multi-unit SAR cases

(8) Prepare formal message traffic related to case (using data extracted from SAR Data Bank)

7.2.2 Station SAR Functions Under The Hub Concept

The principal duty of the Station OOD and Watchstander will be to assume the responsibility for servicing the SAR cases assigned to the Station. When the SAR case is passed from the Group OOD to the Station OOD, the Station OOD will have the full responsibility for performing the mission. The Station Watchstander will have the following responsibilities:

(1) After receiving case assignment from Group, notify Station OOD

(2) Handle all VHF/FM radio communications with Station's rescue units assigned to case (if rescue unit is in radio coverage range of VHF/FM radio available to Station)

(3) Maintain chart plot of distressed boat's position (data bank entry item)

(4) Maintain chart plot of rescue unit's position (data bank entry item)

(5) Enter "on-scene" arrival of rescue unit (Data Bank entry item)

(6) Final resolution of case

The Group OOD and Communications Watchstander can monitor the progress of the SAR case by retrieval of the updated information from the Group SAR Data Bank.

7.2.3 System Operation Under Station-Centered Concept

The control and Communications system is flexible in operation because it can function either under the Hub concept, as described in the preceding paragraph, or it can operate under the Station-centered concept. Under the Station-centered Concept, the Station Watchstander will have the same responsibilities as listed in paragraph 7.2.2, but will also maintain radio watch and process the Requests for Assistance. No change in system hardware design, or in the system architecture, should be required to achieve this flexibility in operation.

7.3 SAR Information Flow

The Control and Communications System concept involves the use of a computer-based system to control the flow of information regarding SAR cases, process the information, and record, retrieve and display the SAR data for the conduct of SAR Operations. A secondary, but important use of the Group SAR Data Bank, is the generation of management reports. For purposes of this discussion, the flow of SAR information is segmented into four SAR Mission stages:

(1) Awareness and Initial Action
(2) Planning
(3) Operations
(4) Mission Conclusion

7.3.1 Awareness and Initial Action Stage

Prior to activation of SAR activity, a determination must be made that an emergency, or potential emergency, situation exists. Then, the available information must be evaluated and appropriate actions initiated. It is very important that reliable information be acquired and required information be accurately recorded. Table 7-1 lists the information elements, in order of importance, that should be entered into the SAR Data Base, and the probable sources of the information elements. These data elements will be entered into the SAR Data Bank via a Watchstander Terminal. A Watchstander will utilize a computer terminal keyboard to make the required data entries. A computer-prompted Data Entry Program will be utilized to facilitate rapid entry of the listed data entry items.

In the Initial Action Stage, SAR actions are initiated in response to an incident. Table 7-1 illustrates the activities that occur during the Initial Action Stage. During this stage the SAR incident is evaluated, based upon the available case information, upon the response options available, and upon the constraints imposed by survivability, estimated response time, weather, sea conditions, etc. The case data entered by a Watchstander is immediately retrievable and may be displayed to the OOD. The OOD may utilize the computer to identify the nearest SAR resource, identify the assigned Station responsibility area, display navigation charts, evaluate alternate enroute times to Datum for boats and aircraft, and other aids to decision making.

Once data is entered into the SAR Data Base, it will be available for use at any level of command.

7.3.2 Planning Stage

During the Planning Stage, effective plans are developed to complete a SAR mission, including the coordination to implement the plans. Table 7-2 shows Planning Stage information flow. The Planning Stage may overlap the Initial Action Stage, since starting the Planning Stage depends upon an evaluation of the urgency of the reported SAR incident. The Planning Stage is concerned with the activities necessary to locate the SAR incident. Five events comprise the Planning Stage:

Table 7-1. SAR Information Flow, Awareness and Initial Action Stage

Information Req'd	Source of Information	Notes	Information Stored/ Processed
Distressed Craft Data: - Name - Registry No. - Position - Type of emergency - Data/time of position report - Boat description - POB and Condition **Assistance Needed** **Heading, Speed, Fuel Status** **Identity of Reporting Agent**	- Received directly from Marine craft involved - Reported by other boat - Reported by shore observer	VHF/FM radio CB Radio Telephone	- Watchstander enters distressed craft data into Data Bank - Automatic data/time Annotation of receipt of distress call. - Boat description entered - POB entered ---
Incident Evaluation: - Survivability of POB - Resource availability - Severity classification	- Case data retrieved from Data Bank - Resource status retrieved from Data Bank - Survivability charts from Data Bank - Navigation charts presented on terminal display		- ETA of SRU processed by computer - Datum stored in memory - SAR unit assigned stored in memory
Overdue Reports: PRECOM EXCOM Harbor Checks	- Automatic Dial-up of PRECOM/EXCOM and harbor check lists	Marinas, bridge custodians, fishing/bait dealers Marine fuel and supply dealers	- Collected data entered into case file.

Table 7-2. SAR Information Flow, Planning Stage

Information Req'd.	Source of Information	Notes	Information Stored/Processed
Estimate of Datum Coordinate			
- Time since position report	- Retrieve from SAR Data Bank		Data stored in computer memory
- Boat type, freeboard, hull, etc.	- Retrieve from SAR Data Bank		
- Wind direction & strength	- Estimate, based upon reports		
- Tide, sea conditions	- Report from distress case		
- Drift rate			
SARP Computation	Single Datum computation	Display on OOD terminal	May computed by Group computer or Central USCG computer.
CASP Computation	Simulation program - produces possible datums		Computed by Central USCG computer.
Search Area Size	Based upon SARP and/or CASP computations		Search area boundaries may be presented on OOD display
Search Area Coverage			
- Size			
- Resources available	- From SAR Data Bank		
Search Pattern Selection			
- Datum accuracy	Retrieve from SAR Data Bank, or estimates	Selected search pattern chart on OOD terminal	Selected search pattern coordinates stored in Data Bank.
- Search area size			
- Search platform			
- Navigation accuracy			
- Visibility			
- Sea/weather conditions			

(1) Estimate Coordinates of the Datum
(2) Determine Size of Search Area
(3) Select Search Pattern
(4) Determine Area Coverage
(5) Develop Search Plan

If the position of the distress case is accurately known and the drift factor is small, search planning is relatively simple. Search planning is more difficult when only the general area of search is known. Two computerized search planning aids are available from the USCG central computer:

(1) Search and Rescue Planning System (SARP)
(2) Computer - Assisted Search Planning System (CASP)

SARP utilizes position-determination methods, and is considered adaptable to implementation on the Group Computer. SARP is well adapted to cases where the incident position can readily be defined. SARP provides a single datum as a recommended search area.

CASP uses a simulation method to solve the search-planning problem. Simulation takes into account the uncertainties and inaccuracies present in input data, and provides a number of datum points; the datum points are mapped to provide a graphic presentation of possible datums.

After the size of the search area is determined, the search planner selects a search pattern. Search pattern selection depends upon several factors, such as accuracy of datum, size of the search area, type of search platform, maneuverability and navigational accuracy, weather and sea conditions. The search planner utilizes his display and computer to lay out the specific search pattern to be employed. The chart of the search area is displayed, and a graphic overlay of the specific search pattern is generated. The search datum and search pattern is transmitted to the Station OOD, and a hard copy may be printed for use by the boat crew. The Station OOD will monitor the execution of the designated search pattern by observing the periodic automatic display of the SAR units position relative to the designated search pattern track. The computer also generates and transmits steering commands to the boat's coxswain (course-to-steer, time-to-go) as an aid to accurate navigation of the designated track of the search pattern.

7.3.3 Operations

The Group Control and Communications System provides an efficient means of communicating necessary information from the OOD to the SAR unit, and for transmitting on-scene SAR operational data to the OOD. Automatic boat position reports and routine "Ops Normal" reports are transmitted from the boat to the computer via VHF/FM data transmissions, and are available for display to the Watchstander and OOD. Table 7-3 shows information flow during the Operations Stage. Navigation and course-to-steer commands are periodically transmitted to the boat, and presented on the message panel.

Table 7-3. SAR Information Flow, Operations Stage

Information Req'd.	Source of Information	Notes	Information Stored/Processed
Case Information:			
- Supplement update to boat crew	- Watchstander and OOD - may be retrieved from SAR Data Bank	FM voice and digital MSG panel	Supplement case data transmitted via digital messages and voice.
- Case event reporting	- Message panel selection of standard operational status messages		Case events stored in computer memory
	- May be supplement by voice comms.		Watchstander may enter supplemental case data via display and keyboard
Navigation			
- SAR unit position reports to station	Loran C TD's transmitted from boat to station	Polling	Date/time annotated Loran C TD's converted to lat/long coordinates and stored
			Boat position presented on graphic display to Watchstander
- Course-to-steer inst. to coxswain	Computer determines steering vector to bring boat back to intended track		Computer monitors boat position and track; compares actual vs. intended track
- Search plan execution - Tracking - Time-to-go	Computer monitors accuracy of search pattern tracking		Information presented on boat's message unit
	Computer provides estimated time to next course change.		Automatic date/time event logging.

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(73)

Voice communications will be used for SAR operations, but the automatic processing of routine information will ease the burden on the boat crew and Watchstander. A message display panel is also used to delineate operational events such as Arrived at Datum Position, and Date and Time annotations. This information is automatically entered into the data base using data telemetry via VHF-FM radio link. Digital data communications is much more efficient than voice communications because it provides a higher data rate, is less error prone, and requires less human involvement to communicate.

7.3.4 Mission Conclusion

There are five events that characterize the mission conclusion stage:

(1) Return to Station
(2) Boat Crew Debriefing
(3) Refueling/Maintenance
(4) Relief Boat Crew Manning
(5) Mission Documentation

The Control and Communications System provides support to the Watchstander, OOD, and boat crew during the Mission Conclusion Stage. While the boat is returning, the position of the boat is automatically updated and displayed, so the OOD can determine the boat's availability for assignment to another case.

Debriefing of the boat crew and preparation of the Assistance Report is simplified, because some of the required information was entered into the SAR data base during the conduct of the SAR mission. Thus, the boat crew is not called upon to provide the elements of information required for each Assistance Report. Under normal operating conditions, a printout of a nearly complete Assistance Report should be available upon the return of the boat.

The system can also be used to maintain information on boat readiness status, and the availability of standby boat crews.

Table 7-4 shows information flow during the Mission Conclusion Stage.

One of the important goals of the Control and Communications System is to accurately record SAR case data, in order to provide the Coast Guard with timely and accurate SAR management data. The SAR case data is entered as it occurs, and is edited and corrected at the point of entry. Then, all summary management reports derived from this data base are as accurate and as reliable as the data entries.

7.4 Group-to-Station Communications Link

To implement the Group-centered Control and Communications system design concept described in this subsection, it will be necessary to provide a highly reliable link between Station and Group communications

Table 7-4. SAR Information Flow, Mission Conclusion Stage

Information Req'd.	Source of Information	Notes	Information Stored/Processed
Return to Station			
- Return course plot	Intended track set up by Station OOD, using graphics and chart display terminal		
- Navigation instructions to coxswain	Computer-generated course-to-steer, derived from return course plot	Polling	Boat position and actual track presented on station Watchstander's display
- SAR unit position reports to station	Loran TD's, transmitted from boat to station		
Crew Debriefing			
- Property value saved	Boat crew provides required data items for assistance report.		Data provided by boat crew entered via Watchstander terminal
Fuel and Maintenance			
- Fuel req'd. to fill - Repairs and parts req'd.	Boat crew provides required data items for assistance report.		Data provided by boat crew entered via Watchstander terminal
Relief Boat Crew Manning (if req'd)	Relief boat crew list		Retrieved from computer memory bank
Mission Documentation	Retrieved from computer memory	Hardcopy printout for review with boat crew	SAR case data reviewed and edited by Watchstander and boat crew

centers. This may be accomplished by the use of dedicated, leased landlines that are suitable for data communications. An alternative link that could be considered is a microwave link; low-cost microwave relay hardware is readily available.

In order to implement the Hub concept, both voice and data communications will be employed to interchange information and manage SAR operations. It is necessary that tie lines connect each local community within a Group to the Group Communications Center so that reports or requests for assistance may be handled by the Group watchstanders.

At the time the Group OOD decides to assign a SAR case to a Station, he can either call the Station on the telephone or on the high-level VHF intercom. The case data, entered into the Group Data Bank, is displayed to both the Station Watchstander and the Group OOD. The case data is transmitted via landline data link from the Group computer to the Station terminal. The Station Watchstander may also enter case information to the Group data base as the information is developed.

7.4.1 Data Communications, Phone Line

Transmission of data between Stations and Group Offices will utilize the commercial telephone network. It is planned to utilize data modems that are compatible with regular voice-bandwidth telephone lines. Either leased lines or dial-up phone lines may be utilized for data communications, depending on local conditions, traffic density and utilization factors, communications reliability, and costs.

The standard data transmission speed is 4800 bps in the U.S. for voice-grade phone lines; this speed is considered adequate for network data transmission between Stations and the Group Office.

Data communications are programmed for a batch polling mode. The Group minicomputer acts as the data collection point for the network. Information items, inquiries, and other transactions entered on a Station terminal are transmitted via the phone line data communications network to the Group computer. Acknowledgment and replies are routed to the Station terminal originating the transaction.

7.5 Station-to-Boat Communication

Digital data between small boats and the Station will be transmitted via FSK on a marine VHF working channel. It is possible to share a working channel, wherein voice and data transmission can be time-shared.

The alternative to channel-sharing would be to establish a dedicated digital data channel. Although a dedicated data channel would offer many advantages, the availability of such a channel for total U.S. coastal confluence coverage is not known.

It is well-known fact that more than 50 percent of the time used by a typical voice conversation is composed of periods of silence. During the past several years, several techniques have been developed to exploit these silence periods for transmission of other voice or data transmissions. An example of this adaptation is the Bell System Time Assignment Speech Interpolation (TASI); TASI allocates channel capacity to a conversation only when a party is actively speaking. During silence periods, the channel is relinquished and becomes available for other use.

For operation of a channel-sharing concept in a low communications traffic density environment, the digital message can be transmitted in a store-and-forward mode. The shared working channel can be monitored for other traffic (carrier detection) and data message transmitted during a pause period. The TASI concepts are also applicable to channel-sharing in a high communication traffic density environment.

Refinements of the TASI concept, based on digital encoding techniques which reduce the bandwidth per active speaker to accommodate additional speakers, also have been implemented. Two such techniques are: adaptive pulse-code modulation and variable-rate adaptive multiplexing, both developed by the U.S. Army. In these systems, when the number of active speakers exceeds the channel capacity during overflow periods, performance degradation is shared among all speakers by reducing the sampling rate per conversation. Thus, no single call is significantly degraded.

Although the proposed voice and digital data-sharing concept is not based upon digitized speech transmission, TASI principles could be applied to utilize the speech silence periods for interpolated transmission of speech and digital data packets.

The interpolation of data into speech silence periods is an ideal approach to utilize idle channel capacity without degrading either the speech or data. This is especially true for data that can be delayed by a few tenths of a second, since it can then be readily fitted into the silence periods as they occur, without violating the time constraints on data delivery. An important development which contributes to this technique is "packet switching". Packet switching of voice is a natural way to take advantage of the burstiness of speech in a network environment and prevent network resources from being inefficiently dedicated to speakers during silence periods. Under this scheme, both voice and data are accommodated by the store-and-forward packet-switched concept, but different packet sizes and different transport protocols could be used for data and speech.

The proposed RF Data Communications link is based upon the transmission of one (or more) 35-character serial data words, or messages. The data is encoded 7-level ASCII, 10 bits/character. Figure 7-2 illustrates the packet data format that was developed for the Vessel Traffic Control System (VTS). This message format is suitable for message interchanges with small boats. The data rate is 1200 baud, and a message would occupy approximately 1/3 second.

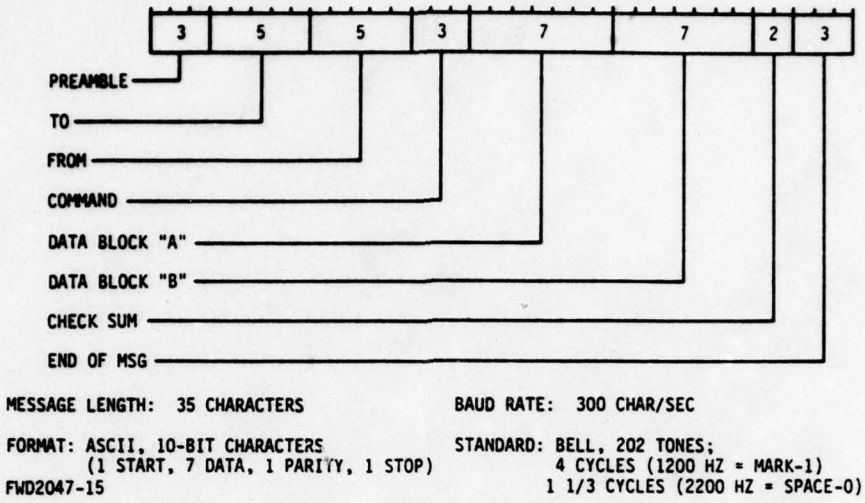


Figure 7-2. Data Word Format

7.5.1 Data Transmission via VHF Radio

In order to evaluate the suitability of a voice-bandwidth VHF communications channel for the reliable two-way transmission of digital data, a theoretical analysis of bit error probability was made. The analysis was based upon the manufacturer's published characteristics of the TRITON receiver, typical antenna heights and characteristics, VHF transmitter power, and other relevant characteristics. The analysis was based upon the use of non-coherent, two-tone (1200 Hz and 2200 Hz) FSK. The analysis indicates that for an error probability of 1×10^{-6}, the range from the boat to the high-level antenna is 44.5 miles. The result indicates that for SAR operations by small boats in coastal confluence zones, the data transmission system would be entirely adequate.

The communications systems analysis for VHF transmission of digital data is presented in Appendix E.

7.5.2 Data Transmission via HF Radio

When small boats are dispatched to handle SAR missions beyond the VHF coverage zones (35 to 125 nmi from shore), the only available alternative radio communication means are the marine HF channels assigned for Coast Guard use. The following channels are in current use:

2.182 MHz - Distress, Calling
2.670 MHz
2.676 MHz
3.120 MHz
5.696 MHz

These channels use single-sideband voice modulation (3-kHz bandwidth), at 100W PEP -- a maximum power for shore installation, and 50 to 75W PEP for vessel-based transmitters.

High-frequency propagation is characterized by two modes of wave propagation: ground wave and sky wave. Long-range HF communications utilize sky-wave propagation. Sky waves are propagated by multiple reflections of radio energy from the ionsphere and the ground. The ionsphere consists of several layers (D layer, E layer, F_1 layer, F_2 layer). High-frequency energy is reflected or refracted from these layers, depending on incidence angle and radio frequency. Diurnal changes in these layers change the sky wave paths. Also, there are short-term variations in the multi-path reflection characteristics of the ionsphere layers that result in large scale variations in received signal strength, or signal fade.

Ground wave HF propagation can be utilized for ranges beyond 100 miles. The received signal level was calculated for the following conditions:

- HF Frequency: 3 MHz
- Radiated Power: 100W, PEP
- Range: 125 nmi

The calculated received signal level was:

$$P_r = -32 \text{ dBm}$$

Background noise in the HF band is principally caused by atmospheric noise, lightning discharges. Calculation of the atmospheric noise level for the information bandwidth indicates:

$$N_p = -122 \text{ dBm}$$

Comparison of the received-signal power level to the background noise level indicates a favorable condition for reliable digital data transmission.

The serious limitation in utilizing HF for data communications is the interference between sky-wave and ground-wave signal arrivals. The path attenuation for ground-wave and sky-wave signal arrivals at a 100-mile range is approximately equal; thus, the received signal at the antenna may be in or out-of-phase with the received signal. An analysis of the time variant vs. frequency characteristics of HF fading was conducted by General Atronics, a subsidiary of the Magnavox Government and Industrial Electronics Company. A spectral analysis of eight bands of audio subcarriers on a 5-MHz carrier indicated that frequency selective, time-varying fades (≈ one second) occurred on one or two audio subcarriers at a time, but at no time did all the subcarriers disappear.

Several types of HF data modems have been developed for use by the Navy for long-range data communications, covering a range data rates from 75 bits/second to 2400 bits/second. Modems with higher data rates are far more complex and expensive than the lower date rate modems. The family of HF modems utilize frequency and time diversity to cope with multipath interference problems.

The simplest, and lowest-cost implementation would be a two-tone frequency-shift-keyed asychronous 75-bits per second keyer, compatible with standard FSK teletypewriters. Each data bit is simultaneously keyed on two tones (1575 Hz and 2425 Hz). (Refer to Appendix F of this report for an analysis of digital data transmission.)

7.5.3 Message Panel

In order to display navigation information and operational data to the Coxswain, and to provide a means for the Coxswain to initiate messages for transmission, a Message Panel is required. The Message Panel will encode and transmit standardized status update messages to the Station (or Group) Watchstander. The Message Panel serves two purposes:

(1) Formats and transmits brief digitally-encoded status messages
(2) Receives and displays brief messages from Group to Station

In addition to the message-handling capability, the Message Panel would function as a modem for periodic automatic or polled transmissions of digitized LORAN-C time differences for transmission to the Station or Group control center.

The Message Panel also provides a rapid and simple way for the Coxswain to enter routine status reports, or to respond to interrogations.

A preliminary concept layout of the Coxswain's Message Panel is illustrated in figure 7-3. The Message Panel consists of four sections:

(1) Incoming message lamps section
(2) Message transmission selection section
(3) Alphanumeric display
(4) Numeric keyboard for data entries

The RECEIVE message section is illuminated by 10 lamps that are controlled by incoming messages. The hardware decodes the digital patterns, and the interpretation of each pattern is left to the local Group commander so that the messages used are those most useful for that organization.

The TRANSMIT message section consists of 10 lighted pushbutton switches identifying common messages that are most often used locally. After the message is selected and the light behind the switch confirms that the message was properly entered, the TRANSMIT switch is depressed to send the message.

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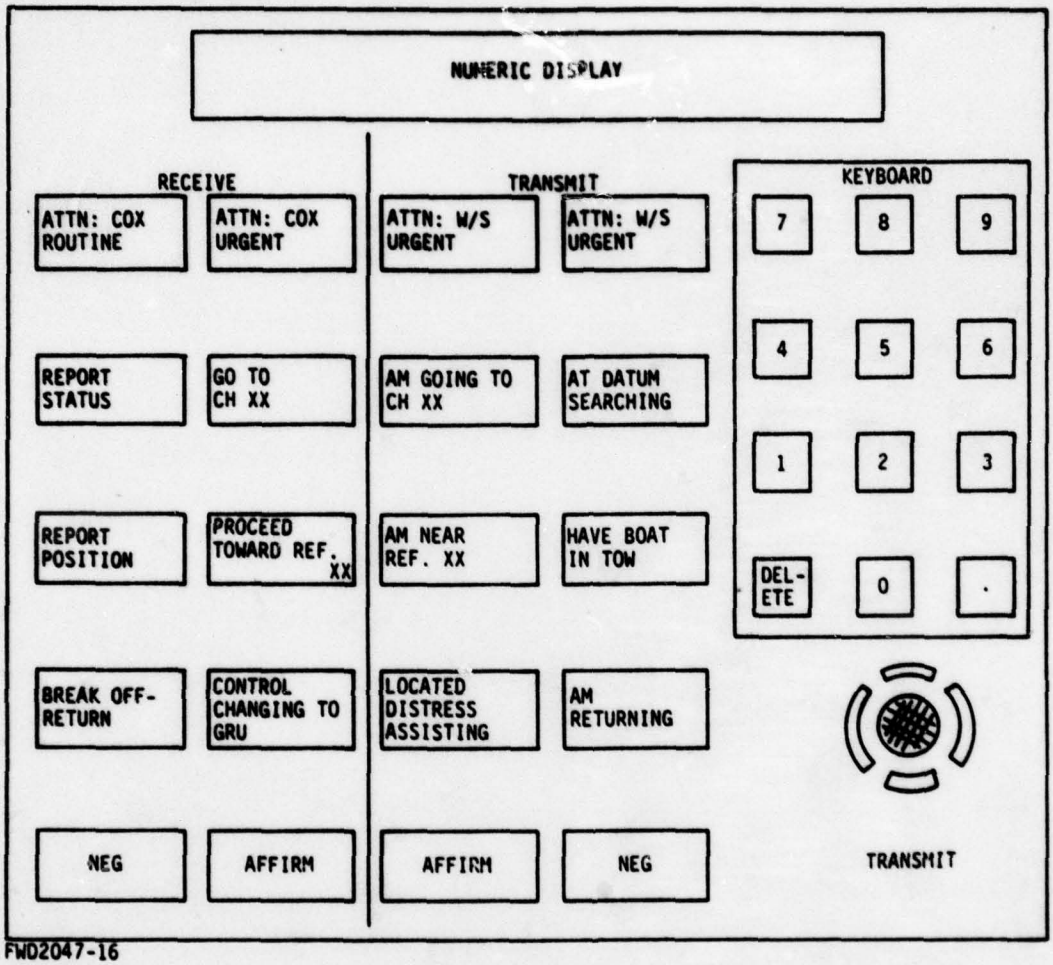


Figure 7-3. Message Panel

The numeric display and keyboard are used for display and for entry of numbers associated with messages sent. The numbers can represent channel numbers, case number, nautical miles, and geographical reference numbers of other quantitites defined locally.

