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First Coast Guard District NDS Voice Traffic Baseline Model Report

epared for:

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elivery Order DTCG-39-97-F-E00178

August 1997

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EXECUTIVE SUMMARY

The National Distress System (NDS), is a network of approximately 300 remotely-controlled VHF-FM radios and antennas used for monitoring the Maritime Distress Frequency (CH 16-156.8MHz) and for providing distress, safety, and United States Coast Guard (USCG) command & control (C^2) communications coverage. The USCG is researching alternative communications systems for potential use in the modernization of the NDS. To assist in developing an estimate of the data and voice traffic carried over the NDS in the First Coast Guard District, computer simulations will be conducted using OPNET (a network simulation tool). Both present and future (next 4 years) projections will eventually be made for the model. A present-day voice traffic baseline model has been developed as a reference for forecasting potential future NDS traffic volume. The baseline model will be used to confirm the validity and credibility of the forecasted model. This report presents the voice traffic baseline model and describes the methodology and analysis used to develop the model. The most important portion of this report are the attached data files. These files can be used to load into the OPNET model.

The model is presented as a series of functions, empirical data, and histograms that represent NDS voice traffic in the First Coast Guard District. The model is the result of data collected through monitoring communications log tapes, reviewing station logs, and conducting on-site personnel interviews. The computer program, ExactFit, was used as an aid in analyzing the data and for formatting the results into a format acceptable by OPNET.

The First Coast Guard District voice traffic baseline model was developed with the best information that is currently available. However, the model is dynamic in the sense that further data collection and analysis is pending, contingent to the remainder of this task. As additional information becomes available, the model will be refined and validated. It is important that this model reflect current NDS communications in the First Coast Guard District since it will be instrumental in developing an estimate of the data and voice traffic carried over the NDS in the First Coast Guard District four years from now.

FIRST COAST GUARD DISTRICT
NDS VOICE TRAFFIC BASELINE MODEL REPORT

Introduction

Purpose

The purpose of this report is to document the First Coast Guard District (CGD1) voice traffic baseline model and describe how it was constructed.

Background

The National Distress System (NDS), is a network of approximately 300 remotely-controlled VHF-FM radios and antennas used for monitoring the Maritime Distress Frequency (CH 16-156.8MHz) and for providing distress, safety, and United States Coast Guard (USCG) command & control (C^2) communications coverage. The USCG is researching alternative communications systems for potential use in the modernization of the NDS. To assist in developing an estimate of the data and voice traffic carried over the NDS in the First Coast Guard District, computer simulations will be conducted using OPNET (a network simulation tool). Both present and future (next 4 years) projections will eventually be made for the model. A present-day voice traffic baseline model has been developed as a reference for forecasting potential future NDS traffic volume. The baseline model will be used to confirm the validity and credibility of the forecasted model.

Scope

This report describes the First Coast Guard District NDS voice traffic baseline model. The following sections provide the rationale, approach, overview of the model design, description of unit type, data collection, analysis methodology, and presents the voice traffic baseline model. This report sets the stage for the subsequent reports (Desired Capabilities, Traffic Model, and Unit Profile) under this task.

Model Preparation

Purpose of Model

The purpose of the First Coast Guard District voice traffic baseline model is to mathematically represent present-day NDS voice traffic in this district. The model will be used as a reference for forecasting potential future NDS traffic volume and for simulation using the OPNET network simulation program.

Model Overview

The First Coast Guard District voice traffic baseline model is composed of probability distribution functions and empirical distributions representing transmission duration, transmission frequency (how often a transmission occurs), and transmission recipient for NDS voice traffic in CGD1. A series of functions have been generated for each of the unit types shown in Table 1. Expressions are provided in the format required for entry into OPNET. The empirical distributions are provided as an ASCII file on a disk. Appendix A contains a listing of the contents on each disk showing the unit type to which each file is related. The data describing the transmission recipient is provided only as a histogram in the text of this report.

