LEVEL

REPORT NO. CG-D-17-79

AD A071486

NEW ORLEANS VESSEL TRAFFIC SERVICE WATCHSTANDER ANALYSIS

D.B. Devoe
J.W. Royal
C.N. Abernethy

U.S. DEPARTMENT OF TRANSPORTATION
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
Transportation Systems Center
Cambridge MA 02142

MAY 1979
INTERIM REPORT

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD
Office of Research and Development
Washington DC 20590

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

NOTICE

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
CG-D-17-79		

4. Title and Subtitle	5. Report Date
NEW ORLEANS VESSEL TRAFFIC SERVICE WATCHSTANDER ANALYSIS	May 1979
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
D.B. Devoe, J.W. Royal, and C.N. Abernethy	DOT-TSC-USCG-79-1
9. Performing Organization Name and Address U.S. Department of Transportation Research and Special Programs Administration Transportation Systems Center Cambridge MA 02142	10. Work Unit No. (TRAIS) CG 913/R9002
	11. Contract or Grant No.
	13. Type of Report and Period Covered Interim Report October 1977-April 1978
12. Sponsoring Agency Name and Address U.S. Department of Transportation U.S. Coast Guard Office of Research and Development Washington DC 20590	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

A team of human factors specialists analyzed the performance of watchstanders in the U.S. Coast Guard Vessel Traffic Center at New Orleans, LA. Data collected included copies of the center's forms and logs, records of watchstander activities for a total of 13 hours of observation, timed measurements of typical watchstander activities, records of 10 in-depth interviews with center personnel, stress questionnaires adminstered to 11 watchstanders, and photographs of equipment and workspace layout. Analysis of the data yielded tentative models of time utilization and the relationship of activity to traffic load and eight suggestions for improving operations.

17. Key Words	18. Distribution Statement
Vessel Traffic Services, Watchstander Performance, Human Factors, Traffic Management	DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	150	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

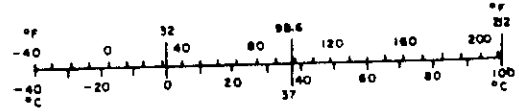
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.036	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

This is an interim report on the analysis of watchstander activities at the New Orleans Vessel Traffic Service. The study was performed by the Human Factors Branch of the Department of Transportation, Transportation Systems Center (TSC), under the sponsorship of the US Coast Guard, Office of Research and Development. Further analysis of the New Orleans data is planned, with particular emphasis on developing a model of watchstander activities. This report, however, is descriptive of activities at New Orleans VTS and stands alone as an analysis of operations.

The authors wish to express their sincere appreciation to LCDR C.T. Johnson and LT P.R. Corpuz of the Office of Research and Development and to CDR B.E. Joyce and all the personnel of the New Orleans VTS for their support and encouragement in every phase of this study. We gratefully acknowledge the guidance and contributions to the report provided by Dr. H.P. Bishop, Program Manager and Chief, Human Factors Branch (DTS-532) at TSC. Appreciation and recognition is also offered to R.A. Rudich and K.J. Kearns of TSC, for their expert assistance in the tedious task of reducing and analyzing the data.

Since the data were collected for this study, many of the suggestions and recommendations contained herein have been implemented by the commander at the New Orleans VTS, although, not necessarily as a result of this study.

One significant change was the placement of Coast Guard personnel at strategic points along the river to report traffic conditions back to the center via radio and telephone.

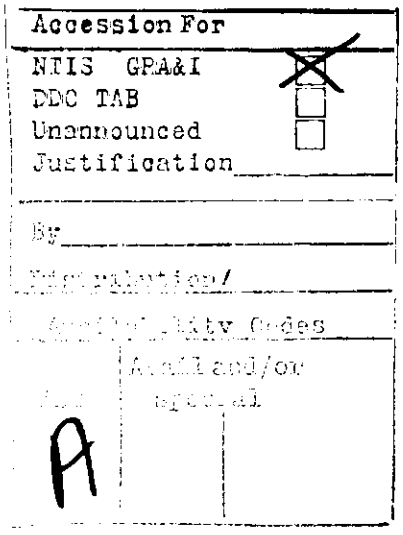


TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (CONTINUED)

LIST OF ILLUSTRATIONS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

NOLA ABBREVIATIONS

CCTV - Closed Circuit Television

COE - Corps of Engineers (Army)

COTP - Captain of the Port

CPO - Chief Petty Officer (enlisted paygrade E7, E8, or E9)

CRT - Cathode Ray Tube

DR - Dead Reckoning

ETA - Estimated Time of Arrival

ETD - Estimated Time of Departure

Hz - Hertz

LOA - Length Overall

MHz - Megahertz

NOLA VTS - New Orleans Vessel Traffic Service

PEM - Position Entry Module

PPI - Plan Position Indicator

QM - Quartermaster

RD - Radarman

SAR - Search and Rescue

SOA - Speed of Advance

SOP - Standard Operating Procedure

TSC - Transportation Systems Center

TSS - Traffic Separation Scheme

VHF-FM - Very High Frequency-Frequency Modulated

VMRS - Vessel Movement Reporting System

VTC - Vessel Traffic Center

VTS - Vessel Traffic Service

EXECUTIVE SUMMARY

In this, the third study in a program of Vessel Traffic Service (VTS) watchstander evaluations, a team of human factors specialists from the Department of Transportation, Transportation Systems Center (TSC) visited the New Orleans VTS (NOLA VTS) from April 10 through April 14, 1978 and collected data on operations at the Center. The data were taken back to TSC and analyzed for information which would provide a comprehensive description of watchstander activities and workload. The following data were obtained:

- Copies of VTS forms and logs,
- Detailed records of watchstander activities for a total of 13 hours of observation,
- Records of 10 in-depth interviews with VTS personnel,
- Stress questionnaires administered to 11 watchstanders (plus information obtained from stress questionnaires from 12 watchstanders obtained in October 1977)
- Critical incident interviews with 11 watchstanders,
- Photographs of equipment and workspace layout.

The New Orleans VTS area is divided into four sectors (three fully and one partially operational), each served by a sector watchstander at separate watch stations in the center. The watch team is supervised by a watch officer and a watch supervisor. Each watch station has a radio console for VHF-FM communications with masters and pilots of participating vessels. A CRT display and computer terminal at each station provides a dynamic display showing each known vessel's location and direction of travel, as determined by an automatic, dead-reckoning computer update, and a method for listing data on the status of traffic in the system. Information on vessel traffic comes into the center by vessels communicating over the radio; there is no direct traffic surveillance either by radar or television.

Each watchstander monitors his display, his assigned VTS radio channel, and channels 13 and 16; periodically communicating

with the vessels in the system, requesting information and giving advisories.

At the time of this study, there was an average peak traffic load of 100 vessels underway at any time (during daylight hours), with a maximum of 75 percent participation. Combing the three operational sectors, there was a mean of 42 communications per hour accounting for 39 minutes of total watchstander time. This averages out to about 13 minutes per sector watchstander. The total number of computer displays called up on the CRT was 175 per hour (taking 26 minutes per hour), or about 58 per watchstander. When all of the activities of watchstanders are combined, the following average time per activity allocations are derived:

ACTIVITY	AMOUNT OF DUTY TIME
Communications	22%
Tracking/Computer Activity	34%
Monitoring, Radio/Computer	30%
Job-Related Conversation	7%
Non-Job-Related Activity	7%
TOTAL	100%

The major findings of the personnel interviews reflected watchstander concern with the following problems:

- Poor participation by mariners,
- Lack of positive surveillance,
- Communications problems.

The results of the stress questionnaires indicated appreciable stress levels in most of the watchstanders which were largely attributed to lack of confidence in advisories (due to incomplete or erroneous input from users), lack of surveillance, problems with communications, and, perhaps, work schedules.

The recommendations of this study are as follows:

a. Give highest priority to the acquisition of surveillance aids.
b. Redesignate sector boundaries to better conform to transmitter capabilities,

c. Reassign communications channels to sectors or locks to reduce interference between VTS and lock radio transactions,

d. Provide for longer vessel identification word in computer.

e. Provide a capability for displaying two lists simultaneously in the status tabular area of the CRT,

f. In training, stress the symbolic nature of the radar-simulated display.

Comments are made, in the report, concerning the drawbacks of a strictly voluntary system at New Orleans but, at this time, no recommendation concerning NOLA VTS becoming a mandatory system appears warranted.

1. INTRODUCTION

1.1 PURPOSE

In order to reduce the probability of vessel collisions and groundings in crowded waterways, and to keep individual vessels apprised of the total traffic situation, the U.S. Coast Guard is operating several vessel traffic services (VTS's). To profit from the experience gained in operating these VTS's, both to improve present services and plan future services, the Coast Guard's Office of Research and Development has undertaken a broad program of analysis of VTS operations.

Human performance is basic to the operation of a VTS. The principal product of a VTS is a traffic advisory communicated by a VTS watchstander to a vessel master or pilot via VHF radio. The value of the advisory is dependent on the skills of the various watchstanders in acquiring and monitoring traffic data, in integrating the data into a coherent picture of present and anticipated traffic, and in composing and delivering a clear, concise, and accurate traffic advisory. Therefore, the Coast Guard has recognized that any model of VTS operations and productivity must include the influence of watchstander performance on system performance. The Coast Guard's Office of Research and Development has commissioned the Human Factors Branch of the Department of Transportation's Transportation Systems Center (TSC) to obtain and analyze data on watchstander performance and to integrate the results into models of watchstander activity and productivity.

1.2 SCOPE

For its first year's work on this study of VTS watchstanders, TSC has undertaken the collection and analysis of data on watchstander activities in routine operations in four operating VTS's: Houston-Galveston, Puget Sound, New Orleans, and San Francisco. This report presents the initial results of the analysis of the third VTS -- New Orleans.

2. DESCRIPTION OF NEW ORLEANS VESSEL TRAFFIC SERVICE

2.1 PURPOSE OF VTS'S

The Ports and Waterways Safety Act of 1972 authorizes the Coast Guard to operate VTS's in designated areas to "...prevent collisions and groundings and to protect the navigable waters of the VTS area from environmental harm resulting from collisions and groundings."* Vessel traffic services meet this objective by "...advising the masters of vessels with sufficient information to avoid the dangerous situations--before they occur."**

2.2 GENERAL CHARACTERISTICS OF THE NEW ORLEANS VTS

The New Orleans, LA, Vessel Traffic Service (NOLA VTS) provides a continuous service to vessel traffic on the Mississippi River from the Gulf of Mexico to the port of Baton Rouge, some 265 miles with additional side channels.*** At the time of the TSC observations the system was carrying an average of 380 vessels at any one time, only about 30% of which were underway. However, only partial service for the upper 84 miles of the system was being provided at the time of this study.

> "There are approximately 270,000 vessel transits annually in the New Orleans area, about 1/3 of which are tank ships and tank barges. About 140 million tons of petroleum, chemical, and petrochemical products are handled yearly. The Coast Guard has designated 22 area terminals as facilities of particular hazard...Thus, we have numerous potentially dangerous cargos transiting a confined waterway which borders on many vulnerable facilities and is close to a major population center."†

*Code of Federal Regulations, 33CFR161.101, 1977

**New Orleans VTS Watchstanders Manual August 1977.

***Unless otherwise specified, the descriptive material in this report comes from the following sources:

NOLA VTS Watchstanders Manual, August 1977.
NOLA VTS Operating Manual, September 1977
Operating Instruction Manual for the NOLA VTS, October 1977.
Working documents provided by the NOLA VTS.

†Federal Register, 41, 118, p. 24605, June 17, 1976.

The NOLA VTS recognizes nearly 200 destination points within its area. In addition to the Mississippi River, the system covers Southwest Pass (21.8 miles), South Pass (15.5 miles), and a combination of the Mississippi River Gulf Outlet, the Intracoastal Waterway, and the Inner Harbor Canal (77.8 miles). For operational purposes, the VTS area has been divided into four sectors. Figure 2-1 shows the VTS area with the sector boundaries. Figure 2-2 schematically portrays the various waterway segments, giving their boundaries in terms of standard mile markers.

A VHF-FM radio system permits the NOLA VTS to communicate directly with vessels in its area. There are 5 transceiver sites (shown in Figure 2-1). Two radio frequencies (Channels 11 and 12) have been reserved exclusively for VTS use. Channel 14 is used by the VTS and by various locks and bridges on the river.

2.3 FUNCTIONS

The NOLA VTS is a voluntary system, based on a vessel movement reporting system (VMRS), in which participating vessels report by radio to the VTS at specified locations, giving their positions and intentions, and the VTS responds with an advisory on encounters and conditions that the vessel may expect. The principal functions performed within the VTS are monitoring and advising.

2.3.1 Vessel Reporting

A vessel participating in the NOLA VTS is expected to maintain a listening watch on the assigned VTS channel and to make a series of reports to the VTS via VHF-FM radio. An initial report is made at least 15 minutes before a vessel enters the system, providing the vessel's name, destination, route, schedule, and additional descriptive data on the vessel and its cargo. Movement reports are made when the vessel enters the system and at specified reporting points along the route. Each movement report includes vessel name, position, time of entry or passing reporting point, and either speed or estimated time of arrival (ETA) at the

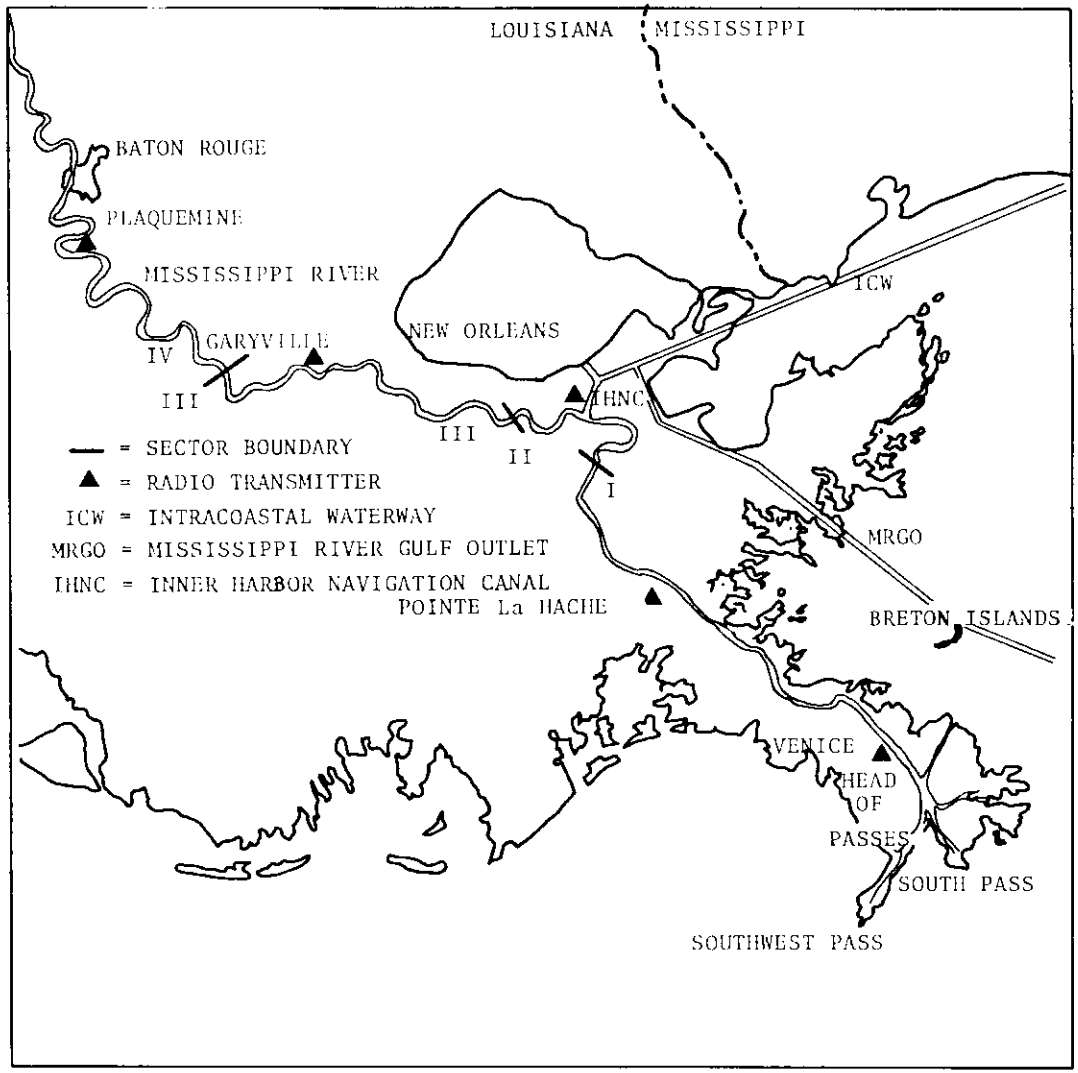


FIGURE 2-1. VESSEL TRAFFIC SERVICE AREA NEW ORLEANS LA

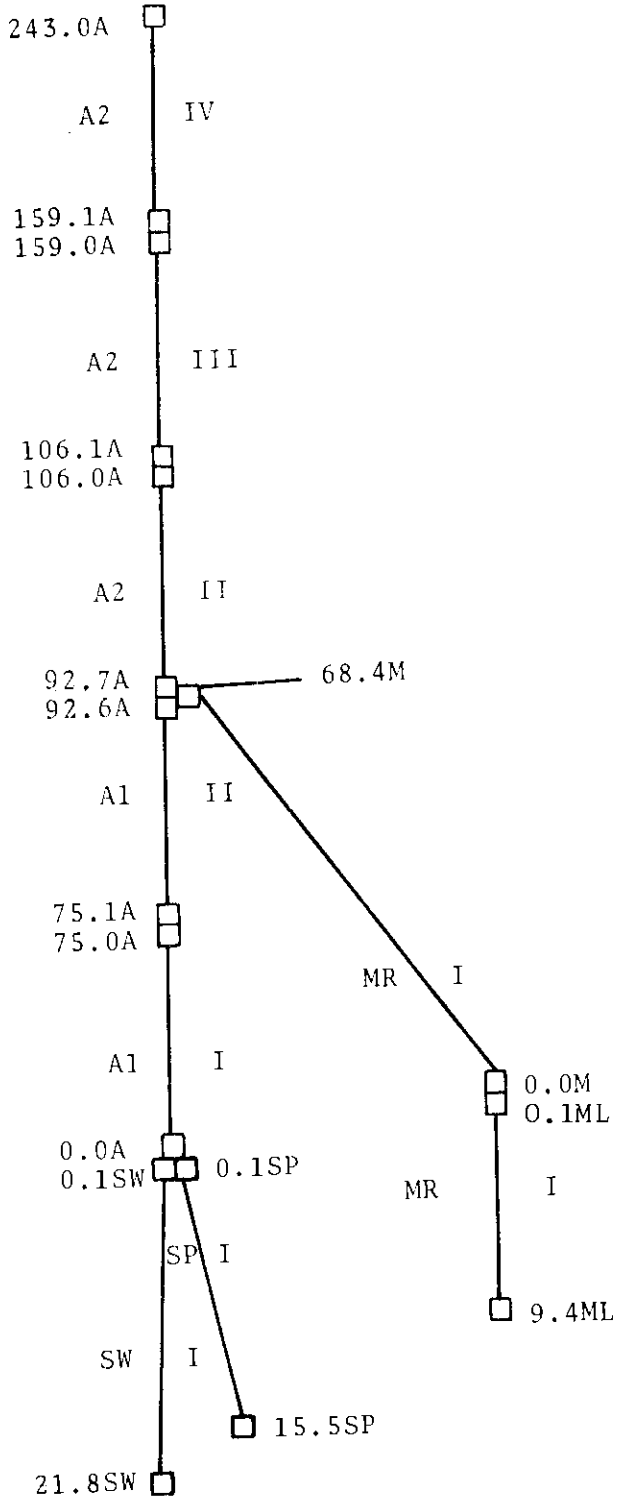


FIGURE 2-2. BOUNDARIES OF NOLA VTS WATERWAY SEGMENTS

next reporting point. There are 32 reporting points, including the sector boundaries. A final report, giving vessel name, location, and time, is made whenever a vessel departs from or moors within the VTS area.

Although participation is voluntary, all vessels subject to the Bridge-to-Bridge Radiotelephone Act, (e.g., ferries, passenger vessels, towboats, tugboats and many other vessels) are encouraged to participate.

2.3.2 Monitoring

The information received by the VTS from vessel reports is manually entered into a computer which integrates the data into a model of the traffic situation. Every 30 seconds, the computer uses the latest data to update (by dead reckoning) the position of every vessel underway in the system. Whenever new information on a vessel is entered into the computer, a revised position is calculated automatically. The computed model of the traffic situation is presented to watchstanders at the VTC on cathode ray tube (CRT) displays. Each CRT display shows a map of one of the system sectors with symbolic representations of vessels in their latest estimated positions. The watchstander may also select tabular lists of supplementary data for display on the CRT. Details of the information available to the watchstander are given in Section 2.6.2.

Each sector watchstander continuously monitors the situation display for his sector, calling up supplementary information by keyboard actions. Whenever information is received from the VMRS, the watchstander keys the data into the computer. The sector watchstander is responsible for anticipating the development of potentially hazardous situations and taking appropriate actions to avoid incidents, if possible, and to resolve incidents that do occur.

2.3.3 Advising

Whenever a vessel reports to the VTS, or whenever VTS personnel judge it desirable to contact the vessel, the sector watchstander provides the vessel with a traffic advisory. Basically, the advisory tells the vessel what encounters (meetings, passings, crossings, etc.) to expect up to the next reporting point. Information on aids to navigation and other factors that can affect a transit is also provided. In emergencies, cautions and directions may be issued, but under normal circumstances, a watchstander will not make a "recommendation," nor attempt to "control" vessel movements.

2.3.4 Additional VTS Functions

Because of its communications facilities, the NOLA VTS will relay messages between Coast Guard units and between vessels and on-shore company installations when it does not interfere with the basic functions.

To be able to perform the VTS functions, watchstanders also perform such support functions as training and the preparation and dissemination of records, reports, and messages.

2.4 STAFFING AND SCHEDULING

2.4.1 General Staffing

At the time of this study the NOLA VTS had an allowance of 45 personnel, 33 of whom were divided among four watch sections as shown in Table 2-1. Each section included one watch officer, one watch supervisor, at least six sector watchstanders qualified on all sectors, and one trainee when assigned.