It is expected that the principal use of the Message Panel will be for the Coxswain's reception and display of steering instructions and operational direction from the Operations Center.

7.6 Boat Navigation System Concept

7.6.1 Loran-C Navigation

The present-day limitations of navigational capabilities of small boats have been discussed earlier in this report. A concept for a

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navigation reference system for USCG boats (41 ft. and 44 ft.) will be presented in this section.

The Navigational System concept is to utilize re-broadcasted, digitally encoded Loran-C time differences from the boat to the Station via the VHF radio link. The concept of navigation by the use of Loran-C time differences has been implemented and tested by the U.S. Coast Guard for helicopters. The heliocopter test data was collected by NAFAX at the National Aviation Facility Experiment Center, a FAA test facility located at Atlantic City, N.J. with U.S. Coast Guard personnel flying the test missions. The test data was reduced by the Systems Control Co. of Palo Alto, California.

The tests results indicated that the Loran-C navigation system was superior to the conventional airborne navigation systems, VOR and DME. Offshore measurements on the position of a charted buoy indicated a CEP error of less than 400 ft, with a 8-ft mean error. (These results were realized under the adverse condition of using the old East Coast Loran-C chain that produces an unfavorable gradient).

7.6.2 Selection of Loran-C Navigation System

Selection of Loran-C as the navigational reference system is based upon the following considerations:

(1) The Department of Transportation National Navigation Plan* designates Loran-C as the government-provided radio navigation system for the coastal confluence zone.

(2) Loran-C provides the required coastal confluence zone coverage for the marine areas of greatest interest to the Coast Guard.

(3) Loran-C is capable of providing the 0.1 nmi navigation accuracy for small boat SAR operations for most marine areas.

(4) Loran-C is becoming the accepted and widely adopted navigation system within the marine community. Thus, it is important that airborne and surface SAR activities be referenced to a single navigational reference system.

(5) Loran-C has demonstrated a potential for accurate search pattern execution.

Appendix D describes the coverages provided by the Loran-C system for the coastal confluence zones of the United States. A summary of Boat Navigation System is presented in table 7-5.

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* Anonymous, Department of Transportation National Plan for Navigation. DOT-TST-78-4 November 1977.

Table 7-5. Summary of Boat Navigation System

Environment	Requirement	Feature	Benefits
(1) Operational			
Environment, platform - Training - Space (chart) - Opportunity (limited - other jobs coxswain) Environment, sea & weather (Visibility, foul weather, waves) Offshore missions (5-125 mi. range of operations)	Automatic operation Coastwise coverage: 0-125 nmi offshore Location accuracy: 0.1 nmi Compact reliable display & control panel for coxswain.	Man/machine interface Automatic coordinate transformation by computer Automatic computation of distances between waypoints Situation display at OOD & Watchstander's terminals	Continuous navigation information available Less crew effort required for navigation
Stated Goals (By G-OSR)			
Reduced transit time	Minimize time to arrive and datum	Route planning	Lower operating costs Quick response Improved resource utilization
Improve search execution	Accurately traverse legs of a designated search pattern	(1)(2) Waypoint navigation Course to steer Range and bearing Time-to-go (or distance)	Achieve state POD with less search time
Management Data Collection			
Accurate SAR data distress information: Lat/long Distance off-shore	Single position determination/ recording	(2)(3) Position monitoring and recording-(track history) (1,2,3) 125 nmi range (max.) 30 nmi range for 99% of of time	More accurate MGT data Improved MGT decisions Resource mix i.e. capabilities Fuel estimates What types comm/nav equipment to put on boats
Sortie Distance to scene of distress or Distance to search area	Calculate Distance	1/10 nmi accuracy IAW CG-397	
Other OPS			
Boundary definition ATON	Single-position determination Single-position determination	Lat./long. readout	Provides for accurate ATON placement and verification Eliminate uncertainty of marine of boundary location (ELT missions)

7.6.3 Boat Navigation System Concept

Figure 7-4 illustrates the Boat Navigation System concept. The equipment aboard includes an automatic Loran-C receiver, a Message Panel and Display, and a standard VHF/FM marine transceiver. The Loran-C receiver automatically receives two Loran-C signals, and the time difference signals are digitized and transmitted to shore via burst transmission (voice BW) over a VHF/FM working channel to a high-level receiving site.

The data baseband signal is recovered at the high-level VHF site, and transmitted via the existing telephone line to the Station's communication center. The digitally-encoded time difference signal is then recovered and processed by the Station's CPU to derive the boat's address code and latitude/longitude position coordinates. Position and steering commands are digitally encoded and transmitted via the same channel to the Message Panel Display for the boat's coxswain.

Boat's position reporting may be initiated or controlled in several different ways:

Polling from Operations Center
Automatic periodic broadcasts
Included in boats transmitted message

The frequency of the need for the boat's position depends upon the type of mission, weather, and the particular type of navigational problem encountered.

7.6.4 Search Pattern Execution

The Probability of Detection in conducting search operations will be substantially improved with the use of the proposed navigation system. This conclusion is based upon the results of field tests of the TDL-424 navigator system. The TDL-424 was evaluated as a navigational reference for conducting various search patterns. HH-52A helicopters were used as the test platform. An evaluation of the accuracy achieved in flying a "creeping-line" search pattern was made. The same pattern was traversed; one set of flights utilized VOR/DME as the navigational reference, and the other test flights utilized the TDL-424 Loran navigator. Comparison of relative tracking accuracies are illustrated in figures 7-5 and 7-6. The use of the Loran-C navigator resulted in a significant improvement in the accuracy of execution of the legs of the "creeping-line" search pattern (figure 7-6), as compared to that achieved by a VOR/DME airborne navigation system.

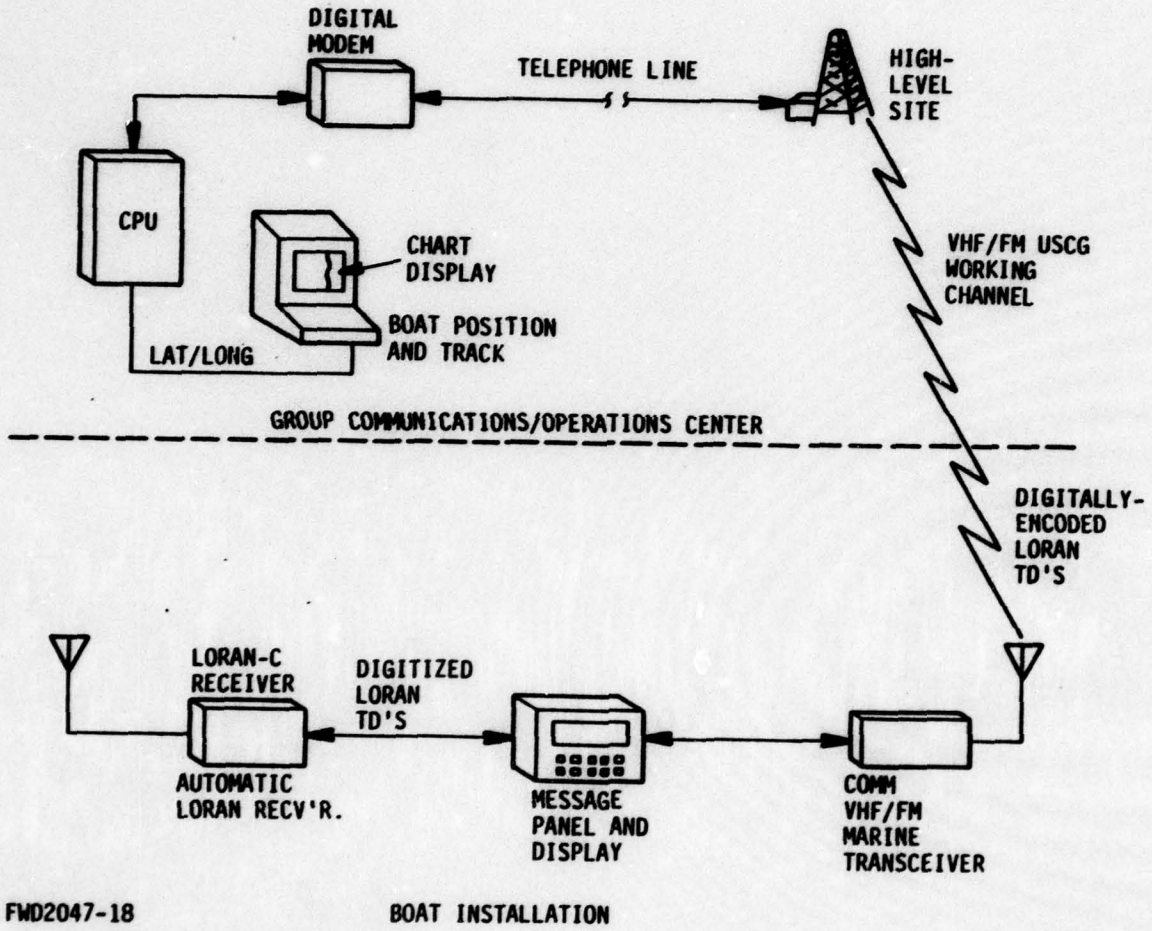


Figure 7-4. Boat Navigation System Concept with Loran-C

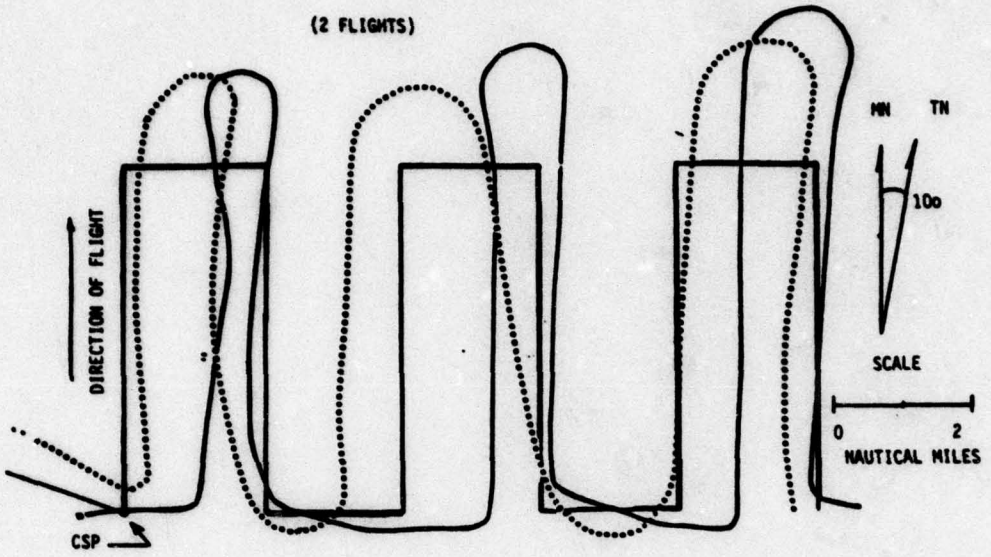


Figure 7-5. Creeping-line Search Pattern Accuracy, H-52A Helicopter with VOR/DME Navigation System

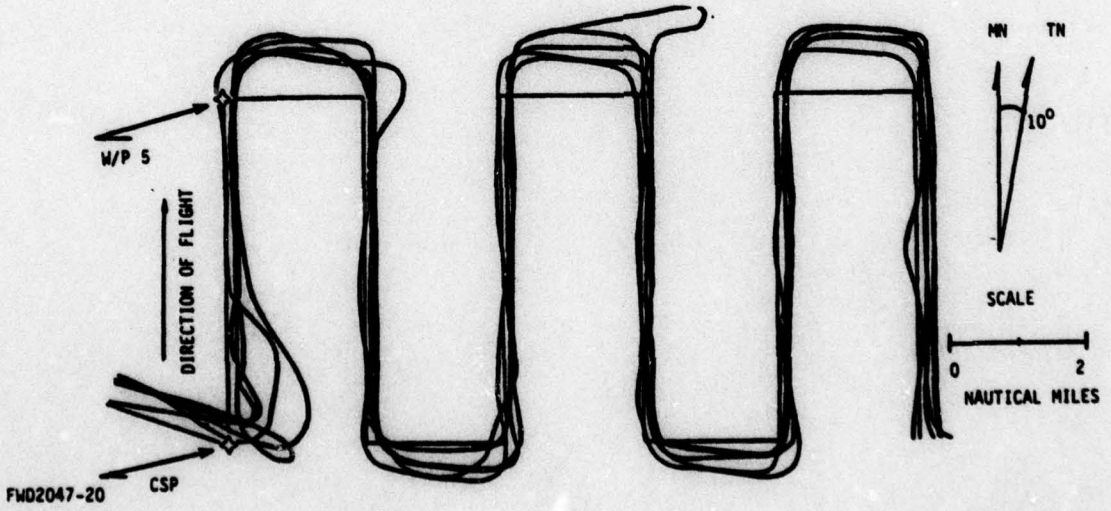


Figure 7-6. Creeping-line Search Pattern Accuracy, HH-52A Helicopter with TDL 424 Loran-C Navigation System

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The reported test results* from the USCG operational flight test evaluation of the TDL-424 Loran navigator are summarized as follows:

(1) The Loran-C navigator system performed accurate, repeatable and operationally meaningful search and rescue missions including creeping line, sector and expanding square search patterns.

(2) The Probability of Detection (POD) using Loran-C on a creeping-line search was calculated as 77.33 percent for the first search compared to a desired value of 78.00 percent.

(3) The Loran-C navigator system demonstrated superior performance on all search and rescue patterns compared to conventional VOR/DME navigation techniques.

(4) The POD using conventional VOR/DME was calculated as 68.4 percent on the first pass.

(5) The conventional flights indicate that 1.5 searches would be required to achieve 78 percent POD while the Loran-C flights show 1.04 searches are required. Therefore, the Loran-C system provides a 31 percent reduction in the number of searches required to achieve 78 percent POD.

The test results are significant with respect to airborne SAR operations, and illustrate the magnitude of potential improvement in the efficiency of search operations conducted by small boats. The projected benefits in improvement in search pattern execution include the following:

(1) Reduction in boat hours dedicated to search operations

(2) Improved resource utilization, because boats assigned to SAR operations will become available for a new assignment

(3) Improved Probability of Detection for the areas searched

The analysis of the flight test results indicated that the use of the Loran-C navigator provides a 31-percent reduction in the number of searches required to achieve a 78-percent Probability of Detection. Since the accuracy of execution of present search operations is not known, a projection of reduction in boat search time cannot readily be made. Since small boats do not have VOR/DME, it is reasonable to assume that the reduction in required search time will be at least 31-percent, and probably greater, perhaps as much as 40-percent reduction. This would result in a very favorable Cost/Benefit ratio if both the cost of boat operating hours and the possible reduction of capital cost for the resources required for SAR operation are considered.

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* CG-D-9-77 "An Operational Flight Test Evaluation of a LORAN-C Navigator", March, 1977.

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7.6.5 Effectiveness of the Navigation Concept (Search and Rescue)

The projected effectiveness to the Coast Guard from the use of an accurate boat navigation system falls into several areas: improved mission effectiveness and accurate SAR management data collection and reporting.

7.6.5.1 SAR Mission Effectivness. - The current limitations imposed by the lack of an accurate navigation system were discussed in subsection 2.8, and a set of requirements for a small boat navigation system was developed. The proposed small boat navigation system is intended to satisfy the stated requirements, and it is our belief that most, or all of the problems involved in the current mode of small boat navigation will be solved through the use of the navigation system.

The Coxswain and boat crew will be in an improved posture to efficiently handle SAR missions because continuous and accurate "own boat's" position coordinates are available. The proposed navigation system requires less crew effort than the present means of navigation.

The proposed navigation system can reduce the sortie time because of the reduced transit time to datum and the improved efficiency in traversing search patterns.

7.6.5.2 Aids to Navigation. - The availability of a Loran-C referenced system aboard small boats will improve the capability of the boat to determine whether or not an aid is in its proper position. The repeatability of Loran-C time differences is excellent. Therefore, if the positions of aids are charted according to Loran-C coordinates, accurate monitoring the position of an aid will be easily accomplished.

Installation of aids to navigation, using a small boat as a platform, will also be facilitated by the availability of a Loran-C display aboard.

7.6.5.3 Enforcement of Laws and Treaties. - Many ELT actions taken by the Coast Guard depend upon the accurate location of designated marine boundaries. The proposed Loran-C navigation system will provide the needed capability. The benefit will be an improved capability to identify violations of laws and regulations, and the effective enforcement of these regulations.

7.6.6 SAR Management Data Collection

The sortie data required for the SAR data base includes reporting the distance traveled to the scene of the distress (or the distance to the search area) and time annotations of the significant events of the SAR operation. The proposed small boat navigation system provides continous Loran position coordinates to the computer at the Station. The

boat coxswain can enter his status on the boat's Message Panel and the SAR event status is transmitted to the computer via VHF/FM radio link.

The computer can compute transit time and automatically enter time annotation. The accuracy of the position and time-related SAR data will be better than the boat crew's memory, and the SAR statistical data collected for the SAR data base will be more accurate. The benefits resulting from the improved facility for entering SAR management data include the following:

- Reduce the cost of SAR data collection
- Improve the quality of SAR data
- Facilitate the collection and summarization of SAR management information

The current cost of collection and summarization of SAR management information is approximately $500,000 per year. Part of this cost is due to the man hours dedicated to preparing, coding, and editing SAR Assistance Report forms; and part of the cost is the preparation of data for computer processing; this includes keypunch and verification, and the time required to generate reports. Since the entry of SAR case data into the data base at the source makes it possible to eliminate several steps in data entry, a significant reduction in the cost of SAR data entry should be achieved.

At present, the availability of SAR management data is one year late. With the proposed data entry concept it is possible to achieve timely SAR management reports as required.

The availability of timely and accurate SAR management information will provide a basis for SAR management decision making. Examples of these decision-making areas include:

(1) Best Resource Mix and Utilization

(2) Budgeting

(3) Fuel Utilization

(4) Requirements Analysis for Small Boat Communications and Navigation Equipments

(5) Budgeting and Future Planning

7.7 Financial Accounting Integrated Data System (FINAIDS)

7.7.1 Functional Requirements

The shortcomings of the present system for handling Station and Group office administrative functions were discussed previously in section 2 of this report. Review of the present-day problems involved with

Station and Group Office administrative tasks indicates that utilization of modern data management techniques would substantially reduce the costs of administration, and would simplify and expedite procurement of the necessary goods and services by Station and Group Offices. The entry and editing of ordering and accounting information at the point of obligation will reduce human error and expedite the processing of data and the preparation of administrative management reports.

The following supply and accounting functions have been selected for implementation as a part of the Group Control and Communications System:

(1) Accounting (FINAIDS III)
(2) General Ledger Keeping
(3) Purchasing Catalog (Mostly federal supply)
(4) Status of Purchases
(5) Inventory Control
(6) Report Generation

In order to implement a Coast Guard-wide Supply and Accounting system, standardization of procedures is a necessity.

Implementation of the FINAIDS accounting system will provide a standardized Coast Guard-wide system for accounting procedures. This standardization is a necessary requirement for including the processing of supply, purchasing, and accounting functions as elements of the Group Control and Communications System.

7.7.2 FINAIDS Concepts

The Survey Team became aware of the Coast Guard's Financial Accounting Integrated Data System (FINAIDS) project through conferences with the Planning and Procedures Staff.

The Coast Guard is in the process of converting the entire accounting system to a standard integrated system--FINAIDS (Financial Accounting Integrated Data System). The implementation of FINAIDS was initiated in 1974, and was planned for three phases:

Title	Level	Functions
FINAIDS I	Headquarters	Headquarters basic accounting Service-wide consolidation Cost target reporting
FINAIDS II	District	All of FINAIDS I with automated disbursing scheduling
FINAIDS III	Group	Field accounting and reporting

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The objectives of FINAIDS include combining modern accounting concepts and fresh data-processing techniques into a modern accounting information system that will realize the potential of the central Coast Guard computer. In addition to providing a new Coast Guard-wide standardized structure for maintenance of accounts, the use of FINAIDS will promote operational efficiency and enhance effective management decision-making.

The FINAIDS I program objectives have been accomplished in several districts, and implementation of FINAIDS II and FINAIDS III will probably be combined. Thus, the Coast Guard is now actively working toward the goal of a standardized, unified Coast Guard-wide accounting system. In conjunction with the program's short-term goals, it is planned to have the three levels (I, II, & III) operating in the FY 1981-82 time frame.

The objectives and the plans for implementation of FINAIDS III were discussed with the USCG Accounting Policy, Planning, and Procedures Staff. Several items were discussed with respect to performing FINAIDS data entries at the unit level. Also discussed was the utilization of Station and Group terminals and data processing equipments for maintenance of Station Target Ledger Personal Property Accountability Reports, Message reports, and similar reports wherein the data entries and the point of control are maintained at the unit level. It was apparent that FINAIDS III objectives can be better realized by the use of one-time data entries at the unit level, and that the station OIC's needs can be best served through the immediate availability of financial data on a local terminal.

The functional requirements presented are in general agreement with the objectives of FINAIDS III, supplemented by some additional functions that are considered useful to Group Offices and Stations. The set of requirements will be set forth in terms of a set of general functional requirements; also, a list of the specific types of data entries and report generation will also be presented. Some general requirements are:

(1) Transactions originated at Point of Control (Unit Level)

(2) Standardized file of object codes

(3) Computer/operator interface planned for simplified data entry, edit, and coding

(4) Inquiry and data retrieval capability--ready access to stored data

(5) Provision for local information file

(6) Simplified generation of formal periodic reports

7.7.3 Elements of Administrative Data Handling Requirements

(1) Supply Catalog Listing

(a) Nomenclature

(b) Stock No.

(c) Current pricing data

(d) Source data (includes federal stock items commonly used)

(e) Vendor file

(2) Order Entry - Source Data Automation

(a) Applicable information derived from item (1) above inserted by operator-controlled selection

(b) SURF data ordering format

(c) Ordering data checked and entered at point of control

(d) Scheduled delivery date

(e) Standard coding look-up tables

(3) Purchase Order Status Monitoring

(a) Listing of outstanding purchase orders

(b) Listing by promised delivery, object classification, purchase order, date, or other sorting criteria

(4) General Mess Data Entry and Reports

The FINAIDS system will utilize a local data terminal for mess data entry; FINAIDS will provide the following data entry, summarization, and reporting functions:

(a) Unit level mess data entry

(b) Standardized format and heading information

(c) Data entries based upon CG-2576 form:
- Sale of Stores--keyboard entry
- Sale of Rations & Meals--keyboard entry

(d) Historical data for summary of accounts receivable derived from local data bank

(e) The current general mess operating statement for the unit is maintained in local memory until report is required by district

(f) Data from the general mess operating statement at either the detail or total level, depending upon the information feedback desired. (Detailed entry provides outstanding accounts receivable and accounts payable aging, accounts payable reconciliation with payables processed by District, and the automatic generation of ITV's.) Once entered, data is forwarded to the Headquarters computer with the minimum cycle data, and is edited and returned, if necessary for correction. Once all general mess data is entered correctly, it is accepted by the FINAIDS system and stored until all Districts are ready to run the month-end routines.