Table 1. Unit types.

Unit/Resource	Abbr.	Definition
Activity/Group	GP	A group or activity exercising command of stations and small boats and having a communications center controlling high sites.
Station	ST	Station having one or more standard boats and VHF watch activity.
Small Boats	SB	Boats used to accomplish the missions of a group/activity or station.
Buoy Tender	BT	Cutters with a primary mission of maintaining aids to navigation.
Other Cutters	PB	Cutters with a primary mission of SAR, law enforcement, or other Coast Guard missions.
Fixed-Wing Aircraft	FW	Fixed-wing aircraft used for law enforcement, SAR, or other Coast Guard missions.
Rotary-Wing Aircraft	RW	Rotary-wing aircraft used for law enforcement, SAR, or other Coast Guard missions.
Motor Vessel	MV	Non-Coast Guard vessels, such as, commercial vessels, recreational vessels, pilot vessels, tugs, and other government agency vessels.
All Call	AC	All vessels (government and civilian).

An additional unit type has been included in the recipient histogram. It represents “all call” (AC); a transmission intended for all stations listening to the channel. For example; a Coast Guard group is announcing or sending a marine information broadcast. A model for an air station has not been included, as insufficient data was available. It is anticipated (that as a unit profile is developed for an air station) additional data will be available and an air station model will be formulated.

Model constraints are: (1) it is assumed that CG Group Woods Hole and the attached stations are representative of all group or activity communications in CGD1, (2) duration

and frequency are calculated on all data in the database, and (3) as the model is to be representative of a high capacity day, recipient information has been generated using May 26, 1997, Memorial Day. Although May 26 was not the busiest day, it is judged to be more representative of a typical high capacity day. This judgment is based on data provided in both operations reports and anecdotal data gleaned from unit visits. Both sources indicate boating activity builds from Memorial Day through June reaching a plateau during July and August, and draping off sharply after Labor Day. All operational personnel indicated that VHF-FM activity correlates directly to the level of boating activity.

Method of Data Collection

The collection of data to support the construction of the CGD1 voice traffic baseline model was accomplished by monitoring communication log tapes, validating the data by reviewing Coast Guard unit logs and conducting on-site personnel interviews. Sixty tapes from Group Woods Hole for January and February plus tapes for May 19-27 were provided as government furnished information (GFI) and were monitored in accordance with a sampling plan.

The sampling plan concentrated on recordings from the three busiest high sites in Group Woods Hole: Sandwich (Cape Cod Canal), Newport and Nobska (Woods Hole). The Stancil tape recordings had to be monitored in real time. There were several tapes that were either blank or incomplete. These limitations resulted in the monitoring of 23 communication days. That effort produced approximately 25,000 records of transmissions. Available data entry hours resulted in 13,662 records in an Access data base. This data provides the basis for the voice traffic baseline. Days actually represented in the database are May 22, 24, 25, 26, 27 and February 11, 12, 15, 16, 21, 22, 23, 28.

For each transmission, the following information was recorded: track, start time, duration of transmission, sending unit, receiving unit, category of information transmitted (categories are shown in table 2), comments, and the VHF-FM channel used. Unit operations logs were reviewed and together with information obtained during on-site personnel interviews, were used to validate the data collected from the tapes. Information from the communications log tapes was entered into a database providing 13,662 records as a base for analysis.

Table 2. Traffic categories.

Category	Definition
SAR	Search and Rescue—any voice traffic related to the reporting, searching for, or coordination of a distress situation.
Nav	Navigation—any voice traffic related to the departure, movement of, passing situations, or other navigation voice traffic of vessels.