2.4.2 Selection

Full Lieutenants, with seagoing experience as operations officer on a high-or medium-endurance cutter, or as Commanding Officer of a patrol boat, are selected as watch officers. Anyone with an average or above average proficiency rating and due for a

TABLE 2-1. NOLA VTS OPERATIONAL COMPLEMENT

CDR Commanding Officer

LCDR Executive Officer

	Section 1	Section 2	Section 3	Section 4
LT	1	1	1	1
RDC	1	1	1	1
QMC	1	1	1	1
RD2	1	2	1	3
QM2	1	1	3	2
RD3	3	1	1	
QM3	1	1		

shore assignment may be selected for a VTS watchstander assignment. Special consideration is given to those who volunteer for the assignment. In general, VTS watchstander assignments have been made from Radarman (RD) and Quartermaster (QM) ratings. A normal tour of duty is three years.

2.4.3 Training

Training is primarily on-the-job (OJT). Briefings and orientation trips are arranged, but there is no formal schedule of classes. This center has employed a former pilot who, as part of his duties, acts as an in-training advisor. He lectures on the commercial activities along the river, techniques of piloting, rules of the road, and arranges some of the orientation trips. However, he does not function as an "instructor" in the usual sense. Every trainee must complete six periods of training, designed to be accomplished in six months; however, each trainee proceeds at his own pace, some finishing earlier, occasionally someone failing to qualify at all. Generally, it takes up to six months for a watchstander to become fully proficient.

The first period of the training course usually involves initial indoctrination during the normal working hours. This period lasts for approximately one week. Trainees must become familiar with the Organization/Regulation Manual; read the Notices and Instructions; learn operations, chain of command, and the watch-schedule; attend a lecture on VTS history, mission, and area of responsibility; tour the facility; and understand equipment operation. Periods 2 through 5 involve familiarization with each sector. Each of these four periods consists of six watches at a sector followed by a vessel ride on that sector. Trainees rotate through all four sectors. Each of these four periods lasts approximately two weeks. Trainees are to learn all communications and computer console controls, all computer keyboard functions, and the purposes for guarding each of the FM channels available. Trainees are to become familiar with navigation and radio communications procedures and memorize the geography of each sector including abbreviations and mile marks. At the end of these four

periods, trainees take a written examination covering this material. Period 6 is the final qualification. The trainee must demonstrate proficiency as a watchstander on all four sectors to the satisfaction of the Executive Officer or the watch officer.

2.4.4 Work Schedule

There is a regular rotation of four watch sections through watch shifts and days off. Watch shifts are 12 hours long. The day shift starts at 0700 and finishes at 1900 followed by the night shift from 1900 to 0700. Watchstanders must report to the center one-half hour prior to the beginning of their shift to become familiar with the traffic situation.

Watchstanders work the day shift for three days, then have 96 hours off. They then work the night shift for three nights, then have 72 hours off. The standard watch schedule is presented in Table 2-2.

Typically, during a watch shift the watchstanders operate one sector position, with a relief break approximately every 2 hours at the watch supervisor's discretion.

2.5 OPERATING POSITIONS

The NOLA VTS provides its services by assigning various activities to the following operating (or duty) positions: watch officer, watch supervisor, sector watchstander and external communicator. A basic watch section comprises one watch officer, one watch supervisor, and six sector watchstanders. Four sector positions are continually manned, while the other two watchstanders are either on break or performing external communicator duty. As a rule, a watchstander does not man a sector position for more than two hours without a break. One or more trainees may also be assigned to each watch section.

2.5.1 Watch Officer

This position is always manned by a commissioned officer who serves as the direct representative of the Commanding Officer.

TABLE 2-2. TYPICAL WATCH SCHEDULE

Week 1	M	T	W	T	F	S	S
0700-1900	1	1	1	3	3	3	2
1900-0700	2	2	2	4	4	4	1
off	3	3	3	1	1	1	3
off	4	4	4	2	2	2	4
Week 2							
0700-1900	2	2	4	4	4	1	1
1900-0700	1	1	3	3	3	2	2
off	3	3	1	1	1	3	3
off	4	4	2	2	2	4	4

The watch officer is in overall charge of the watch and is responsible for the conduct of the watch and the completion of its mission. He conducts general supervision of all activities and may intervene at any position to resolve difficulties.

2.5.2 Watch Supervisor

This position is always manned by a Chief Petty Officer (CPO*). The watch supervisor monitors the activities of the watch and provides guidance and assistance to watchstanders as needed. He may provide relief of sector watchstanders during watch rotation, meals and the like. Watch rotation is generally conducted at the watch supervisor's discretion.

2.5.3 Sector Watchstander

Each sector watchstander mans a sector position. He receives communications from all participating vessels in his sector and issues traffic advisories as required from his communications console. He continually monitors the traffic situation as revealed to him by the VMRS, by his computer-generated situation display and associated data lists, by messages overheard on the bridge-to-bridge radio frequency (Channel 13) which he monitors, and by any other available source (such as looking out the window directly at traffic on the river). He enters information into the computer as obtained from a vessel's initial, position and final reports, using the keyboard on his display console. He also uses the keyboard to call up display lists as needed to prepare advisories or to increase his knowledge of the details of sector traffic. Where available, he may operate, or supervise operation of, traffic control lights.

The sector watchstander anticipates developing traffic problems and advises masters and pilots in time for them to initiate corrective action. In emergencies and with the approval of the watch officer, he may issue directions such as not to enter certain

*Enlisted pay grade, E-7, E-8, or E-9.

areas, not to overtake certain traffic, not to exceed a certain speed, and the like. (These same actions may be initiated under direction of the Captain of the Port). When the situation permits or requires it, he assists other agencies by relaying messages via his communications equipment.

2.5.4 External Communicator

The external communicator duties include guarding the teletype circuit, the telephone system, and Channels 13 and 16. These duties involve handling routine enquiries from other agencies, including the general public, and relaying messages. At the time of the TSC observations, the duties of external communicator were shared by the watch officer, the watch supervisor and any watchstanders on rest breaks, rather than being assigned specifically to one watchstander.

2.6 EQUIPMENT AND WORKSPACE

2.6.1 VHF-FM Radio and Communications

The NOLA VTS has a VHF-FM communications system that allows the center to communicate with all vessels within the VTS area of responsibility. This system consists of 5 remote transceiver sites and a microwave relay station. (Locations of the transceiver sites are shown in Figure 2-1.) Three frequencies have been reserved for VTS use and are assigned as follows:

Sector I	Channel 12	(156.600 MHz)
Sector II	Channel 11	(156.550 MHz)
Sector III	Channel 14	(156.700 MHz)
Sector IV	Channel 11	(156.550 MHz).

(Channel 14 is shared with the locks.)

Additional frequencies that may be selected as required include Channel 13 (bridge-to-bridge communications), Channel 16 (maritime emergency channel) and Channel 6.

Communications Consoles. Each of the seven operating positions (5 sector watchstander positions, supervisor, and external

communicator) has a communications console. All consoles have most features in common. These features include controls (push-buttons or knobs) for:

Selection of channels to be heard on headsets
Selection of channels to be heard on console speakers
Selection and operation of VTC intercom
Selection and operation of assigned transceviers
Operation of tape recorders to replay the last recorded message.

(Figure 2-3 shows a typical sector watchstander's communications console.)

Three of the sector watchstander consoles and the supervisor's console have controls for operating and monitoring three sets of traffic control lights. The supervisor and the external communicator both have a weather monitor panel with a speaker and controls for monitoring broadcasts from the local National Weather Service, and both positions have a 29-line telephone call director. The external communicator has an automatic telephone answering unit which can automatically answer incoming calls with a pre-recorded message.

The supervisor alone has a special console through which assignment of transceiver sites is made for the consoles at the other positions. Therefore, at any position, channels can be selected for monitoring and transmitting, but only the supervisor can determine which transceiver site will be used. This console also has a fault sensing panel for monitoring the status of the microwave, power and telemetry systems.

Other Equipment. There are two teletype printers located in the external communications room, one to provide hard copy of computer lists selected at the display consoles, the other for communication with agencies outside the VTC. The equipment room contains the VTS audio logging recorder, a 28-channel tape recorder that continuously monitors and records on 24-hour tapes all VHF communications within the VTS area, selected telephone communications with the VTC, and the time (24-hour clock).

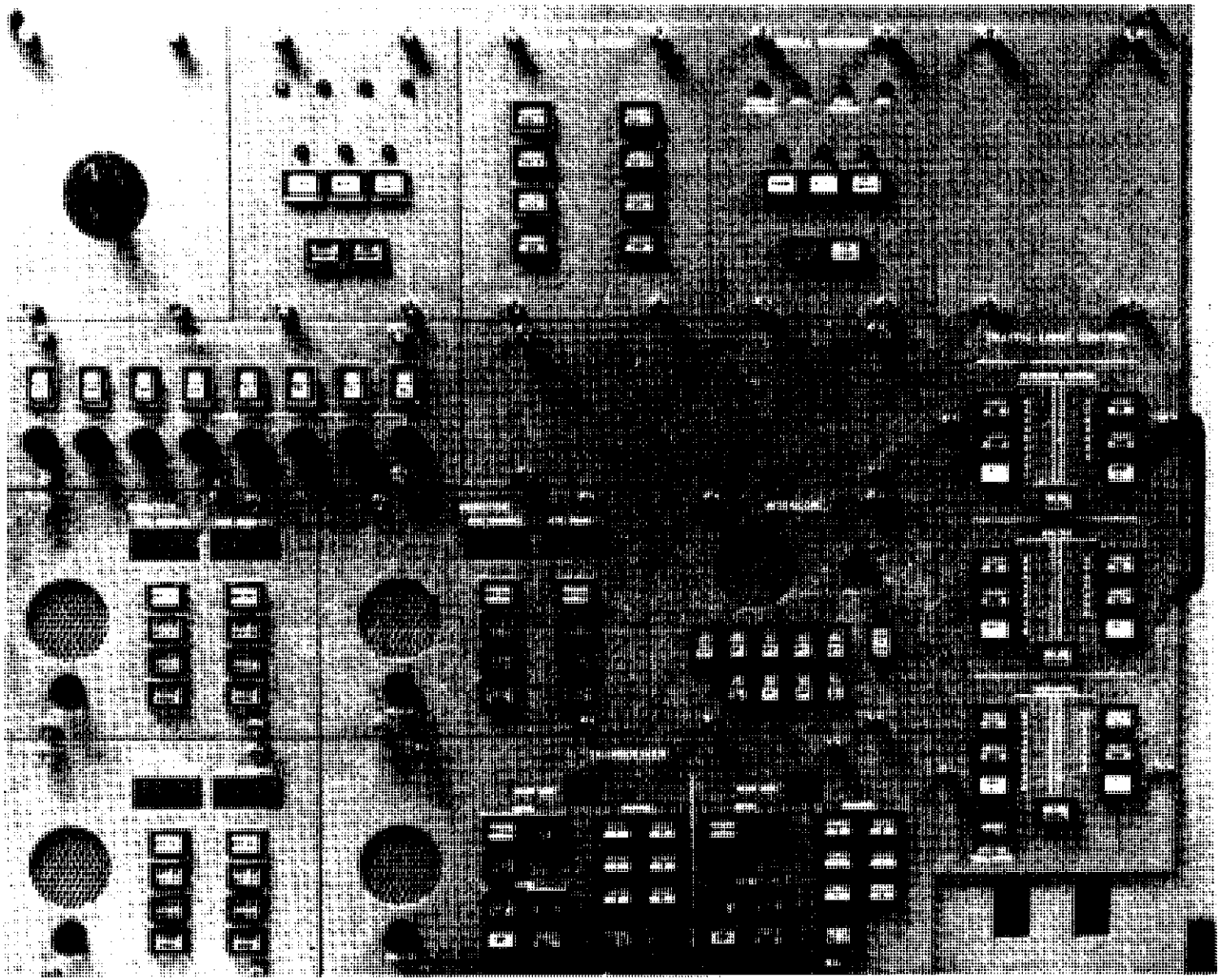


FIGURE 2-3. SECTOR WATCHSTANDER'S COMMUNICATIONS CONSOLE

2.6.2 Display Console

Console. The NOLA VTS has a computer that accepts, integrates, stores, and displays vessel traffic information. Using a vessel's location, destination, and speed of advance (SOA), it dead-reckons every underway vessel's position and updates this information in the displays every 30 seconds. The VTS personnel interact with the computer through input-output terminals (the display consoles), one of which is shown in Figure 2-4.

There are eight display consoles in the VTC, one at each sector watchstander position, one in the external communications room, and two at the supervisor's position. One of the supervisor's display consoles is a slave unit, which will repeat any display showing on a selected sector watchstander's display but which cannot be used to exercise any control. Otherwise all eight display consoles are identical.

Each display console contains a 22-inch CRT for the presentation of alphanumeric and geographic data to the operator. The CRT periphery is encircled by a compass rose. Operator controls are located on the four panels that surround the CRT. These panels are back lit to provide illumination in a darkened environment. Separate controls are provided for independent adjustment of the illumination of the compass rose and the other front panel lights.

The operator controls include such capabilities as adjustments of power, intensity, focus, scale, centering, expansion, leader length, and character size. There are also inhibit switches which can be used to delete such groups of data as vessels upbound, downbound, awaiting entry, anchored, or crossing; vessel designators; geographic symbology; leader lines; vessel position symbols; and tabular data.

Keyboard. A keyboard for data entry and display selection is attached to each console (except the supervisor's slave unit). The 64 back lit keys are arranged in a matrix that includes:

26 alphabetic letters in standard typewriter ("QWERTY") arrangement

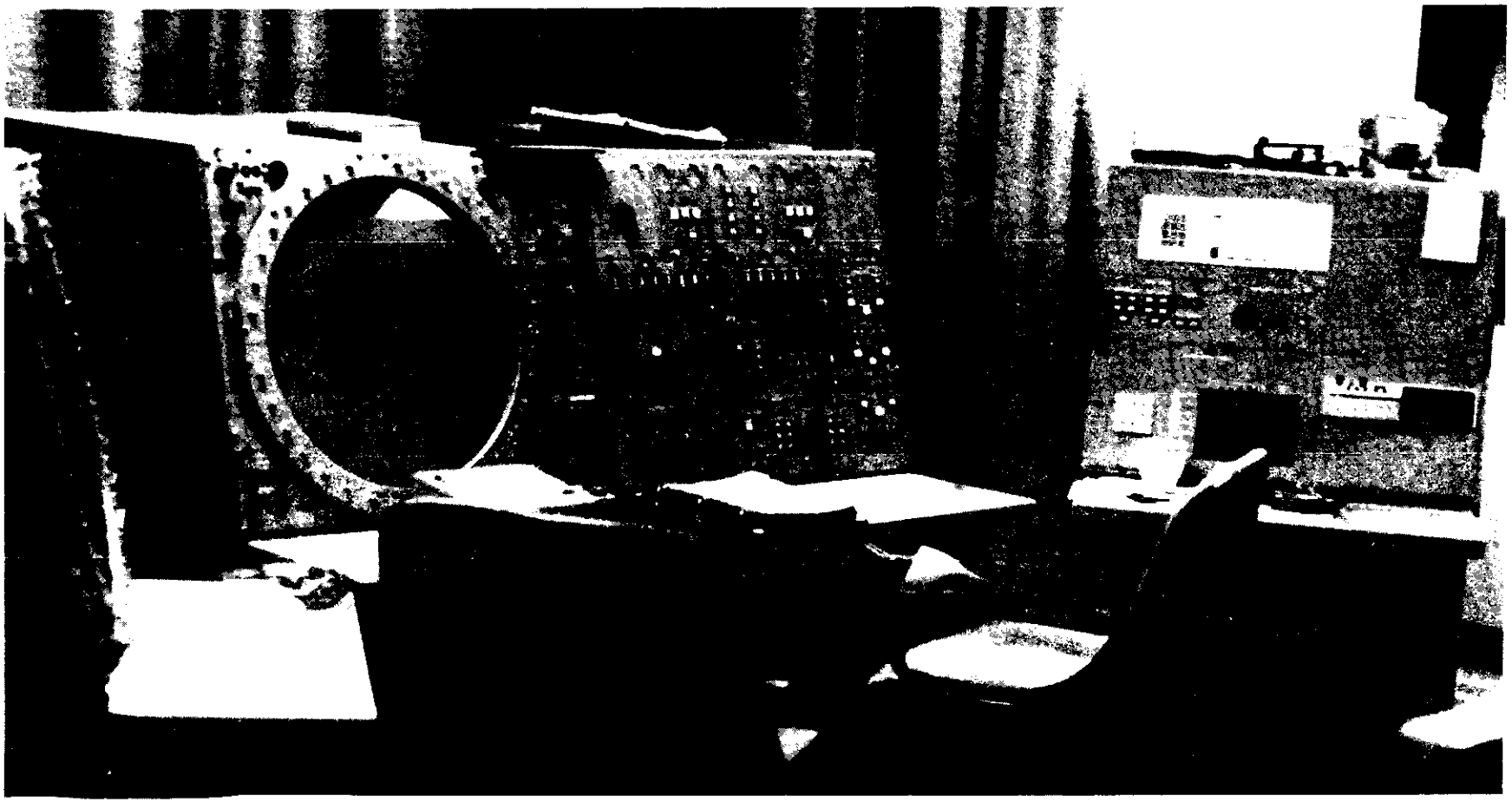


FIGURE 2-4. DISPLAY CONSOLE

10 numerics in standard telephone keypack arrangement.

13 function keys (such as "Vessel Status", "Traffic Summary", etc.)

7 miscellaneous keys (such as "Enter", "Print", etc.)

8 unassigned keys

Figure 2-5 shows a keyboard.

Position Entry Module (PEM). The PEM is a small joystick control that positions a cursor symbol on the CRT display. The unit also has an "Enter PEM" pushbutton to enter a PEM-indicated position into the computer. The PEM unit is attached to the keyboard (see Figure 2-5).

Displays. Alphanumeric and symbolic information is generated at selected locations on the CRT with a 30-Hz refresh rate. As a background for this information, a video mapping unit generates a map by a radial sweep of 3 seconds per cycle. An individual map may be selected for each sector, presenting a stylized view of the basic geographic data, such as the waterway, landmarks, bridges, and navigational aids. The map may be offset or expanded using the console switches. The individual map formats are shown in Appendix A.

Dynamic Display. The dynamic display shows the positions of vessels in the waterway, using a symbol for the vessel coded to indicate mode of operation and direction of movement. A leader line connects each position symbol with a 4-character data tag. The first three characters in the data tag constitute a vessel designator, consisting of one numeral and two letters randomly assigned by the computer. The fourth character is a letter code for type of vessel. All elements of the dynamic display are offset or expanded with the map. In addition, the size of characters and the length and direction of leader lines can be independently controlled. Figure 2-6 shows the basic symbols used in the dynamic display.

Every 30 seconds, the computer dead-reckons the position of every moving vessel in the system and updates its position on the dynamic display, advancing the leader and data tag with the vessel