(5) Inventory and Personal Property File

(a) Purchased items to be capitalized (over $300) entered in inventory file for file update, upon entry of material receiving report.

(b) Review and edit performed at control point (of data entry), (may be reviewed at Group or District)

(c) Property file maintained current

7.7.4 Administration and Supply Benefits

The potential benefits achievable through the use of a well-designed administrative data management system can be summarized under three major headings:

(1) Accuracy of entries and reports

(2) Speed and timeliness of information handling

(3) Savings in manpower, money, and time

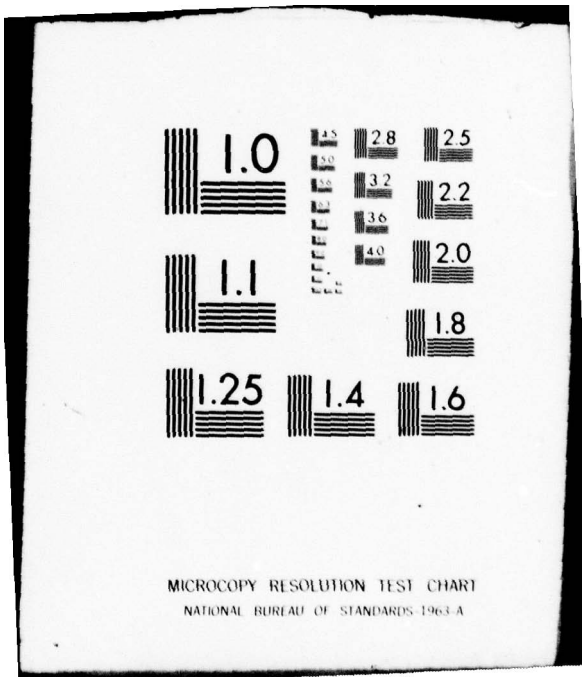
7.7.4.1 Accuracy of Entries. - Standardized data formats will be used for entry of financial, accounting, and supply data into a data bank. Computer-prompted data entries will be performed and checked at the point of control, which should assure accuracy and completeness. This "one-time" data entry will effect a reduction in errors in data entries, since it will eliminate the error-prone manual processes of coding, transcribing, keypunching, verification, etc. Data entry at the unit level is considered feasible, because of the simplifications achieved by the use of data field selection via the display touch panel, computer look-up and prompting, and other appropriate aids to data entry.

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7.7.4.2 Speed and Timeliness. - Speed in performing data-entry operations is an inherent benefit. One example of time saving in supply management is ordering items from the Federal Stock List. At present, this information is not available at Stations, and preparation of SURF cards can be a time-consuming process. A Consolidated Stock List will be available to each Station display terminal, updated with the latest prices and item identificaion numbers. Thus, the Station may rapidly select and enter an order from the Consolidated Supply List, and the order can be processed quickly. As soon as shipping dates are established, the information is entered into the Data Bank, and the Station can determine the status of outstanding purchase requests.

All transactions entered are available for data processing upon entry and acceptance of the items entered. Preparation of management reports, based upon the stored transactions, is expedited; and rapid turn-around time for reports is realized. With the availability of timely and accurate financial status reports, improved management decision-making should be a benefit to the Coast Guard.

7.7.4.3 Savings. - At present, Stations, Group Offices, and Districts must spend substantial levels of manpower and money to acquire and process data relating to budget, fiscal, and supply management. Simplifications of data entry, and implementation of the "one time" data-entry principle will result in manpower savings. The availability of accurate and timely computer-generated management and fiscal reports will alsc result in improved resource management. Although these benefits cannot be readily quantified, the overall dollar savings should be tangible.

7.8 System Network Concept

The Group Control and Communications network comprises a hardware configuration and system software. The hardware components of the system are illustrated in figure 7-7 and grouped in the following manner:

(1) Group Office

- Minicomputer
- Modem Interfaces, Telephone Lines
- Modem Interfaces, Radio Circuits
- Watchstander Terminal and Display
- Group OOD Terminal and Display
- Administrative Terminal
- Line Printers

(2) Station

- Watchstander Terminal
- General-purpose Terminal
- Line Printer
- Modem Interface, Telephone
- Modem Interface, Radio Circuits

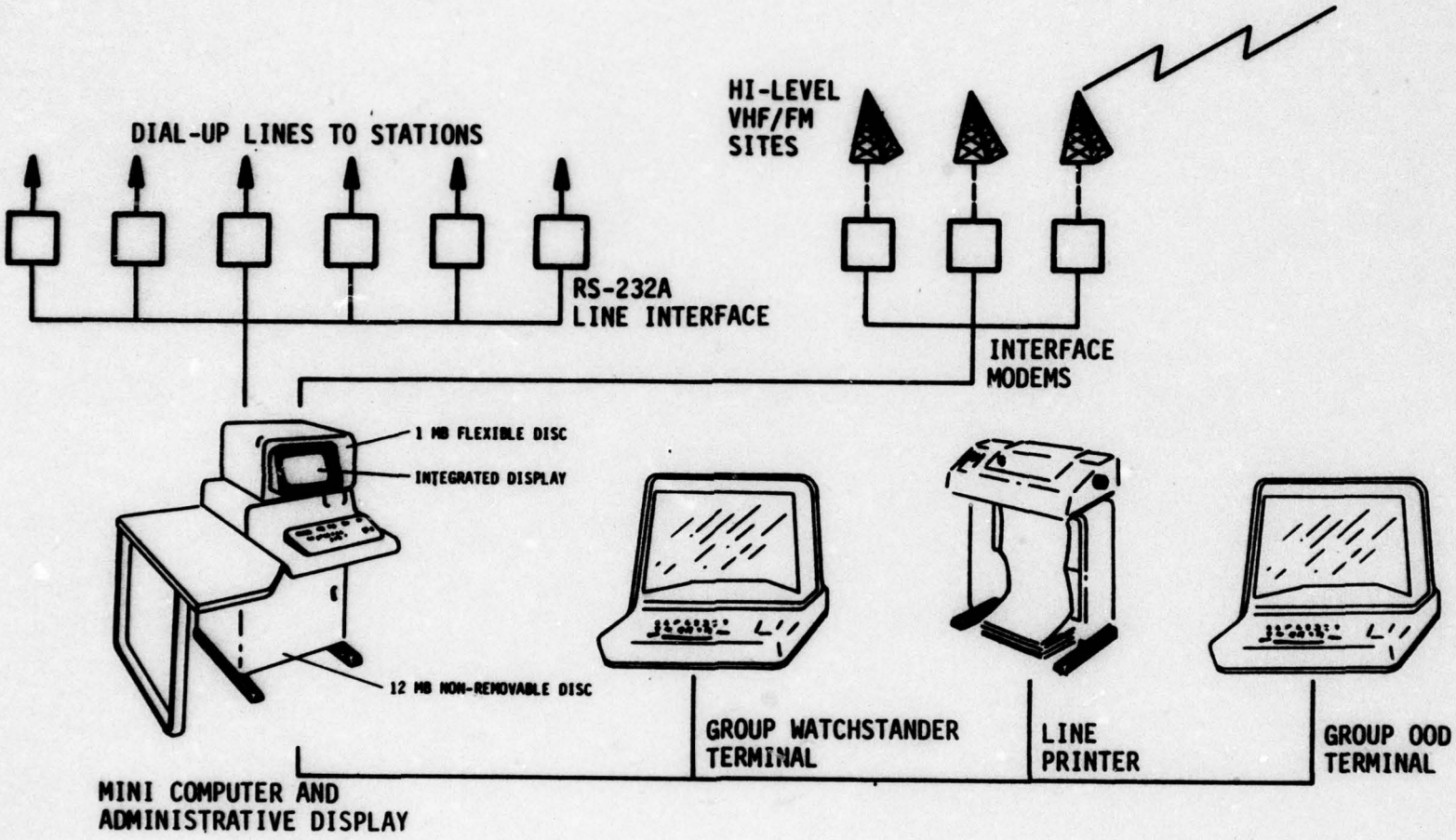


Figure 7-7. Concept for Group Control and Communications System

7.8.1 Group Minicomputer

The Minicomputer is the heart of the Group network, and handles processing of all transaction requests. It is also the principal interface for collection and logging the SAR incident information required for drafting record messages, for establishing SAR case files, and for preparing of periodic SAR management reports.

The Minicomputer will provide a capacity for reference information files for Group office and Station use. Examples of such reference files would be:

- SAR Resource/Status
- Group Cutter Lists
- Medical Facilities - Hospitals, ambulances, etc.
- PRECOM and EXCOM - Lists
- Suspect Vessel Histories
- Notice to Mariners
- Summary of Local Fishing Regulations

The Minimcomputer memory capacity should be able to store at least 24 hours of transactions for ready access at OOD and Watchstander terminals. Several minicomputer manufacturers now offer minicomputers that have expandible mass memories that may be added to the basic minicomputer unit. These add-on mass memories may be purchased as 10 to 120-megabyte disc drives, providing the needed mass memory requirement for a particular application.

The Group Minicomputer will provide coordinate transformation capability for transformation of Loran-C time differences to latitude and longitude, so that the position coordinates of Coast Guard SAR units can be either automatically graphically displayed on a terminal, or may be plotted on a chart. The Minicomputer will also maintain a track history of boat position.

In addition to the SAR data handling tasks, the Group Minicomputer will provide capability for administrative support in commissary management, budget and financial management (FINAIDS), order entry and supply functions, and the preparation of related management reports.

The major manufacturers of minicomputers and peripherals are now making major efforts to service the small business and commercial market. There are several manufacturers that are in a position to provide minicomputer mainframes and peripherals that should satisfy the speed storage, and thruput requirements of the Group Minicomputer. Major minicomputer manufacturers offer expandable minicomputer families, wherein the system can be expanded from a limited set of application programs to a larger and more powerful computer system. Flexibility and growth capability are very desirable features, and should be considered in the specification and procurement of computer equipments.

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7.8.2 Terminals

Each Station of the Group has two terminals; one Watchstander Graphics Terminal and one General-Purpose Terminal. The Station terminals are linked to the Group computer via leased voice-grade telephone circuits or dial-up lines. Each Station terminal has access to the group SAR data base. The Station terminals will be "smart terminals" and have local memory and data handling capacity to independently perform the information processing and computations that are required for processing SAR cases, and associated information storage, retrieval, and transmission to the Group SAR Data Bank.

7.8.2.1 Watchstander Terminal. - The Watchstander's terminal performs the following major functions:

(1) Source data entry

(2) Local data storage and retrieval

(3) Data communications/message handling

(4) Remote job entry

(5) Automatic date-time annotation

(6) Polling and display of boat positions

(7) Coordinate conversion Loran-C to lat/long

(8) Chart

(9) Record message generation

(10) Case data filing

In order to satisfy the requirements for display of SAR navigation and situation presentation, the Watchstander's terminal is an interactive graphics terminal. This graphics terminal has an adequate memory capacity, and organization to automatically display local area nautical charts, and present graphic symbols and identification tags for the boats involved in SAR cases.

The use of a plasma panel is recommended for the Watchstander's terminal. The plasma panel permits the use of rear-projected images, with superimposed computer-generated graphic symbols and alphanumerics. This capability facilitates display of boat positions, intended and actual track, datums, and search patterns.

The combination of a plasma panel and a touch-panel entry provides a rapid and accurate means of entering coordinates, selecting data fields, designating items for storage or processing, and similar functions. It has been demonstrated that touch-matrix data entry is easier and faster

than keyboard entry for many types of data-entry functions. The use of a touch-matrix overlay on a display requires a high degree of linearity and precise image size control; experience has shown that these requirements are best satisfied by a plasma panel. The plasma panel does not require a refresh memory. Refresh of the display is a heavy user of CPU time.

7.8.2.2 General Purpose Administrative Terminal. - A general-purpose display terminal is considered adequate for handling admnistrative data entry and retrieval, CRT display of alphanumeric data is suitable, and graphics are not required. Off-line preparation of administrative reports, storage and retrieval of financial data, look-up of standard stock list items are examples of information processing that can readily be performed on terminal equipped with digital tape cassettes. For example, a set of standard data-entry forms may be stored on a tape cassette. The data-entry blanks to be entered are identified by underlining (or inverse video), and the item entries may be retrieved from memory summarized and entered in the designated window.

Off-line preparation of administration reports allows the operator the opportunity to review and edit reports and messages prior to transmission of reports to the next command level.

7.8.3 Data Modems, Phone Line

The Data Modem may be an integral part of the minicomputer system design, or it could be a separate hardware module. The line protocol regulates message traffic by polling Station terminals to send and receive data. A commonly-used line protocol, Binary Synchronous, utilizes block data transfer, with provisions for effective error-checking and correction. Each data block is checked, and an acknowledge bit returned to the sender. A data block would be automatically retransmitted if the receiving Station did not acknowledge.

Since it is planned to utilize polling for data communications between the Group minicomputer and Station terminals, a half-duplex modem, capable of a data rate of 4800 bps, is considered adequate for the application.

7.8.4 Modem Interface, Radio Circuits

The requirements for a Data Modem Interface to Radio Circuits are similar to the functions described for Telephone Line Modems. Since it is planned to carry both voice and data on the same radio channel, a special modem would be needed in order to avoid interference. Protocol for radio circutis can be designed for Coast Guard use and controlled by the Group Minicomputer. Typical bit rates for existing VHF-FM channels range from 300 to 1200 bps. The bit rate for economical HF data communications is 75 bps.

7.8.5 System Priorities and Memory Organization

The Group Control and Communications system is planned to operate in several modes, as described in section 6 of this report. For the purpose of defining the priority of demands upon the system, and hence the program availability and access time, four orders of priority for information processing and data access have been established:

Priority Designator	Description
A	Radio Communications
B	SAR Operations
C	Record Communications
D	Administration

Priority A is the highest-order priority, and takes priority over functions listed under B, C, or D. The system operating priorities for B, C, and D are handled in a similar descending order of priority.

The organization of operating system, the establishment of priority interrupts, and the organization and implementation of the computer memory and computer cycling times are based upon the hierarchy of system operational priorities. In actual operation it is highly likely that this prioritization will not be apparent to a system operator.

A brief description of each of the types of information processing and the corresponding data fields is presented.

7.8.5.1 Radio Communications - Priority A. - Maintenance of data communications with a SAR unit under way is considered a first-order priority for message communications. Thus, all elements of the operating system and reference files that are required for preparation and transmission messages directed to SAR units (and messages received from SAR units) must be readily accessible.

Polling protocols are used for message interchanges with boats. Each boat in the Group has a discrete address, and polling sequences utilize these addresses for identification of messages transmitted and received. Two types of polling sequences are used: Routine and Immediate. Routine polling sequences are programmed to monitor the "OPS Normal" status of SAR units under way. Immediate polling sequences may be initiated by the Watchstander to transmit priority information to a boat, and to closely monitor his position and status.

When a boat is dispatched to handle a SAR case, the Watchstander enters the event, and the boat is automatically entered into the Routine polling sequence. The polling interrogation interval may be selected by the OOD; the polling interval range will probably be 12 to 15 minutes.

When precise boat position and status monitoring is required, the SAR unit is transferred to the Immediate polling sequence. Initiation

of the Immediate polling sequence may be under Watchstander control, or may be computer-controlled. The Immediate sequence is used to closely monitor the boat's position relative to Datum, and to provide accurate track information. The Immediate mode is also employed to transmit course-to-steer information to the boat traversing the legs of a Search pattern. The polling interval range is one minute, or less, depending upon the need for tracking accuracy.

The Routine and Immediate polling sequences are variable-length sequences, wherein SAR units are entered into the sequence register by the Watchstander upon case assignment, and are withdrawn from the sequence when position and status monitoring is no longer required.

Since the high-level VHF sites and the utilization of working channels are controlled by the Group Communications Center, the boat polling sequences are resident in the Group computer. Station and Group Watchstanders will enter and withdraw SAR units from the Routine and Immediate polling sequences, as required.

7.8.5.2 SAR Operations - Priority B. - The next order of priority for information access and processing relates to data entry and retrieval of SAR case data. The interactive SAR data-entry program is used to prompt and assist the Watchstander enter the necessary data elements associated with the case.

Under the Hub concept the initial-case data entries will normally be handled by the Group radioman Watchstander. At the time the Group OOD determines which SAR resources are required, the accumulated case data file will be transmitted via the 4800-bps data link to the responsile Station. Then, subsequent case data information relating to action taken to resolve the case are entered by the responsible Station Watchstander.

Since it is very important to retain and protect all information relating to SAR cases in progress, periodic updates of all case data entered into the local Station memory will be trnasmitted to the Group, and entered into the current case data file.

In order to efficiently perform the required case data entries, the Watchstander must have rapid access (2 to 5 seconds) to several data-entry and reference files, including the following:

- SAR Case Data Entry
- Navigation Charts
- Geographic Names - Cross-Index
- Type & Location - ATONs
- Weather Data
- Local Information
- SAR Resource Status File
- SAR Case No. Sequence Register

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These files must be stored in a memory that provides the required access interval, but are not necessarily instantaneously accessible from the Minicomputer memory. Thus, the reference files can be retained in a suitable mass memory and become accessible, as required, for SAR case data-entry operations.

Some of the data elements comprising a SAR case file can be programmed for automatic logging into the file. Examples of automatic data logging includes:

(1) Group Case No. Assignment
(2) Date/Time Event Annotation
(3) SAR Unit position Coordinates (Polling Responses)

SAR record communications utilize a standardized message format, and modern word-processing techniques can be applied to rapidly composing the text of a formal message by extracting the key data items retrieved from the case data stored in the active case file (SITREP) or closed case file (for final case messages). The use of operator-selectable message-heading information, retrieval of words and phrases form the case data information, stored date/time annotations, and other word processing and manipulation techniques minimizes the number of keystrokes necessary to complete the message.

7.8.5.3 Record Communications - Priority C. - Preparation, transmission, and storage and retrieval of SAR record communications are classified as C priority. Under the Hub concept, most of the SAR SITREPS and messages related to SAR cases will be prepared by the trained Group Radiomen. The messages will utilize the SAR case data files; the preparation of the message will utilize the following operating and reference files for message preparation:

(1) Active SAR Case Data File
(2) Closed SAR Case Data File
(3) Navigation Charts
(4) Message Routing and Address List
(5) SITREP Message File

7.8.5.4 Administration - Priority D. - The administrative traffic, including all FINAIDS, supply, and other general administrative communications, is classified as a D priority. The practical effect of the message-processing priorities will hardly be noticeable to the terminal user, except for short delays under exceptional circumstances of high message traffic density.

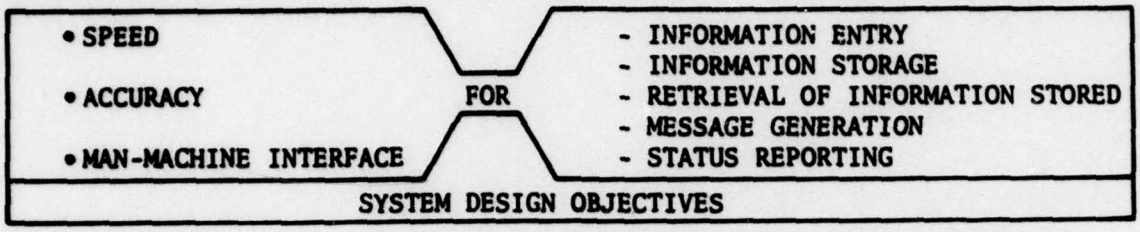
7.9 System Architecture

7.9.1 System Performance Objectives

The design goal of a Group Control and Communications and information handling system is to provide a substantial improvement in the communication and control functions at the Group Office level and below. It is

planned to effect this improvement by providing the means of reliable, high-speed digital data transmission between the Group Office and Station, and between the Station and the boats assigned to the Station.

The system design objectives of the Group Control and Communications System include the following major improvements in system performance:



Speed is an important factor in information entry. The current employed methods of SAR data entry are time-consuming, as described previously in this report. Real-time data entry, wherein the data elements are entered into a Group Data Bank as they are received (either automatically or via a man-machine interface), is considered one of the prime objectives of the Group Control and Communications System design concept.

Speed is also an important system performance factor in information storage and retrieval. A central SAR computer with memory bank is utilized by the Group and Station Watchstanders for information storage and retrieval. Information elements on a SAR case are entered by the Watchstander's handling the request for assistance, utilizing a computer-assigned Group Case Number. SAR case status is immediately available, upon request, to the Station and Group Watchstanders and/or the Station and Group OOD's. Thus, the information regarding the case is displayed and is readily available for decision-making, for resource allocation, initiation of search activities, or other appropriate responses.

Hand-in-hand with speed is accuracy. Data entry into a data bank by means of alphanumerics and symbols provide data elements that have a lower information error rate than data elements that those transmitted via voice (radio or landline circuits) and are recorded by hand. For voice-transmitted data such as boat registration numbers, latitude and longitude, place names, etc., it is necessary to laboriously "spell-it-out", using standard phonetics, verification techniques, etc., that are both error-prone and very time-consuming. By contrast, both speed and accuracy are source-achievable by the use of computer-prompted data entries into a Group Data Bank. Accuracy of the data elements is assured, because the Watchstander views and verifies the data elements on a display prior to entering the data into the Group Data Bank.

At present, the status of SAR cases is reported up the chain of command by formatted SAR SITREP messages, transmitted via teletype. The word processing associated with message composition, editing, correction,

addressing, and preparation for transmission will be greatly simplified by utilization of a Group SAR Data Base. By the use of operator-prompted and menu-selection techniques, it has been demonstrated that SAR record messages could be efficiently prepared for transmission in a fraction of the time required by present-day methods.

It is the opinion of the Study Team that, with the immediate access to the Group SAR Data Base, the status of SAR cases can be readily available to the Group or Station OOD; the necessity for generating SAR SITREP messages will be reduced. This will tend to reduce the volume of formal message traffic.

7.9.2 System Architecture Design Principles

As a result of recent improvements in the design of the various elements of computer hardware - CPU's microprocessors, minicomputers, memories terminals, data modems and peripherals, many options are open to the computer system designer that were not available a few years ago. Computer system designers were limited to the use of a central computer for performing all information processing and computations. Computations and data processing, programming and other computer-related operations were highly centralized, and not user-oriented.

The next step in the development of distributed, rather than centralized, system architecture was the development of time-sharing and remote terminals. These developments, together with the appearance of user-oriented computer languages, opened the way for a much broader application of computers to a wide range of users.

A further step in the evolution of user-oriented computer systems is the availability of the "smart terminal." These new families of terminals employ microprocessors, disc packs, and cassettes, RAM's, ROM's, and are capable of performing computation functions, pre-processing of data within the terminal. Then, the processed information may be rapidly transmitted to a central computer for additional operations.

In order to design the system architecture to be optimum for the Group Control and Communications System, it is necessary to utilize the best information available to the Study Team relative to the present day needs and an estimate of additional future requirements.

In addition to the user-oriented system operating requirements, there are additional system architecture requirements:

(1) Reliability
(2) Maintainability
(3) Expandability
(4) Flexibility
(5) Usability

There are specific system architecture design principles that can be utilized to satisfy one or more of the above requirements. Table 7-6 illustrates how system architecture design techniques are utilized to effect the needed system operating characteristics.

A brief description of these design principles is given in the following paragraphs.

7.9.2.1 Distributed Architecture. - Distributed Architecture is an implementation technique in which multiple processors are used and individual tasks can be assigned to run in one of several processors. In order to implement Distributed Architecture it is necessary that there exist a two-way path between any pair of processors, software tasks are written using device independent code, and the operating system for the network is capable of controlling the flow of data throughout the network.