Category	Definition
RC	Radio check—any request or response for a radio check.
MIB	Marine Information Broadcast—the broadcasting by Coast Guard Units to all stations that can receive routine marine information.
UMIB	Urgent Marine Information Broadcast—the broadcasting by Coast Guard Units to all stations that can receive urgent marine information.
LE	Law Enforcement—any voice traffic related to fisheries or other law enforcement related patrols.
MEP	Marine Environmental Protection—any voice traffic related to the investigation, clean up, or coordination of an environmental incident.
ATON	Aids to Navigation—any voice traffic related to the construction, maintenance, or positioning of aids to navigation.
Suprt	Support—any voice traffic, such as, hailing, administrative, or those not included in the above categories.
Unk	Unknown—could not identify message category.

Data Analysis

Analysis of data was completed using MS Access, Excel, and ExpertFit. Data was extracted from the database according to the unit type, VHF-FM channel, duration, frequency, and recipient. To develop and test the distribution of duration and frequency data, the extracted data was analyzed in ExpertFit. ExpertFit aided in determining the best fit theoretical distribution or establishing the rationale for using empirical data. The recipient data was analyzed in Excel and the histograms developed in Corel Draw.

Voice Traffic Baseline Model

Model Description

The First Coast Guard District voice traffic baseline model consists of probability distributions functions, empirical data, or histograms for each of the unit types. For each unit type, functions are provided in three areas: duration of transmissions, frequency of transmissions, and the recipient of transmissions. The functions are provided for transmission on VHF-FM channel 16 and for transmissions on VHF-FM working channels.

Model of Unit Types

For each unit type, information is provided in one of two forms. The duration and frequency of transmissions are represented by continuous data that are provided as empirical data formatted for use in OPNET. Due to the length of data for duration and frequency of transmission, it is provided only as a file on a disk. The recipient function is represented by discrete data that are displayed as a histogram. This histogram shows the

relative frequency for each of the unit type's probability of being the recipient of a transmission from the unit type being modeled.

3.2.1 Group/Activity (GP)

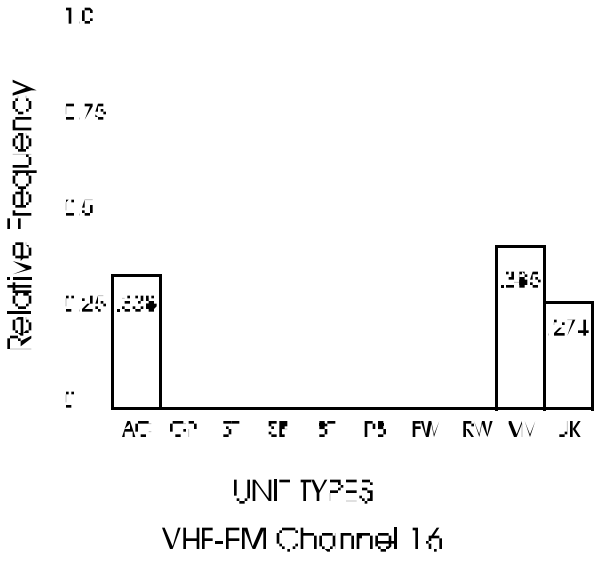
Duration Function

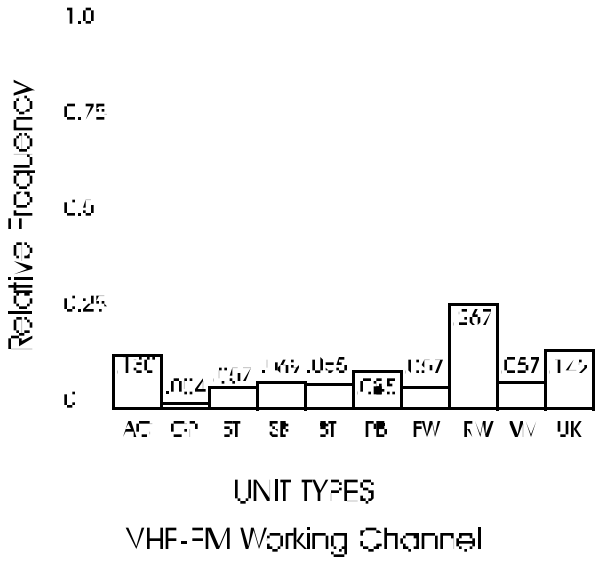
VHF-FM channel 16	GPDUR16.DAT
VHF-FM working channels	GPDURWK.DAT