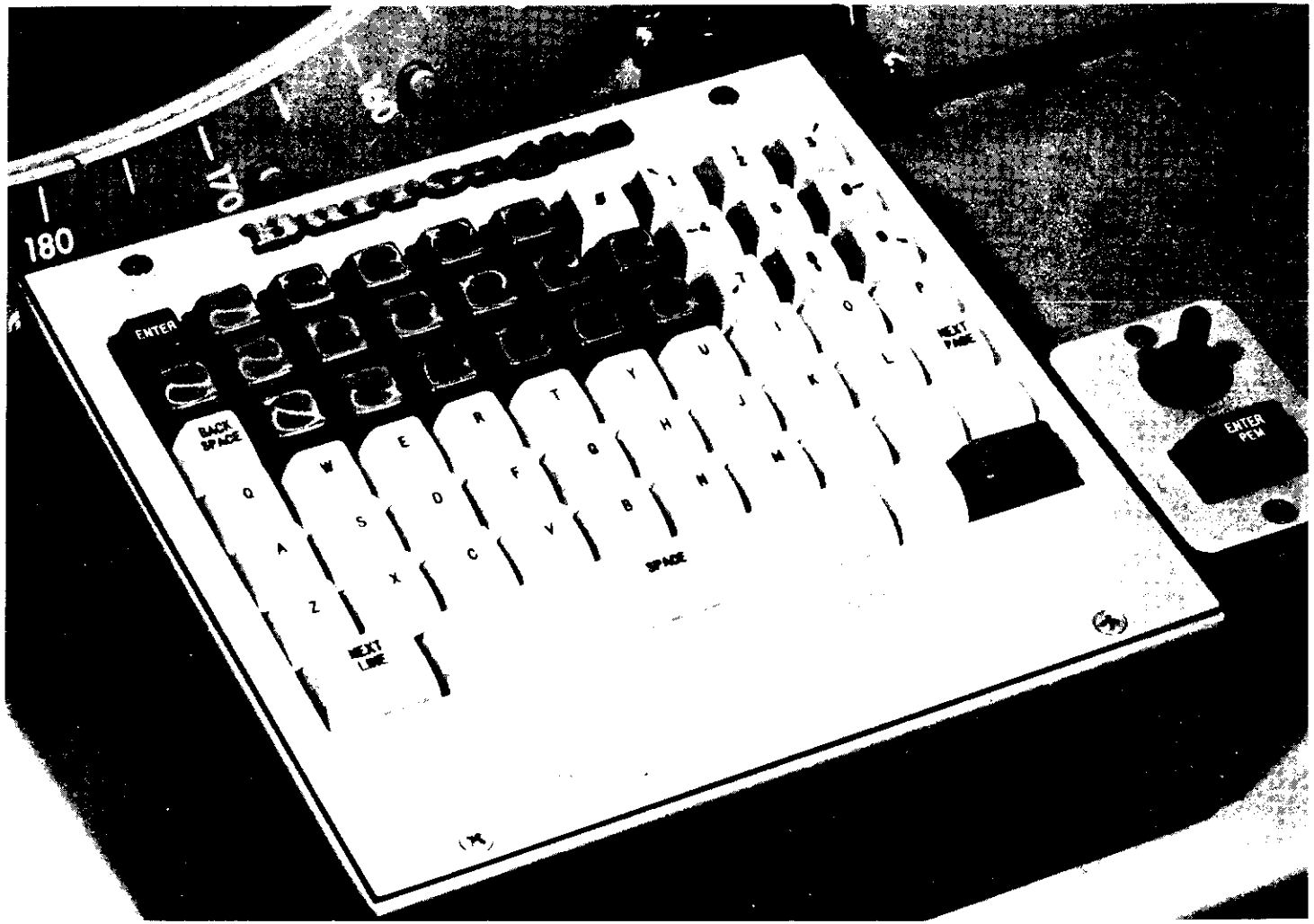


FIGURE 2-5. KEYBOARD WITH POSITION ENTRY MODULE

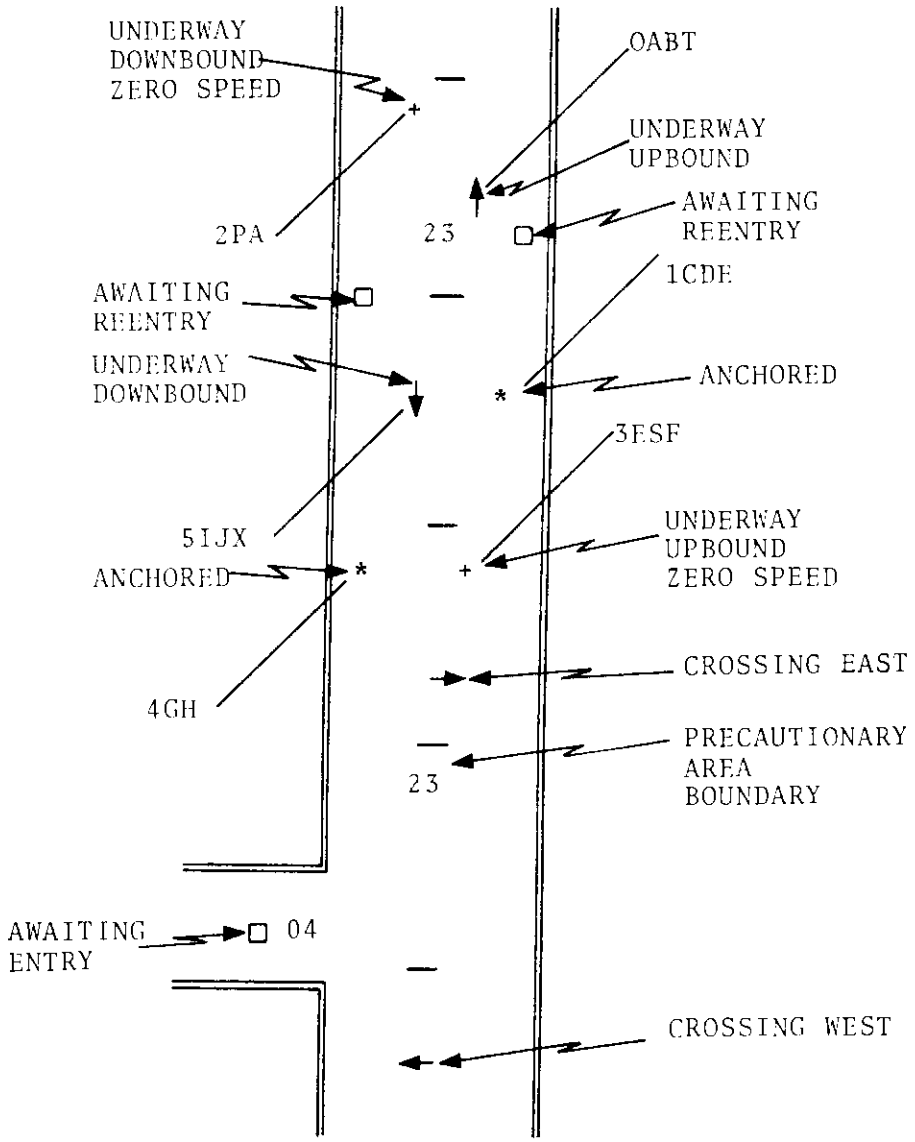


FIGURE 2-6. SYMBOLS USED IN DYNAMIC DISPLAY

symbol. Whenever a displayed symbol reaches a specified reporting point, the symbol is advanced no further and the symbol, leader, and data tag commence flashing on and off. Flashing continues until the operator takes some appropriate action to cause tracking to resume. When a symbol has been flashing for ten minutes (the flashing period is selectable anywhere from 2 to 10 minutes), the words "HOLD ALERT" appear on the CRT and also flash until action is taken.

System Tabular Area. At any location designated by the operator, the following system tabular information is continuously displayed: time (to nearest minute), date, sector being displayed, and the number of seconds (1-30) since the last position update. This area is also used for the "HOLD ALERT" message, and a precautionary area alert message (flashing "PA ALERT") used when certain unacknowledged alarm conditions are present.

Status Tabular Area. For any location designated by the operator, any one of several data lists may be called up by appropriate keyboard action. These lists constitute one means whereby the operator communicates with the VTS system. Data entry is effected by filling in blanks in the new vessel status lists via keyboard action. Other lists simply present system status information on request. The lists are:

New Vessel Status
Vessel Status
Critical Traffic
Vessels Anchored
Vessels Docked
Vessels Underway
Awaiting Entry-Reentry
Operator Information
Precautionary Areas Definition
Precautionary Area Alert.

An example of each of these lists is given in Appendix A. Figure 2-7 shows a typical CRT display, including map, dynamic data, system tabular data, and a system status list.

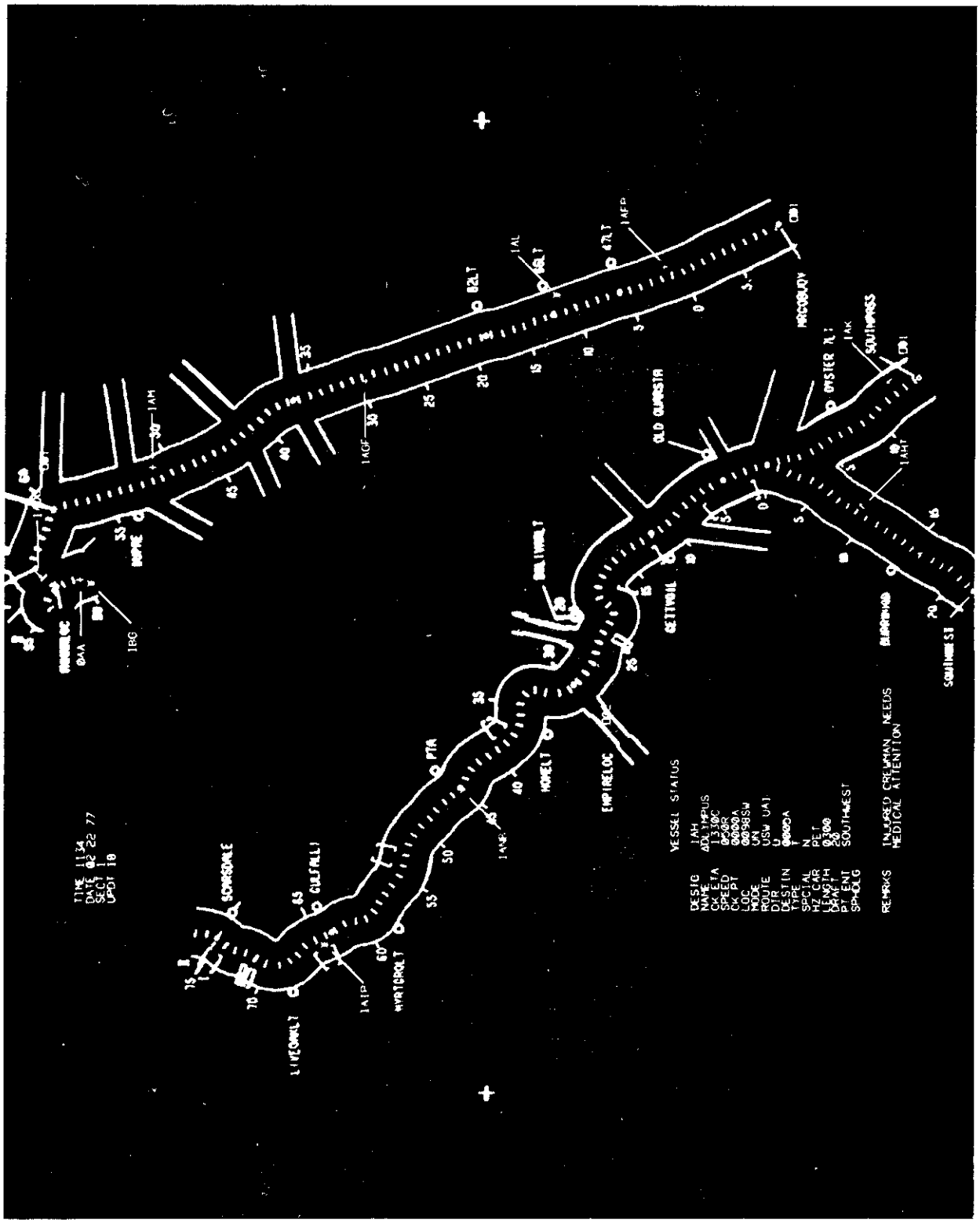


FIGURE 2-7. CRT DISPLAY

Console Operation. Data entry is effected primarily by appropriate keyboard actions, principally through the use of one of the following function keys and the appropriate alphanumeric keys:

- o New Vessel
- o Vessel Status
- o Track Continue
- o Track Correct
- o Track Terminate.

There are additional functions mainly used by the supervisor to set up operating positions and operating information.

The new vessel and vessel status function keys call up the related status tabular lists. A cursor marker can be keyed to any space on the list and desired data can then be keyed in. Actuation of any of the other function keys will call up a prompter list in the status tabular area which will guide the operator in making the necessary entries. Position information may often be entered using the PEM. As entries are keyed, they appear on the display for preview but enter the computer for processing only when the "ENTER" key is pressed.

Whenever the "PRINT" key is pressed, the status tabular data currently on display will be printed on the teletype in the external communications room. A buffer memory permits entry of print requests at a much greater rate than the printer's response.

To assure detection and correction of erroneous entries, the computer checks each "ENTER" action against such criteria as wrong sequence of keys, numerical values outside acceptable ranges, missing data, and the like. When an error is detected, an error symbol is displayed at the appropriate location, and an explanation is given in the lower portion of the status tabular area under the heading "VALUE WRONG," "VALUE MISSING", or "CONFLICT." If no errors are detected, the message "ACCEPTED" is displayed, and the entry is processed.

2.6.3 Supervisor's Equipment

At the supervisor's position there is a fully operational display console, a communications console, a supplementary communciations console for assigning transceiver sites to the sector positions, and a slave display console that can be set to repeat everything displayed at any one of the sector position display consoles. The position also includes a small desk for the watch officer.

2.6.4 Workspace Layout

The operations room at the NOLA VTC is approximately 20 by 60 feet. It can be illuminated by fluorescent ceiling lights, but is generally kept at a low level of illumination by the use of a dimmed overhead spotlight at each operating position, to minimize interference with the CRT displays. Windows overlook the main waterway at the western side of its junction with the Inner Harbor Navigation Canal (in Sector II). The windows are covered with heavy drapes in the daytime; however, the Sector II watchstander will sometimes observe traffic from the window, since this constitutes the only available direct check on the accuracy of the computed traffic situation. The room is air conditioned and has sound-absorbent panels in the ceiling.

About two-thirds of the operations room is occupied by the sector positions, each position having a display console and a communications console. Figure 2-8 shows the arrangement of equipment and workspace, Figure 2-9 shows a general view of the sector positions area, and Figure 2-10 shows one of the sector positions. At the time of the TSC observations, Positions 2, 3 and 4 were assigned to Sectors I, II and III, respectively. Position 5 was assigned to Sector IV for monitoring only, and Position 1, sometimes used for separate operation of Sector IA, was unmanned.

The remaining third of the operations room is occupied by the supervisor's position and an entrance ramp, as shown in Figures 2-8 and 2-11.