Another factor which should be considered in the development of the architecture is anti-obsolescence, which is important because of the rate at which the technology is changing. The facility to be developed must be useful over its useful life and, therefore, must be amendable to newly developed hardware (and software, if appropriate) developments as they become available. The use of distributed computing power permits this objective to be accomplished either by upgrading the individual processing elements, or replacing or augmenting them with new hardware elements as they become available. This can be accomplished in an evolutionary fashion without scrapping the hardware investment that already exists in the system. This technique contributes to expandability (by allowing more processors to be added to the network) and reliability (by allowing automatic reconfiguration, as described in a paragraph 7.9.2.4 of this section).

7.9.2.2 Background Hardware Diagnostics. - Continuous monitoring of all hardware components of the system should be provided, either by "self-checks" performed by the hardware itself or under computer subsystem control In either case, when such tests indicate a faulty subsystem, the Watchstander Supervisor shall be notified of this event either on his computer display or by "fault lights" or other appropriate means.

7.9.2.3 Fault Isolation Diagnostics. - Specialized hardware diagnostic programs should be developed to aid in the identification and localization of faulty hardware components. The Watchstander should be provided capability to take the unit off-line and cause the execution of these diagnostic programs.

7.9.2.4 Automatic Reconfiguration. - The system should continue to provide service (albeit in a degraded fashion) in the event that one or more hardware modules or communications links fail. If available, redundant hardware modules would be automatically switched on-line.

Table 7-6. System Properties

Architecture Design Techniques	Reliablility	Maintainability	Expandability	Flexibility	Useability
Distributed Architecture	X	X	X	X	X
Background Hardware Diagnostics	X	X			
Fault Isolation Diagnostics		X			
Redundancy	X	X			
Automatic Reconfiguration	X	X			
Manual Reconfiguration	X	X			
System Restart					X
Modularity		X	X	X	
Performance Monitoring		X	X		X
Programming Standards	X	X	X	X	X
Documentation Standards		X	X		
Test Standards	X				
Human Factors				X	X

7.9.2.5 Manual Reconfiguration. - The Watchstander should have the capability to remove from service one or more hardware modules for maintenance or service without shutting down the entire system. The system would continue to provide services not dependent on that module. Where redundant modules are available, the Watchstander would have the capability to switch these on-line with minimal down time. The Watchstander would also have the ability to reduce system capability level by suppressing specific watchstander services provided by the computer subsystem in the event system redundancy fails or in the event of unanticipated system loads.

7.9.2.6 System Restart. - There should be a simple procedure to restart operation of the computer subsystem. The computer would "bootstrap" its operating system, applications programs, and constant data base back into memory from a copy stored permanently on a disk or magnetic tape. The computer subsystem would recover the most recent copy of the "volatile" data base containing information that is periodically saved by the system. The extent to which the volatile portion of the data base is used will depend upon the age of the volatile portion. If the computer has been non-operational for too long, the volatile part of the data base would be discarded.

7.9.2.7 Modularity. - All hardware and software elements should be highly modular, where each module would perform a well-defined function and would have a well-defined and simple interaction with the other modules of the system. Modularity contributes to maintainability and flexibility by minimizing the effort involved in making changes in the system implementation.

7.9.2.8 Performance Monitoring. - The software operating system should be capable of monitoring the utilization of computer resources by the computer subsystem and be capable of recording these data for off-line analysis. The operating system is capable of monitoring the amount of computer resources consumed by each of the software tasks. Off-line analysis of this monitor data provides insight into system bottlenecks and information about the amount of resources available for additional tasks. Thus, performance monitoring contributes to maintainability, expandability, and usability.

7.9.2.9 Programming Standards. - Programming of the Control and Communications System should be planned to utilize sound and proven techniques. The techniques to be applied to this program include the following:

(1) Higher-level language vs. machine language
(2) Structured programming

Consideration should be given to the use of a higher-level language, such as FORTRAN, for the development of application software. This approach would have the advantage of programming in a machine-independent language. On the other hand, the inherent inefficiency of memory utilization that is characteristic of FORTRAN would argue against a higher-level

language. The selection of a computer language should be based upon a cost-benefit tradeoff of programming costs (lower for a higher-level language) vs. memory costs. (The memories are becoming cheaper.)

All application tasks should be written as structured code, i.e., GO TO statements shall be limited to their use in IF-THEN-ELSE, DO WHILE, DO UNTIL, and CASE program structures. A structured programming approach to a complex problem is more easily proven to be correct than is an unstructured program. This is true because the flow of control is simpler. Additionally, since the structured program is logically simpler than its non-structured version, its listings are more readable and, therefore, more errors will be caught in desk checking.

Device Independence is the property that I/O transactions are defined in terms of data files and logical units. The operating system will have the capability of dynamically re-assigning physical units to logical units. For example, this property allows the system to function with a faulty supervisor display by assigning the supervisor display logical unit to a physical unit which had been a satellite display.

Data base design principles are discussed in this report because the proper management of the data base is a fundamental aspect of good programming technique. The data base must be designed such that the algorithms which are used to implement the operator services are efficient. Efficiency is realized when data files are organized such that a minimum of disk file access is required and individual data items are easily accessed. There are other data management principles that should be observed. For example, programs should be written without imbedded constants; all constants are required to be in the data base. This principle greatly contributes to program flexibility and maintainability.

7.9.2.10 Test Standard. - Testing should be performed top-down. Top-down testing means that the upper-level control programs are tested first, this software is then used to test the routines called by the upper-level programs, and so on. Each lower-level routine is tested in the environment of higher-level routines which have already been tested.

7.9.2.11 Human Factors. - The Watchstander interface with the system (both hardware and software) should be evaluated to determine if the system provides the requisite information and services in a form that can be conveniently used by the Watchstander. These human factor considerations should include evaluations of Watchstander ease of access to I/O devices and communication equipment, of method and format of display information and data entry, and of maximum system response times to operator input. Factors such as Watchstander training and background should be considered so that personnel with little or no computer expertise can operate and use the system*. A tradeoff evaluation between these factors and system complexity (costs) must be included in the system design.

---

* This requirement is not imposed on system maintenance which requires trained personnel.

7.9.3 System Software Synthesis

The development of requirements for, and the synthesis of, the Operating System and the various specialized applications programs for the Group network are believed to be a major task to be undertaken during the system development phase. Minicomputer manufacturers now offer software packages for operating systems, as well as some applications software, which can be very useful to the system designer.

7.9.3.1 Operating System. - The Operating System is the central manager of system resources. Specification of the minicomputer and the associated operating system are both important elements of system configuration. The Operating System should be capable of handling the required data communications functions (interrupt service, message management, memory management communications services, network management), and the tasks associated with data entry and retrieval.

7.9.3.2 Applications Programs. - In addition to the development of applications programs to service the entry and retrieval of SAR operational data, other specialized applications program modules will be required. Examples of such applications programs include:

(1) SAR Data Base Management Module
(2) Local Information Data File
(3) Report Generator Modules
(4) Loran-C lat./long. Coordinate Transformation Module
(5) Network Service Module
(6) Message Assembly and Disassembly (wireline)
(7) Message Assembly and Disassembly (radio circuits)
(8) Polling Sequence Module
(9) FINAIDS Service Module

APPENDIX A

STUDY TEAM ORGANIZATION AND LIST OF USCG FACILITIES VISITED

The first phase of the Control and Communicat on Study was to conduct a Survey of four designated Group Offices and eight Stations. The purpose of the survey was to observe the present-day operations of the Group Offices and Stations, and to identify problem areas that are associated with each facility.

The Survey Team members included:

Coordinator	T.P. Ellsworth
Operations & Communication	W.H. Serstad, E. Bates
Administration	C.B. Smith

The Survey Team visited USCG facilities in the First, Seventh, Ninth, and Thirteenth Districts. Before visiting the facilities within a District, the Team visited each District Office. Briefings and individual conferences were arranged to cover the technical and administrative subjects of interest.

The following visit schedule was followed:

NINTH DISTRICT

Ninth District	-	13 & 14 October, 1977
Detroit Group Office	-	17, 18, 19, & 20 October, 1977
Cleveland Harbor Station	-	14 October 1977
Belle Isle Station	-	19 October 1977
Toledo Station	-	21 October 1977

THIRTEENTH DISTRICT

Thirteenth District	- 3 & 4 November 1977
Air Station North Bend Station North Bend	- 7, 8, 9, 10 November 1977
Coos Bay Station	- 11 November 1977
Umpqua River Station	- 11 November 1977

FIRST DISTRICT

First District	- 20 & 21 November 1977
	- 21 November 1977
Woods Hole Group	- 28, 29, 30 November 1977
Cape Cod Canal Station	- 1 December 1977
Castle Hill Station	- 2 December 1977

SEVENTH DISTRICT

Seventh District	- 8 & 9 December 1977
Miami Group Office	- 10 December 1977
Miami SAR Unit	- 10 December 1977
Ft. Lauderdale Station	- 9 December 1977
St. Petersburg Group/Station	- 12, 13, 14 December 1977
Clearwater Beach Station	- 14 December 1977
Cortez Station	- 15 December 1977

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APPENDIX B

TRIP REPORT SUMMARIES OF SURVEY TEAM VISITS TO DISTRICTS, GROUP OFFICES, AND STATIONS

85 8/8

(INTEROFFICE COMMUNICATION)

Magnavox

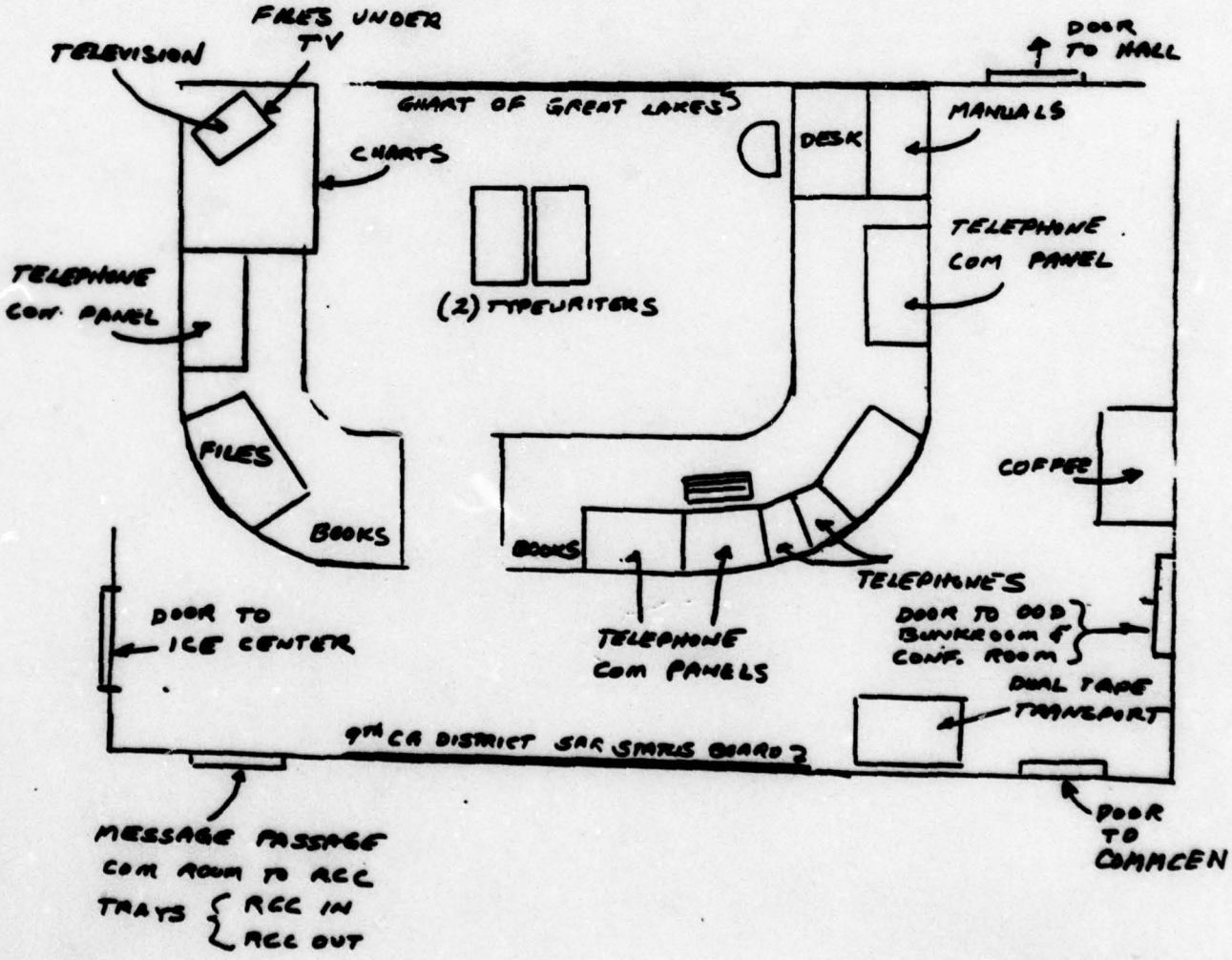
TO: FILE. DATE: 15 NOVEMBER 1977 FROM: E. L. BATES

COPIES TO: T. P. ELLSWORTH
W. H. SERSTAD
C. B. SMITH

SUBJECT: SUMMARY OF SURVEY OF USCG 9th DISTRICT

DATES OF VISIT - October 13 & October 14, 1977

USCG 9TH DISTRICT RCC:



85 8/8 (112) (12)

9th DISTRICT

PERSONNEL:

Cdr. Turner	OSR
Cdr. E.R. Smith	OC
Cdr. E.I. Sullivan	M
Cdr. D. Cunningham	F
Cdr. Jim Hunt	Planning
Cdr. Bob Workman	B
Capt. J.P. Mihlbauer	O
Mr. P.T. Pelzer	OIL

GROUPS IN 9th DISTRICT:

Diluth
Milwaukee
Sault Ste Marie
Detroit
Muskegon
Buffalo

AIR STATIONS IN 9th DISTRICT:

Chicago
Traverse City
Detroit

UNIQUE MISSION IN 9th DISTRICT:

Ice Operations commencing 1 December as described in Annex W to CCGDNINE Operation Plan No. 1 - (FY).

ICE OPERATIONS TASK ORGANIZATION:

Task Groups	Task Commander
Operation Coal Shovel	CO, Coast Guard Group Detroit
Operation Oil Can	CO, Coast Guard Group Milwaukee
Operation Open Buffalo	CO, Coast Guard Group Buffalo
Operation Taconite	CO, Coast Guard Group Sault Ste Marie

The Ice Navigation Center operates at the 9th CG District Office, Cleveland, OH, and is responsible for the collection and dissemination of current data concerning the Great Lakes ice cover.

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Coast Guard Groups provide miscellaneous shore units and small boats, and the District Air Stations provide HH-52A's and HU-16E's for supporting the ice mission. Air Station Elizabeth City previously provided a C-130. For the 1977-1978 ice season, the C-130 is provided by the St. Petersburg Air Station.

Aerial ice surveys, including Side Looking Airborne Radar (SLAR), recon missions are made is accordance with the schedule in Annex W, with additional recon flights scheduled by the Ice Navigation Center as required.

SLAR images are analyzed graphically by the Ice Navigation Center, and the combined SLAR image and graphical analysis are transmitted to Coast Guard Group Sault Ste Marie and also to facsimile equipped boats via the Lorain Radio facsimile network on channels 26 and 28.

Icebreaker MACKINAW is assisted by similarly powered Polar icebreaker WESTWIND, which is moved into the Great Lakes for the ice season. The 110 ft harbor tugs and 180 ft buoy tenders are also used for icebreaking. The tugs have a high horsepower per ton, and are capable of pushing themselves upon the ice and letting their weight do the icebreaking. The buoy tenders are under powered for this mission, so are primarily used to push ice when a channel or open area is available into which the ice may be pushed.

GENERAL NOTES:

NCC communications is by telephone, including FTS, WATS, and a direct line to the District Commander.

Access to the SAR Computer is through COMLANTAREA, New York. CASP and SARP are unusuable on the Great Lakes because of the inaccuracies in the weather inputs and the discontinuity of the land/water interface. The SAR computer very often will predict that a boat shall drift into a land area.

A 12 channel dual magnetic tape transport (Magnasync Moviola, No. Hollywood, CA) is located in the RCC. Each transport records 24 hours, with automatic switch-over to the 2nd transport. All telephone communications at the RCC is recorded, and kept for a one month period.

Competent medical authority is obtained for all medicos and medivacs. Previously, medical authority was obtained from the U.S. Public Health Service, New York; however, a Flight Surgeon is based at the Traverse City Air Station, and all medical matters are now directed to that location.

Each SAR case has an assistance report. The unit assigns a unit case number. If more than one unit is involved, the group assigns a multi-unit case number. SAR Incident Report files are filed by case number, and are kept for 3 years.

Ten percent of the SAR cases are searches, while many more cases receive searches. Because the searches are unique on the Great Lakes, a local computer dedicated to SAR planning would be helpful.

MSO, MEP, Commercial Vessel Safety:

Cdr. E.I. Sullivan Room 2019

Pollution Incident Reporting System (PIRS)

This is a data base system maintained by the District MEP. Coding forms are filled out by the unit (MSO or COTP). The forms are screened by District MEP and sent to Data Processing (Branch under Comptroller - F) for keypunching and entry into a transaction file at the Headquarters computer. The computer response is a Preliminary Edit List which identifies all fatal errors that did not make the transaction file.

Monthly, an update of the Master Record File is run at Headquarters. This update puts all valid transactions submitted by the districts in that monthly cycle on the Master Record File. As a result of this update, the districts receive an Update Reference List for every year that has update data submitted. Also, an Update Error List is generated which identifies transactions that were not processed by the update and are not added to the Master Record.

Upon receipt of the monthly lists, the 9th District MEP reviews the data to ascertain that all updates for the month have been made to the Master Record. Other than this review, no use is made of PIRS at the 9th District. The data is maintained entirely for Headquarters use.

PIRS is explained in detail in manual CG-450, two copies of which are on file.

TYMSHARE

9th District MSO has a TYMSHARE Model 225 terminal which accesses the TYMSHARE computer at Cupertino, CA. via a dial-up telephone line. Eventually all MSO's and COTP's in the district will have these terminals.

Two types of reports are obtainable from TYMSHARE. One is a COMPLETE VESSEL HISTORY which will be available at all terminals.

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This report lists all pertinent info concerning the vessel, including a tabulation of all past violations, and the vessel owner and Captain when these violations occurred. The second report is a RESPONSIBLE PARTY HISTORY which is a tabulation of all violations contributable to a shipping company. This second report will only be available to the District MSO.

Boarding and violation information can also be added to the TYMSHARE historical file from the TYMSHARE terminal.

Merchant Marine Technical

Room 455
601 Rockwell
Cleveland, OH.

Personnel: Cdr. Gordon Piche
Capt. Bill Bleekley, USCG Ret.
Mr. Mark Tellidge

This organization was discovered from District MSO, however the exact position in the organization is not known.

The organization possesses a Wang computer with 20K of memory, and another 4K on order. The computer has a maximum capability of 32K of memory. A DCS CRT display is used. The system is devoted to scientific use, primarily naval architecture. A small, locally generated, certificate renewal program is the only use of a non-scientific nature.

COMMUNICATIONS:

The Communications Center is the Net Control for the 8383 SARNET Circuit. The 8383 system is the intra-district teletype network operating on leased lines from AT & T. The circuit is a free net, meaning that stations are not required to gain permission from net control prior to sending.

The 8383 net connects the 6 groups and 3 air stations. Each station has a Model 28 ASR teletype capable of sending and receiving 100 words per minute. The circuit and associated teletype equipment is maintained by AT & T.

The 9th District Comm Center also has Western Union Telex (66 words/min.) for communications with non-government addressees.

The Comm Cen maintains a private line teletype circuit (100 words/min.) with the National Weather Service.

Communications with addressees outside of the 9th District is by AUTODIN.

An estimated average of 10,000 TTY messages a month are handled by the 9th District Comm Center.

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9th District

The 9th District Comm Cen has access to the VHF-FM High Level sight located atop the Federal Building, Cleveland, OH., but radio watch is no longer maintained. The VHF-FM equipment at the 9th District is a Motorola C53RTB. The High Levels are crystallized for the following frequencies:

Channel	12	156.6 MHz	Port Op. Safety, Seaway Traffic Control
"	16	156.8 "	Intl Distress, Safety & Calling
"	21	157.05 "	CG Common
"	22	157.1 "	CG-Non Govt., Marine Broadcast, CG Common
"	23	157.15 "	CG Common
"	81	157.075 "	Pollution Control, SAR, Law Enforcement, CG Common

The 9th District has a Motorola Paging System on VHF-FM Channel 21 for key personnel (D, DCS, O, M, OSR, MEP, OOD, OIL, ET).

Each Group in the 9th District has a Group TTY Loop, except Detroit, which has two loops. The loops are 60 ma DC loops, Baudot code. Series loops are employed, and all teletypes are KSR machines (no tape cutting capability). Due to inadequate TTY training of the station watchstanders, sometimes a message page takes up to 4 hours on-line to compose and transmit reasonably error free.

The Stations, Units and Groups are no longer required to issue communication summaries. All messages are kept on file for 30 days and are then destroyed.

Xerox 200 Telecopiers were purchased for Diluth, and installed for a trial period. As a result of the trial, all MSO's are to get telecopiers. USCGD9 would like to place telecopiers at all stations eventually.

USCGD9 Comm Center has a complement of 10 radio men and two chiefs. Two radiomen are on duty at one time.

Vessels entering the St. Lawrence Seaway are received, and USCGD9 enters AMVER daily to determine whether the vessels should be boarded, etc.

COMPTROLLER (F):

The comptroller department comprises of six branches of 12 disciplines. Responsibilities include the following:

1. Personal Property Acquisition and Accounting
2. Procurement (no R & D contracts)
3. Military Pay (Civilian pay is thru FAA).
4. Travel claims
5. Shipments of property, household effects.

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6. Exchange program

7. General messes

8. Postal service and mailroom

9. Financial accounting

10. Budget preparation (Under direction of (Chief of Staff)

11. Budget execution (OG-30)

12. Data Processing

The Data Processing Branch has a Data 100, 70 Series System with dual tape drive and RJE to the Headquarters computer in Washington. The Data 100 is supplied by Headquarters on a lease/buy arrangement.

Also available is a Sycor Terminal dedicated to MILSTRIP.

SAR Assistance Reports are mailed from the unit to District, where they are keypunched and entered into the Headquarters computer. This effort consists of an average of 3000 cards per month update.

The payroll branch has 10 storekeppers, each responsible for nearly 300 men each. These storekeepers keep manual pay records, hand typing the records for each individual. The pay is cut at the dispersing center in Chicago. JUMPS will reduce the manual workload associated with pay records.

STATION CLEVELAND HARBOR:

Cleveland Harbor is a station under Group Detroit. A tour of the station disclosed a watchstander on duty who had approximately 4 months of service in the Coast Guard, and was only about a month out of boot camp. This situation was said to be typical of the inexperience of the watchstanders at the stations.

Cleveland Harbor has a heavy recreational boating SAR case load. The peak occurs during the annual air show conducted along Cleveland lake front.