Frequency Function

VHF-FM channel 16	GPFEQ16.DAT
VHF-FM working channels	GPFEQWK.DAT

Recipient Function





3.2.2 Station (ST)

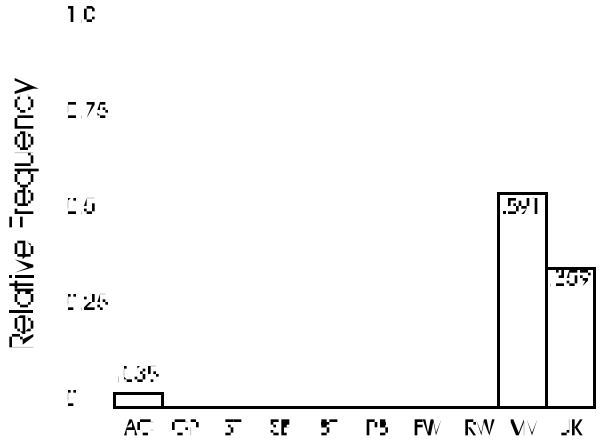
Duration Function

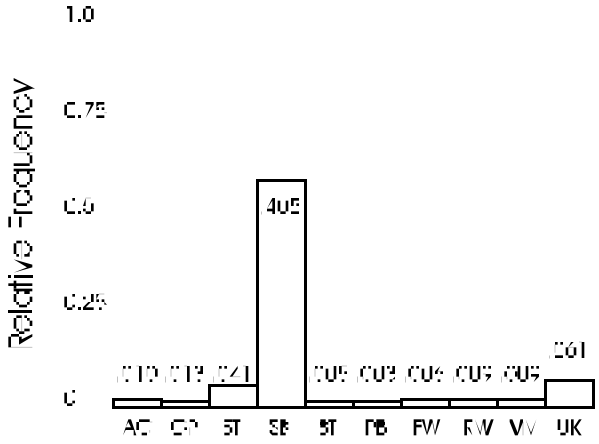
VHF-FM channel 16	STDUR16.DAT
VHF-FM working channels	STDURWK.DAT

Frequency Function

VHF-FM channel 16	STFEQ16.DAT
VHF-FM working channels	STFEQWK.DAT

Recipient Function





3.2.3 Small Boat (SB)

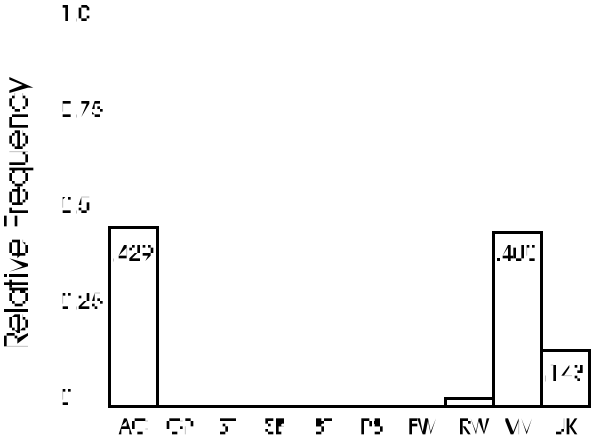
Duration Function

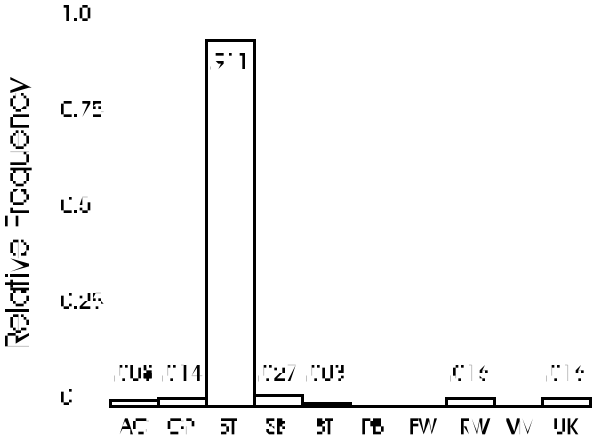
VHF-FM channel 16	SBDUR16.DAT
VHF-FM working channels	SBDURWK.DAT