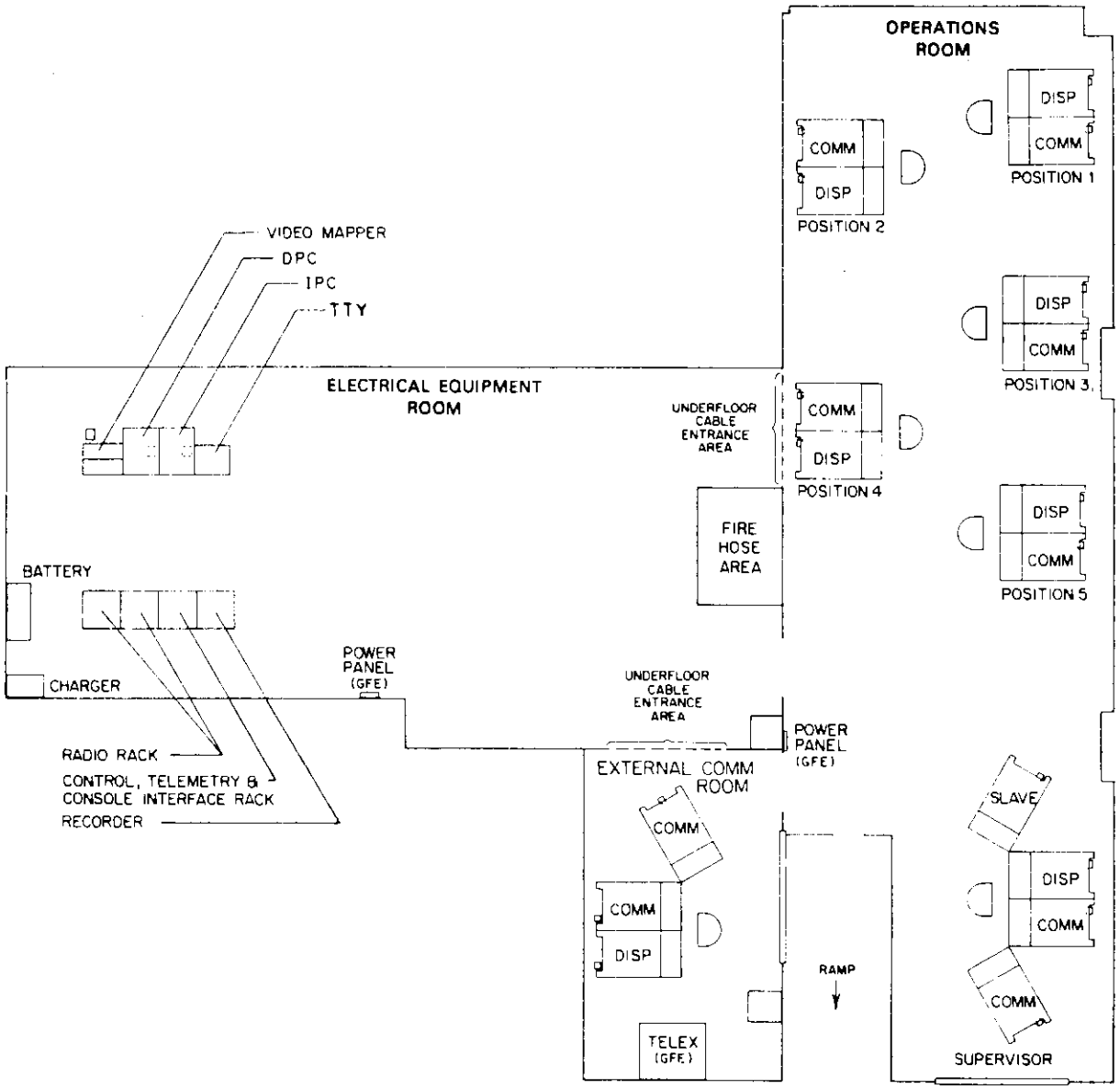


FIGURE 2-8. OPERATIONS ROOM LAYOUT

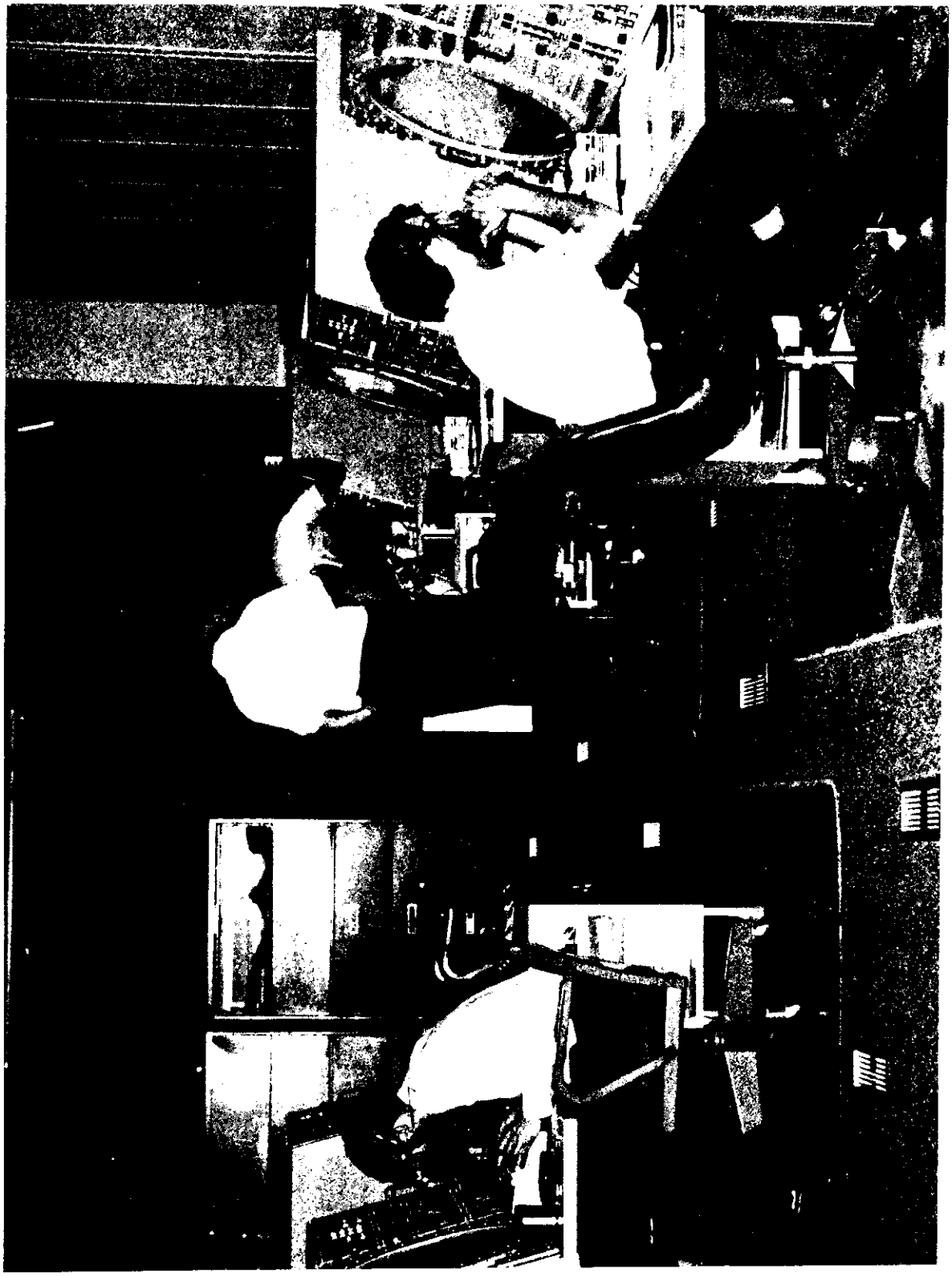


FIGURE 2-9. GENERAL VIEW OF SECTOR POSITIONS

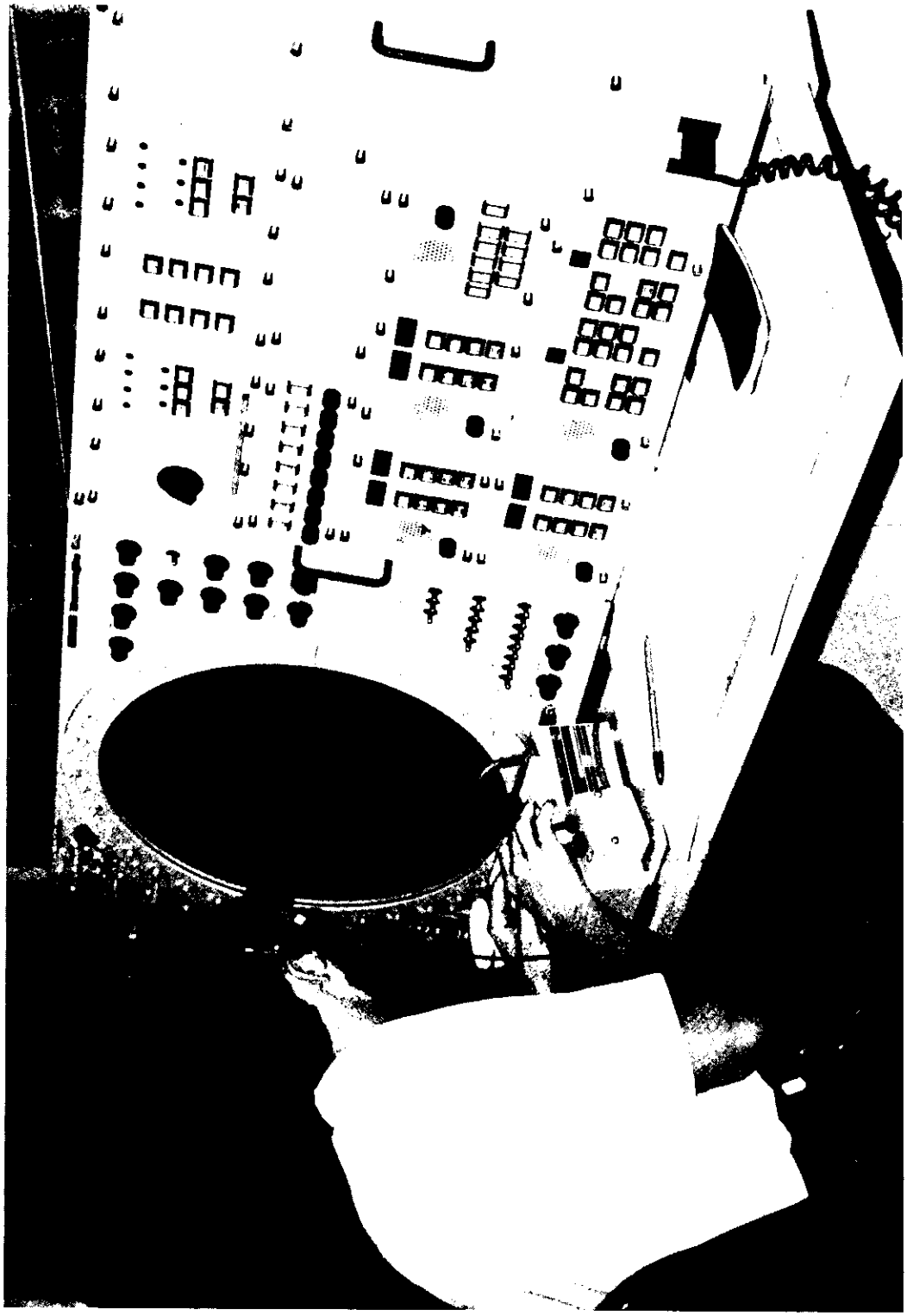


FIGURE 2-10. SECTOR POSITION

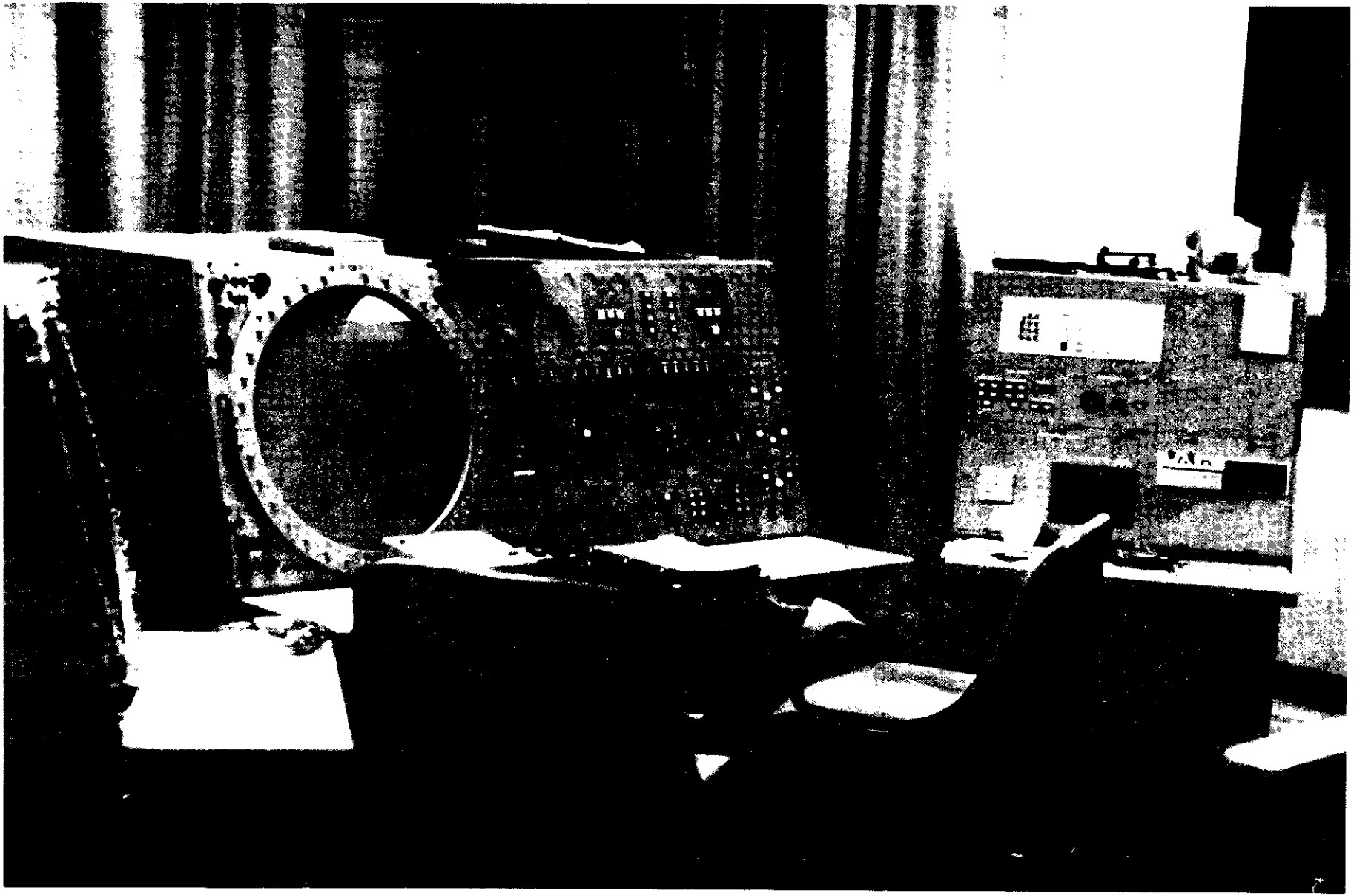


FIGURE 2-11. SUPERVISOR'S POSITION

Adjacent to the operations room are the external communications room (with a display console, two communications consoles, and teletypes), and the electrical equipment room (containing the supporting computer and communications equipment).

2.7 EVENTS IN A ROUTINE TRANSIT

This study is limited to routine VTS operations. Below is described, briefly, the sequence of events as a vessel makes a normal transit within or through the NOLA VTS area. In operation, procedures are regularly adapted to circumstances, and many variations on the described routine may occur. Figure 2-12 shows the sequence of principal events.

2.7.1 Entry

Initial Report. At least 15 minutes before entering the system (from outside the VTS area or from a dock or anchorage within the area) a participating vessel reports its intentions to the VTS sector watchstander, generally via the assigned VHF radio channel. An initial report contains some or all of the following information:

Name of vessel
Type of vessel
Present position of vessel
Destination and route
General nature of cargo carried
Cargo of particular hazard
ETA at point of entry, or time of departure from point within VTS area
Maximum length (including tows)
Maximum beam (including tows)
Configuration of tows
Special handling requirements.

The watchstander makes written notes while receiving this information, then acknowledges the reception. He then calls up the new vessel display and uses the keyboard to enter the data

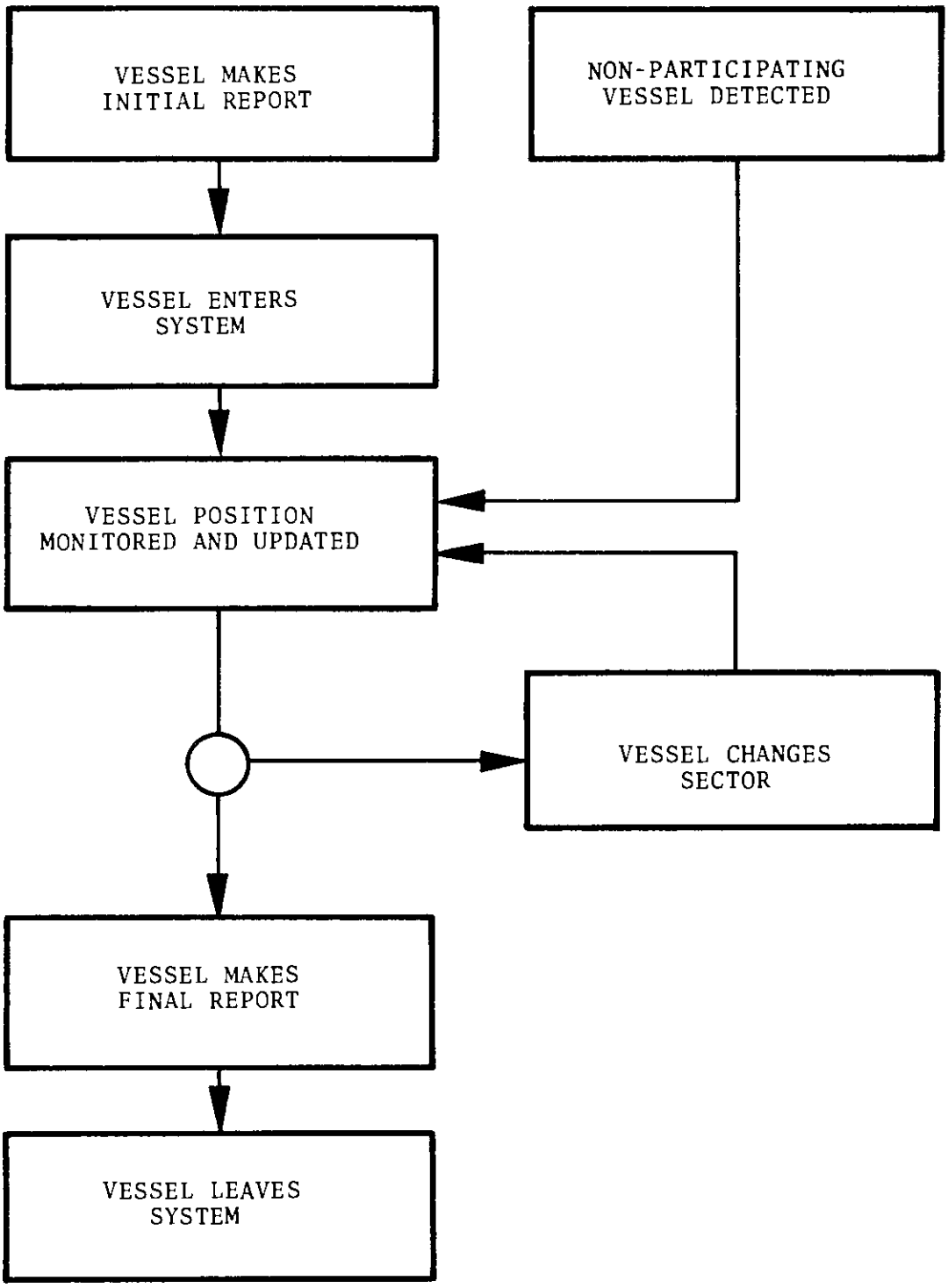


FIGURE 2-12. EVENT SEQUENCE FOR ROUTINE TRANSIT

into computer storage. A few watchstanders can type the information directly into the system while receiving it.

Entry Report. When the vessel enters or gets underway within the VTS area, it reports the following information:

Name of vessel
Position
Time of entry
Next reporting point and ETA (or speed).

The watchstander calls up the vessel status display and uses the keyboard to enter the data. Completion of this entry starts a tracking routine by which the computer calculates the position of the vessel by dead reckoning every 30 seconds. Location of the vessel is automatically updated on the dynamic display and all appropriate listings.

Non-Participating Vessels. Participation in the vessel movement reporting system is voluntary, and there are always numerous non-participants in the system. By maintaining a continuous listening watch on Channel 13 and through reports from other vessels, the watchstander becomes aware of non-participants. When a non-participant is thus detected, the watchstander enters all available information on the vessel and initiates a track. By adding a letter "X" to the vessel designator and appropriate remarks in the vessel status list, the watchstander can readily distinguish between participating and non-participating vessels.

2.7.2 Transit

Routine Position Monitoring and Updating. The watchstander maintains a mental picture of traffic in his sector by monitoring the dynamic display, communications on the assigned sector channel and Channel 13, and any supplementary computer displays he may elect to call up. The principal decisions and actions of the watchstander in performing this function are shown in Figure 2-13.

Position Report. At designated reporting points, the vessel is required to report to the VTS the following information:

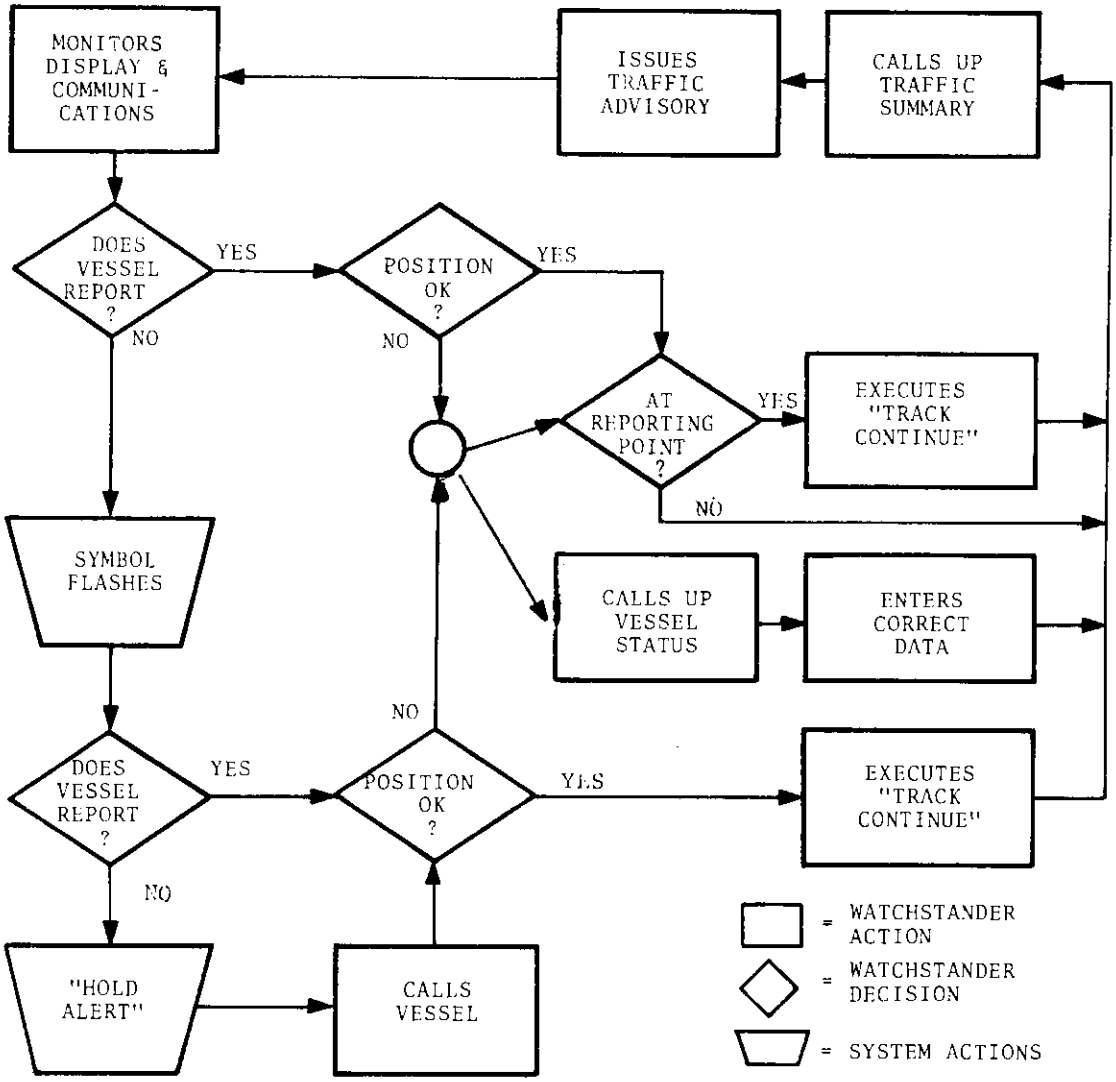


FIGURE 2-13. DECISION FLOW DIAGRAM: VESSEL POSITION MONITORED AND UPDATED

Name of vessel
Position
Time of passing reporting point
Next reporting point and ETA (or speed).

Example: "New Orleans Traffic, ROBERT L., abeam Empire Locks at 1530, estimating Getty Oil, 1650, OVER."

The watchstander checks this information against the dynamic display and supplementary listings (if needed). If the new data and the displays agree, he will execute a track continue action with the appropriate function key, and the computer will continue tracking. If there is disagreement among the data, the watchstander will determine the most probable true location, using all relevant available data. He may correct the track either by moving the vessel symbol to the new location via a track correction action, or he may call up the vessel status display and enter the corrected data via the alphanumeric keyboard. In either case, the computer will automatically make all necessary corrections in all displays and continue tracking. These actions generally require only a few seconds to accomplish.

Traffic Advisory. As soon as the vessel's position is checked and (if necessary) corrected, the watchstander will call up a traffic summary display for the vessel, and using that, plus any other relevant data available, he will give the vessel a traffic advisory. This report tells the vessel the type and location of all traffic he may expect to encounter up to the next reporting point. The advisory will also include special conditions on the river, problems with aids to navigation, and any other information the watchstander considers desirable. Example: "ARGO, Traffic, my computer indicates tanker PETROL NAVIGATOR, NOBR 36, upbound at port ship service and towboat VIKING with six barges on the head downbound near Pilotown Dikes. An unlighted barge has been reported adrift in the vicinity of Shingle Point, OVER."

The VTC does not normally exercise "control" over vessels. However, the watch officer is authorized to take whatever action

is necessary to prevent any maritime mishap. Occasionally, the watch officer or the watchstander may operate traffic control lights.

Hold Function. When the computer has tracked a vessel to its next reporting point, the vessel is "held" in the system (no further advance), and its symbol on the dynamic display is caused to flash until the watchstander takes appropriate action. If a vessel has been held for 10 minutes, the flashing words "HOLD ALERT" appear on the display until the watchstander causes tracking to resume or to be terminated.

Monitoring Non-Participating Vessels. Non-participating vessels do not report to the VTS, and generally the watchstander simply monitors their progress without communicating with them (no traffic advisories). Whenever the watchstander feels that he doesn't know enough about a non-participator to justify tracking, he will drop the track with a track terminate action. The principal decisions and actions associated with a non-participating vessel are shown in Figure 2-14.

Other Communications. In addition to the routines described, the watchstander and the vessel may exchange information at any time that either may desire throughout the transit.

Sector Handoffs. During many transits, a vessel may pass from one sector to another. Since each sector boundary is also a reporting point, the vessel will make a position report at the boundary. The first sector watchstander will respond to the call by advising the vessel of the next sector's assigned radio frequency and requesting the vessel to contact the next sector watchstander. The routine reporting and advisory procedure then follows.

2.7.3 Exit

When a vessel departs from the VTS area or moors within it, the VTS is given a final report containing the following information:

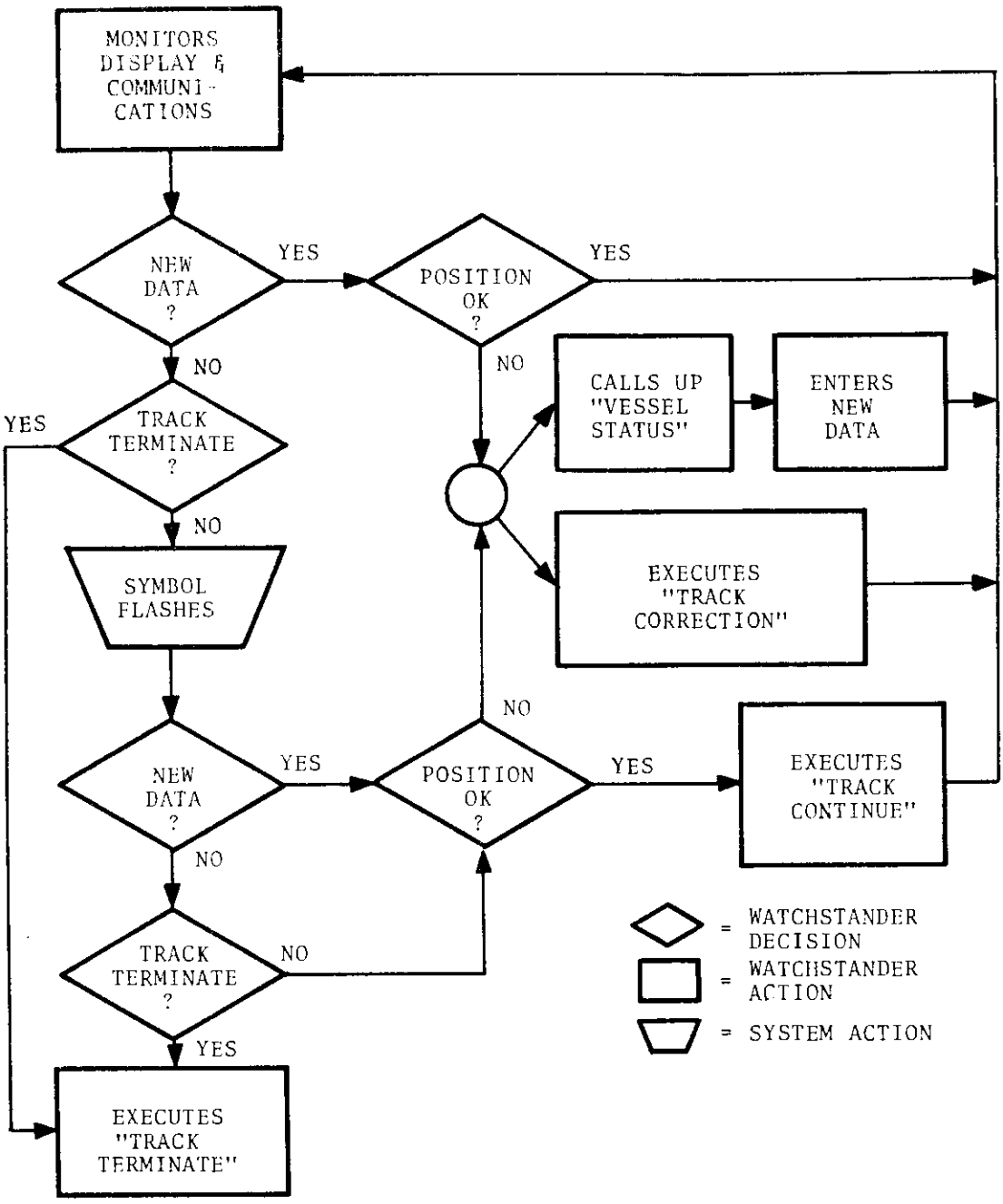


FIGURE 2-14. DECISION FLOW DIAGRAM: NONPARTICIPATING VESSEL POSITION MONITORED AND UPDATED

Name of vessel
Time of departure or mooring
Place of departure or mooring.

Example: "New Orleans Traffic, FRANZ JOSEPH, moored Bienville St. 1345, Final Report, OVER." "FRANZ JOSEPH, New Orleans Traffic, Roger, OUT."

The watchstander then uses the keyboard to execute a track terminate action, including entering one of the following termination modes: anchored, docked, in lock, or departed. The computer then automatically drops the track and adds the vessel to the appropriate location listing (if required), or causes the updated vessel status entry to be recorded on magnetic tape, printed on the teletype, and removed from the system.

3. METHOD

3.1 SCOPE

The data collected during VTS operations at NOLA VTS included: frequency and duration of watchstander activities, recordings of radio communications with vessels, individually administered interviews and stress questionnaires, photographic recordings of center activities, and center records covering the data-collecting periods.

Watchstander activities were observed in order to determine how often and for how long watchstanders perform their various tasks. The sample periods included 13 hours of watchstander observations distributed over the daylight hours from April 10 through April 14, 1978. This sampling entailed 4 hours at each of the three fully operational sectors and one at the fourth sector in which the watchstanders job was mainly one of passive monitoring of vessel traffic. Nine individual watchstanders from two watch crews were observed, covering both morning and afternoon time periods. The exact sampling schedule is presented in Table 3-1. Interviews and stress information were acquired over the same 5 days.