(INTEROFFICE COMMUNICATION)

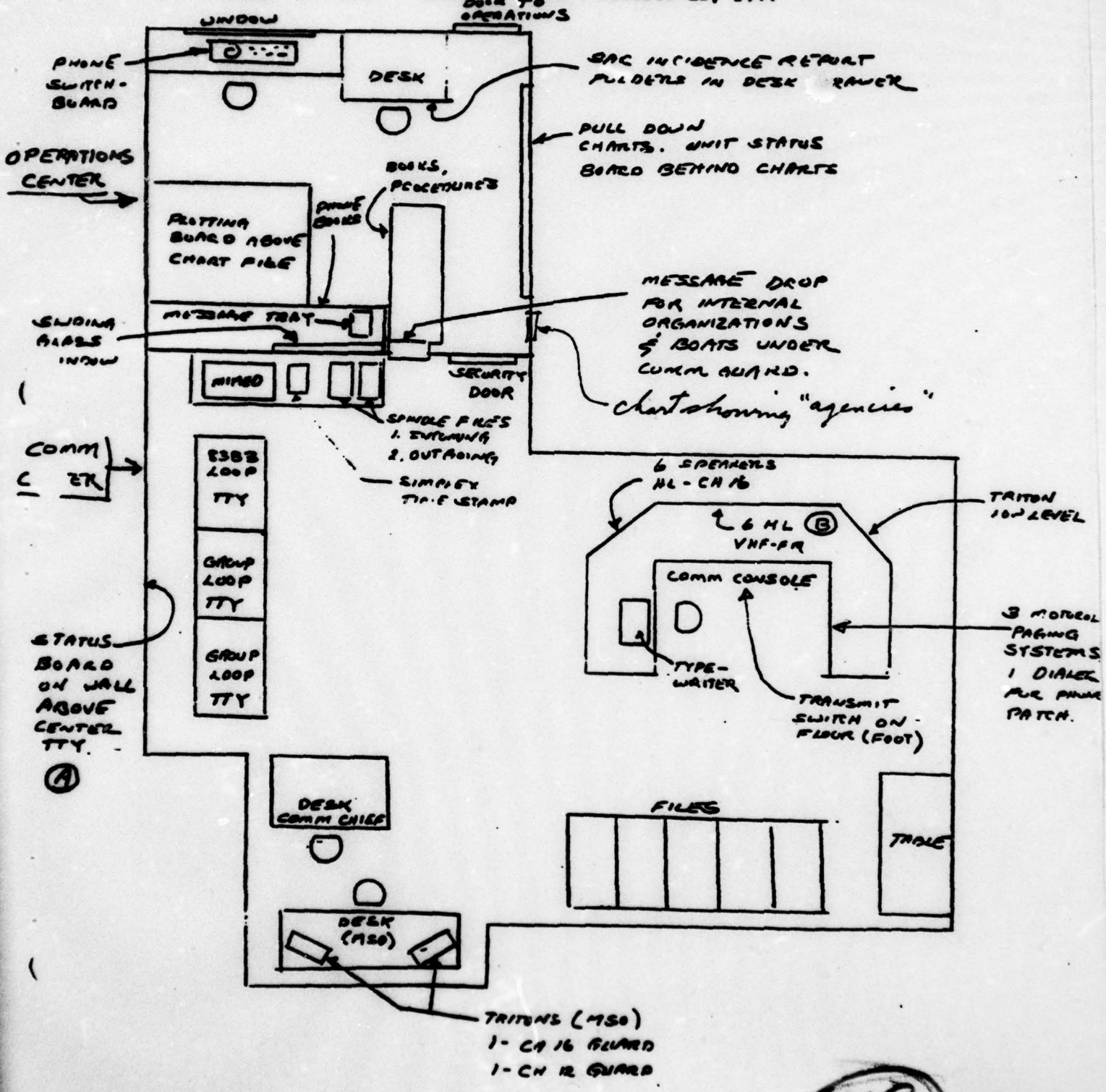
Magnavox

TO: FILE DATE: 19 DECEMBER 1977 FROM: E.L. BATES

COPIES TO: T.P. ELLSWORTH
W.H. SERSTAD
C.B. SMITH

SUBJECT: SUMMARY OF SURVEY OF USCG GROUP DETROIT

DATES OF VISIT - October 17 thru October 21, 1977



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Group Detroit

PERSONNEL:

Capt. R. N. Abrahams	C.O.
Ldr Mike Cook	XO
Ens. Patrick	Operations
BMC Metz	ATON
BMC Guy	Communications
QM1 Mike Norris	Boating Safety

Group/Base Organization chart is in file.

STATIONS IN GROUP DETROIT:

Tawas
Saginaw River
Harbor Beach (seasonal)
Port Huron
St. Clair Flats
St. Clair Shores
Belle Isle
Toledo
Marblehead
Lorain
Cleveland Harbor
Fairport

HIGH LEVEL VHF-FM SITES:

Alpena
Port Austin
Port Huron
Detroit (McNamara Building)
Toledo
Cleveland

Group Detroit is co-located with Base Detroit. An overall organization is maintained, with personnel from each intermingled to fill the positions in the overall organization.

COMMUNICATIONS:

A pictorial of the Operations and Communications Centers is shown on page 1.

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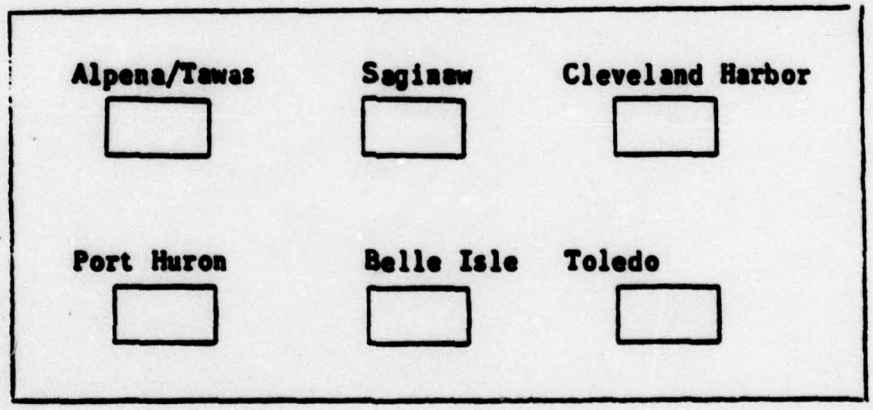
Group Detroit

The status board, identified as (A) on the pictorial contained the following information on the date shown:

JULIAN DATE 290 OCT 17TH 1977 SNED
SHIP/ZKP/STATUS/AREA

MARIPOSA	DR	C	NICHOLSON
KAW	CL	B6	CL
BRAMBLE	PH	B6	PH
MACKINAW	LO	C	LO
44334	BI	A	ENR PH

The Group monitors and has control of 6 High Level (HL) VHF-FM sites. The Motorola control heads for these sites are located on the communications console in the location identified as (B) and are arranged as follows:



The Saginaw site is physically located at Port Austin, and the Belle Isle site is in Detroit.

The group has the capability of complete control over all HL Sites, including channel selection and transmission. Silmultaneous transmission from all six sites is possible, and is used for broadcasting notices to mariners. Group units physically located near the HL sites also have access to the sites.

Group Detroit

The frequencies available for the HL Sites are tabulated in the survey notes of USCGD9, Cleveland.

A radio log is kept in the typewriter at the communications console, and is maintained by the radiomen. When a message is received via VHF-FM, the radio log is replaced in the typewriter by form CG-2655, on which the message is recorded. The message is read back to the source for verification before the communication is terminated.

The Group TTY network is leased from AT&T and consists of two circuits, a northern loop (GT-22272) and a southern loop (GT-22271). The circuits and all equipment are maintained by AT&T. The TTY network is operated as a free net (permission prior to sending message traffic is not required). Exceptions to the free net are ice reports, weather reports, and daily SAR summaries.

No tape cutters exist at the stations, so all messages from that level are composed on-line, hunt and peck. The Group radiomen cut the tape as the message is being received, and then send it back as a verification, and also send it to other stations within the Group as required. The message is put on the 83B3 loop, if required to be sent outside the Group. Much time is spent by the Group radiomen, correcting messages originated at the stations.

Group Detroit comcen also handles all message traffic for the Navy and Marine Reserves and Recruiting Offices in the area.

The message files in the communications center were divided between General Files and Regular Files. The General Files contain all non-operational messages and are maintained for 90 days. The District sends a monthly tabulation of general messages that should be in file. If a message from the tabulation is not found in file, a copy is obtained from District.

Regular files are operational in nature. Most messages are duplicated in the file, with different preamble and data/time codes appearing on each copy. One reproducible copy (mimeo) of the message as received, and one copy of the outgoing message is in file. The file is maintained chronological, by day. Each daily file contains an average of 2 or 3 messages per hour devoted to weather/winds/sea state. A large percentage of the message files contain CASREPS concerning defective equipment, radios, lights, etc. An estimate of total daily message traffic over a 3 month period is recorded in Bill Serstad's notes.

Group Detroit

OPERATIONS (OD SHACK):

The Operations Center contained a telephone switchboard for the base, where all incoming calls were received. The OOD's desk contained a phone with an FTS line dedicated to SAR (Red Phone). Also present was a leased direct line to SARNIA. A Vessel Tracking System (VTS) is maintained by the Canadians at Sarnia. Only the Canadians perform this function on the Great Lakes.

A Visiting Ship Message Log is kept at the communications guard for each ship. These logs were kept in the message drop file (Pictorial, page 1).

The Group assumes SAR Mission Control (SMC) when more than one unit is involved in a case. The District then assums SMC (District RCC) and does the search planning.

Group Detroit maintains a facilities file (cards), but does not maintain a geographical reference file.

A multi-channel tape recorder for recording voice message traffic did not exist at Group Detroit. The general feeling among people interviewed was that a recorder was badly needed.

AIDS TO NAVIGATION:

The ATON function at Group Detroit was a 4 man group, not officially designated as an ANT. The group operates a 46 ft. stern loader and performs scheduled checks, maintenance, and buoy removal before the waters ice for winter. Each time an aid is visited for other than a visual inspection, form CG-4429 (SANDS) is used. Each time vandalism to an aid is discovered, a form letter is issued to the Commandant.

SANDS for aids on the Great Lakes is very poor due to prolonged falsification of the SANDS forms. Currently SANDS contains incorrect serial numbers, and locations due to this falsification. The ATON people desire an accurate file of all of their aids with a history of each aid.

The Mariposa is a buoy tender with a 46-man crew operating on the Great Lakes under District control.

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Group Detroit

STATION BELLE ISLE:

Date of Visit: October 18, 1977

Personnel: BMC Bauchan C.O.

BM1 Pickett X.O.

Belle Isle station has a heavy summer SAR case load, with an area extending to the north into Lake St. Clair and to the south into Lake Erie. Winter activities are primarily vessel monitoring of river traffic and boat maintenance. Inside facilities for boat maintenance were better than average.

The commcen overlooks the river, and the watchstander makes radio contact with all ocean going vessels, gathering information on the vessels, pilot, captain, etc.

A radio log is maintained manually, identifying the time of the event, nature of event, and radio channel used for the communications.

The watchstander has a teletype, without tape cutter, on the northern Group loop. Radio comms consisted of low level VHF-FM and access to the Detroit high level VHF-FM. Channel 16 was monitored on the high level, with much traffic destined for the Detroit Marine Operator.

The station Engineer maintained the boat logs, and extracted information from the logs for the BAMS reports.

STATION TOLEDO:

Date of Visit: October 21, 1977

Personnel: BMC Roman C.O.

Toledo has a heavy summer SAR case load, and assumes comm guard for 4 or 5 ships under Operation Coal Shovel in the winter. Typically these ships are the Woodrush, Sundew, Ojibwa, Mariposa, and KAW.

The buoy tender Mariposa stores the buoys that are removed over winter at Toledo.

The station has a complement of 22 men, including the OINC. Station boats are a 41 ft., 30 ft., and 14 ft., boat and a 16 ft., boat used by MSO and also used for regatta events. The 41 ft. boat has an SPG-57X radar, with a high failure history.

County paramedics from Toledo are taken on medavacs. However, consent from the Flight Surgeon at Airsta Traverse City is required for each medavac.

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Credit cards are issued for each boat and the Govt vehicle. Fuel, oil and certain emergency supplies are purchased on credit card.

Much of the watchstanders activities are answering the telephone and giving weather information to the public.

The commcen has a low level VHF-FM, and access to the Toledo high level VHF-FM, which is located on a TV mast east of Toledo. The console also contained a CDE Direction Finder, which was purchased locally. Station Marblehead is also procuring a DF, and the two stations are planning to triangulate to obtain fixes on boats.

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(125)

(INTEROFFICE COMMUNICATION)

Magnavox

TO: FILE DATE: 12 JANUARY 1978 FROM: E.L. BATES

COPIES TO: T.P. ELLSWORTH
W.H. SERSTAD
C.B. SMITH

SUBJECT: SUMMARY OF SURVEY OF USCG 13th DISTRICT

DATES OF VISIT - November 3 and November 4, 1977.

PERSONNEL:

Capt. Budridge	OSR
Cdr. R.F. Dugan	EEE
Ledr. J.J. Shaw	OSR
Ledr. A.F. Hobson	OL
Lt. W.R. Shaffer	P
Mr. Ted Ruoff	F
Lt. Sprague	OSR
RMC Schuster	Comm
Ledr. Coady	F
Ms. Pat Thomas	ADP
Lt. Auker	B
Cdr. King	B

GROUPS IN 13th DISTRICT:

Seattle
Port Angeles
Astoria
Portland
North Bend

AIR STATIONS IN 13th DISTRICT:

Port Angeles
Astoria
North Bend

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(INTEROFFICE COMMUNICATION) B 701-1

13th DISTRICT

GENERAL NOTES:

District RCC has the typical facilities, plus two Vangard Microfilm Readers and an Acme Visible Electrofile, in which general geographical data is stored on microfiche.

A Geographical Locator published by the US Coast and Geodetic Survey is available to cross reference Indian, French, and Canadian local names and geographical names. Local topographical maps are also used for reference.

The Coast Guard issues the boat registration numbers for the State of Washington. The State of Oregon issues their own.

Each unit assigns consecutive unit case numbers beginning in each fiscal year. Multi-unit case numbers are assigned by the District, and Area case numbers replace the multiunit case number, if the case becomes an Area case. SAR summaries are issued daily, and Assistance Reports are mailed from the unit within 10 days. SAR files are kept in OSR for a period of 5 years.

COMMUNICATIONS:

The commcen handles an estimated 1000 messages per day for a total of approximately 40,000 to 50,000 per quarter. About 50% of these are generated by Group teletypes. A chronological file of all messages is kept for 30 days. A study by commcen personnel indicates that the message traffic has quadrupled in a 3 year period. The commcen also handles the message traffic for Pacific Northwest Outboard, Pier 90, which is the army overseas shipment facility. The various teletype and tape machines in the commcen are as follows:

1. Group teletype loop, excepting Group Astoria, which is on the SARPAC circuit only because Astoria was previously a Radio Station. The Group net is operated as selective call.

2. Teletype net serving Base Seattle, Silshoal (?) Bay Marina, Pier 36 (Group Detroit/ ships), National Oceanographic Administration, KVJ Radio.

3. Teletype dedicated to tape factory.

4. SARPAC net connecting Kodiac, Alaska, Group Astoria, Long Beach, Calif., RCC Victoria, tie line to Hawaii, torn tape to Washington, D.C., SAMLANT, AMVER Center. This machine is also backup for AUTODIN.

5. NOAA Weather. Weather is sent to Group on Group loop twice a day.

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6. Tape only to EPA, Seattle.

7. AUTODIN traffic for all organizations outside the District.

8. Send only to Marine Operators at Seattle, North Bend (days only), Astoria (located in Portland). Machine can be auto-dialed or manual dialed. Notices to mariners are sent on this machine.

COMPTROLLER:

Personnel: Lcdr. Coady
Mr. Ted M. Ruoff
Ms. Pat Thomas

The session was spent in conversation with Mr. Ruoff (F) and Ms. Thomas (Data Processing) with only a brief introduction to Lcdr. Coady (F). Mr. Ruoff is a retired Navy Suppy Chief, who apparently performs as comptroller of the District, with Lcdr. Coady only filling the billet.

Two methods of procurement through the supply system were described. The first method requires the unit to fill out a standard requisition for the initial procurement. Prepunched cards (SURF Cards) are then issued for subsequent procurements of the same items. The units do their ordering direct through the District, bypassing the Group. The second method requires the unit to fill out a Procurement Request, requesting another unit to buy for them. Approximately 6000 SURF Cards per month are processed through the 13th District. The requisitions are received by mail and keypunched at District, and entered into the Headquarters computer via a Data 100 Terminal. The serial numbers of the requisitions are coded to identify the source of the funds for the purchase.

SAR Assistance Reports are mailed to District OSR. They receive a manual review, and are sent to keypunch with a low priority. All accounting and fiscal matters have a higher priority. Because of this priority, and the ADP workload, the SAR Data is generally delayed for 30 to 45 days before inputted to the Headquarters computer.

The Data Processing Section at the 13th District has a staff of 7 permanent people, plus 1 welfare trainee. Two programmers are on the staff, one being Pat Thomas, who has assumed the duties of Acting Branch Chief due to the retirement of the previous Chief. A minimal amount of programming is

done in RPG, COBOL and FORTRAN. The UT-14 Unility is also used somewhat.

Three key batch terminals have been received for integration with the Data 100 Terminal, and will eventually repbace the key-punch machines. Ms. Thomas and one other person were to attend a school on the key batch equipment the week following our visit.

ADP had a large schedule board mounted on one wall, on which monthly work schedules were shown. The following work efforts were shown scheduled for the month of November 1977:

1. Daily Accounting Cycle
2. Milstrip Billing
3. Auxmis Weekly Card Input
4. SANDS Weekly Card Input
5. Auxmis Weekly Reports
6. SANDS Weekly Reports
7. Requisition Status
8. Requisitions
9. Search and Rescue
10. General Ledger
11. 83 Issues
12. Personal Property
13. General Mess
14. SAR Exception File - Monthly
15. SAR Hold File - Monthly
16. Military Pay
17. Motor Pool Edit
18. Auxmis Monthly Reports

AUXMIS:

Personnel: Cdr. King
Lt. Auker

The Auxiliary Management Information System contains the personal and activity data records for the members and units of the Auxiliary. The system is a responsibility of the Office of Boating Safety.

AUXMIS is an automated system involving upwards of 14 input forms and providing several output reports. A copy of the "Auxiliary Member AUXMIS Guide", CG-412-2 was obtained for file.

Auxiliary SAR activities are reported by the Group via the SAR Summary Activity Report.

14% of the overall SAR in the 13th District was performed by the Auxiliary. In Puget Sound, 45% of the SAR was performed by the Auxiliary.

13th DISTRICT

PLANNING:

The Office of Planning in the 13th District is accumulating SAR statistics and presenting the data in various unique manners. To assist in this effort, the following equipment is in use:

1 - HP 9830A Calculator
1 - HP 9806A Printer
1 - HP 9862A Plotter
1 - HP 9865A Cassette Memory
1 - Infotek Systems FD 30A Mass Memory (floppy disc) (On loan)

The data input for these statistics is primarily from SAR Assistance Reports. Individual review of each assistance report is made, and additional interpretation of the data is made, and the data is appropriately altered before entry into memory. Programming effort is done in BASIC.

GROUP/STATION SEATTLE:

Personnel: CWO Rhodes Opns

Group Seattle and Station Seattle are co-located and share communication facilities. The Group commcen had a single teletype, with the 13th District commcen handling the out-going traffic from the Group.

The Group consists of three 82 ft. cutters and one station with 6 men and a 41 ft. boat (Station Bellingham).

The commcen contained a Xerox telecopier, with a dedicated line for the telecopier and phone patch between all group units and Seattle VTS.

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TO: FILE DATE: 12 JANUARY 1978 FROM: E.L. BATES

COPIES TO: T.P. ELLSWORTH
W.H. SERSTAD
C.B. SMITH

SUBJECT: SUMMARY OF SURVEY OF USCG GROUP NORTH BEND

DATES OF VISIT - November 7 thru November 11, 1977

PERSONNEL:

Cdr. Passmore	CO
Lcdr. Minor	Opns
Cdr. Keane	XO
Lt. D.F. Walker	Supply

STATIONS IN GROUP NORTH BEND:

North Bend Air Station (Co-located)
3 - H52's 1362
1446
1426

Chetco River Station, Brookings, OR.
Telephone: 469-3885
Boats: 44305
44335
44311
26143
253304

Rogue River Patrol, Gold Beach, OR.
(Seasonal patrol from Chetco River Station)
Telephone: 247-7249

Coos Bay Station, Charleston, OR.
Telephone: 888-3266
Boats: Intrepid (52 ft)
44399
44361
44408
253303

Coquille River Patrol, Bandon, OR.
(Seasonal patrol from Coos Bay Station)
Telephone: 347-3112

Umpqua River Station, Winchester Bay, OR.
Telephone: 271-2137
Boats: 44303
44331
36498
253307

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Group North Bend

Siuslaw River Station, Florence, OR.
Telephone: 997-3631
Boats: 44394
44401
253306

Yaquina Bay Station, Newport, OR.
Telephone: 265-5381
Boats: Victory (52 ft)
44300
44400
253308

Depoe Bay Station, Depoe Bay, OR.
Telephone: 765-2123
Boats: 44407
44373

Loran Station Cape Blanco, Sixes, OR.

Electronic Shop, ESMT, Empire, OR.

ANT Coos Bay, Charleston, OR.

Loran Monitor Station, North Bend, OR. (At Air Station)

HIGH LEVEL VHF-FM SITES:

Yaquina Head
Heceta Head
Seven Devils
Port Oxford
Cape Sebastian

Group North Bend is co-located with Air Station North Bend. Therefore, the organization is heavy in officer ranks. The aviators are given Group duties. In general, the Group is organized better, with better facilities than other groups surveyed.

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OPERATIONS:

The OOD console contains the telephone switchboard. Much of the OOD's time is spent answering incoming calls and paging personnel in the facility. The OOD also has a UHF aircraft band transciever, but no marine band VHF-FM. Similarly, the commcen has marine band transcievers but no aircraft band equipment. Coordinating SAR missions involving both aircraft and boats necessitates that the watchstander and OOD each man their stations, and communicate with each other through a window in the wall between the two rooms. This is only a minor inconvenience, and does offer the advantage of having the aircraft communicator isolated from the large volume of Channel 16 traffic.

In addition to the above, the OOD console also contains two telephones, SARTEL and Dial-up.

The operations room is common for the Group and Airsta, to the following information was maintained in the room for flight planning:

1. Klamath Falls Sectional Chart
2. Seattle Sectional Chart
3. WAC Charts, CF-16 and CG-18
4. VFR Terminal Area Charts
5. IFR Chart L1/L2
6. Approach Plates - Vols. 1/2, 3-9
7. AP/1B Charts (Area Planning)
8. Oregon State Highway Maps
9. DD 365F Charts
10. VFR/IFR Supplements
11. US Man. (Low Altitude Instrument Approach Procedure)
12. SID's (Standard Instrument Departure)
13. IFR Charts - Complete
14. VFR Charts - Complete

Also located in the room is a teletype (receive only) on the NOAA Weather network.

AVIATION ENGINEERING:

Aircraft maintenance has been scheduled and controlled through CAMP (Computerized Aircraft Maintenance Program). Beginning in late 1977 the service is contracted with the following organization:

CAMP Systems Incorporated
Hanger A
ISLIP - MacArthur Airport
Ronkonkoma, New York 11779
Telephone: (516) 588-3200
TELEX: 14-4577 CAMPSYS RKNK
Tony Costa, President
Stephan Brodsky, Aircraft Maintenance Analyst

The CMS Program is a very extensive, well planned program being conducted by aircraft and computer specialists. As such, the program has a chance of success. Prior to contracting with CAMP, a similar program was contracted with Technology, Inc., Dayton, Ohio, who rented computer time from Ohio State University. This program was not successful because the personnel involved were primarily computer specialists with very little aircraft knowledge.

A copy of the following manual was obtained for the file:

COMPUTERIZED AIRCRAFT MAINTENANCE PROGRAM, Interim Instruction Manual for the U.S. Coast Guard HH-52A, Computerized Maintenance System.

STATION COOS BAY:

Date of Visit: November 8, 1977

Personnel:

BMC White CO

The commcen at Coos Bay Station has a Code-A-Phone for weather and bar information. The Code-A-Phone is on a published phone number for access by the public.