Frequency Function

VHF-FM channel 16	SBFEQ16.DAT
VHF-FM working channels	SBFEQWK.DAT

Recipient Function





3.2.4 Buoy Tenders (BT)

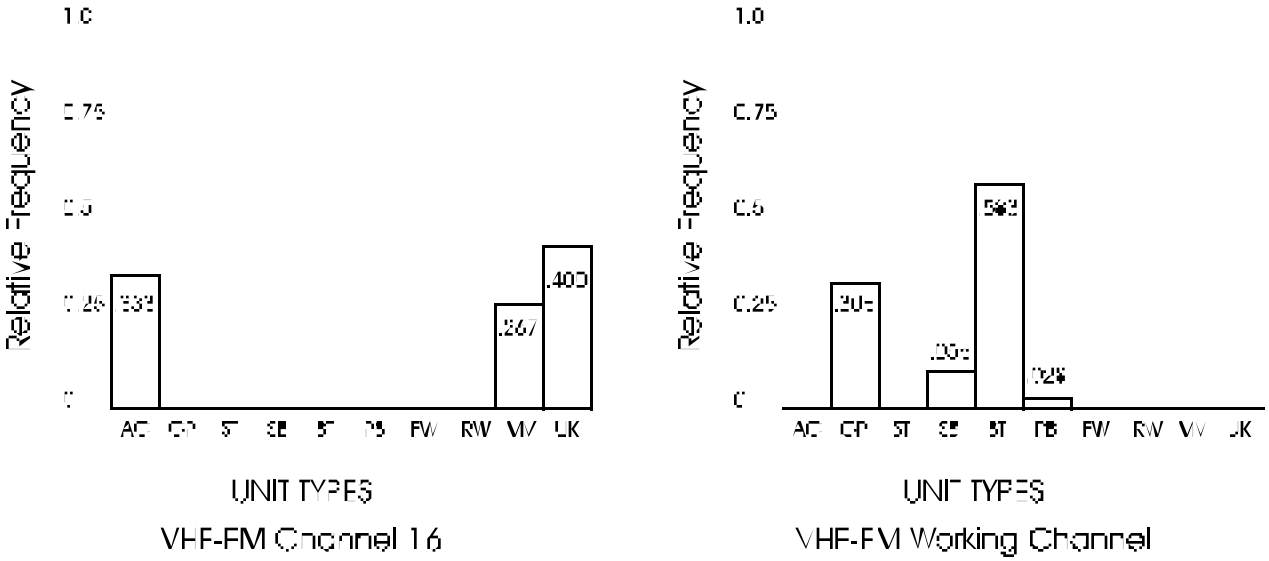
Duration Function

VHF-FM channel 16	BTDUR16.DAT
VHF-FM working channels	BTDURWK.DAT

Frequency Function

VHF-FM channel 16	BTFEQ16.DAT
VHF-FM working channels	BTFEQWK.DAT

Recipient Function



3.2.5 Other Cutters (PB)

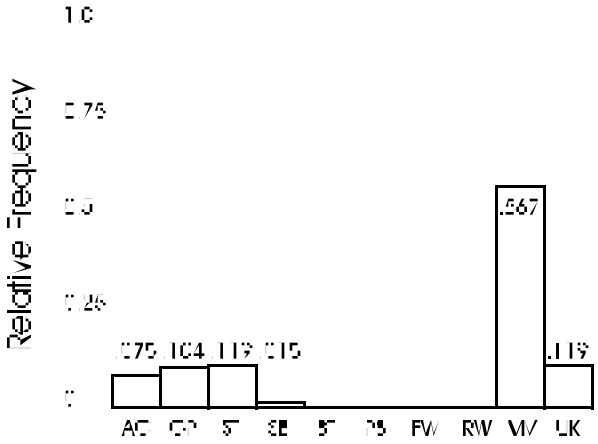
Duration Function

VHF-FM channel 16	PBDUR16.DAT
VHF-FM working channels	PBDURWK.DAT

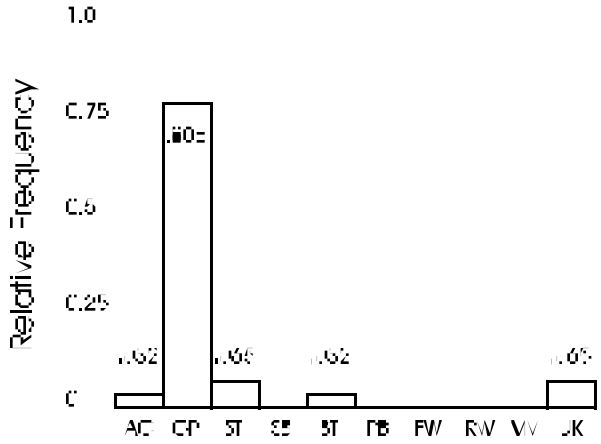
Frequency Function

VHF-FM channel 16	PBFEQ16.DAT
VHF-FM working channels	PBFEQWK.DAT

Recipient Function



VHF-FM Channel 16



VHF-FM Working Channel

3.2.6 Fixed-Wing Aircraft (FW)

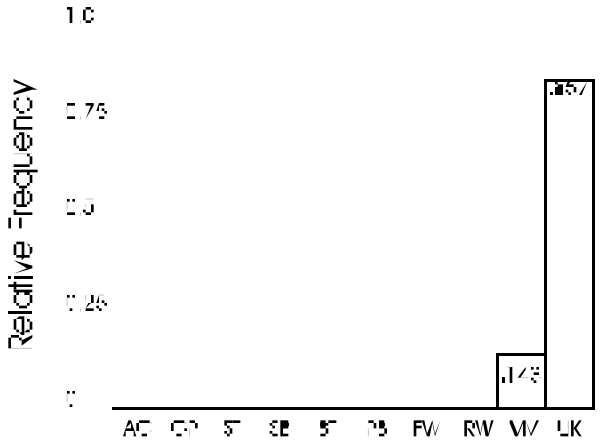
Duration Function

VHF-FM channel 16	Insufficient Data
VHF-FM working channels	FWDURWK.DAT