3.2 PROCEDURES

3.2.1 Traffic Data

Information on vessel traffic in the system during periods of data collection was obtained from VTC records and from computer printouts. These printouts included a complete listing of vessels anchored, docked, and awaiting entry in the sector, obtained just before each hour of data recording; listings of vessels underway in the sector, taken at the beginning and at the end of each recording hour and at ten-minute intervals during the hour; and selected critical traffic listings, made at the option of one of the observers.

TABLE 3-1. DATA COLLECTION SCHEDULE

Run No.	Date	Time	Sector
1	4/10/78	1645-1745	III
2	4/11/78	0930-1030	III
3	4/11/78	1100-1200	III
4	4/11/78	1345-1445	II
5	4/11/78	1530-1630	III
6	4/12/78	0915-1015	II
7	4/12/78	1100-1200	I
8	4/12/78	1330-1430	I
9	4/12/78	1500-1600	II
10	4/13/78	0920-1020	II
11	4/13/78	1110-1210	I
12	4/13/78	1415-1515	I
13	4/13/78	1700-1800	IV

3.2.2 Watchstander Activity Data

An observer, seated behind and to one side of the watchstander, kept a running narrative on a cassette tape recorder of the activities of a single watchstander at this sector station. These activities were basically of three types: monitoring the traffic situation, including radio and display; interacting with the computer; and communicating with vessels participating in the system.

Within each of these three categories, the frequency of specific activities was noted and, durations of the longer lasting activities were recorded.

While one observer was obtaining activity data on the watchstander another was monitoring a second computer display, identical to that of the watchstander. Whenever the watchstander made a data change in one of his displays, the second observer attempted to obtain a printout of the change. Occasionally, however, the watchstander changed displays too quickly for the copy to be made.

Activities of the watch officer and the watch supervisor were observed for an hour each in order to obtain an understanding of the tasks associated with those positions.

3.2.3 Interviews

Ten individual interviews were conducted by one interviewer. Each interview generally followed the same format and covered the same topics but was open-ended. The interviewer and interviewee were seated comfortably either in the lounge area or in the public observation room. The interviewer was assured that he was not being evaluated in any way and that he would remain anonymous. All interviewees were asked to be completely candid, as their comments would be used as additional information in the evaluation and future improvement of the VTS system. The interviews proceeded as a conversation, with the interviewer observing the planned format but freely following up leads and probing interesting

topics at his discretion. Each interview lasted approximately one hour.

3.2.4 Stress Questionnaires

A questionnaire designed to elicit information on subjective stress was administered to 11 watchstanders. The questionnaire contained 30 items (20 on body sensations, 10 on mood) that could be simply checked off by the subject. (A copy of the questionnaire appears in Appendix C.) Watchstanders recruited for the critical incident interviews described in the next section were asked to participate in this survey of stress levels. At the beginning of the interview, the experimenter explained the purposes of both the survey and the critical incident interviews. He further explained that although their purposes were related, watchstanders could participate in one and not the other. If the watchstander agreed to participate in the stress survey, the experimenter handed him the written instructions to read immediately, and answered any questions. The experimenter gave him a packet of 16 copies of the questionnaire and asked that the watchstander complete them four times daily for four days and mail them back to the experimenter in the envelop provided. To coordinate the results of the questionnaire with the work schedule, watchstanders were instructed to begin the survey on the first day of their next three consecutive days on duty. They were to complete the last four questionnaires on the first day following their break.

3.2.5 Critical Incident Interviews

A structured interview designed to gain information identifying sources of stress was conducted with 13 watchstanders. This interview dealt with three main topics: possible changes in equipment, layout, and procedures which could identify, reduce or eliminate stress; individual stress responses; and specific incidents which were stressful. (A copy of the interview form appears in Appendix C.) Watchstanders were temporarily relieved from duty to participate in both this interview and the survey

described in the previous section. For those watchstanders who agreed to participate in the critical incident interview, the interviewer asked each question from the interview form and recorded the watchstanders response on the form. This interview generally lasted about 20 minutes.

4. RESULTS

4.1 TRAFFIC

The traffic loads for NOLA VTS over the 5 days of this study, taken from the watch officer's log, are presented in Table 4-1. The time of peak traffic load was not correlated with any particular time of day but varied throughout the week from late morning (1100 hours) on April 10, to late evening (2200 hours) on April 13. These peak loads varied from 83 to 117 vessels active in the system at a given time. Actual participation in the VTS system was impossible to measure precisely since NOLA VTS has no direct surveillance of the river other than by physically looking out the window to see what ships are outside the VTC. But, of the known vessels in the system at these peak times, an average of 69 percent of them actively participated for at least part of their transit. Records of traffic load at the end of each watch (i.e., 0700 and 1900 hours) were also maintained by the watch supervisors. Mean traffic load was 74 (75 percent participation) and 85 (76 percent participation) vessels at 0700 and 1900 hours, respectively.

Table 4-2 summarizes the traffic data by sector for the 13 hours of observation. The fully operational sectors (Sectors I, II, and III) had approximately the same traffic load (around 27 vessels) while Sector IV had only 16 known vessels in the system. The resultant mean traffic load for the entire system was 97 vessels with 77 percent participation.

In the above analyses, non-participating vessels comprise only those vessels known to be in the system, either from monitoring Channel 13 or from information received from participating vessels.

4.2 SECTOR WATCHSTANDER ACTIVITY

Basically, the activities of the watchstanders were identical but there were a few operations which varied according to the

TABLE 4-1. DAILY TRAFFIC SUMMARY FOR OBSERVATION DAYS

PEAK TRAFFIC				TIME: 0700 HR		TIME: 1900 HR	
DATE	TIME	NO. OF VESSELS	PERCENT PARTICIPATION	NO. OF VESSELS	PERCENT PARTICIPATION	NO. OF VESSELS	PERCENT PARTICIPATION
4/10	1120	105	66	-	-	98	70
4/11	1527	117	55	70	71	98	71
4/12	1610	94	7I	80	65	75	81
4/13	2200	83	83	70	87	70	81
4/14	-	-	-	75	76	-	-
MEAN		100	69	74	75	85	76

TABLE 4-2. TRAFFIC SUMMARY FOR OBSERVATION HOURS BY SECTOR

SECTOR	RUN	TOTAL NO. OF VESSELS	PARTICIPATION (IN PERCENT)
1	7	26	96
	8	23	91
	11	25	92
	12	29	72
MEAN		26	87
2	4	31	65
	6	25	64
	9	25	92
	10	22	72
MEAN	1	26	64
3	1	32	63
	2	27	70
	3	33	67
	5	23	65
MEAN		29	66
4	13	16	94
Mean Traffic for entire system over 1 hour.		97	77

particular sector. Watchstanders at each sector maintained a guard on both the single site for their assigned channel and on Channels 13 and 16. Sector I watchstanders had the added responsibility to monitor and transmit over a second assigned site. This entailed switching back and forth on Channel 12 from the site covering the Head of Passes to the site covering the upper portion of Sector I including the Inner Harbor Navigational Canal. (See Fig. 2-1).

Sector II watchstanders were the only ones with any form of direct traffic surveillance. When they wanted to know what the traffic situation was like near the VTC they simply went to the window and looked at the river. Sector IV, though not officially operational, provided limited service to traffic traveling between New Orleans and Baton Rouge. Since there was little emphasis put on the operation of this sector, not many vessels used the Sector IV service and it was usually manned by a trainee. Therefore, Sector IV was not included in the following analyses. In all other respects the operation of the different sectors was essentially identical.

4.2.1 Communications

Complete evaluation of watchstander activities, as they relate to communications, was difficult since a large proportion of the information on a vessel's status was obtained from monitoring Channel 13; even though virtually all of the communication interactions were carried out over the assigned VTS channel for a given sector. The majority of the following analyses are restricted to transactions and communication activity on the VTS-assigned channels and are summarized in Table 4-3.

The mean number of communications for the four hours of data at each of Sectors I, II, and III were 12.5, 14.3, and 15.3, respectively. Summing these means the total mean communication time for the fully operational portion of NOLA VTS was 42 communications per hour. The amount of time dedicated to these communications was between 11 and 15 minutes in each of the three sectors.

TABLE 4-3. COMMUNICATIONS DATA FOR SECTORS (TIME IN MINUTES)

	SECTOR I				SECTOR II				SECTOR III				SECTOR MEANS			GRAND MEAN
RUN NO.	7	8	11	12	4	6	9	10	1	2	3	5	I	II	III	
NUMBER OF COMMUNICATIONS	17	12	12	9	17	14	12	14	16	13	17	15	12.5	14.3	15.3	14.0
TOTAL TIME DEDICATED TO COM'S	14.7	14.2	7.8	16.2	12.2	10.0	10.2	12.8	17.1	10.6	16.7	14.0	13.2	11.3	14.6	13.0
TOTAL TIME OF ACTUAL VTS-VESSEL COM'S	11.2	9.6	6.3	13.9	10.1	8.1	8.4	10.9	12.6	9.2	12.2	10.7	10.3	9.4	11.2	10.3
EXTRANEOUS COM'S ON VTS CHANNEL	*	0.5	1.5	1.3	1.1	6.8	*	6.2	24.7	21.4	23.8	6.4	1.1	4.7	19.1	8.3
C.U.** VTS-VESSEL COM'S	.25	.24	.13	.27	.20	.17	.17	.21	.28	.18	.28	.23	.22	.19	.24	.22
C.U. VTS-VESSEL VOICE TRANSACTIONS	.19	.16	.10	.23	.17	.13	.14	.18	.21	.15	.20	.18	.17	.16	.19	.17
TOTAL C.U. FOR ALL RADIO TRANSACTIONS	*	.17	.14	.25	.15	.25	*	.29	.62	.51	.60	.29	.19	.23	.51	.33
MEAN TRAFFIC LOAD	19	22	21	18	17	17	22	19	27	25	23	21	20	18.8	24	20.9
PEAK TRAFFIC LOAD	26	23	25	29	31	25	25	22	32	27	33	23	25.8	25.9	28.9	26.8
% PARTICIPATION AT PEAK TRAFFIC	96	91	92	72	65	64	92	72	63	70	67	65	87.8	73.3	66.3	75.8

*Data not available
**C.U. = Channel utilization (percent of total time dedicated to communications)

The only major difference between the sectors, in terms of total communication traffic, is in the amount of extraneous, non-VTS related transmissions. Sector I had an average of 1.1 minutes per hour; Sector II, about 4.7 minutes per hour; and Sector III, slightly more than 19 minutes per hour.

Traffic in Sector I is made up mostly of vessels going to and from the Gulf of Mexico and the Inland Waterway and required little radio interaction with the VTS or with other vessels. In Sector II, there was more local traffic, hence more communication on the radio. The major increase in radio transmission in Sector III, however, comes from the vessels communicating with the locks over the same channel assigned to VTS for that sector.

When channel utilization (time spent in communication divided by total time available for communication) is evaluated from the standpoint of total channel usage very different results, relative to strict VTS communication, are shown. Channel utilization functions for VTS-related communications are .17, .16, and .19 for Sectors I, II, and III, respectively. When the total amount of radio transactions over the assigned VTS channel are considered (including extraneous communications) the channel utilization values increase to .19, .23, and .51 for the three sectors. The increase from .17 to .19 in Sector I and .16 to .23 in Sector II reflects pilots and masters communicating among themselves, but the major portion of the increase from .19 to .51 in Sector III can be explained by communications between the locks and the pilots and masters.

Another measure of communication problems is the number of calls made by vessels and by the VTS which received no response. In Sector I, 20 percent of the calls made by 4 vessels were not responded to by VTS either because the watchstander was already engaged in conversation with another vessel or else contact could not be established due to noise in the system or a weak receiver on board the vessels. The non-response calls to VTS in Sectors II and III were 3 and 15 percent, respectively.

Non-response from the vessels, however was much greater; 56 percent for Sector I, 69 percent for Sector II, and 72 percent for Sector III. The reasons for this high non-response rate are not clear, but it probably reflects one or more of the following explanations:

a) weak transceviers on board the vessel,
b) extraneous conversation on the VTS channel overriding the attempted communication (especially in Sectors II and III),
c) inattention to the radios by masters and pilots,
d) personal decision not to answer a call.

Whatever the reasons, this tendency not to respond to VTS calls only adds to the frustration of the watchstander and to those masters and pilots who are cooperating.

4.2.2 Computer Activities

Since the computer and its associated display systems are the core of the information processing aspect of NOLA VTS it is obvious that much of a watchstander's activities should involve interactions with the computer. A summary of these activities is presented in Table 4-4.

In Sector I, watchstanders called up an average of 45 displays per hour, mostly vessel status displays. Sector III was next, with 60 per hour. Sector II watchstanders called up the greatest number of displays, 70 per hour. Since the number of displays called up per sector does not seem to vary with traffic load it is felt that these differences are related more to individual watchstander differences than to any real functional differences.

The lower portion of Table 4-4 (time at displays) indicates that watchstanders spend from 40 to 50 percent of their time interacting with the computer and its display. By combining these duration data with the frequency data it can be seen that watchstanders spend an average of 27 seconds on each display called up.

TABLE 4-4. FREQUENCY AND DURATION OF WATCHSTANDER COMPUTER ACTIVITY

	SECTOR I				SECTOR II				SECTOR III				MEANS			
DISPLAY / RUN NO.	7	8	11	12	4	6	9	10	1	2	3	5	I	II	III	GRAND MEAN
VESSEL STATUS	37	17	30	43	89	32	61	39	58	37	44	34	32	55	43	43
TRAFFIC SUMMARY	4	6	10	14	12	5	7	5	15	10	7	7	8.5	7	10	8.5
NEW VESSEL	4	5	1	4	9	4	4	3	6	2	1	3	3.5	5	3	4
OTHER DISPLAYS	2	1	0	2	6	3	0	4	5	3	6	0	1	3	4	3
TOTAL NO. OF DISPLAYS	46	29	41	63	116	44	72	51	84	52	58	44	45	70	60	58
TIME AT DISPLAYS (MIN'S)	26.8	18.5	24.8	23.5	36.8	25.3	33.5	26.5	26.8	23.8	22.3	20.3	23.4	30.5	23.3	26
TIME/DISPLAY (SECONDS)	35	38	36	22	19	35	28	31	19	27	26	28	31	26	23	27

Most of this time was related to operations on the vessel status display.

When a watchstander initiated the vessel status display there were seven major operations or changes which could be made. The frequencies of these classified operations are presented in Table 4-5. Most of the operations on the vessel status display followed either a communication with the vessel or occurred after hearing pertinent information over Channel 13 and included changes to the vessel's location (28 percent of all changes) and SOA (22 percent). These changes usually were followed by alterations in the comments written in the "special handling" and "remarks" sections of the display (23 percent).

4.2.3 Other Activities

As mentioned earlier, the only form of direct traffic surveillance occurred when the watchstander for Sector II walked over to and looked out the window at the river. He did this an average of four times per hour with an mean duration of slightly more than 30 seconds per trip.

Other recorded activities, presented in Table 4-6, include the frequency and duration of activities involving a) maintaining a written list of current vessels in the sector, b) communicating with other VTS personnel in job-related discussions, and c) non-job-related conversations with other personnel.

Looking across sectors, the average time spent writing on the vessel lists was a little more than 3 minutes per hour (191.25 seconds) and the time engaged in job-related conversation averaged 4-3/4 minutes per hour. In each of these categories watchstanders in Sector II were the most involved and Sector I watchstanders, the least. The overall total time spent in non-job-related conversation, averaged only 25 seconds per hour with no meaningful differences between sectors.

TABLE 4-5. OPERATIONS ON VESSEL STATUS DISPLAY

OPERATION / RUN	SECTOR I				SECTOR II				SECTOR III				SECTOR MEANS			GRAND MEAN
	7	8	11	12	4	6	9	10	1	2	3	5	I	II	III	
STATUS	0	0	0	0	1	0	0	1	0	0	0	0	0	.5	0	.17
MODE	2	0	0	1	8	1	2	0	1	2	5	2	.75	2.75	2.5	2
NAME	0	0	2	3	12	2	0	0	1	4	3	4	1.25	3.5	3	2.58
LOCATION	10	4	5	11	19	10	12	1	13	5	6	5	7.5	10.5	7.25	8.42
CHECK POINT	0	0	2	0	1	2	0	0	1	1	2	1	.5	.75	1.25	.83
SOA	7	1	6	6	11	5	13	3	9	8	10	2	5	8	7.25	6.75
COMMENTS	7	1	6	7	19	8	3	2	16	5	7	4	5.25	8	8	7.08
OTHER	0	0	0	4	15	2	2	1	4	0	4	0	1	5	2	2.67
TOTAL	26	6	21	32	86	30	32	8	45	25	37	18	21.25	39	31.25	30.58

TABLE 4-6. FREQUENCY AND DURATION (IN SECONDS) OF WRITING AND CONVERSING ACTIVITIES OVER SECTORS

	SECTOR I				SECTOR II				SECTOR III				SECTOR MEANS			GRAND MEAN
OPERATION	7	8	11	12	4	6	9	10	1	2	3	5	I	II	III	
WRITING FREQUENCY	9	10	5	9	2	12	16	6	19	8	7	8	8.25	9	10.5	9.25
DURATION (SECONDS)	135	195	90	135	30	210	345	390	270	255	75	165	138.75	243.75	191.25	191.25
TIME/EVENT	15	19.5	18	15	15	17.5	21.56	65	14.21	31.88	10.71	20.63	16.82	27.08	18.21	20.7
JOB-RELATED CONVERSATION FREQUENCY	11	5	7	6	15	10	11	23	10	14	15	10	7.25	14.75	12.25	11.42
DURATION (SECONDS)	345	120	180	135	285	300	360	495	180	300	285	210	195	360	243.25	266.75
TIME/EVENT	31.36	24	25.71	22.5	19	30	32.73	21.52	18	21.43	19	21	26.9	24.41	19.9	23.74
NON-JOB-RELATED CONVERSATION FREQUENCY	0	0	3	3	3	0	1	2	0	2	0	1	1.5	1.5	.75	1.25
DURATION	0	0	75	60	60	0	15	30	0	45	0	15	33.75	26.25	15	25
TIME/EVENT	0	0	25	20	20	0	15	15	0	22.5	0	15	22.5	17.5	20	20

4.2.4 Total Time Allocation

The prescribed tasks of watchstanders can be classified into three major categories; communications, tracking, and monitoring. This grouping subsumes virtually all of the activities performed during a watch by each sector watchstander with two minor categories, job-related conversation and non-job-related activities, accounting for the remainder. Table 4-7 contains the time allocation data for each run, a summary for each sector, and a grand mean for the system as a whole. A graphic representation of the sector means is presented in Figure 4-1.

Communications, occupying 22 percent of watchstander time, include all the time that a watchstander's prime concern was communication with pilots and masters even though he may have been involved in other activities simultaneously.

Tracking/computer time, 34 percent of the total available time, included those times when a watchstander was initiating a display, reading, editing, and entering data except when these activities occurred during a communication. This overlap of communications, and tracking, occurring about 9 percent of the time, was time attributed to communications.

For 30 percent of the time, watchstanders were busy monitoring the traffic situation in two ways: either by inspecting the dead-reckoning display or listening for calls on their assigned VTS channel and for relevant information over Channel 13. Generally, watchstander monitoring was an extremely active and intense process. Each watchstander, especially in Sectors II and III, had to maintain high vigilance on Channel 13 in order to discern information about a vessel in their sector. Even though monitoring time was greater in Sector I then in Sectors II and III, this reflects less activity in other job-related work rather than more intense monitoring.

Job-related conversations with other VTS personnel as described earlier, accounted for seven percent of all watchstanders activity. The remainder, seven percent, was time the watchstanders were involved in non-job-related activities.