Coos Bay Station continuously mans a lookout tower overlooking the Coos Bay bar. The tower is equipped with binoculars and telescopes, a low level VHF-FM and telephone. The tower watchstander reports bar information, weather, etc. every 3 hours to the station watchstander, over land line. The station passes this information to Group via teletype. The tower watchstander also visually logs every vessel in and out of the bar.

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STATION UMPQUA RIVER:

Date of Visit: November 10, 1977

Personnel:

BMC Haigh CO

Umpqua River Station is located on Salmon Harbor, one of the largest pleasure craft harbors on the west coast. An average of 230 boats leave the harbor each day, with as many as 500 boats reported through the bar in a day. The primary recreational activity is salmon fishing. Most boats are logged outbound through the bar from 6 to 9 AM, with most returning at noon, and back out in the afternoon. A lookout tower is maintained overlooking the bar, and in the afternoon and evening a 44 ft bar patrol is generally maintained until the boats are logged back through the bar.

The station conducts approximately 300 cases per year, mostly tows. The biggest day was 12 cases.

The station has no access to a high level, performing with only a low level VHF-FM.

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TO: FILE DATE: 18 JANUARY 1978 FROM: E.L. BATES

COPIES TO: T.P. ELLSWORTH
W.H. SEGSTAD
C.B. SMITH

SUBJECT: SUMMARY OF SURVEY OF USCG 1st DISTRICT

Dates of Visit - November 21 and November 22, 1977

Personnel:

Capt. B.A. Hoyland	OSR
Ldr Carroll	OSR
RMC Burns	Comms
Mr. Desisto	ADP
Ldr Marotta	MEP

Groups in 1st District:

Woods Hole
Boston
Southwest Harbor
Portland

Air Station in 1st District:

Cape Cod

General Notes:

District RCC had an Oliveti Underwood Programma 101 with programs for search planning. The individual familiar with the machine was not available, so no information was obtained. The following address was contained on the machine:

Olivetti Underwood
Programma Specialist
122 E. 23rd St.
N.Y., N.Y. 10010
Sales: 677-5200

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The commcen has a DBA Systems, Inc., MHG5400A Message Header Generator, which was unique from the other districts that were surveyed. Message headers were stored in the machine and canned headers were cut on AUTODIN tapes with the machine.

Data Processing possessed the usual Datt 100 Terminal, and is in process of installing Key Batch Terminals to replace key punches. The Data 100's were obtained on a lease-purchase agreement with Headquarters funds. There is no cost to the district. There are no programmers at District ADP, but some local programming in COBOL is done by the staff on an overtime basis. All keypunching is done in the office, with overtime being used to eleminate the necessity of contracting.

District MEP had a TYMSHARE Terminal, with access to the TYMSHARE computer at Cupertino, Calif. Three different people attempted to demonstrate the terminal with no success, due to lack of operator knowledge. The supply of paper for the terminal was exhausted and success was never achieved. MSO, located at Base Boston was said to have better use of the terminal.

GROUP BOSTON:

Date of Visit - November 22, 1977

Personnel:

Capt.	R.R. Houvener	CO
CWO	R.C. Collins	Opns
CWO	M.R. Caster	F & S

The following SAR case loads were defined for the stations within the Group:

Station	Fiscal 1976 7-1-75 to 7-1-76	7-1-76 to 10-1-76	Fiscal 1977 10-1-76 to 10-1-77
Merrimac River	420	208	422
Pt. Allerton	963	501	1044
Scituate	446	270	412
Gloucester	462	199	444
Boston	430	269	560

A detailed review of the Pt. Allerton file showed that the largest percentage of the cases were tows due to engine failure and fuel exhaustion.

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Magnavox

TO: FILE DATE: 19 JANUARY 1978 FROM: E.L. BATES

COPIES TO: T.P. ELLSWORTH
W.H. SEMSTAD
C.B. SMITH

SUBJECT: SUMMARY OF SURVEY OF GROUP WOODS HOLE

Dates of Visit - November 28 thru December 2, 1977

Personnel:

Cdr. Josephs	Deputy CO
CWO Pulcifer	Electronics
RM1 R.L. Smith	Comms
CWO Partridge	Personnel
(?) Chief Davis	Operations
BMC McManus	ANT

Stations in Group Woods Hole:

Race Point
Chatham
Brant Point
Menemsha
Castle Hill
Block Island
Cape Cod Canal
Point Judith

High Level VHF-FM Sites:

Newport Bridge
Nobsha Point
Nantucket
Provincetown

General Notes:

Woods Hole has an Industrial complex with a 29 person complement, all civilian.

Station Chatham has 2 ET's assigned, and Station Castle Hill has 3 ET's assigned.

The previous SAR season was not as busy as previous ones, contributed by Group communications personnel to the following three factors:

1. Many people suffered financial hardship over the previous winter, contributing to less boating in the summer.

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2. The Group had a split TTY loop, resulting in more rapid message handling.

3. The Group incorporated an abbreviated SITREP for certain cases, resulting in more rapid message handling.

Tape cutters were only in use at Group comms and Castle Hill Station. Additional tape cutting facilities are scheduled to be installed in the future.

Race Point is scheduled to get a new station in 1½ year.

Woods Hole is building a new commcen and opsen. When complete, Group RM will control all High Level sites.

The new radio console contains a Magnasync/Moviola Insta-Call Cassette player/recorder for recording and instantaneous playback of radio messages and traffic.

Following is a list of high level sites in the 1st District:

1. Newport Bridge, Site 180
2. Woods Hole (Nobska Point), Site 181
3. LG Consolan Tower (Nantucket), Site 182
4. Pilgrim Monument (Provincetown), Site 183
5. Boston Building, Site 184
6. Eastern Pt.
7. Mt. Agamenticus (York), Site 185
8. Mt. Independence (WHE 33), Site 186A
9. MCB82 Tower (Brunswick), Site 186
10. Owls Head, Site 187
11. Mt. Cadalluc, Site 188
12. West Quoddy Head, Site 189

ANT WOODS HOLE:

Personnel:

BMC McManus

ANT Woods Hole has a billet of 8 men, but the Group CO has given them 2 extra men, for a working complement of 10. The increased personnel requirement is justified by the following boat crew requirements:

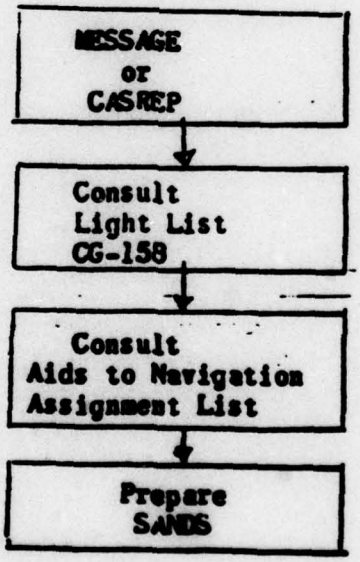
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ANT BOATS	CREW
55 ft.	4
45 ft.	4
21 ft.	
16 ft.	3 desired (2 min.)
Truck	(2)
	8-10 men. also occupied in office

There are 662 navigation aids in the surrounding area, 280 aids the direct responsibility of ANT W/H. The aids are categorized as follows:

QUANTITY	TYPE or RESPONSIBILITY
77	Bittersweet
154	White Sage
13	White Heath
81	Minor lights & day beacons
15	Lighted buoys
282	Unlighted buoys

Working an aid usually begins in the following manner:



The ANT boats do not have Loran. Aids are placed to an accuracy of 35 to 50 ft. by use of a sextant. The Tide Book is referenced for computing drifts, etc.

A typical ANT work day was cited as similar to November 29, 1977 (The day prior to our interview) when the ANT boats performed the following activities:

Boat	Buoys Worked	Sextant Angles Shot
55 ft.	8	16 to 20
45 ft.	9 to 11	18 to 27
21 ft.	(C Status)	
16 ft.	(Short range - not used)	

The personnel from ANT Woods Hole often spend summer week ends working on modular towers and light houses. Complete remodeling is undertaken, such as reroofing, installing new doors, painting, etc.

Chief McManus expressed the need for a course computer for aiding the placement of buoys. The course computer would perform the computations involving boat movement from a buoy location sextant shot to a desired new sextant shot.

CAPE COD CANAL STATION:

Date of Visit - December 1, 1977

The station had 28 persons aboard, against a billet of 27. Four persons were women, 2 of whom were coxswain trainees. A drastic turnover in personnel was experienced, with nearly complete turnover in the last year.

The watchstander duty is performed by 2nd class and below rated personnel.

Two 1st class rated people were aboard (one awaiting transfer). About 75% of the 1st class's time is spent on paper work.

Approximately 20 to 25 SAR cases per year involve bridge jumpers.

The Comco 911 VHF-FM transceiver was categorized as having a high failure rate.

Group Woods Hole

CASTLE HILL STATION:

Date of Visit - December 2, 1977

Personnel:

CWO3 William C. Brizendine CO
ET2 Barbe

The station has 31 men assigned. 607 SAR cases were handled last year.

The Castle Hill High Level amplifier and antenna is located atop the Newport Bridge, with land line control from the station.

Personnel rated 3rd class and below are assigned watchstander duty. During off season, the watchstander performs 8 hour watches.

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Magnavox

TO: FILE DATE: 19 JANUARY 1978 FROM: E.L. BATES

COPIES TO: T.P. ELLSWORTH
W.H. SEMSTAD
C.B. SMITH

SUBJECT: SUMMARY OF SURVEY OF USCG 7th DISTRICT

Dates of Visit - December 8 and December 9, 1977

Personnel:

Cdr. Russell	OSR
Cdr. Murtagh	F

Groups in 7th District:

Miami
St. Petersburg
Key West
Mayport
Charleston

Air Stations in 7th District:

Miami
Borinquen
Savannah
St. Petersburg

COMPTROLLER:

SAR Assistance Reports are inputted to the Headquarters computer weekly. Due to the heavy keypunch activity, some keypunching is contracted.

The NEW SANDS will create an estimated 450% increase in keypunching over the existing SANDS system. (Estimated by 7th District ADP).

Commissary Reports are described in Volume 4, Comptroller Manual, CG-264. Jupiter Loran Sta conducts over $1 million in exchange business per year, mostly to retired servicemen living along that area of the coast.

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7th District

District 7 ADP personnel feel that the true benefit of a terminal at the station or group level could come from a tie in to District, bypassing the keypunch operation.

GROUP MIAMI:

Date of Visit - December 9, 1977

Personnel:

Lt. Ashforth
BMC Landgraff

General Notes:

Miami has a new commcen in the planning stage.

Miami is unique in organization, having a Group and Base with SAR mission, but does not have a Station. The Base has the mission responsibilities of a Station, but not the organization identification.

STATION FORT LAUDERDALE:

Date of Visit - December 9, 1977

Personnel:

Lt. Cashdollar OINC

General Notes:

Fort Lauderdale has the best facilities of any station that was surveyed. The station also is the only one surveyed that has a commissioned officer as OINC.

The commcen/opcen contained SAR Kits for each boat and vehicle. Each kit contained credit cards, supplies, equipment, forms, charts, abbreviated regulations, etc., required in the performance of a mission by the boat or vehicle. Prior to the launch of each boat, the coxswain grabs his SAR Kit on the way to the boat, in the manner that a doctor grabs his bag.

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7th District

The 41 ft boats in the 7th District are now required to cover missions to 125 miles off shore. The boats are equipped with their comm equipment, radar and compass for navigation. No other navigational equipment is aboard, and searches are difficult to conduct with accuracy.

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(INTEROFFICE COMMUNICATION)

Magnavox

TO: FILE

DATE: 19 JANUARY 1978

FROM: E.L. BATES

COPIES TO: T.P. ELLSWORTH
W.H. SEASTAD
C.B. SMITH

SUBJECT: SUMMARY OF SURVEY OF USCG GROUP ST. PETERSBURG

Dates of Visit - December 12 through December 15, 1977

Personnel:

Lt. R.B. Vanasse	Deputy CO
RMC Williams	Comms
QMC Boyles	Opns

Stations in Group St. Petersburg:

Station	Boats
Yankeetown	40ft, 20 ft, 17 ft
Clearwater	40, 17, 41
St. Petersburg	30, 40, 16, 30
Cortez	41, 40, 17
Ft. Meyers	42, 30, 17

High Level VHF-FM Sites:

Steinhatchee
Crystal River
Tarpon Springs
Seminole
Venice
Naples

General Notes:

REACT monitors CB Channel 9 and reports SAR Cases to the Coast Guard. An estimated 90% of the CB cases turn out to be complete hoaxes.

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Group St. Petersburg

Group St. Petersburg is co-located with Station St. Petersburg. The Group Deputy CO is the Station OINC.

Much of the intercoastal waterway is not covered by radio communications due to the directional characteristics on the high level VHF-FM antennas.

STATION CLEARWATER:

Date of Visit - December 14, 1977

Personnel:

BMC Hogan OINC

Station Clearwater has about 700 SAR cases per year. The station is in the 4th year, operating from a house boat moored off the Clearwater Beach causeway on the inland side of Clearwater Beach.

There are approximately 50,000 boats registered in Pinellas County. Florida is the 6th in boat registration and 1st in property damage. 60 people were killed in the State in boating accidents last year.

The station has a Triton low level transceiver only, with no access to high level. The station is to be put on the Seminole high level eventually. Station commcen monitors 2182 HF only, but does not transmit. The 41 ft boat can transmit on HF.

The station has 21 men. A new station is to be opened on Sand Key in Fiscal 1979. The house boat will be moved to Sand Key in fiscal 1979 and a new structure will be built in fiscal 1980.

The station has a $3500 per quarter budget, excluding heat which is paid by the District and 10,000 gal/quarter of fuel paid by the District.

The boat log is usually entered by the watchstander.

The commissary report generally is about 2 days effort by the cook. Three-fourth of a day is spent by the Opns Exec. Petty Off. with SAR files (editing assistance reports, etc.)

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Group St. Petersburg

The station has dial-up phone and TTY comms with the Group.

Several holes in VHF-FM comms with the boats occurs at near ranges in the intercoastal waterway.

STATION CORTEZ:

Date of Visit - December 15, 1977

Personnel:

BMC R.J. Lloyd OINC

The station was commissioned in April 1976 in a building that was constructed in 1890. The facilities were remodeled by station personnel. There are 18 people on board with 3 boats. The XO is a woman, who recently married the cook.

525 SAR cases were handles last year. Between 800-1000 cases are predicted for 1978 with an anticipated 21 people and 3 boats.

Comms is by a 25 W. Triton low level. The station is to be put on the Venice high level eventually.

Cortez is on the Group TTY loop, with no tape reperforater. The station would like TTY comms with other group units without having to output on the group machine, which is now impossible.

Chief Lloyd is insistent upon the stations necessity to maintain local communications with the public and with their boats. He feels that only the Station OINC knows the personality and peculiarities of his coxswain, and only the OINC can properly interpret his communications.

The following communications lineup exists in the Station boats:

BOAT	COMMS	EQUIPMENT (VHF)
41 ft	VHF-FM + HF	Triton + Guard for VHF
40	VHF-FM + HF	Comco 911
17	VHF-FM	Triton (no guard)

The station does not monitor 2182.

A review of message files gave the following information:

During September 1977 there were 19 messages from ANT St. Petersburg and 7 messages sent to ANT St. Petersburg consisting of ATON discrepancies, ATON discrepancy temporary corrections, and ATON discrepancy corrections.

During October 1977 there were 92 SAR cases resulting in approximately 150 messages sent and 100 messages received.

The biggest case load are groundings, with disabled boats being second.

ST. PETERSBURG AIR STATION:

Date of Visit - December 13, 1977

St. Petersburg Air Station is not a Group unit, but is a unit of the District. However, the station was visited during the week of the Group visit.

Personnel:

(?) Chief Ray Vandal		Avionics
Mr. T.J. Christiano	(not present)	Avionics

A C-130 from St. Pete was in Cleveland on SLAR mission for the winter.

The TTY operators position of the C-130 was inspected. The position contained an ASR-32 (BAUDOT) Teletype, CV-1053/ARC modem (P/O ARC-94 HF Transceiver) and ARR-41 Receiver (back-up HF). The aircraft has dual ARC-94's, with HF radio No. 2 used for RTTY.

The area occupied by the ASR-32 was measured to be as follows:

Depth	24"
Width	22½" clear
Height	14½" overall, 13½" under cables
Shelf in front:	19" x 23"

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Group St. Petersburg

ASR-32 Transmission codes:

5 level start-stop signals with 7.5 unit transmission pattern.

ASR-32 Electrical Characteristics (from Teletype Corp. Bulletin 273B):

Signal line current 20 or 60 ma
Nominal input to selector 0.5 amp at 20 VDC
Operating Margins - all signal contacts and distributor:
Long telegraph loops 15 to 70 ma at 48 to 240 VDC inductive
Short telegraph loops 58 to 72 ma at 16 to 22 VDC resistive
ASR-32 speeds:
100 wpm (words per min), 600 opm (operations per min) from tape.

The C-130 contains a Loran receiver, and a copy of the following manual was obtained for file:

Loran C/D Type ADL-81, Background Notes and Operating Instructions, Navigation Systems, Inc.

The C-130 contains an LTN-72R inertial navigator with 3 standard USCG search patterns mechanized as follows:

1. Ladder (creeping line)
2. Sector
3. Square (expanding square)

The following manual (not obtained) describes the INS:

IP72R-02, Operators Guide for United States Coast Guard C-130 Aircraft, Inertial Navigation System With Standard Search Patterns, May 1977, Litton Aero Products, Woodland Hills, Calif.

The following manual describes the HF radio in the C-130:

NAVAIR 16-30ARC94-1, HSI, Radio Sets ARC-94, ARC-129, ARC-120, 1 Jan 66.

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APPENDIX C

TABULATION OF RESPONSES TO COMMUNICATIONS TRAFFIC QUESTIONNAIRES AND TABS SENT TO GROUP OFFICES AND STATIONS

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Magnavox
GOVERNMENT & INDUSTRIAL ELECTRONICS COMPANY
1313 PRODUCTION ROAD • FORT WAYNE, INDIANA 46808 • 219-482-4411
Cable Address Magnavox Telex 023-2442 TWX 810-332-1503

19 April 1978

Commander
U.S. Coast Guard Group Woods Hole
Woods Hole, MA 02543

Dear Sir:

As you remember, the Magnavox Communications Study Team visited your Group late last year during the survey portion of a study contract funded by U.S. Coast Guard Headquarters.

We are now attempting to broaden this information base for this study. We are asking for your help in doing so.

We saw your Group in operation during a non-peak SAR load period. We are interested in learning more about your information flow density when the associated tasks most heavily tax your manpower and equipment. Of particular interest in this study is the Group Radioman's job. We recognize that the utilization of the Radioman's time must be highly adaptive to the situation, and that it is difficult to define his job in terms of specific tasks to be performed.

We are nevertheless attempting to analyze the radioman's job from the standpoint of the kinds of things he would be expected to do during a busy SAR weekend day. With this in mind, would you please fill out the enclosed TAB and answer the questions set forth. We would also appreciate receiving any comments regarding relevant information not covered in the TAB and Questionnaire, and which you feel is important in describing the job of the Group Radioman.

We have enclosed station letters and questionnaires for the stations that we visited in your group, and these should be forwarded to the OIC at these stations.

The information received from this Questionnaire will be combined with the information received from the other USCG stations that were visited during the survey. Thus, we do not intend to specifically identify the source of data

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OVER SIXTY YEARS OF CREATIVE ELECTRONICS

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from a particular station in our analysis. Sometime during the next week or so would you give this your attention. We appreciate your cooperation, and we believe the information supplied will be very valuable as an input to the Control and Communication Study for the USCG.

Thank you,

MAGNAVOX GOVERNMENT & INDUSTRIAL
ELECTRONICS COMPANY

T. P. Ellsworth
Study Program Manager

Encls: (a) Communications Questionnaire (Group)
(b) Group TAB (Radioman)
(c) Letter and Enclosures to Station Cape Cod Canal
(d) Letter and Enclosure to Station Castle Hill

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COMMUNICATIONS QUESTIONNAIRE - GROUP WOODS HOLE

1. Radioman's Workload

   a. Are there times when the radioman becomes so overwhelmed that he falls behind in handling his job?

   _____

   b. If so, what results from this delay?

   _____

   _____

   _____

   c. What do you feel are the most significant problems in operation of pony loop(s)?

   _____

   _____

   _____

   _____

   _____

   d. Please list all facilities for which you maintain communications guard or monitoring tasks (including non-USCG entities).

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

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2. Traffic Estimates

Please estimate the percentage of the total TTY message traffic generated by:

a. Group Office Function:

b. Co-located Industrial Base:

c. Co-located Lifeboat Station:

d. Other Communications Guards such as those listed in Para. 1-d:

_____ _____%

_____ _____%

_____ _____%

_____ _____%

_____ _____%

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GROUP TAB

(Radioman)

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
RADIO				
Distress Channel (Ch. 16)				
Distress Channel (Other, specify)				
Working Frequency (Primary)				
Working Frequency (Other)				
Intercommunications				
Broadcasts Required (Ch 16, 22)				
Broadcasts Required (Other channels)				
TTY - DISTRICT LOOP				
Receive and Transmit in Relay				
Originate Message				
Receive Message (no relay)				
Informal "Conversation"				
TTY - PONY LOOP				
Receive and Transmit in Relay				
Originate Message				
Receive Message (no relay)				
INFO ROUTING AND REPRODUCING MESSAGES				

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GROUP TAB

(Radioman)

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
LOOK UP OF INFORMATION IN REFERENCES (Phone books, status boards, instructions, etc.)				
PERSONAL TIME FOR CHOW, HEAD CALLS, ETC.				
OTHER TASKS (Specify and comment)				

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Magnavox
GOVERNMENT & INDUSTRIAL ELECTRONICS COMPANY
1313 PRODUCTION ROAD • FORT WAYNE, INDIANA 46808 • 219-482-4411
Cable Address: Magnavox Telex 023-2442 TWX 810-332-1503

19 April 1978

Officer in Charge
Station Cape Cod Canal

Dear Sir:

As you remember, the Magnavox Communications Study Team visited your station late last year during the survey portion of a study contract funded by U.S. Coast Guard Headquarters.

We are now attempting to broaden the information base for this study. We solicit your help.

We visited your station during a non-peak SAR period. For the purpose of our study, we are interested in learning more about communications during the peak SAR season, when the associated tasks most heavily burden the station's available manpower, equipment and facilities. Of particular interest in this regard is the communications watchstander's job. We recognize that the job of the watchstander cannot be isolated from the operation of the rest of the station, and that his ultimate purpose is to help the Officer in Charge to effectively carry out the mission of his station. We are also aware that the utilization of the watchstander's time must be highly adaptive to the situation, so that it is not possible to specify an objective definition of his job in terms of specific tasks to be performed.

We are nevertheless attempting to analyze the Group and Station Watchstanders' jobs from the standpoint of the kinds of things that each of these men would be expected to do during a busy SAR weekend day. A special TAB form and Questionnaire form has been prepared for each of the stations visited by the Survey Team. The data submitted should represent an estimate of the workload of the busiest weekend during the 1977 SAR season.

The information received from this Questionnaire will be combined with the information received from the other USCG stations that were visited during the survey. Thus, we do not intend to specifically identify the source of data

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OVER SIXTY YEARS OF ... (illegible)

from a particular station in our analysis. Sometime during the next week or so would you give this your attention. We appreciate your cooperation, and we believe the information supplied will be very valuable as an input to the Control and Communication Study for the USCG.

Thank you,

MAGNAVOX GOVERNMENT & INDUSTRIAL
ELECTRONICS COMPANY

T. P. Ellsworth
Study Program Manager

Encls: (a) Communications Questionnaire (Station)
(b) Station TAB (pp 1&2)

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QUESTIONS - STATION WATCHSTANDER

1. Watchstander's Workload
   a. Are there times when the watchstander becomes so overwhelmed that he falls behind in handling his job?
   b. What happens then?
2. Watchstander Qualifications
   a. Are there any unique training or qualification procedures used to establish the watchstanding function at your station?
   b. Is turnover of personnel a serious problem in manning the watchstander's position?
3. Watchstander's Schedule
   a. During peak SAR season, what is the typical watch schedule for a watchstander?
   b. What is his typical work week (hours) during the peak SAR season?