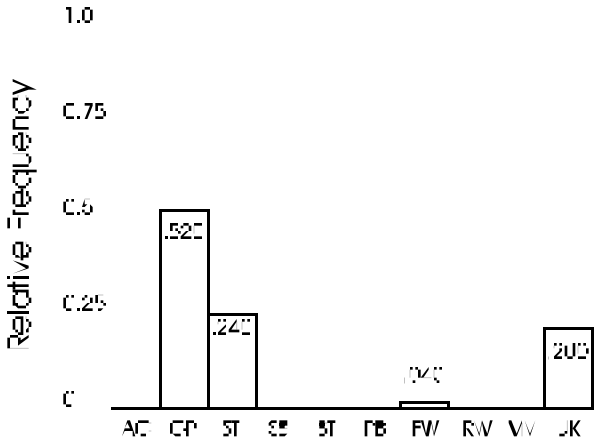
Frequency Function

VHF-FM channel 16	Insufficient Data
VHF-FM working channels	FWFEQWK.DAT

Recipient Function



VHF-FM Channel 16



VHF-FM Working Channel

3.2.7 Rotary-Wing Aircraft (RW)

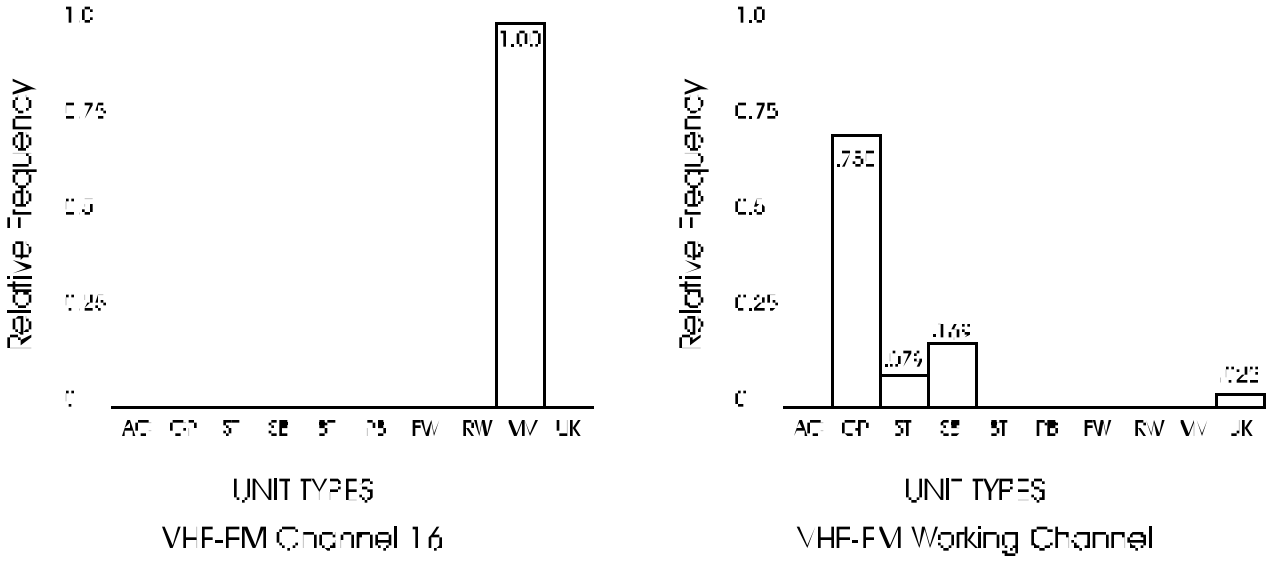
Duration Function

VHF-FM channel 16	RWDUR16.DAT
VHF-FM working channels	RWDURWK.DAT

Frequency Function

VHF-FM channel 16	RWFEQ16.DAT
VHF-FM working channels	RWFEQWK.DAT

Recipient Function



3.2.8 Motor Vessel (MV)

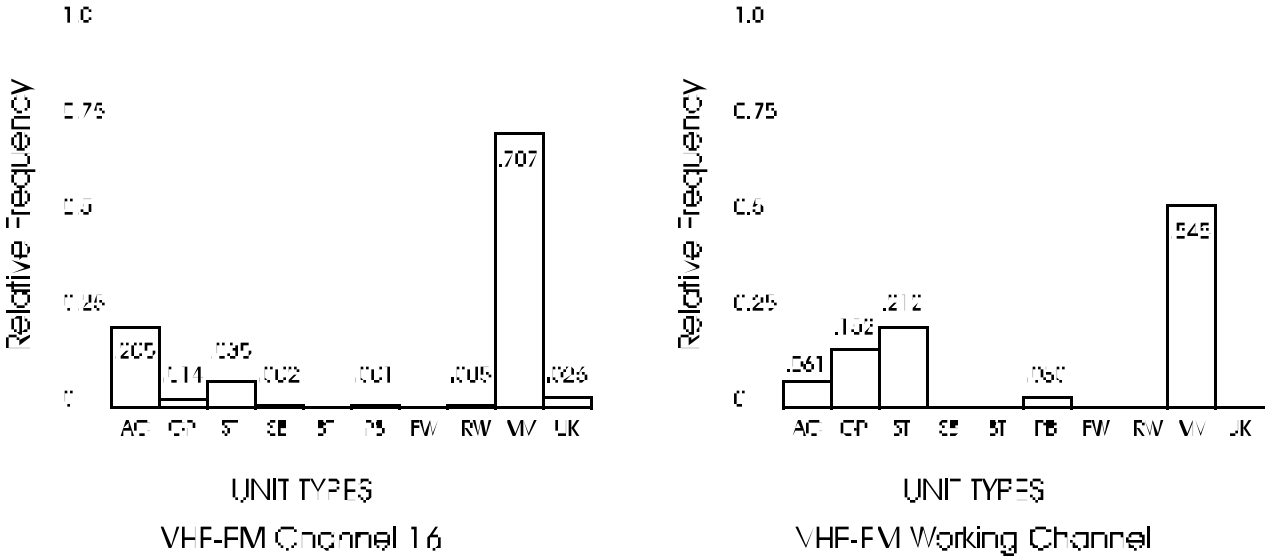
Duration Function

VHF-FM channel 16	MVDUR16.DAT
VHF-FM working channels	MVDURWK.DAT

Frequency Function

VHF-FM channel 16	MVFEQ16.DAT
VHF-FM working channels	MVFEQWK.DAT

Recipient Function



Summary

The First Coast Guard District voice traffic baseline model has been developed with the best information currently available. However, the model is