TABLE 4-7. FREQUENCY, DURATION AND PERCENT OF TIME AVAILABLE (FREQUENCY/DURATION) DEDICATED TO ACTIVITY CATEGORIES (DURATIONS GIVEN IN MINUTES)

DURATION

	SECTOR I				SECTOR II				SECTOR III				SECTOR MEANS			DURATION/ FREQUENCY			GRAND MEAN
ACTIVITY / RUN NO	7	8	11	12	4	6	9	10	1	2	3	5	I	II	III	I	II	III	
COMMUNICATION	14.7	14.2	7.8	16.2	12.2	10	10.2	12.8	17.1	10.6	16.7	14	13.2	11.3	14.6	.22	.19	.24	.22
TRACKING/ COMPUTER	20.5	13	21	16.5	29.3	21.5	29.8	20.5	21.3	20.8	16.8	15	17.8	25.3	18.5	.30	.42	.31	.34
MONITORING	17.6	25.6	25.3	20.6	10	18.3	10.3	17.4	14.8	17.8	15	21.8	22.3	13.9	17.3	.37	.23	.29	.30
JOB-RELATED CONVERSATION	5.7	2	3	2.3	4.8	5	6	8.2	3	5	4.7	3.5	3.2	6	4.1	.05	.10	.07	.07
NON-JOB-RELATED ACTIVITIES	1.5	5.2	2.9	4.4	3.7	5.2	3.7	1.1	3.8	5.8	6.7	5.7	3.5	3.5	5.5	.06	.06	.09	.07
TOTAL													60	60	60	1.00	1.00	1.00	1.00

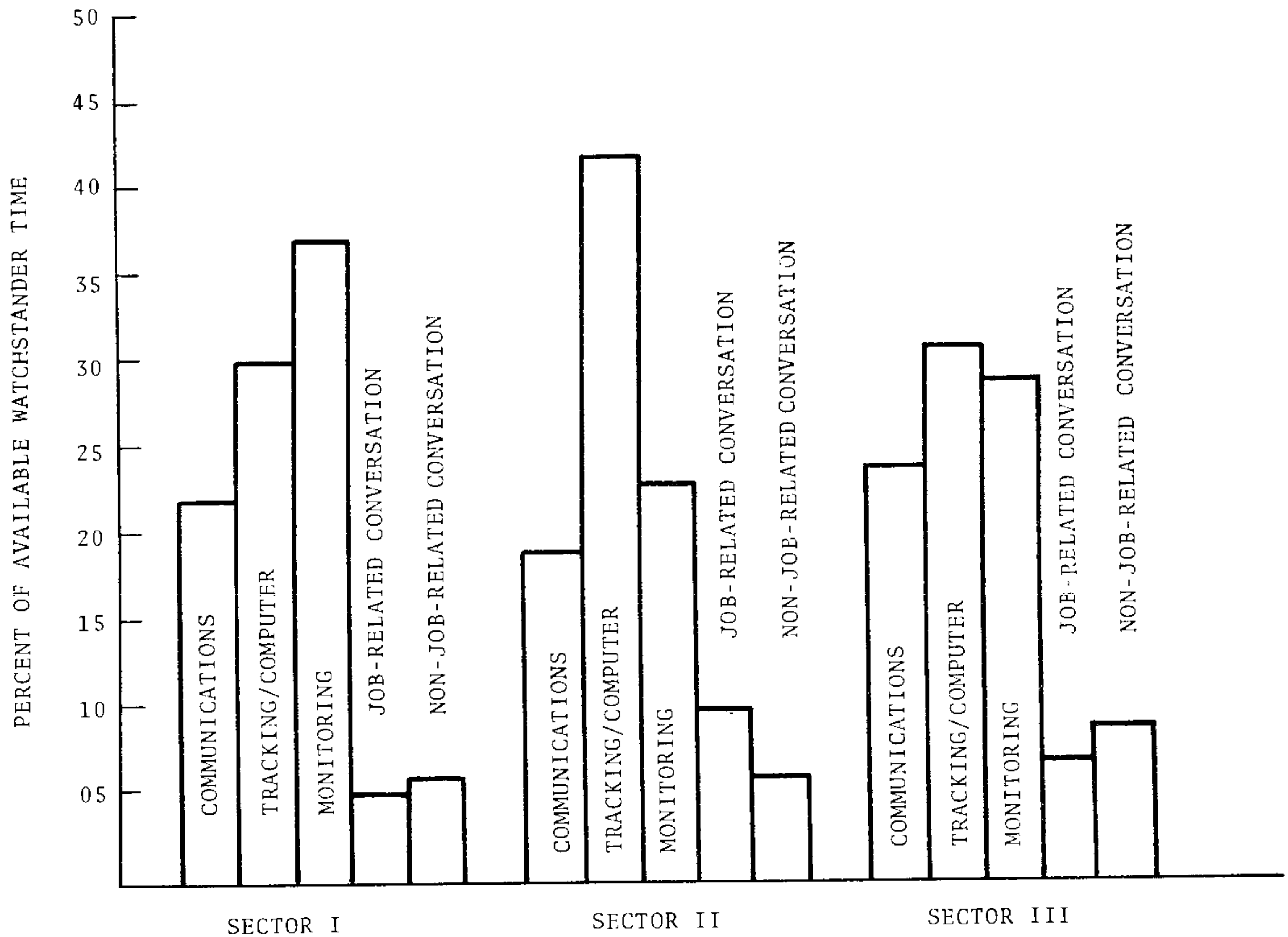


FIGURE 4-1. PERCENT OF AVAILABLE WATCHSTANDER TIME DEDICATED TO ACTIVITY CATEGORIES BY SECTORS

4.3 ACTIVITIES OF OTHER PERSONNEL

In addition to the watchstanders at the three fully operational sector stations, and the partially operational Sector IV, there are nominally three other stations in a full watch team; the watch officer, watch supervisor, and external communicator. At the time of this study, however, the external communication position was not being manned, but his duties were performed by various members of the rest of the team.

4.3.1 Watch Officer

The watch officer was observed for a total of about an hour, distributed over several periods. Basically his duties can be divided into three job-related categories: administration, monitoring, and supervision.

The time spent in administrative duties (15 percent) involved writing in his logs, answering and making calls on the telephone, and interacting with the front office at the VTC. Monitoring (20 percent of the time) involved inspecting the traffic situation by calling up the dynamic displays for a given sector, listening to Channel 13, 16, and various VTS channels and reading information received from the teletype or other printed sources. Almost 20 percent of his time was devoted to assisting sector watchstanders in their jobs. (The amount of time varied, depending on the availability of the watch supervisor to perform these tasks). This involved activities such as answering questions, giving instructions, and, under certain circumstances, taking over communications.

4.3.2 Watch Supervisor

Basically, the watch supervisor's job is similar to the watch officer's except he spends more time assisting the sector watchstanders with problems and much less time on administrative duties. A major difference between the watch supervisor and the officer is that the supervisor often spells the watchstanders when they are due for a rest break.

4.4 INTERVIEWS

The greatest awareness of how a system operates resides in those who operate it. To tap this source of vital information, 10 watchstanders were given in depth interviews covering all aspects of VTS work. Their principal judgments and opinions are summarized below. Details of their responses are given in Appendix B.

4.4.1 General Services

There was a consensus that a vessel traffic advisory service is needed in the NOLA VTS area (B3)*. However, all but one interviewee rated the present service as only fair to poor (B4, B27). The principal problems cited as affecting quality of service were inaccuracy of data and poor communications (B4). On the other hand, mention was made of special services (principally relaying messages) by the VTS that were of value and were well received by users (B26).

4.4.2 Inaccuracy of Data

Inaccuracy of data was attributed to lack of participation by area traffic and lack of surveillance equipment (B4, B5, B24, B25). Interviewees generally estimated that less than half of the vessel traffic in the VTS area was participating in the voluntary VMRS (B5, B22, B25, B28). Without aid from surveillance equipment, the watchstander could obtain information on non-participants only from secondary sources, mainly transactions overheard on Channel 13. This lack of information resulted in poor advisories and further reluctance on the part of pilots and masters to participate in the service. Other reasons given for inaccurate data included erroneous position reports (B25) and omissions by the watchstander (B27), sometimes caused by such distractions as maintenance or failure of equipment and pressure by the supervisor (B24). Additional reasons given for failure of some vessels to participate in the service included apathy,

*A letter reference indicates an appendix to the report. Thus, B3 refers to Paragraph 3 in Appendix B.

varying needs for information, interruption of other bridge duties, and an unfavorable opinion of the watchstander based on his communications performance (B5, B22, B27).

In the interviews (B28) and in other conversations, mandatory participation was suggested as a means of assuring more complete participation. This idea raises a potential problem in addition to the political implications and the reluctance of some personnel to use the VTS as a police operation. Interviewers estimated average traffic loads in each sector, degree of participation, and the maximum traffic load that they could handle comfortably (B22, B23). Combined, these estimates suggest that if all vessels were to participate today, the average watchstander would be regularly overloaded on Sectors II and III, and some would be on Sector I.

4.4.3 Communication Problems

Most interviewees complained about some aspect of communications (B4, B24, B25). They noted that some transmitters are not powerful enough to cover their assigned sectors, although this situation could be improved by relocation of sector boundaries (B25). The VTS shares Channel 14 with the Army Corps of Engineers (COE), operators of the locks and bridges in the area. This fact, coupled with the close proximity of the VTS transceiver with those of the COE and the presence of powerful transmitters on the vessels, results in masking VTS communications (B25). Some people misuse the communications, even to the point of heckling the watchstander (B24). Within the VTC, watchstanders are distracted by the sounds from speakers at adjacent positions (B19, B20). Since a transmitting site can be used from only one console at a time, the watch supervisor in order to intervene in any communications, must move to the appropriate sector position and plug his headset into that communications console. One interviewee recommended adding the ability to communicate with vessels to the watch supervisor's station (B25).

4.4.4 Computer Assistance

All interviewees rated the computer as easy to use for both input and retrieval of data (B17). Training and experience in typing are considered helpful but not necessary for keyboard operation. The principal display lists are valued highly and used often, except for operator information, precautionary area list, and precautionary area alert (the latter two applying to only one sector) (B18). Since most of the interviewees like to maintain a handwritten list of vessels underway, some were asked why the vessels underway list was not sufficient. Their reply was that too much keying is required to call up vessels underway (B17, B19). Other recommendations for improving computer value were to allow more characters for entering vessel name and to provide the capability to call up two data lists simultaneously.

General arrangement of equipment was satisfactory to most interviewees. The only suggestions for improvement were to give the watch supervisor a more central location and to attempt to shield each position from noise at adjacent positions (B19).

4.4.5 Work Schedule

Opinions split on the work schedule; five interviewees liked it and five were neutral or disliked it (B14). The principal reason for liking the schedule was for the amount of liberty it provided. Disadvantages of the schedule included long hours, boredom, cycling between day and night watches, and being tired when off duty. Seven interviewees admitted to feeling tired in the latter part of the watch, and six said it affected their efficiency (B15).

There was relatively little response to questions probing the possibility of a sector watchstander's opportunities to help an adjacent operator with a heavy workload. Although some ways of helping were noted, it was evident that the watch supervisor (or a watchstander on a break) is more likely to provide the assistance (B21).

4.4.6 Personnel Considerations

The watchstanders interviewed at NOLA VTS had little to say about training and selection. Training was considered adequate and easy except for the amount of memorization required for local knowledge (B9, B10, B12).

The principal suggestion for selection of personnel for VTS assignments was to select people who indicate a desire for the duty (B13). This idea was consistent with the fact that 6 of the 10 interviewees did not like their assignment (B2). Reasons for disliking the work included the feelings of inadequacy in issuing advisories with little confidence in their accuracy (4.4.2) as well as lack of recognition, pressure from outside, monotony without challenge or responsibility, and disruption of home life. Six of the ten felt that VTS is not a good career assignment, since there is little opportunity to advance in your chosen rate..."you are not doing what you were trained for" (B7). Two people suggested making VTS a rate. Nevertheless, 7 of the 10 interviewees indicated that they would not mind having an assignment at another VTS. Only four would welcome a second tour at NOLA VTS (B8), and three of them said they would like it only if improvements were made. Much of the undesirability of VTS duty, then, appears to be related to conditions at the NOLA VTS rather than to VTS duty in general.

4.5 STRESS QUESTIONNAIRES AND CRITICAL INCIDENTS INTERVIEWS

A stress questionnaire, in which respondents indicated how they felt with regard to body (somatic) feelings and mood, was administered twice to watchstanders at NOLA VTS. The first administration was made to 12 watchstanders in October 1977, and the second to 11 watchstanders in April 1978. The New Orleans VTS was not operational when the questionnaire was first given; watchstanders monitored and tracked vessel traffic for practice but did not interact with mariners over the radio. The second presentation of the questionnaire occurred during the week of data collection when watchstanders were serving a 12-hour shift

in the fully operational VTS. This second group of watchstanders also participated in a critical incident interview designed to identify the sources of stress.

Five watchstanders from the pre-operational and seven from the operational period completed and returned their packets of 16 questionnaires indicating variations in stress four times a shift for three consecutive working days and the first day off. The principal results from both administrations are summarized below. A detailed description of the questionnaire, its administration, and results is given in Appendix C.

For the pre-operational period only two items, "Aching, burning eyes" and "Fidgety", showed appreciable levels of stress. These results did not correlate well with those obtained from either an FAA study of operational air traffic controllers or from Houston-Galveston VTS watchstanders.

Most importantly, these pre-operational New Orleans stress results were considerably less in magnitude than those for Houston-Galveston, an operational VTS similar to New Orleans.

For the operational period, 8 of the 19 somatic items and all of the 11 mood items reflected appreciable stress levels. Especially high stress levels were obtained for the somatic items, "Loss of Temper", "Headache", and "Aching, burning eyes", and for the mood items, "Tired" and "Drowsy". These results correlated well with those from both the FAA and Houston-Galveston studies. Most importantly, these operational NOLA VTS results indicated considerably higher stress than did those for Houston-Galveston VTS. Comparison of pre-operational with operational New Orleans VTS results revealed higher operational stress levels and a different pattern of stress response.

Critical incident interviews were administered to 15 respondents during the operational period at NOLA VTS. The most often reported sources of stress concerned difficulty with radio communications, lack of surveillance equipment, and feelings of inadequacy to perform the job.

5. DISCUSSION AND RECOMMENDATIONS

5.1 LACK OF CONFIDENCE IN ADVISORIES

5.1.1 Effects of Nonparticipation

During the periods of observation, an average of 25 percent of the traffic stored and tracked in the computer was designated as nonparticipating (4.1). This was traffic detected by the watchstanders (generally by monitoring Channel 13) in spite of failure of the vessels to participate in the VMRS. There is no measure of how much additional traffic stays undetected; however, it was the consensus of personnel who were interviewed that less than half of the traffic in the VTS area participates in the VMRS (4.4.2).

Watchstanders are acutely aware of their lack of precise knowledge of the true traffic situation, a condition that is part of a vicious circle of consequences. This chain of effects is illustrated in Figure 5-1 and can be summarized as follows: Failure of many vessels to participate in the VMRS results in advisories from the VTS that are based on inadequate knowledge of traffic and that are often incomplete. Awareness of the inadequacies in the traffic advisories undermines the masters' and pilots' confidence in the VTS and increases their reluctance to participate in the VMRS.

Two secondary effects aggravate the circle further: (1) Some masters and pilots, disillusioned with the value of the VMRS, become careless in giving position reports, thus adding errors to the VTS data base and the resultant advisories. (2) Some watchstanders betray their lack of confidence in their advisories by voice and manner of speaking, which is detected by the pilots and masters, increasing further their reluctance to participate.

Two solutions to this problem, two ways of breaking the vicious circle, have been proposed: (1) Increase the accuracy of the data base and advisories by providing surveillance aids that will give watchstanders information on actual traffic conditions.

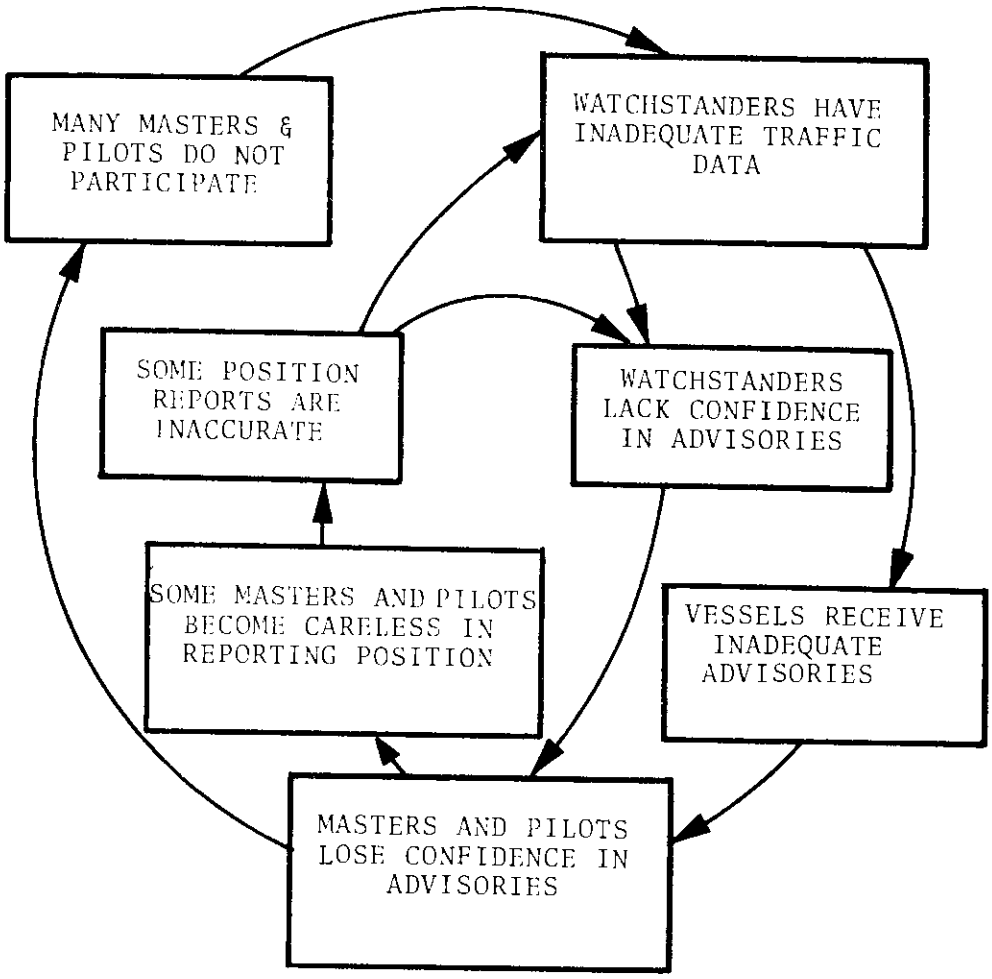


FIGURE 5-1. THE VICIOUS CIRCLE OF NONPARTICIPATION

(2) Increase the completeness of information on vessel traffic by making participation in the VMRS mandatory.

5.1.2 Surveillance Aids

Other VTS's are making effective use of radar and closed circuit television (CCTV) as surveillance aids, and participation in voluntary VMRS's in these areas is indeed far better than in the NOLA VTS area.

Modern radar equipment gives a high resolution all-weather, instantaneous, and continuous picture of actual traffic in its area of surveillance. Although no existing VTS has automatic identification capability, the potential for error is low. The VMRS generally provides enough information for the watchstander to identify returns. Although the winding Mississippi, with structures lining its banks, is not ideal for area radar coverage, it should be possible to locate some surveillance sites with good coverage of extensive portions of the channel.

Use of CCTV has the advantage of providing detail most like what the human observer would see on the spot. Type, and sometimes even the name of the vessel can be seen on the VTC monitors, aiding greatly in identification. Low lightlevel CCTV provides considerable information during hours of darkness. On the other hand, fog, haze and precipitation can obscure TV as it does human vision. Although TV range is limited, careful site selection can provide up-and-down-channel views of many portions of the river.

Even though radar and TV both have limitations as sensors and can not provide complete coverage of the VTS area, the checks on the VMRS information that even a few installations could provide would significantly increase the accuracy of the VTS data base, the accuracy of the VTS advisories, the confidence of users in the advisories, and their participation in the VMRS. This has proven to be the case with regard to radar in Houston, Seattle, and San Francisco, and with regard to TV in Houston.

5.1.3 Mandatory Participation

Imposing mandatory participation in the VMRS in a VTS area is a politically complex problem, involving extensive interactions among shippers, vessel owners, pilots associations, and the U.S. Coast Guard. These factors can not be evaluated in this study. However, the following observation is relevant in VTS areas where surveillance aids have been installed: voluntary participation in the VMRS has increased and is far better than in the NOLA VTS. Apparently, when an accurate traffic advisory system can be operated with confidence, users learn to value the service and want to provide the cooperation required to maintain the service.

5.2 COMPUTER

This study uncovered no serious problems with the computer. Input and retrieval of data are easy to perform and to learn. In general, the display capabilities are adequate for the watchstanders' needs. Only two deficiencies were noted: (1) an inadequate number of characters allowed for vessel identification, and (2) tabular lists limited to one list at a time.

The computer allows for only 10 characters for vessel identification in the vessel status file; thus longer names must be abbreviated. If an operator wishes to retrieve information on a vessel through the name, the name entered for retrieval must be exactly the same as the one in storage. This sometimes prevents retrieval by name. Addition of capacity for a few more characters in the vessel identification would solve this problem.

Tabular lists of information can be displayed only one at a time. Often information from two lists is needed. This forces the watchstander to delete one list in order to call up the other, and to go through another callup routine to get the first list again. For example, a watchstander calls up the traffic summary list while giving a vessel a traffic advisory. Should the pilot or master receiving the information ask a question about one of the vessels he will encounter, the watchstander must erase traffic

summary in order to call up the vessel status list for the vessel in question, then recall the traffic summary in order to continue with the advisory. The capability to call up two tabular lists at the same time would appear to be well worth the effort required to attain it.

A word of caution with regard to synthetic displays is appropriate here. The NOLA dynamic display is a symbolic representation of the general direction and degree of progress of vessels in the system. It shows only those things that someone in the VTS has manually entered, and it never shows lateral location and orientation of vessels. For example, two vessels actually about to collide head-on would be represented on the display as passing with a wide separation. Often vessels are actually on the opposite side of the channel from that shown on the display. Although watchstanders are intellectually aware of these discrepancies between their display and the real world, all they can see is the display, and there is a real risk that, when traffic is dense, they may make decisions based on the belief that the real world is like the display. This risk should be thoroughly explained and discussed during watchstander training, and qualified watchstanders should be reminded of it regularly by their supervisors.

If and when radar sensors are added to the system, it will be important to reprogram the dynamic display to place all symbols in the channel where the radar shows them to be rather than to retain the upbound/downbound position conventions of the synthetic display.

5.3 COMMUNICATIONS

Interviews and observations both uncovered some communications problems.

Because some sectors extend into areas of poor reception for their assigned transceiver, there is a need to re-examine and relocate some sector boundaries.

The sharing of Channel 14 with the locks and bridges poses problems for Sector III, by the masking out and interruption of

VTS communications. This problem could be solved by assigning another channel to the COE for the locks or assigning Channel 14 to a more remote sector.

Within the VTS, watchstanders complain of radio noise from adjacent positions. Some kind of sound shielding is advisable between positions.

5.4 PERSONNEL FACTORS

Although the TSC observations did not disclose any serious personnel problems, two matters warrant some attention: (1) selection criteria and (2) the watch schedule.

The Commanding Officer of NOLA VTS had encountered problems in the past with personnel who could not qualify as watchstanders for reasons that could have been identified in a preliminary screening. Believing that the time and effort lost due to such a misassignment warranted some corrective action, he explored with the district medical officer the possibility of defining a set of physical fitness criteria for VTS duty that could be checked in a preliminary physical examination. The TSC investigators met with the CO and the district medical officer and added their suggestions. The CO has since forwarded a recommendation for selection criteria to the Office of Marine Environment and Systems (G-WLE).

Although the present 12-hour watch schedule at NOLA VTS is popular because of the distribution of liberty time, most watchstanders admit that they become tired during the latter part of the watch and that their efficiency is affected (4.4.5). At this time, nothing definitive can be said about the efficacy of a 12-hour work shift. In situations where vigilance is very important, 12-hour shifts tend to be too long for efficient performance. It is proposed that work shifts at the VTS's be more closely examined before any specific recommendation is made.

5.5 STRESS QUESTIONNAIRES

Most of the increased stress levels from the pre-operational to the operational period at NOLA VTS are probably due to the

responsibility of being fully operational in a new system which lacks proper positive surveillance and does not have full cooperation from its users.

The recommendations offered to help alleviate this problem are the same as for general improvement of the system: get positive surveillance (radar and/or CCTV) and obtain better user participation. This latter recommendation can be achieved in several ways:

1) Positive surveillance itself should increase user participation.
2) More concerted public relations effort with users.
3) Keep working on improving watchstanders' performance, thus instilling more confidence in the users.
4) Make participation mandatory.

Each of these suggestions has its own special problems, but it is evident that for improved user participation and a resultant improvement in personnel morale the system must work more smoothly and more accurately. The vicious circle must be broken somewhere.