STATION TAB

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Radio				
Distress Channel (Ch 16)				
Distress Channel (Other, specify)				
Working Frequency (Primary)				
Working Frequency (Other)				
Intercommunications				
Broadcasts Required, if any				
TTY				
Msg. Originating on Pony Loop				
Msg. Received on Pony Loop				
Informal "Conversations" on TTY				
Phone				
Wx Requests from Public				
Other Non-distress Calls from Public				
Public Reporting Possible Distress				
To & From Other CG Facilities				
Originated				
Received				
Station Phone for Other Purposes (personal calls for personnel, etc.)				

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STATION TAB

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Look up of Information in References (Phone books, status boards, instructions, etc.)				
Weather Monitoring Required at Station				
Personal Time for Chow, Head Calls, etc.				
Other Tasks (Specify and comment)				

RESPONSES TO GROUP COMMUNICATIONS QUESTIONNAIRE

1. Radioman's Workload

   a. Are there times when the radioman becomes so overwhelmed that he falls behind in handling his job?

   "YES"

   "AFFIRMATIVE"

   "Yes, on multiple SAR cases"

   "During SAR season, sometimes SAR interferes with handling teletype traffic and may fall behind in relaying traffic and also time during the winter if something as the winter before last when buoys were pushed off CP by ice the amount of traffic being sent tripled compared to a normal winter. So all in all it depends on circumstances as to the RM falling behind."

   "Yes - occurs 90% of time during day & eve watches."

   "Yes there are times when radio TFC is too heavy to handle MSG TFC."

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b. If so, what results from this delay?

"A heavy backlog of message traffic and a tendency to make far more mistakes due to having to work faster to catch up."

"Message traffic backlog - sending/receiving, message routing backlog, thus general backup in all other associated/assigned tasks and duties."

"Backlog in P and above MSG traffic".

"Backlog in teletype traffic; neglect of other RM duties and RM fatigue."

"Mental strain and fatigue which results in lower efficienty - slower responses to radio calls."

"Messages have to wait to be typed up. messages have to wait to be routed; in general things have to wait till radio traffic slows down."

c. What do you feel are the most significant problems in operation of pony loop(s)?

"Pony loops in themselves are not a problem. The problem is non-radioman (unqualified) type personnel on these circuits. This problem requires the special attention of the group radiomen. As these circuits have no tape cutting capabilities, all messages must be retyped, put in proper format and all typing errors corrected prior to further delivery by the group radiomen. All messages not in the prescribed format must be refered back to the appropriate station with instructions where to find the prescribed format; this is the problem with the pony loops."

"Circuit outages - due to age and type of installation of some equipment: non-communications personnel at stations other than Group Office."

"The major problem is constant hassle from all the STA OOD's and watchstanders about correcting MSG format and spelling."

"The times I had the opportunity to work it in split mode I found no problems, still there are times we still fall behind in traffic due to station watchstander's inability to type."

"Delay in reception of incoming traffic due to unskilled operators at the station level. The forementioned operators delay message delivery due to slowness in rogering."

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2. Traffic Estimates

Please estimate the percentage of the total TTY message traffic generated by:

a. Group Office Function: 4%

b. Co-located Industrial Base: 4%

c. Other Communications Guards such as those listed in Para. 1-d.

COAST GUARD PONY LOOP STATIONS:	85%
COAST GUARD SHIPS:	5%
NAVY & MARINE CORPS COMMANDS:	2%

a. Group Office Function: 25%

b. Co-located Air Station: 15%

c. Other Communications Guards such as those listed in Para. 1-d:

ALL OTHER UNITS COMBINED:	60%

a. Group Office Function: 10%

b. Co-located Industrial Base: 5%

c. Co-located Lifeboat Station 70%

d. Other Communications Guards such as those listed in Para. 1-d:

POINTS/CAPES	5%
ANTS (MH/BRISTOL)	4%
TOWLINE	1%
LTSTA'S	1%
WHITE SAGE	4%
GROUP OFFICE	15%
CO-LOCATED LIFE BOAT STA'S	80%
OTHER	5%

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KC

GROUP TAB

(Radioman)

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
RADIO	10	33	40	07
Distress Channel (Ch. 16)	0	0	0	0
Distress Channel (Other, specify)	0	66	30	14
Working Frequency (Primary)	2	10	6	02
Working Frequency (Other)	15	25	300	20
Intercommunications	15	25	112	09
Broadcasts Required (Ch 16, 22)	0	0	0	0
Broadcasts Required (Other channels)				
TTY - DISTRICT LOOP				
Receive and Transmit in Relay	20	90	350	70
Originate Message	4	25	15	05
Receive Message (no relay)	2	10	10	03
Informal "Conversation"	1	02	4	01
TTY - PONY LOOP				
Receive and Transmit in Relay	20	90	350	70
Originate Message	2	10	5	02
Receive Message (no relay)	12	30	77	20
INFO ROUTING AND REPRODUCING MESSAGES				
26 Messages x 7 copies =	182	25	-	-
379 Messages x 7 copies =	-	-	2,653	25

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GROUP TAB

(Radioman)

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
LOOK UP OF INFORMATION IN REFERENCES (Phone books, status boards, instructions, etc.)	10	10	50	05
PERSONAL TIME FOR CHOW, HEAD CALLS, ETC.	0	0	3	1
OTHER TASKS (Specify and comment)				
MAKING RADIO LOG ENTRIES (BCST/SAR/ETC)	15	15	110	10
CHECKING TTY TRAFFIC FOR CORRECTNESS ONCE IT IS DELIVERED & ROUTED	20	05	350	15
* NOTIFYING ACTION ADDRESSEES BY TELEPHONE ONE PRIORITY AND ABOVE TRAFFIC	4	3	20	2
* HANDLING TRAFFIC BY TELEPHONE & FACSIMILE TELECOPIER	3	2	6	1

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GROUP TAB

(Radioman)

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
RADIO	50	60	150	80
Distress Channel (Ch. 16)	50	60	150	80
Distress Channel (Other, specify) 2182	10	30	50	50
Working Frequency (Primary)	50	60	200	80
Working Frequency (Other) 22/12/83	30	40	100	60
Intercommunications	5	20	20	50
Broadcasts Required (Ch 16, 22)	1	5	2	10
Broadcasts Required (Other channels)				
TTY - DISTRICT LOOP				
Receive and Transmit in Relay	20	40	50	70
Originate Message	10	20	20	40
Receive Message (no relay)	10	20	30	30
Informal "Conversation"	1	--	2	--
TTY - PONY LOOP				
Receive and Transmit in Relay	50	60	100	80
Originate Message	10	20	30	40
Receive Message (no relay)	15	30	30	40
INFO ROUTING AND REPRODUCING MESSAGES	130	50	300	80

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GROUP TAB

(Radioman)

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
LOOK UP OF INFORMATION IN REFERENCES (Phone books, status boards, instructions, etc.)	5	5	15	10
PERSONAL TIME FOR CHOW, HEAD CALLS, ETC.	0	0	0	0
OTHER TASKS (Specify and comment) Cleanup/wake ups/pub checks/ Checking/RC/pub corr/			1 1 1 1	5 5 5 5

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GROUP TAB

(Radioman)

		Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
RADIO					
Distress Channel (Ch. 16)		4	100%	12	25%
Distress Channel (Other, specify)	2182	1	50%	2	5%
Working Frequency (Primary)	157.05	16	40%	256	60%
Working Frequency (Other)	157.1	10	20%	100	30%
Intercommunications		5	15%	40	30%
Broadcasts Required (Ch 16, 22)		5	1%	5	3%
Broadcasts Required (Other channels)		0	0	0	0
TTY - DISTRICT LOOP					
Receive and Transmit in Relay		20	90%	200	70%
Originate Message		7	100%	20	30%
Receive Message (no relay)		4	10%	20	4%
Informal "Conversation"		1	1%	2	1%
TTY - PONY LOOP					
Receive and Transmit in Relay		20	100%	100	75%
Originate Message		15	100%	70	60%
Receive Message (no relay)		10	100%	40	30%
INFO ROUTING AND REPRODUCING MESSAGES		80	90%	180	40%

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171

GROUP TAB

(Radioman)

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
LOOK UP OF INFORMATION IN REFERENCES (Phone books, status boards, instructions, etc.)	4	3%	20	5%
PERSONAL TIME FOR CHOW, HEAD CALLS, ETC.	0	0	0	0
OTHER TASKS (Specify and comment) Checking Traffic Totaling Traffic Clean-ups	N/A	N/A	N/A	20%

RESPONSES TO STATION WATCHSTANDER QUESTIONNAIRE

1. **Watchstander's Workload**

   a. **Are there times when the watchstander becomes so overwhelmed that he falls behind in handling his job?**

   "YES"

   "YES - Several Saturday and Sunday afternoons during SAR season particularly end of June until end of August."

b. What happens then?

"Assistance by other personnel is given until things are back to normal."

"Active SAR is handeled first; then less important jobs, i.e., ATON, Station Admin, Maintenance."

"Other personnel help out."

"Watchstander must keep all scratch paper and manage the best he can, patience!"

"1. calls the ac-xpo for help
2. gets a liberty crew member to help him
3. calls the USCG AVX for help."

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(174)

2. Watchstander Qualifications

a. Are there any unique training or qualification procedures used to establish the watchstanding function at your station?

"There is qualification procedure used to qualify watchstanders."

"NO"

"Unit trains program approx. 40 hours."

"I wouldn't say that any unique training procedures are taught other than TTY."

"NO"

NOTE: Coos Bay does however require the individual to pass a written test before standing watch alone.

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b. Is turnover of personnel a serious problem in manning the watchstander's position?

"Off and on, it runs in streaks."

"YES"

"YES"

"YES. Transfers during SAR season (or just prior to) is a problem. It is very difficult to teach a man just off a Coast Guard Cutter or out of Boot Camp how to stand watch (properly) during a busy period."

"It can be at times, but not always. Manpower is the most serious problem, not enough people to man the station and boats - thus not allowing enough rest time for the people."

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3. Watchstander's Schedule

a. During peak SAR season, what is the typical watch schedule for a watchstander?

"It varies with the number of personnel. Usually one day on from 1000 to 1000, with station work until 1600. The watchstander stands duty once every four days."

"24 on, 16 off. 8 hour work day on off days."

"2, 4 hour watches in 24 hour period."

"Most watchstanders 4 hours on, 12 hours off. This unit has permanent watchstander that stands 12 hours on 0800-2000 Saturday and Sunday during peak SAR season."

"2 out of 3 liberty with a recall duty section which is used about 25% of the time."

b. What is his typical work week (hours) during the peak SAR season?

112-120 hours (avg.)

"Two week schedule: 136 first 7 days, 72 second 7 days."

"88 hour total week

32 hours in comm cen

---

56 remaining hours devoted to SAR boats/station work."

"Approximately 42 hours for permanent watchstander: others vary."

"100-110+ hours per week- this includes the hours spent on board during his/her normal work week."

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STATION TAB

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Look up of Information in References (Phone books, status boards, instructions, etc.)				
Weather Monitoring Required at Station				
Personal Time for Chow, Head Calls, etc.				
Other Tasks (Specify and comment)				

STATION TAB NO. 1

		Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Radio					
Distress Channel (Ch 16)		3	100%	12-14	75%
Distress Channel (Other, specify)	CH12-22	1	100%	9-12	25%
Working Frequency (Primary)	CH21	20	100%	100-150	100%
Working Frequency (Other)	NONE		100%	100-150	100%
Intercommunications		20	100%	100-150	100%
Broadcasts Required, if any					
TTY					
Msg. Originating on Pony Loop		1	50%	12-14	50%
Msg. Received on Pony Loop		2	10%	9-10	10%
Informal "Conversations" on TTY		0	0	2-3	10%
Phone					
Wx Requests from Public		20	20%	100	15%
Other Non-distress Calls from Public		10	10%	30	10%
Public Reporting Possible Distress		2-4	20%	4-6	20%
To & From Other CG Facilities					
Originated		4-6	2	10	5%
Received		2-4	5%	5	5%
Station Phone for Other Purposes (personal calls for personnel, etc.)		2	2	2-4	5%

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STATION TAB No. 1

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Look up of Information in References (Phone books, status boards, instructions, etc.)	10	5%	20	5%
Weather Monitoring Required at Station	.33	1%	6	5%
Personal Time for Chow, Head Calls, etc.	1	1%	20	5%
Other Tasks (Specify and comment) *	3-4	1%	20	10%

*Includes radio req. for wx. marine operator and assisting inbound ship to GNT Comms with C/S pilot as well as reporting vessel we have been directed to watch for.

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STATION TAB No. 2

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Radio				
Distress Channel (Ch 16)	6	10%	10	20%
Distress Channel (Other, specify) 2182	1	6%	1	6%
Working Frequency (Primary)	10	24%	40	45%
Working Frequency (Other)	4	4%	20	9%
Intercommunications				
Broadcasts Required, if any				
TTY				
Msg. Originating on Pony Loop	2	30%	30	30%
Msg..Received on Pony Loop	3	N/A	15	10%
Informal "Conversations" on TTY				
Phone				
Wx Requests from Public	1	2%	10	20%
Other Non-distress Calls from Public	6	12%	30	45%
Public Reporting Possible Distress	2	2%	10	20%
To & From Other CG Facilities				
Originated	1	2%	3	6%
Received	1	2%	3	6%
Station Phone for Other Purposes (personal calls for personnel, etc.)	10	24%	3	45%

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STATION TAB No. 2

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Look up of Information in References (Phone books, status boards, instructions, etc.)	2	4%	10	20%
Weather Monitoring Required at Station	1	3%	3	24%
Personal Time for Chow, Head Calls, etc.	1	2%	3	2%
Other Tasks (Specify and comment)				

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STATION TAB No. 3

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Radio				
Distress Channel (Ch 16)	40	30%	200	70%
Distress Channel (Other, specify) Ch. 9 CL 2182 KHZ.	1	5%	1	5%
Working Frequency (Primary)	20	20%	100	40%
Working Frequency (Other)	20	20%	100	30%
Intercommunications	15	10%	30	20%
Broadcasts Required, if any A to Navigation Storm Warning, etc.	1	5%	1	5%
TTY				
Msg. Originating on Pony Loop	5	50%	20	50%
Msg..Received on Pony Loop	5	50%	15	50%
Informal "Conversations" on TTY		N O	N E	
Phone				
Wx Requests from Public	10	10%	30	20%
Other Non-distress Calls from Public	20	10%	100	20%
Public Reporting Possible Distress	2	5%	10	10%
To & From Other CG Facilities				
Originated	5	10%	5	10%
Received	15	30%	20	50%
Station Phone for Other Purposes (personal calls for personnel, etc.)	1	.5%	5	5%

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STATION TAB No. 3

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Look up of Information in References (Phone books, status boards, instructions, etc.)	1	5%	3	5%
Weather Monitoring Required at Station	1	5%	7	20%
Personal Time for Chow, Head Calls, etc.	0	0%	2	10%
Other Tasks (Specify and comment) Watch Room Cleanup	0	0	1	3%

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STATION TAB No. 4

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Radio				
Distress Channel (Ch 16)	3	30%	6	10%
Distress Channel (Other, specify)				
Working Frequency (Primary) 23	3	30%	6	10%
Working Frequency (Other)				
Intercommunications		N / A		
Broadcasts Required, if any	1	1	24	1
TTY				
Msg. Originating on Pony Loop	6	100%	30	20%
Msg..Received on Pony Loop	10	90%	30	50%
Informal "Conversations" on TTY	15	25%	35	15%
Phone				
Wx Requests from Public	6	10%	12	5%
Other Non-distress Calls from Public	6	10%	15	5%
Public Reporting Possible Distress	10	10%	15	5%
To & From Other CG Facilities				
Originated	20	100%	75	50%
Received	25	100%	75	50%
Station Phone for Other Purposes (personal calls for personnel, etc.)	10	10%	30	10%

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STATION TAB No. 4

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Look up of Information in References (Phone books, status boards, instructions, etc.)	20	50%	50	25%
Weather Monitoring Required at Station	2	2	2	2
Personal Time for Chow, Head Calls, etc. For crew? Per person	?			
Other Tasks (Specify and comment)				

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STATION TAB

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Radio				
Distress Channel (Ch 16)				
Distress Channel (Other, specify)				
Working Frequency (Primary)				
Working Frequency (Other)				
Intercommunications				
Broadcasts Required, if any				
TTY				
Msg. Originating on Pony Loop				
Msg. Received on Pony Loop				
Informal "Conversations" on TTY				
Phone				
Wx Requests from Public				
Other Non-distress Calls from Public				
Public Reporting Possible Distress				
To & From Other CG Facilities				
Originated				
Received				
Station Phone for Other Purposes (personal calls for personnel, etc.)				

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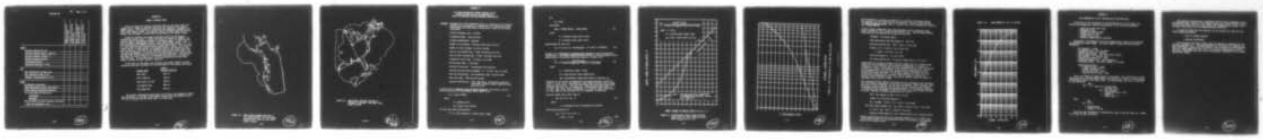
STATION TAB

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Look up of Information in References (Phone books, status boards, instructions, etc.)				
Weather Monitoring Required at Station				
Personal Time for Chow, Head Calls, etc.				
Other Tasks (Specify and comment)				

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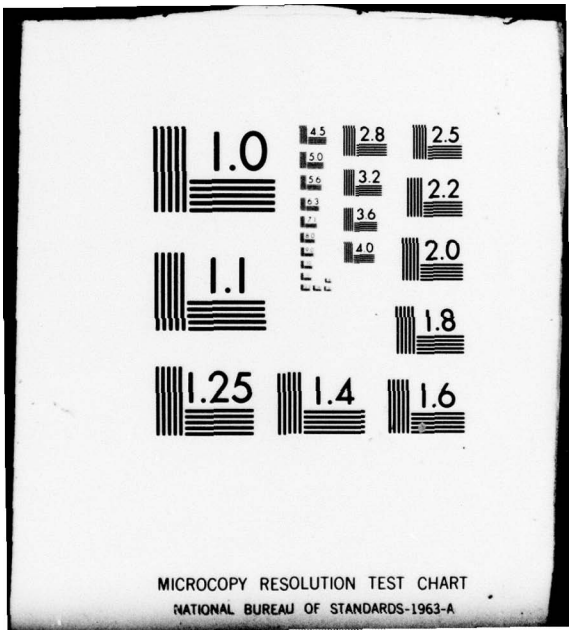
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USCG GROUP CONTROL AND COMMUNICATIONS SYSTEM STUDY.(U)
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NATIONAL BUREAU OF STANDARDS-1963-A

STATION TAB

	Number of Occurrences in Busiest Hour	% Time on Task During Busiest Hour	Number of Occurrences During Busiest Day	% Time on Task During Busiest Day
Radio				
Distress Channel (Ch 16)				
Distress Channel (Other, specify)				
Working Frequency (Primary)				
Working Frequency (Other)				
Intercommunications				
Broadcasts Required, if any				
TTY				
Msg. Originating on Pony Loop				
Msg. Received on Pony Loop				
Informal "Conversations" on TTY				
Phone				
Wx Requests from Public				
Other Non-distress Calls from Public				
Public Reporting Possible Distress				
To & From Other CG Facilities				
Originated				
Received				
Station Phone for Other Purposes (personal calls for personnel, etc.)				

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APPENDIX D

LORAN-C COVERAGE ZONES

Figure D-1 shows the coastal confluence zones for the East Coast, Caribbean, Gulf of Mexico, and Great Lakes that are covered by the updated LORAN-C chains. This coverage is provided by the Northeast, Southeast, and Great Lakes LORAN-C chains. The drawing clearly indicates that the required coastal zone coverages in these areas are provided by the LORAN-C chains.

Figure D-2 presents the coastal confluence zones for the Alaskan, Canadian West Coast, and U. S. West Coast that are covered by LORAN-C. The required coastal confluence coverage is provided by the U. S. North Pacific, Gulf of Alaska, Canadian West, and U.S. West Coast LORAN-C chains. The new configuration of LORAN-C stations along the west coast of the U. S. (fig. D-1) uses some stations located several hundred miles inland. The inland location results in phase delays in propagated signals; such delays are variable in space as a function of the characteristics of the ground over which the signal propagates. The Loran grid thus established is very stable, but exhibits some distortions which have not yet been eliminated. The distortion may amount to several tenths of a microsecond variation over a distance of about 50 miles. On the other hand, the new configuration provides good signal strengths and good geometric precision.

On the basis of the above, the following approximate LORAN-C position accuracies have been estimated for different parts of the Coastal Confluence:

Coastal Zone	LORAN-C Position Accuracy
East Coast	600 ft.
Gulf of Mexico	400 ft.
West Coast N of 35^{0}	800 ft.
Los Angeles Area	1000 ft.
San Diego Area	1500 ft.

The coastal confluence coverage zones and accuracy requirements for small boat navigation is provided by the LORAN-C system, with the exception noted for the Los Angeles and San Diego areas, as noted above.