still dynamic in that further data collection and analysis is pending, contingent on the remainder of this task. As more information becomes available the model will be refined and validated. It is important that this model reflect current NDS communications in the First Coast Guard District since it will be instrumental in developing an estimate of the data and voice traffic carried over the NDS in the First Coast Guard District both at present and into the future.

References

(1) Law, Averill M. and W. David Kelton: *Simulation Modeling and Analysis*, 2nd ed., McGraw-Hill, Inc., New York, 1991.
(2) Law, Averall M. and W. David Kelton: *ExpertFit Users Guide.*
(3) First Coast Guard District Telephone Directory.

Appendix A

Listing of Empirical Data Files
(Disk attached)

GPDUR16.DAT
GPDURWK.DAT
GPFEQ16.DAT
GPFEQWK.DAT
STDUR16.DAT
STDURWK.DAT
STFEQ16.DAT
STFEQWK.DAT
SBDUR16.DAT
SBDURWK.DAT
SBFEQ16.DAT
SBFEQWK.DAT
BTDUR16.DAT
BTDURWK.DAT
BTFEQ16.DAT
BTFEQWK.DAT
PBDUR16.DAT
PBDURWK.DAT
PBFEQ16.DAT
PBFEQWK.DAT
FWDURWK.DAT
FWFEQWK.DAT
RWDUR16.DAT
RWDURWK.DAT
RWFEQ16.DAT
RWFEQWK.DAT
MVDUR16.DAT
MVDURWK.DAT
MVFEQ16.DAT
MVFEQWK.DAT

Appendix B

Acronyms

Acronym	Definition
ANT	Aids to navigation team
AOR	Area of Responsibility
CCGD1	Commander, First Coast Guard District
CG	Coast Guard
FV	Fishing Vessel
LE	Law Enforcement
MEP	Marine Environmental Protection
MIB	Marine Information Broadcast
MV	Motor Vessel
NDS	National Distress System
OPNET	A discrete-event network modeling and simulation software package produced by MIL 3, Inc.
PDF	Probability distribution function
PV	Pilot Vessel
RC	Radio Check
RV	Recreational Vessel
SAR	Search and Rescue
UMIB	Urgent Marine Information Broadcast
WMEC	Coast Guard medium endurance cutter
WPB	Coast Guard patrol boat