5.6 RECOMMENDATIONS

Analysis of the data collected on watchstander activities and the responses to the interviews and stress questionnaire has revealed several areas that appear amenable to improvements. It is recommended that consideration be given to these changes and that their feasibility be given study.

a. Give highest priority to the acquisition of surveillance aids. (5.1.2)
b. Redesignate sector boundaries to conform better to transmitter receptivity. (5.3)
c. Reassign communications channels to sectors or locks to reduce interference between VTS and lock radio transactions. (5.3)
d. Provide for a longer vessel identification word in the computer. (5.2)

e. Provide a capability for displaying two simultaneous lists in the status tabular area of the CRT. (5.2)

f. Continue effort to define personnel selection criteria. (5.4)

g. In training, stress the fact that the symbolic representation of vessels on the dynamic display is merely a representation of their general direction and degree of progress and never of their actual position and orientation in the waterway. (5.2)

h. Sound-shield individual sector positions. (5.3)

APPENDIX A

EXAMPLES OF COMPUTER DISPLAYS

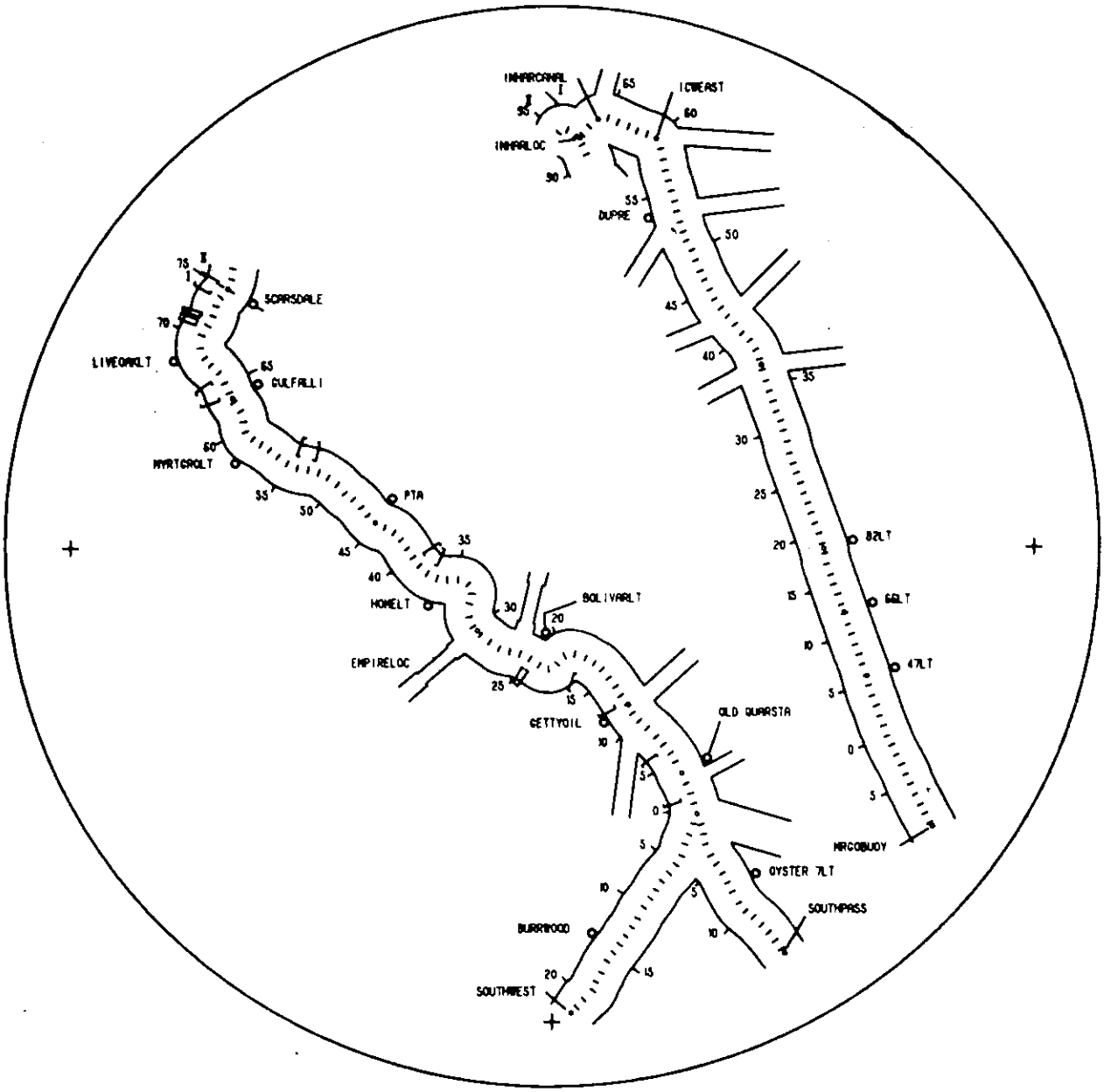


FIGURE A-1. SECTOR I MAP PROJECTION

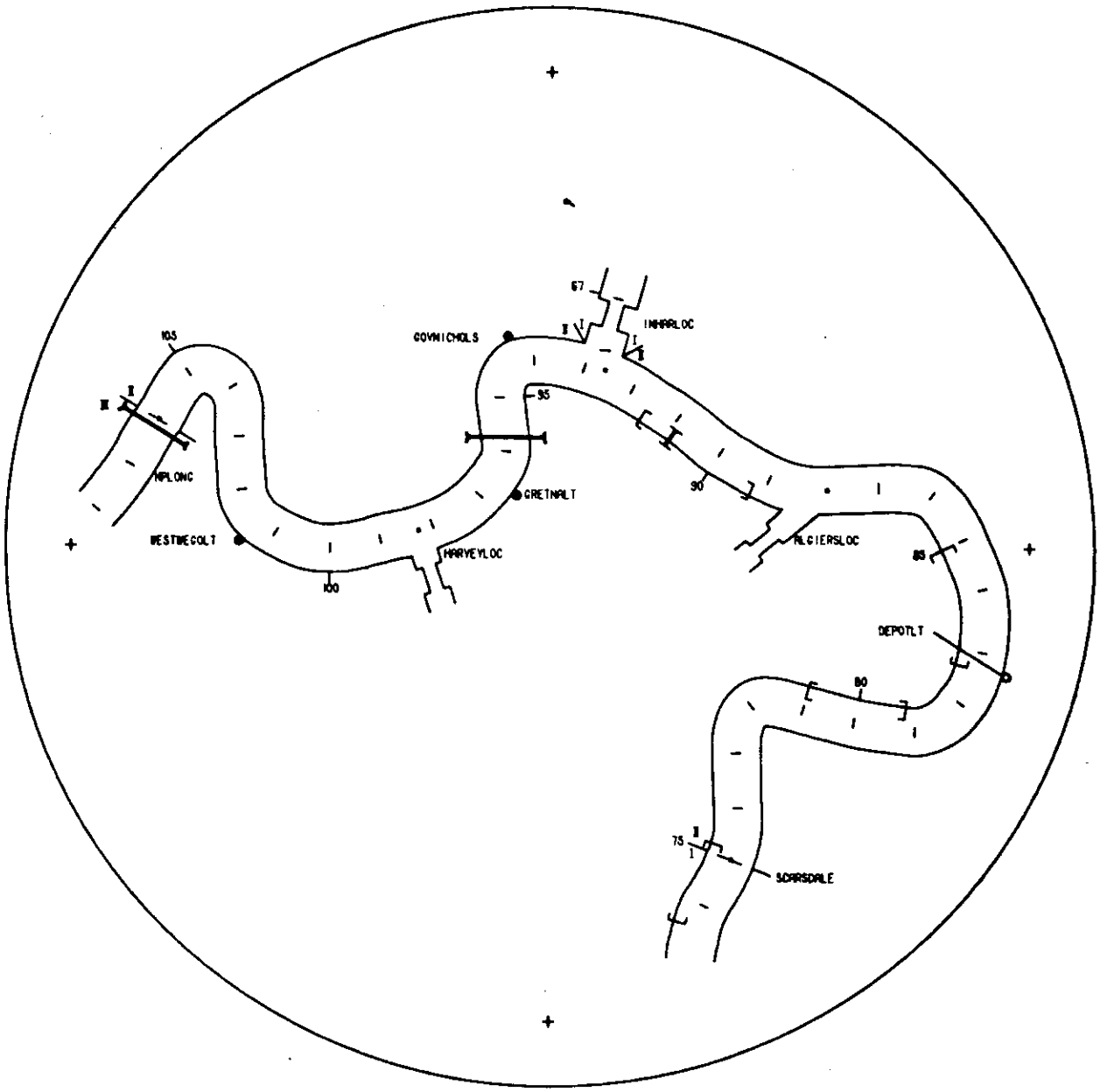


FIGURE A-2. SECTOR II MAP PROJECTION

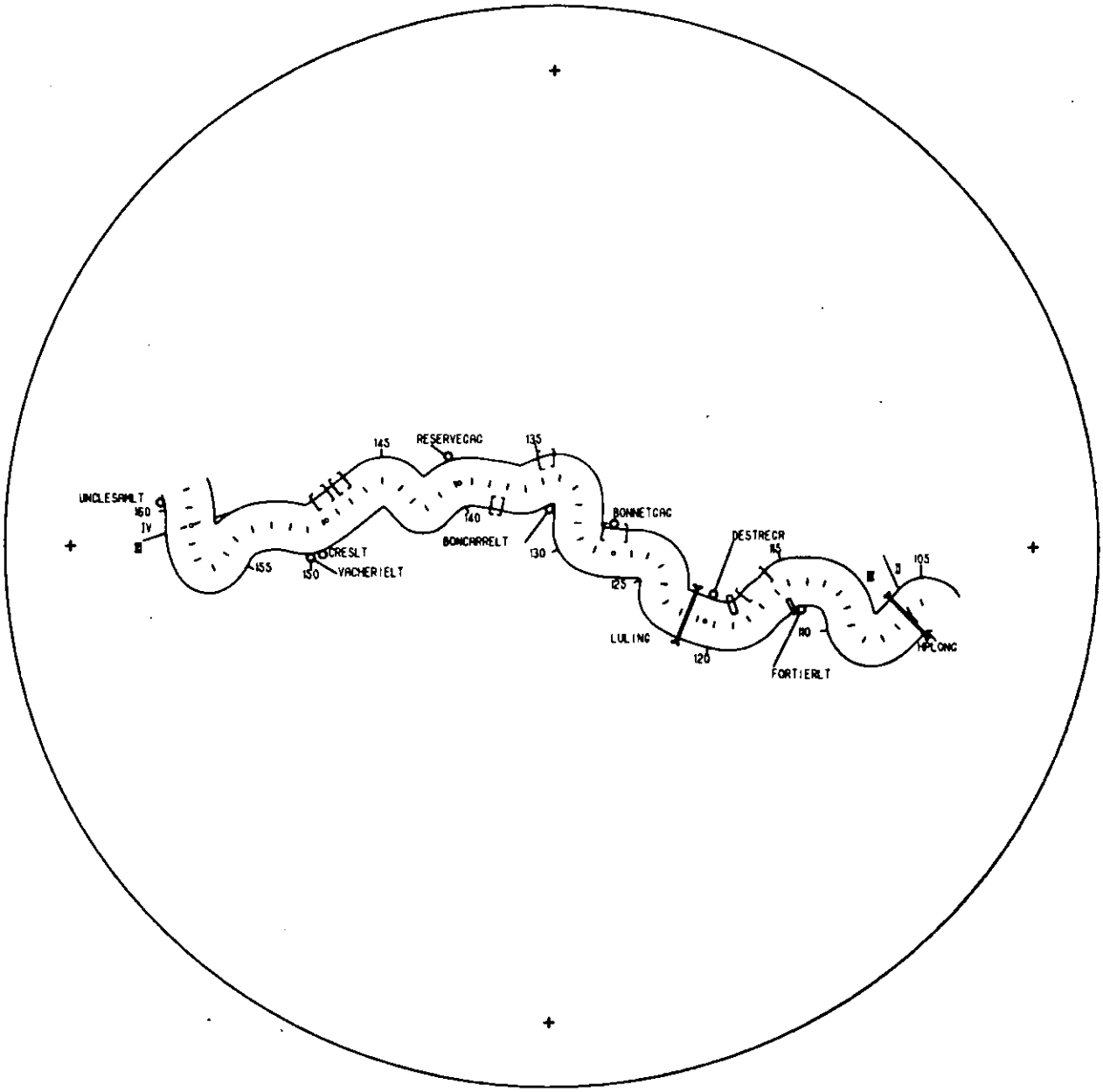


FIGURE A-3. SECTOR III MAP PROJECTION

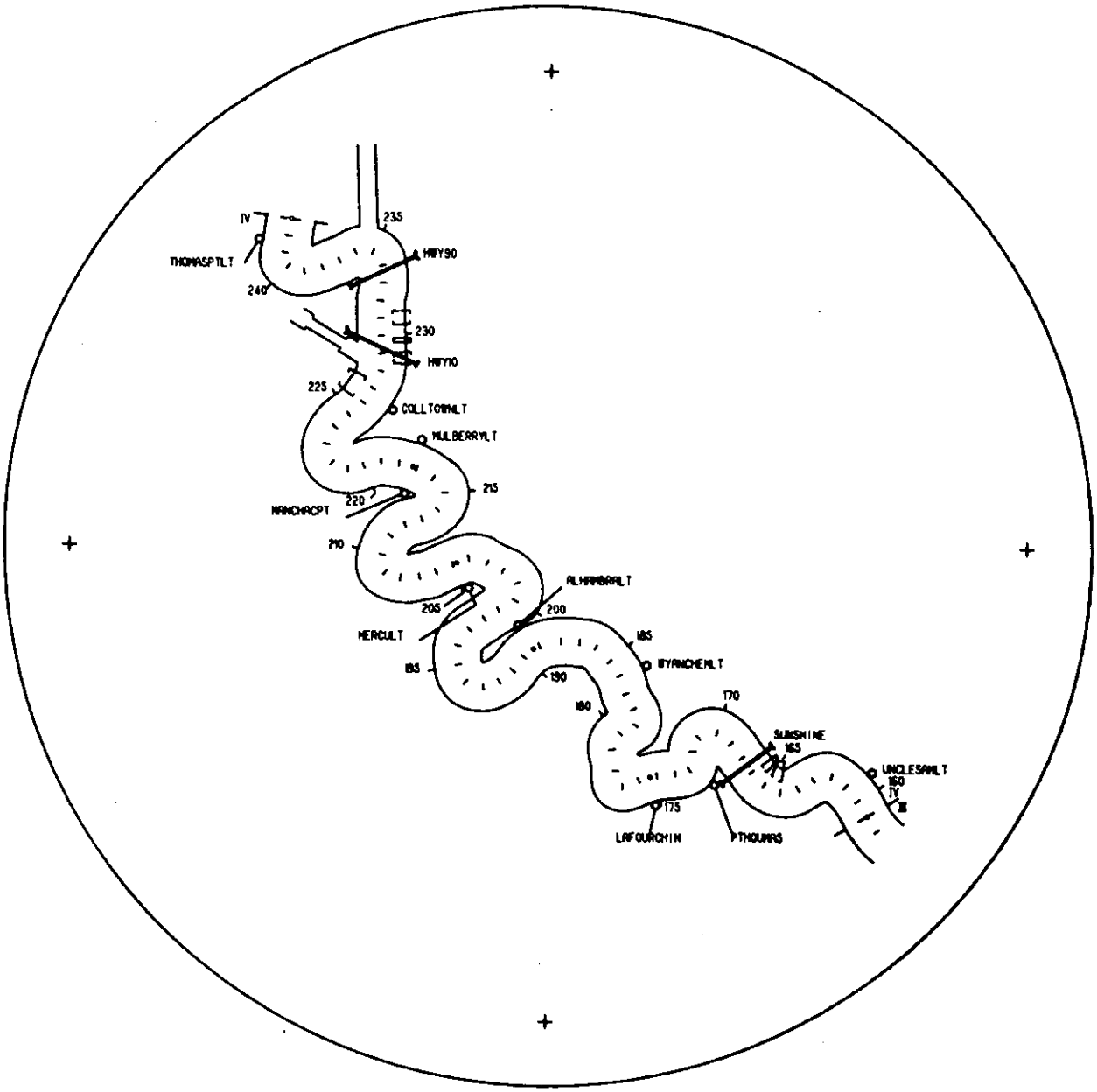


FIGURE A-4. SECTOR IV MAP PROJECTION

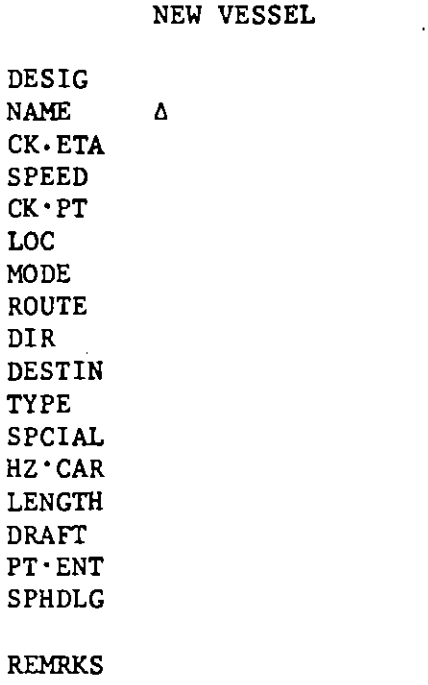


FIGURE A-5. NEW VESSEL FUNCTION PROMPTER

VESSEL STATUS

DESIG	2KL
NAME	ΔCINDERELLA
CK·ETA	1315R
SPEED	146C
CK·PT	0880A
LOC	0923A
MODE	UN
ROUTE	UMR DA1 DSW
DIR	D
DESTIN	CLAIRFREE
TYPE	B
SPCIAL	N
HZ·CAR	PET
LENGTH	800
DRAFT	20
PT·ENT	INHARCANAL
SPHDLG	RADIO OUT
REMRKS	8 BARGES

FIGURE A-6. VESSEL STATUS INFORMATION

CRITICAL TRAFFIC

DES	NAME	LOC	EN	TIME
1AB	SUBARUJIMA	1158A		
1AC	MARY LOU	1200A	A	2250
1AD	CORINTHOS1	1220A	A	2310
1AF	CHRISTINA	1230A	O	2320
1AE	MUD HEN II	1240A	M	2345
2AG	GOOD LUCK	1250A	Z	0015
2AI	MARINER I	1260A	O	0045
2AH	ELIZABETH	1270A	A	0100
2AJ	CINDERELLA	1280A	Z	0130
1CK	TARAWA	1290A	O	0150
1CL	ANNABELLE	1300A	O	0200

TURN PAGE

M = Meeting
Z = Crossing or
Zero Speed
O = Overtake
A = Anchored or
Awaiting Reentry

FIGURE A-7. EXAMPLE OF A CRITICAL TRAFFIC SUMMARY LIST

VESSELS ANCHORED

DES	NAME	CAR	MM
1AB	CORINTHOSI	ACY	1300A
2CD	MARY LOU		1280A
3EF	CHRISTINA	CLX	1270A
4GH	GOOD LUCK		1260A
1IJ	MUD HEN II	PPL	1250A
2KL	MARINER I		1240A
3MN	ELIZABETH	EPC	1230A
4OP	CINDERELLA		1220A
1PA	TARAWA	POX	1210A
2BC	ANNABELLE		1200A

TURN PAGE

FIGURE A-8. EXAMPLE OF A VESSELS ANCHORED LIST

VESSELS DOCKED

DES	NAME	CAR	MM
1AB	CORINTHOS1	ACY	1300A
2CD	MARY LOU		1280A
3EF	CHRISTINA	CLX	1270A
4GH	GOOD LUCK		1260A
1IJ	MUD HEN II	PPL	1250A
2KL	MARINER I		1240A
3MN	ELIZABETH	EPC	1230A
4OP	CINDERELLA		1220A
1PA	TARAWA	POX	1210A
2BC	ANNABELLE		1200A

TURN PAGE

FIGURE A-9. EXAMPLE OF A VESSELS DOCKED LIST

VESSELS UNDERWAY

DES	NAME	CAR	MM
OAA	CORINTHOS1	ACY	1300A
OAB	MARY LOU		1280A
OAC	CHRISTINA	CLX	1270A
OAD	GOOD LUCK		1260A
OAE	MUD HEN II	PPL	1250A
OAF	MARINER I		1240A
OAG	ELIZABETH	EPC	1230A
OAH	CINDERELLA		1220A
OAI	TARAWA	POX	1210A
OAJ	ANNABELLE		1200A

END LIST

FIGURE A-10. EXAMPLE OF A VESSELS UNDERWAY LIST

AWAITING ENTRY·REENTRY

DES	NAME	PT·ENT·LOC	TIME
OAA	CORINTHOS1	ALGIERSLOC	2230
OAB	MARY LOU	HARVEYLOC	2250
OAC	CHRISTINA	HARVEYLOC	2310
OAD	GOOD LUCK	ALGIERSLOC	2320
OAE	MUD HEN II	0934A	2345
OAF	MARINER I	HARVEYLOC	0015
OAG	ELIZABETH	HARVEYLOC	0045
OAH	CINDERELLA	ALGIERSLOC	0100
OAI	TARAWA	0953A	0130
OAJ	ANNABELLA	ALGIERSLOC	0150

TURN PAGE

FIGURE A-11. EXAMPLE OF A VESSELS AWAITING ENTRY/REENTRY LIST

```
OPERATOR INFO

SECTOR 1

001
 WEAT  GALE WARNING
       (TEXT)
       (TEXT)

002 PROTECT
 SAR   (TEXT)
       (TEXT)
       (TEXT)

END LIST
```

FIGURE A-12. EXAMPLE OF AN OPERATOR INFORMATION LIST

```
PRECAUTIONARY AREAS

NO  LOCST     LOCEN

 1  1230A     1260A
 2  0010SP    0020SP
 3  0025SW    0055SW
 4  0150M     0200M
17  0300M     0350M
18  0010SW    0060SW
19  0100SP    0150SP
20  0750A     0800A

END LIST
```

FIGURE A-13. EXAMPLE OF A PRECAUTIONARY AREAS DEFINITION LIST

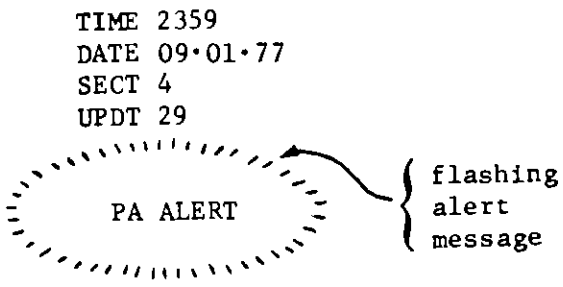


FIGURE A-14. SYSTEM TABULAR AREA WITH PRECAUTIONARY AREA ALERT DISPLAYED

PRECAUTIONARY AREA ALERT

DES	NAME	PA	ACK
2CD	MARY LOU	3	
4GH	GOOD LUCK		A
1PA	TARAWA		A

END LIST

Note: A = PREVIOUSLY ACKNOWLEDGED

FIGURE A-15. PRECAUTIONARY AREA ALERT LIST

APPENDIX B

INTERVIEWS AT NOLA VTS

Individual interviews were conducted with watchstanders during the same days that observations were made. The interviewer and interviewee were seated comfortably in a room that was quiet and free of interruptions. The interview was conducted as a conversation. The interviewer was guided by a format in order to cover all topics, but the exact wording of questions and order of topics were varied to allow spontaneity in the interviewees' responses.