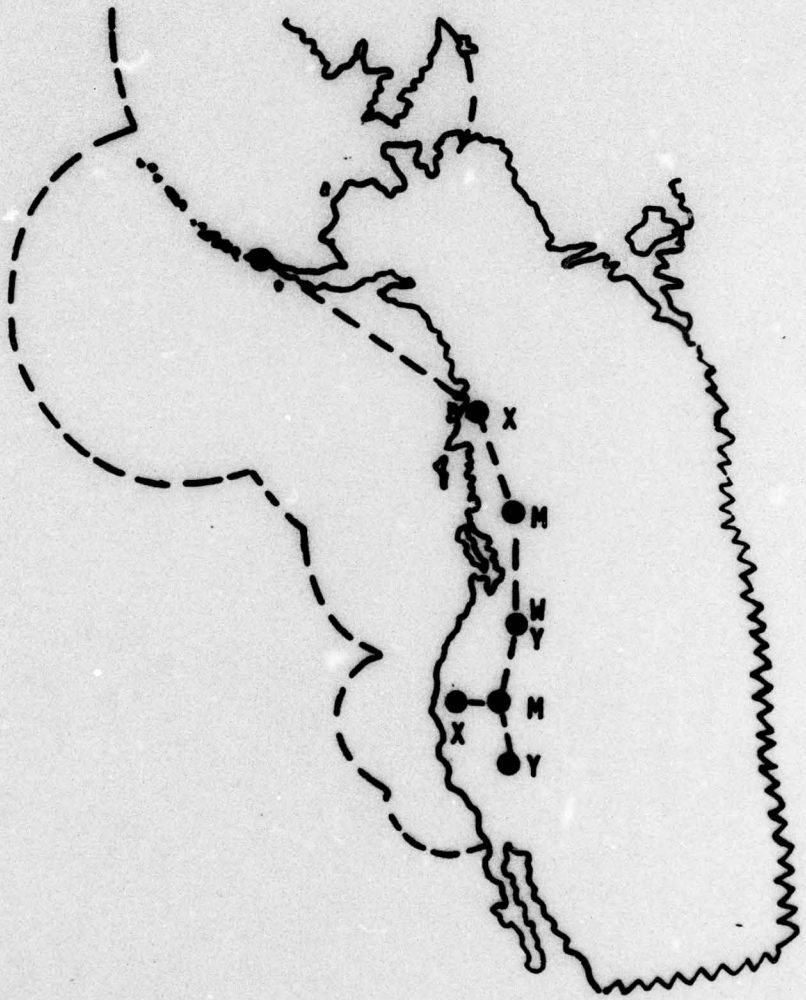


FIGURE D-1: MARINE AREA COVERAGE PROVIDED BY U.S. NORTH PACIFIC, GULF OF ALASKA, CANADIAN WEST, AND U.S. WEST COAST LORAN-C CHAINS

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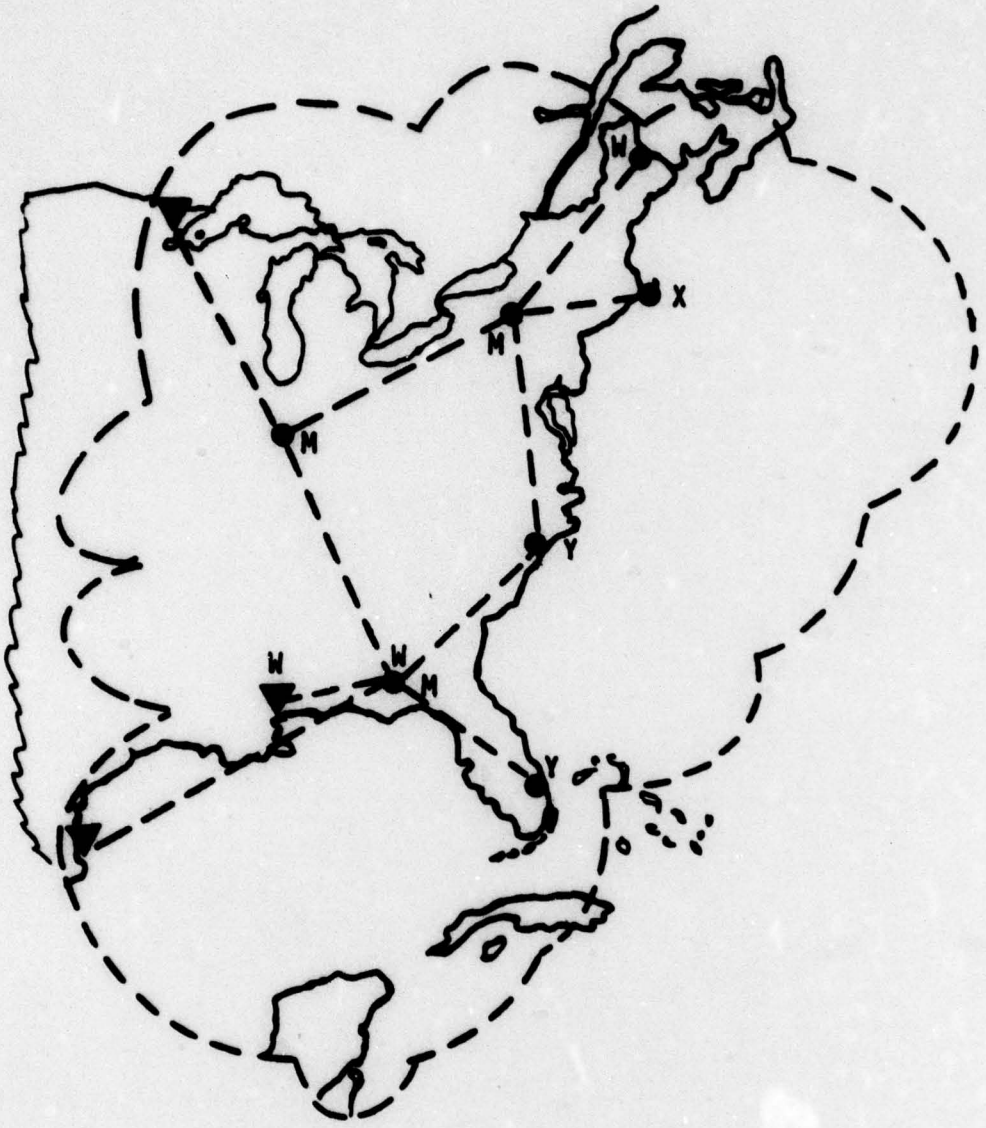


FIGURE D-2: MARINE AREA COVERAGE PROVIDED BY NORTHEAST, SOUTHEAST, AND GREAT LAKES LORAN-C CHAINS

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APPENDIX E

BIT ERROR PROBABILITY VERSUS DISTANCE FOR AN OVER-WATER VHF-FM DATA LINK EMPLOYING AN AUDIO FSK BASEBAND WITH NON-COHERENT DEMODULATION

Problem: Determine bit error probability (P_e) as a function of the distance between the two antennas of a VHF-FM data link employing an audio FSK baseband with non-coherent demodulation, under the following conditions:

Carrier frequency (f_c): 157 MHz

Propagation path: over sea water

Antenna polarization: vertical

Height of one antenna: 100 feet above water surface

Height of other antenna: at water surface

Gain of one antenna (G_1): 6 dBi, including line loss

Gain of other antenna (G_2): 0 dBi, including line loss

Transmitter power (P_T): 25 watts = 14.0 dBW

FM deviation (Δf): 5 kHz peak

Receiver FM detector: conventional discriminator

Receiver post-detection passband: 0 - 3.5 kHz (f_M = 3.5 kHz)

FSK tone frequencies: two sinusoidal tones, each $<$3.5 kHz

Data rate (R_B): 1200 bits per second

Receiver sensitivity: -146.1 dBW input, sinusoidally modulated 5 kHz peak, produces output signal-to-noise ratio of 12 dB

On page 21-25 of Reference Data for Radio Engineers, 5th Edition, the bit error probability for non-coherent FSK is shown to be:

$$P_e = \tfrac{1}{2} \exp(-E/2N_o) \qquad (1)$$

where

E = energy per bit

N_o = noise power density

For the case under consideration:

$$E = S \times (\text{bit duration}) = S/(\text{bit rate}) = S/R_B$$

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and

$$N_o = N/f_M$$

from which

$$E/N_o = (S/R_B)/(N/f_M) = (S/N)(f_M/R_B) \qquad (2)$$

where

S = receiver signal power output

N = receiver noise power output

Substituting (2) into (1):

$$P_e = 0.5 \exp [-0.5 (S/N)(f_M/R_B)] = 0.5 \exp [-1.458(S/N)] \qquad (1a)$$

On page 337 of Principles of Communication Systems by Taub and Schilling, (McGraw-Hill), the output signal-to-noise ratio of an FM discriminator, when demodulating a sinusoidally modulated signal, is shown to be:

$$\frac{S}{N} = \frac{(3/2)\beta^2 (S_i/N_M)}{1 + (12\beta/\pi)(S_i/N_M) \exp \{-\frac{1}{2}[1/(\beta + 1)](S_i/N_M)\}} \qquad (3)$$

where

β = modulation index = $\Delta f/f_M$

S_i = discriminator input signal power

N_M = discriminator input noise power in bandwidth f_M

Equation (3) is plotted in Figure E1 for the given modulation index (β = 5.0/3.5 = 1.43), over a discriminator input signal-to-noise ratio (S_i/N_M) range of 0 dB to 28 dB. This plot shows that the sensitivity-level value of output S/N (12.0 dB) is produced by a discriminator input S_i/N_M of 12.5 dB. This value, which corresponds to a receiver signal input level of -146.1 dBW, is the reference for all subsequent calculations.

Receiver signal input power (P_R) is:

$$P_R = P_T + G_1 + G_2 - A \qquad (4)$$

where

A = propagation path attenuation in decibels

Evaluating equation (4):

$$P_R = 14.0 + 6.0 + 0.0 - A$$

$$= (20.0 - A) \text{ dB} \qquad (4a)$$

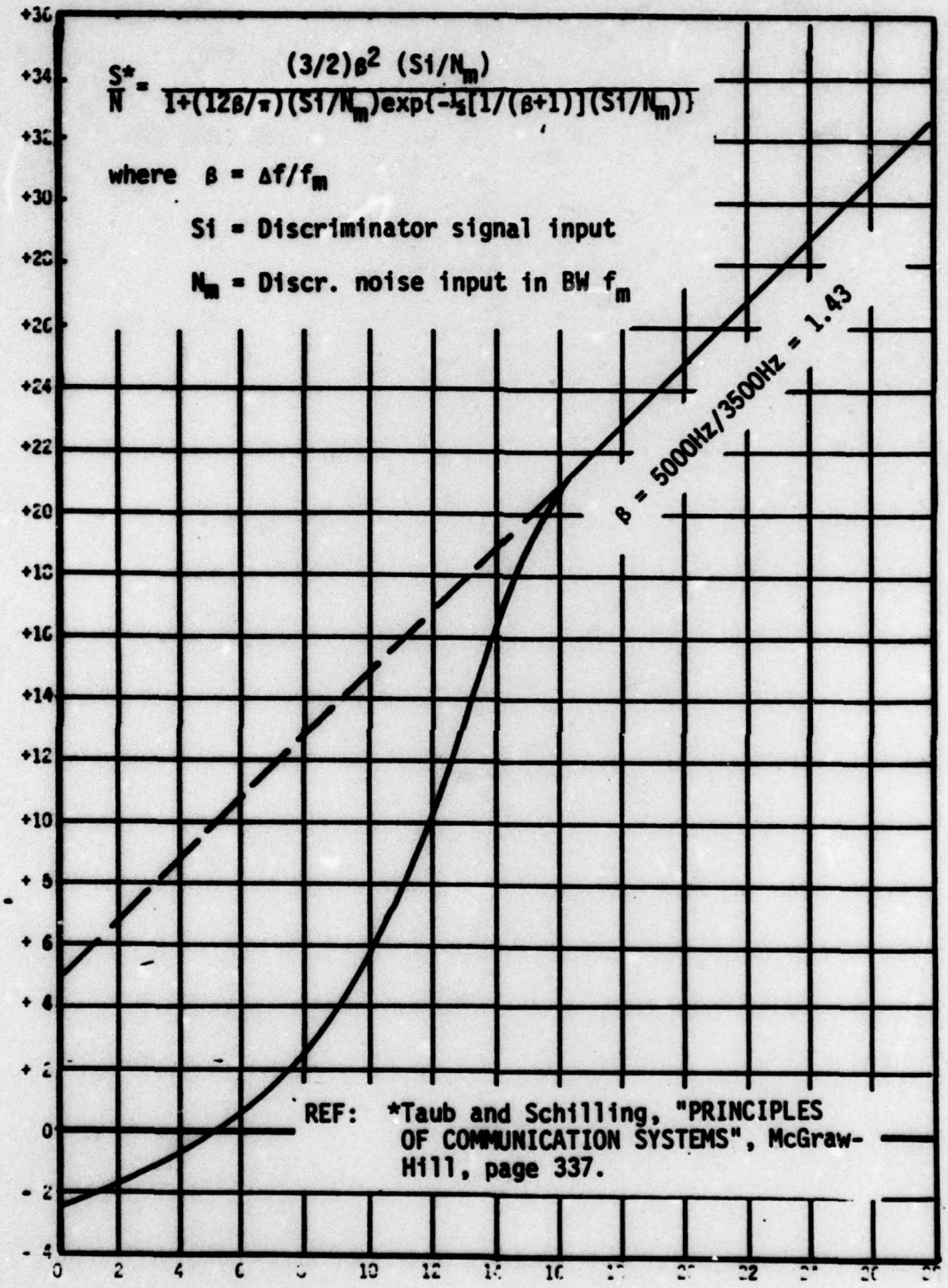


FIGURE E-1: DISCRIMINATOR OUTPUT SIGNAL-TO-NOISE RATIO (S/N) VS. INPUT SIGNAL-TO-NOISE RATIO (Si/N_m) FOR β= 1.43

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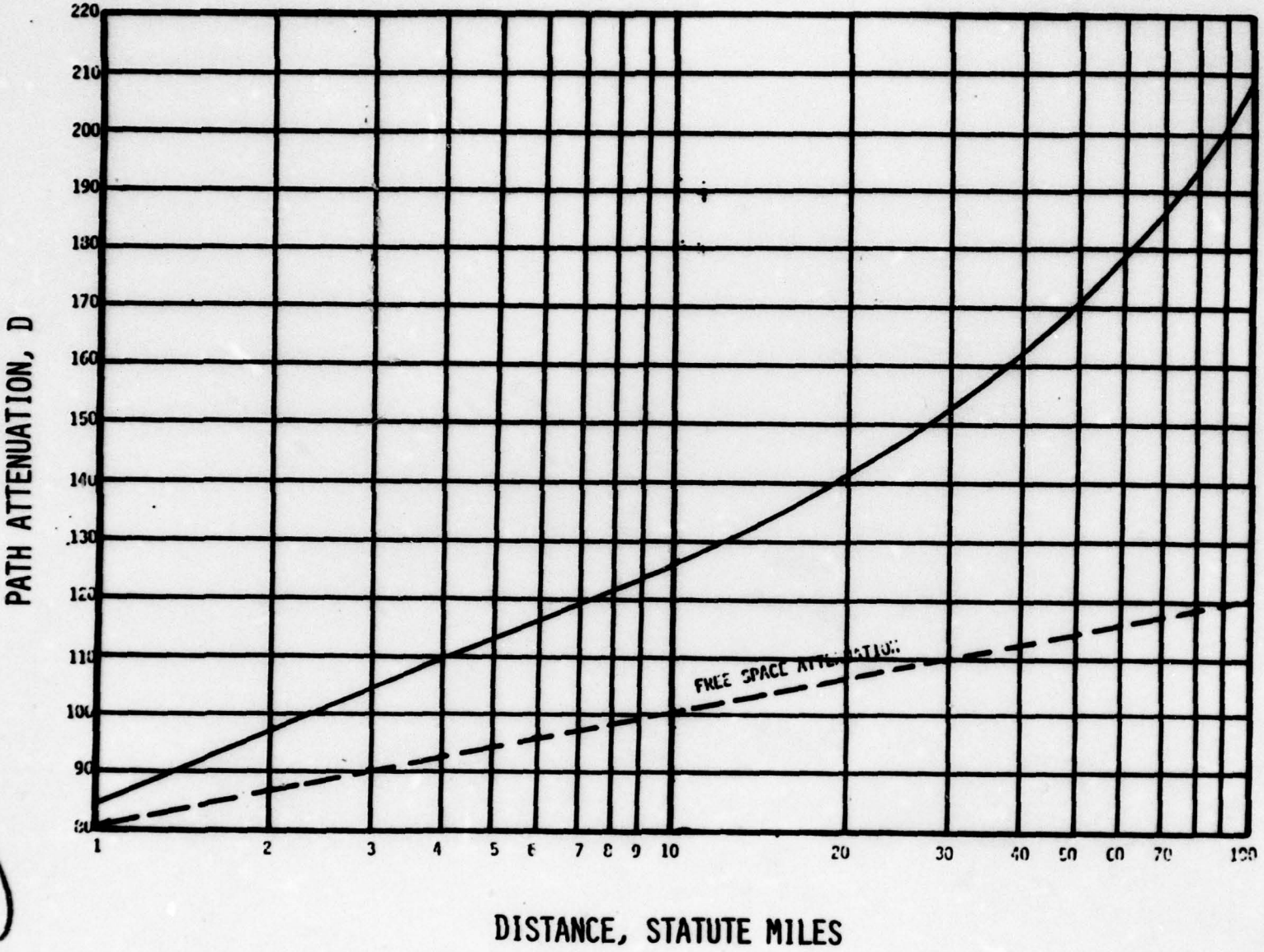


FIGURE E-2: PATH ATTENUATION VS. DISTANCE OVER SEA WATER

Path attenuation is plotted in Figure E2 as a function of distance between two antennas, for the conditions of this problem. The plot is derived from the NDRC Propagation Curves, Issue 3, October 1944, Bell Telephone Laboratories, Inc., Report 966-6C.

A plot of error probability (P_e) versus distance can be constructed using Figure E3 Equation (4a), Figure E2 and Equation (1a). The following sequence illustrates the calculation of one point on the plot:

Distance: 45 statute miles

Path attenuation (A)(from Figure 2): 167.5 dB

P_R (from equation 4a): 20.0 - 167.5 = -147.5 dBW

$S_i/N_M = 12.5 - (-146.1) + P_R = 158.6 + P_R$

$= 158.6 + (-147.5) = 11.1$ dB

S/N (from Figure 1): 8.1 dB = 6.457

P_e (from equation 1a): $0.5 \exp [-1.458(6.457)] = 4.1 \times 10^{-5}$

Application of the above procedure over the range of 44 to 51 statute miles yields the error probability curve plotted in Figure E3. As a point of reference, it will be noted that an error probability of 1×10^{-6} is achieved at about 44.5 miles. The behavior of the curve at distances less than 45 miles suggests that the error rate rapidly becomes infinitesimal as the distance is further decreased. In an actual system, of course, the curve would become asymptotic to a "ground" value determined by factors not related to the transmission path. This value, however, should be orders of magnitude below a P_e of 1×10^{-6}.

The foregoing analysis makes no allowance for the transmission path variables that are normally experienced in real-life situations. These variables, which can total as much as ± 20 dB, are the result of such factors as sea surface conditions, antenna attitude, and antenna pattern. It is therefore desirable to investigate the performance of the data link with a safety-margin allowance of 20 dB. Assuming a maximum allowable P_e of 1×10^{-6}:

$S/N = [\ln (2P_e)]/(-1.458) = 9.0 = 9.5$ dB

$S_i/N_M = 11.6$ dB (from Figure 1)

$P_R = (S_i/N_M) - 158.6 = 11.6 - 158.6 = -147.0$ dBW

For 20-dB safety margin, $P_R' = P_R + 20.0 = -147.0 + 20.0 = -127.0$ dBW

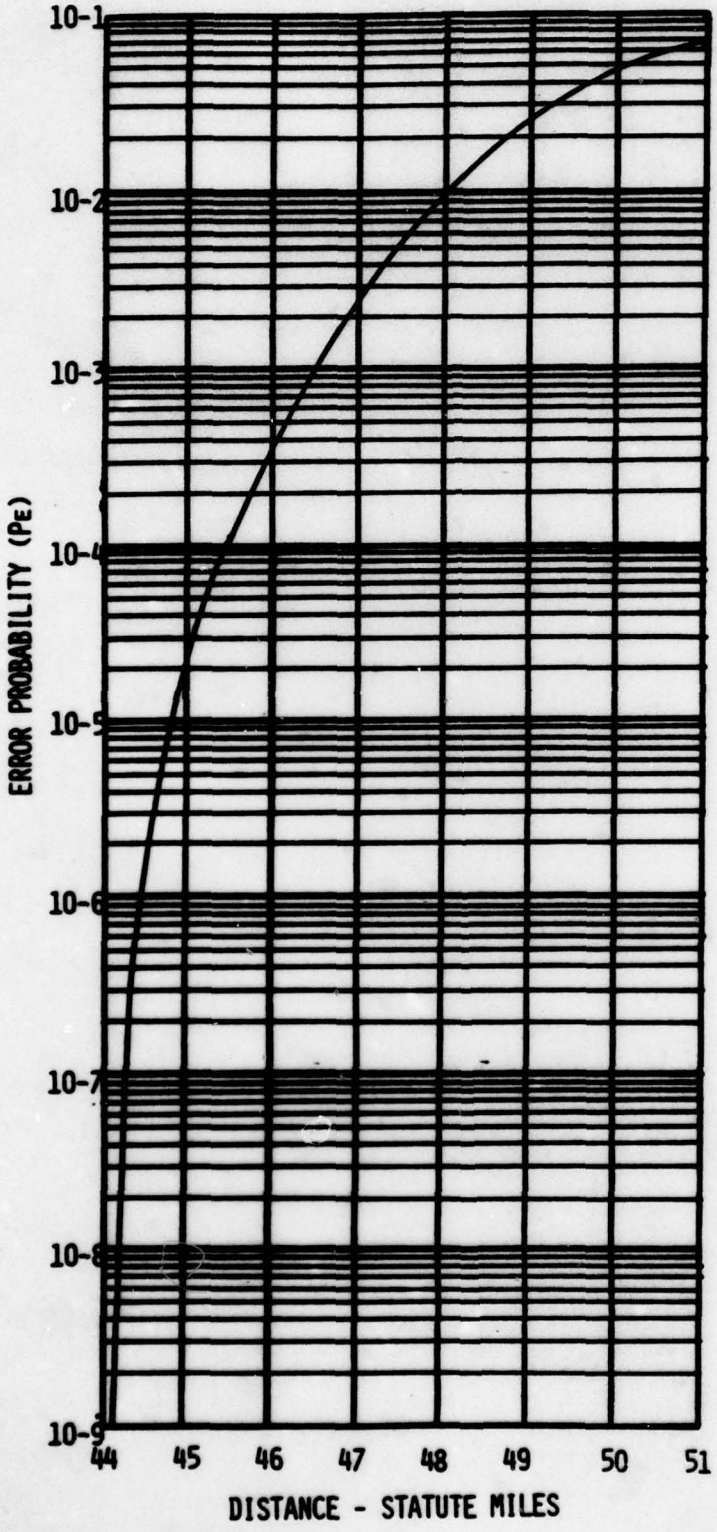
$A = 20.0 - P_R' = 20.0 - (-127.0) = 147.0$ dB

Distance (from Figure 2) = 24.5 statute miles = 21.3 nautical miles

Similar calculations show that for a maximum allowable P_e of 1×10^{-8}, with a 20-dB safety margin in the transmission path, the distance is 24.0 statute miles (20.9 nautical miles).

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FIGURE E-3: ERROR PROBABILITY (P_E) VS. DISTANCE



APPENDIX F

DATA TRANSMISSION VIA HF TWO-TONE DATA LINK OVER WATER

Calculation of the performance of the performance of an HF FSK data link, ground wave propagation, requires consideration of the following parameters:

- Receiving system noise level
- Propagation loss
- Radiated transmitter power
- Antenna gain (or loss)
- Antenna lead-in loss
- Effective communications bandwidth

Calculation of performance of the data communication system can be performed by estalbishing a power budget. The power budget is based upon the following parameters:

- HF Frequency: 3.3MHz
- Propagation Path: Over sea water
- Antenna Polarization: Vertical
- Shore Antenna Height: 100' above water surface
- Boat Antenna: 27' vertical whip
- Transmitting Antenna Gain: 5dbi
- Receiving Antenna Loss: -2dbi (mismatch)
- Transmitter Power: 100 watts (+20Dbw, Or 50 Dbmw)

Modem Characteristics:
- Signalling Rate: 75BAUD
- 2-tone, asychronous
- BW for each tone: 100Hz
- Receiver Noise Figure: 10db

First, the effective radiated power is calculated. This calculation is based upon the use of a two-tone modem, wherein the same digital signal is simultaneously transmitted by means of two audio tones. The average power per tone is calculated by the expression:

$$P_M^1 = \frac{PEP}{n}^{1.5}$$

where P_M = Average Power per tone, watts
PEP = Peak Envelope Transmitter Power, watts
n = Number of modem tones = 2

Thus,

$$P_M = \frac{100}{2}^{1.5}$$

= 35 watts/tone
= +15Dbw or +45 dbm

Since the same information is transmitted on each fo the two tones, P_M = +45Dbw is utilized for the calculation.

(201)

(201)

This analysis indicates that, considering receiver noise, atmospheric noise, and shipboard noise, that the 77 db signal-to-noise ratio should provide a highly-reliable error-free link for two-way digital data communications between a boat and shore installation for the assumed operating conditions.

It should be noted that this analysis did not consider two items that can affect system performance:

- nulls in antenna patterns

- sky-wave interference

The calculated 77db signal excess should be adequate to compensate for the effects of antenna nulls. The two-tone modem will be effective in handling sky-wave interference, since the nulling effect is both frequency and time-dependent. There is a high probability that a null will not occur simultaneously on the two signal frequencies that are used for simultaneous transmission fo the 75BAUD digital data stream.

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REFERENCES

1. U.S. Coast Guard Search and Rescue Reports Manual, CG-397.

2. U.S. Coast Guard Office of Boating Safety - "Boat Attrition Rates" - Ken Fruend, March, 1978.

3. U.S. Coast Guard - SAR Statistics, 1977, CG-489.

4. U.S. Coast Guard COMDINST 2300.3A.

5. U.S. Coast Guard Report "An Operational Flight Test Evaluation of a LORAN-C Navigator", March, 1977.