The interviewer explained the aims of the project and the interview, stressing the fact that the system, not the interviewee, was being evaluated. Then the interviewer asked, and encouraged discussion of, a series of questions. The nature of each question (not necessarily the exact wording used with each interviewee) is given below, followed by a summary of the responses.

1. How long have you been in the U.S. Coast Guard? How long have you been at NOLA VTS? What were your previous assignments? The answers to these questions are tabulated in Table B-1. This sample constitutes 29 percent of the NOLA VTS complement and represents an aggregate of 9 years of VTS experience.

2. Do you like working at the NOLA VTS? Four interviewees liked the assignment, six disliked it. No specific reasons were given for liking the duty, and two who said they liked it added negative comments. Reasons for disliking the assignment included statements that the advisory information is unnecessary and often repetitious, there is much effort for little recognition, there is pressure from the outside, the work is monotonous with no challenge or responsibility, and home life is disrupted (you're either in bed or on watch).

3a. Is some form of vessel traffic advisory system necessary for the NOLA area? Only one interviewee felt that the VTS was unnecessary; he suggested "more pilot intervention."

TABLE B-1. RESPONSES TO BIOGRAPHICAL QUESTIONS

Interviewees	Years in Coast Guard	Months at NOLA VTS	Years of Sea Duty	USCG Schools	Other Training and Experience
Officer	9.0	11	4.0	Academy	
Enlisted					
1	3.5	12	2.0	Radar	
2	4.0	12	2.2	QM	Typing, Computer entry
3	3.8	11	2.0	Radar	
4	4.5	7	4.0	Radar	Typing
5	3.5	9	2.0	Radar	
6	3.0	11	1.5	Radar	Typing
7	3.5	12	10.0		Typing, Navy 10 yrs.
8*	5.0	12	9.0	Radar	Navy 10 yrs, Air Controller 6 yrs
9*	3.0	11	2.0		
Mean Enlisted	3.8	11	3.9		

*Interviewees 8 and 9 were interviewed during a preliminary visit.

3b. Who should operate it? Four interviewees felt that the USCG should operate the VTS; two preferred a Civil Service operation, and one a private operation. Three interviewees had no opinion. One felt that Sector I is not needed except at 60-Mile Point. Another noted that, although the USCG has good training in laws and regulations, it is spread too thin with its SAR and law enforcement responsibilities.

4. How well does this VTS meet the needs of the area? Eight interviewees felt that the service is fair to poor. Another said that the information on type of traffic is excellent but the location of traffic is poor. Only one rated the service as good. The principal reason for low ratings (five responses) was the inaccuracy of the data. Three mentioned lack of sensors (such as radar), and two mentioned poor communications. One commented: "Anyone who listens to us is a fool; we're a hazard to navigation". Another, who had similar feelings, pointed out that it is not the fault of the VTS.

5. How well do masters and pilots cooperate? On the average, the group indicated that 78 percent of the ferry masters give excellent to good cooperation, but only 43 percent of the tow masters and 46 percent of the pilots. Since there are relatively few ferries, the consensus seems to be that somewhat under half of the people in command of vessels in the system are cooperative. Reasons given for half-hearted cooperation included apathy, varying needs for information, and lack of confidence in the accuracy of the data. It was pointed out that some pilots will judge the watchstander and participate only if they have a favorable opinion of his competence (see also Item 22).

6. Is the VTS properly appreciated? Opinion was about evenly divided as to whether masters and pilots appreciate the VTS. Comments noted that they appreciate it but are disappointed with what it does, that they don't fully understand it, that they have made some good comments on it, and that they merely tolerate it. Only five interviewees were willing to estimate the general public's appreciation of the VTS--all negative. Three said the

public doesn't know about it, one said the press is negative, and one felt that public opinion is improving. Seven interviewees estimated the Coast Guard's appreciation of VTS services. Five gave positive responses. The two negative responses attributed lack of appreciation to lack of communication--"We're the other outfit."

7. Is the VTS a good career assignment? Four interviewees said, "Yes," six said, "No." Two of those who considered VTS a good career assignment said it was preferable to sea duty; one said it should be a "rate;" the fourth added that..."there are problems here." On the negative side, four noted that VTS duty does not advance your career because you are not doing what you were trained for. One negative respondent also thought that VTS duty should be a "rate."

8. Would you want another tour at NOLA VTS? At another VTS? Four interviewees said they would like another tour at NOLA VTS, but three of them qualified their answer--in 10 years, if difficulties were ironed out, and with improvements. The other six gave unqualified no's. However, seven interviewees indicated an interest in the tour at some other VTS. One of the negative repliers added: "I'm not a career man."

9. Was your training for VTS duties adequate? Nine interviewees responded, "Yes". The negative response was qualified with: "But it's better now." There were two comments: that you'd have to be a qualified pilot to be fully trained, and that training involves too many river rides.

10. What was hardest to learn? Three interviewees simply stated that nothing was hard for them to learn. Seven mentioned local knowledge, particularly the memorization involved. Other items were language and how to avoid "VALUE WRONG" computer entries.

11. How long does it take to qualify? Responses ranged from 2 to 6 months, with a mean of 4.3.

12. Have you any ideas for improving training? Five interviewees offered no suggestions. Three suggested fewer river rides. Other suggestions: Give the trainee a few river rides and time sitting beside consoles before he starts the book work. Include typing training. Enforce the quarterly requalification requirement. Assign fewer people to training duty.

13. Have you any ideas for the selection of personnel for VTS duty? Suggestions offered for selection criteria follow, with the number offering each criterion given in parentheses:

An indication that the duty is desired (4); one interviewee recommended a preview of the job.

Training in typing (3).

Sea duty (2).

Selection from rates other than RD and QM (2); one interviewee recommended a special rate.

Selection from lower grades, but not right out of boot camp (1).

Experience in radio communications (1).

Exclusion of people with a history of nervous problems (1).

14. How do you like the present watch schedule? Five interviewees liked the present schedule, three disliked it, and two were neutral. Reasons for liking the schedule included the liberty time and reduction in driving time. Two who liked the schedule still had reservations--disliked the long hours; noted drawbacks with too few people. Reasons for disliking the schedule were long hours, shifting back and fourth frequently between day and night watches, and being tired when off duty.

15. Do you get particularly tired in the latter part of the watch? Does it affect your efficiency? Seven interviewees reported feeling tired in the latter part of the watch, and six said it affected their efficiency. One interviewee noted getting equally tired on an 8-hour watch, and one reported getting tired, taking a break, and then being OK. Other comments included: "about 4:30 a.m. it is unreal," "...your mind goes out to lunch," and "...it affects your patience."

16. Rank the difficulty of the duty positions. Most of the interviewees (7) considered Sector I the most difficult. Sectors II and III were rated about equal in difficulty--Sector II because it is hectic, Sector III because of the radio traffic from the locks on its channel. Although Sector IV was only being monitored, one interviewee commented that it would still be the easiest sector position if it were being worked. All agreed that external communicator was the easiest position to work.

17. Rate the computer for ease of data input and retrieval. All interviewees rated the computer as easy to use both for input and retrieval of data. Most watchstanders maintain a handwritten listing of vessels underway; two reported that there is too much keying required for the vessels underway computer listing, that the computer cannot keep up with their keying speed, and that they might substitute the vessels underway lists for their handwritten lists if less keying were required. It was also noted that more characters are needed for the vessel name.

18. Rate the various computer listings for value, usage and accuracy. The average ratings on a scale of High (H), Medium (M), Low (L), and Very Low (VL) were as follows:

Listing	Value	Usage	Accuracy
Vessel status	H	H	H
Critical traffic	H	H	M
Vessels anchored	H	M	M
Vessels docked	H	H	M
Vessels underway	H	H	M
Awaiting entry/reentry	L	VL	M
Operator information	M	M	H
Precautionary area list	VL	VL	M
Precautionary area alert	VL	VL	M

Comments regarding the value of the listings included: vessels underway is redundant to the situation display; vessels underway would be more valuable if it could be called up easier; nobody ever uses the precautionary area list and alert. Regarding frequency of usage: precautionary area list is used only in Sector

I. Regarding accuracy: reports are not accurate--so you cannot rely on the lists; they neglect to report vessels anchored.

19. Would you like to see a different arrangement of equipment? Seven interviewees said, "No," to this question. One said, "Yes," but offered no alternative arrangement. One interviewee would put the watch supervisor in the middle, on a raised platform, with two sector positions on each side and a quiet teletype, eliminating the external communicator position. One interviewee would angle each communications console so that it would mask out sounds from adjacent positions; he said that a cubicle is needed.

20. Rate the operations room with respect to illumination, noise, and ventilation. One interviewee had no comments on this item. Eight thought the illumination was good; one didn't like working in the dark. Five interviewees gave the room a medium rating, three a good rating, and one a bad rating with respect to noise. Comments were that background noise is confusing, especially when all monitors are turned up. Specific mention was made of problems with Channel 13 and, in Sector III, Channel 14. Six interviewees rated the room high with regard to ventilation, two commenting that it must be good because they are not bothered by smokers. There are two complaints that the room is cold...that the floor vents are drafty.

21. Can a sector watchstander help another sector watchstander who is overloaded? Does this happen often? There was general agreement (7 of 10) both that intersector assistance can be given and that it does not happen very often. When one watchstander is very busy or has poor communication with a vessel, an adjacent watchstander may handle some of his calls by temporarily switching his transceiver to the other position's frequency. Or the adjacent watchstander may monitor the other man's calls and remind him of missed communications. An adjacent watchstander may also help a busy watchstander by keying up a display or performing a track continue operation. However, communications assistance is more often provided by the watch supervisor than by an adjacent watchstander.

22. What is the average number of vessels in a sector? What is the percent participation? For the three operational sectors, estimates were as follows:

	Sector I	Sector II	Sector III
Range	18-30	13-30	20-35
Mean	25	18	24
Participation (%)	82	50	35
Calculated average load	30	36	69

One interviewee noted that participation depends on the operator; an authoritative voice will attract participation, while a cut-and-dried voice will lose it (see Item 5).

23. What is the maximum number of vessels a Sector Watchstander can handle comfortably? For the three operational sectors, estimates were as follows:

	Sector I	Sector II	Sector III
Range	20-45	15-43	20-45
Mean	33	36	31

Although these are crude estimates, it appears that if all vessels were participating, the average operator would be overloaded on Sectors II and III, today, and some would be overloaded on Sector I.

24. Do some situations, tasks or incidents seriously increase the difficulty of VTS operation? Five interviewees mentioned communications problems, including bad communications in Sectors I and III, SAR calls taking precedence in a sector, and misuse of channels (including heckling). Three interviewees cited such river incidents as a collision, grounding, barge breakaway, or man overboard. Two noted maintenance or failure of equipment. Two interviewees said that pressure and distraction by the supervisor is a problem. Other problems noted once included: lack of visual information on traffic, confusion in the use of the "X" designator, late rotation (over 3 hours on a position), and horseplay.

25. What functions most badly need improvement? Seven interviewees suggested communications improvements, including more transmitter power, getting either the VTS or the locks off Channel 14, more working channels, changes in sector boundaries for better channel utilization, a multichannel monitor at each position, and the ability for the supervisor to communicate with vessels from his own position. Seven interviewees called for surveillance aids (radar and television) and more accurate position reporting. Two interviewees proposed the capability to call up 2 listings at the same time. Additional individual suggestions included increased participation, dropping Sector IV, and closing down the VTS until improvements are made (see also Item 28).

26. Can you recall instances where the VTS was a significant aid in resolving an incident? All such incidents involved use of the VTS communications capabilities, mainly in relaying messages, such as notifying the COTP and vessels of accidents and incidents, helping with SAR calls, and helping vessels with weak radios. The VTS also provides public relations type services, such as lining up pilots, finding berths, locating vessels for agents and making flight reservations.

27. Can you recall instances where the VTS caused an incident or made one worse? Three interviewees could recall no such instances. Among instances recalled were: VTS communications interfering with other bridge duties (4 interviewees), vessels placing too much reliance on VTS advisories (2 mentions), and bad information (such as failure to mention a dredge in an advisory).

28. Do you have anything to add? Five interviewees added comments. Two stressed the need for more participation--one would make it mandatory. Two others urged exploration of the relationships with the COTP and with other Coast Guard commands. Other comments were: assign people where they want to go; the work is monotonous; look out for the needs of the watchstanders as well as the users, and shut down and evaluate the NOLA VTS (see also Item 25).

APPENDIX C

STRESS LEVELS AND SOURCES AT THE NEW ORLEANS VTC

C.1 INTRODUCTION

In staffing a vessel traffic center care must be taken not to overly stress any individual watchstander. Excessive stress leads to poor morale, degenerative health, and accidents.[1] Numerous comments by both officers and watchstanders and careful observation have indicated the presence of stress at the VTC's, however, no systematic assessment has been made. An assessment of stress performed by the Federal Aviation Administration[2] (FAA) successfully established elevated stress levels among air traffic controllers, a position similar to watchstanders, using a paper-and-pencil questionnaire.

A modified version of the FAA questionnaire has been completed by nine watchstanders at the Houston-Galveston VTS and nine watchstanders at the Puget Sound VTS. Detailed descriptions of procedures and results are available for Houston-Galveston[3] and for Puget Sound[4] VTS's. This same stress questionnaire was administered twice to watchstanders at the New Orleans VTS. The first administration was made to 12 watchstanders in October of 1977 and the second to 11 watchstanders in April of 1978. The New Orleans VTS was not operational during the October 1977 administration; watchstanders monitored and tracked vessel traffic for practice, but did not interact with mariners over the radio. During the April 1978 administration, watchstanders served a 12-hour shift in a fully operational VTS. This second group of watchstanders also participated in a critical incident interview designed to pinpoint the sources of stress (see Section II). The following material first treats the procedures and results of the October 1977 administration; then the April 1978 administration; then compares the two.

C.2 PREOPERATIONAL STRESS LEVELS

C.2.1 Subjects: Twelve watchstanders at the New Orleans VTS served as subjects during breaks in their 8-hour workshifts. The average age of these watchstanders was 26.8 years and they had served in the U.S. Coast Guard for an average of 6.4 years.

C.2.2 Apparatus: The questionnaire (see Table C-2) consisted of 30 items assessing the degree of stress in terms of susceptible somatic and mood states on a continuous scale from "None" through "Moderate" to "Severe". This scale is in contrast to the items used by the FAA which assessed only the presence or absence of such symptoms.

C.2.3 Procedure: Watchstanders were recruited either individually or in a group. Upon finding an individual on a break or meeting with a group of watchstanders at the end or beginning of a shift, the experimenter introduced himself and explained that since stress had been reported at the Puget Sound VTS, a questionnaire had been devised to assess stress levels among watchstanders at New Orleans. Each watchstander who agreed to participate was given written instructions (see Table C-1). Any questions were answered, and the watchstander began filling out the questionnaire.

Subjects scored each item by indicating the distance along the scale from None through Moderate to Severe corresponding to their degree of response to each item. The experimenter observed the watchstander's method of answering to assure that it complied with the instructions. The questionnaire required about 2 minutes to complete.

Watchstanders then received a packet of 16 questionnaires to be completed according to the following schedule. For each of 4 days, watchstanders were to complete one questionnaire just prior to a shift (Pre), one about halfway through (During), one immediately upon ending the shift (Post), and one at least 3 hours later at home (Home). Four days were specified because watchstanders worked one shift for at least 4 days before taking a

TABLE C-1. INSTRUCTIONS FOR STRESS QUESTIONNAIRE

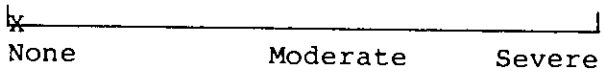
U.S. Department of Transportation
Transportation Systems Center
Kendall Square
Cambridge MA 02142

This survey is designed to assess the physical and psychological effects you experience in connection with your work as a U.S. Coast Guard Vessel Traffic Services watchstander. Under no circumstances will your answers become a part of your personnel file or in any way affect your status in vessel traffic services work. You will be assigned an identification number so that all responses from each individual can be kept together. These data will be stored at the Transportation Systems Center until summarized. At that point there will be no further need to identify an individual's data and all forms will be destroyed.

Your task is to rate the degree of physical or psychological effects you are experiencing at the time you fill-out the rating form. You are to complete the rating form four times each working day: Just before beginning a shift, during a break or lull about half way through a shift, at the end of the shift, and at home at least three hours after a shift. You are to do this for one week.

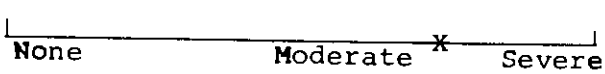
Your specific task on each form is to rate the degree of physical or psychological effects you are presently experiencing for each item from none through severe by marking an X anywhere along the line as illustrated in the examples below. Suppose at the time you are completing the form you do not have a headache, then mark the item as shown:

1. Headache:



Suppose you do have a headache at the time you are completing the form, then depending upon its degree you might mark the item as shown:

1. Headache:



Your cooperation is greatly appreciated. Thank you.

TABLE C-2. STRESS QUESTIONNAIRE

Complete only these first two lines.

I.D.: _____ DATE: _____ SHIFT: _____

TIME OF DAY	PRE	DURING	POST	HOME
TRAFFIC LOAD:	_____	_____	_____	_____
WEATHER:	_____	_____	_____	_____

Each line below represents a scale of symptoms you might experience ranging from none to severe. For each item below please mark an (X) anywhere along the line corresponding to the degree of symptom you are now experiencing. (You may go beyond the ends of the line if you wish.)

1. Headache:	None	Moderate Severe
2. Constipation:	None	Moderate Severe
3. Sweating:	None	Moderate Severe
4. Twitching muscles:	None	Moderate Severe
5. Dizziness:	None	Moderate Severe
6. Poor appetite:	None	Moderate Severe
7. Chest pains:	None	Moderate Severe
8. Loose bowels:	None	Moderate Severe
9. Loss of temper:	None	Moderate Severe
10. Difficulty in breathing:	None	Moderate Severe
11. Aching or burning eyes:	None	Moderate Severe

TABLE C-2. STRESS QUESTIONNAIRE (CONTINUED)

12. Indigestion or heart burn: None Moderate Severe

13. Difficulty in staying awake. None Moderate Severe

14. Stiffness or body tenseness: None Moderate Severe

15. Bothered by distracting noise: None Moderate Severe

16. Nausea or sick to your stomach: None Moderate Severe

17. Asthma: None Moderate Severe

18. Insomnia: None Moderate Severe

19. Backache: None Moderate Severe

Each line below represents a scale of moods you might feel ranging from none to severe. For each item below please mark an (X) anywhere along the line corresponding to the degree of mood you feel at the present moment. (You may go beyond the ends of the line if you wish.)

1. Worry: None Moderate Severe

2. Uncomfortable None Moderate Severe

3. Tense: None Moderate Severe

4. On edge: None Moderate Severe

5. Irritable: None Moderate Severe

6. Fidgety: None Moderate Severe

7. Depressed: None Moderate Severe

TABLE C-2. STRESS QUESTIONNAIRE (CONCLUDED)

8.	Upset:	None	Moderate	Severe
9.	Anxious:	None	Moderate	Severe
10.	Tired:	None	Moderate	Severe
11.	Drowsy	None	Moderate	Severe

break. The questionnaires were then returned to the experimenter through the mail.

C.2.4 Results:

Five watchstanders completed and returned their packets of 16 questionnaires. Table C-3 presents the results from the pre-operational New Orleans VTS ordered by the magnitude of the post-shift median* scores for those items whose post-shift score exceeded a rating of None, 0.85. Of the 19 somatic items, only "Aching or burning eyes" indicated appreciable stress; of the 11 mood items, only "Fidgety" indicated appreciable stress.

The results for the only appreciably rated somatic and mood items, "Aching burning eyes" and "Fidgety", are presented graphically in Figures C-1 and C-2, respectively. Each figure presents the 75th percentile, median, and 25th percentile values for the four periods during the shift in which the questionnaire was completed: before going on duty (PRE), while on Duty (DUR) just after going off duty (POST) and after arriving at home (HOME). The numbers on the vertical axis indicate the distance (in centimeters) along the rating scale from None (0 to 0.85 cm) through Moderate (3.50 to 5.25 cm) to Severe (8.0 to 9.5 cm) at which watchstanders marked each item. These items are typical in that nearly every item exhibited a worsening trend throughout the shift. The 75th percentile and 25th percentile spread of ratings about the median is typical of the spread in scores for other items.

Finally, Figures C-3 and C-4 show trends of the most sensitive somatic and mood items over the four days. Both types of items exhibited increases across the work week; and the magnitude of these increasing trends was about the same as that across periods within a day.

*Median: The middlemost rating; half the ratings fall above the median, half below.

TABLE C-3. MEDIAN STRESS SCORES, PREOPERATIONAL NEW ORLEANS VTS

	Somatic Index			
Item	PRE	DUR	POST	HOME
Aching or burning eyes	0.45	0.74	1.03	0.69
	Mood Index			
Item	PRE	DUR	POST	HOME
Fidgety	0.42	0.84	0.95	0.40

Note 1. The stress scores indicate the distance (in centimeters) along the scale from None (0.00 to 0.85 cm) through Moderate (3.50 to 5.25 cm) to Severe (8.0 to 9.5 cm).

Note 2. Only those items for which the POST Median score exceeded 0.85, None, are tabulated.

Note 3. Median: The middlemost rating; half the ratings fall above the median, half below.

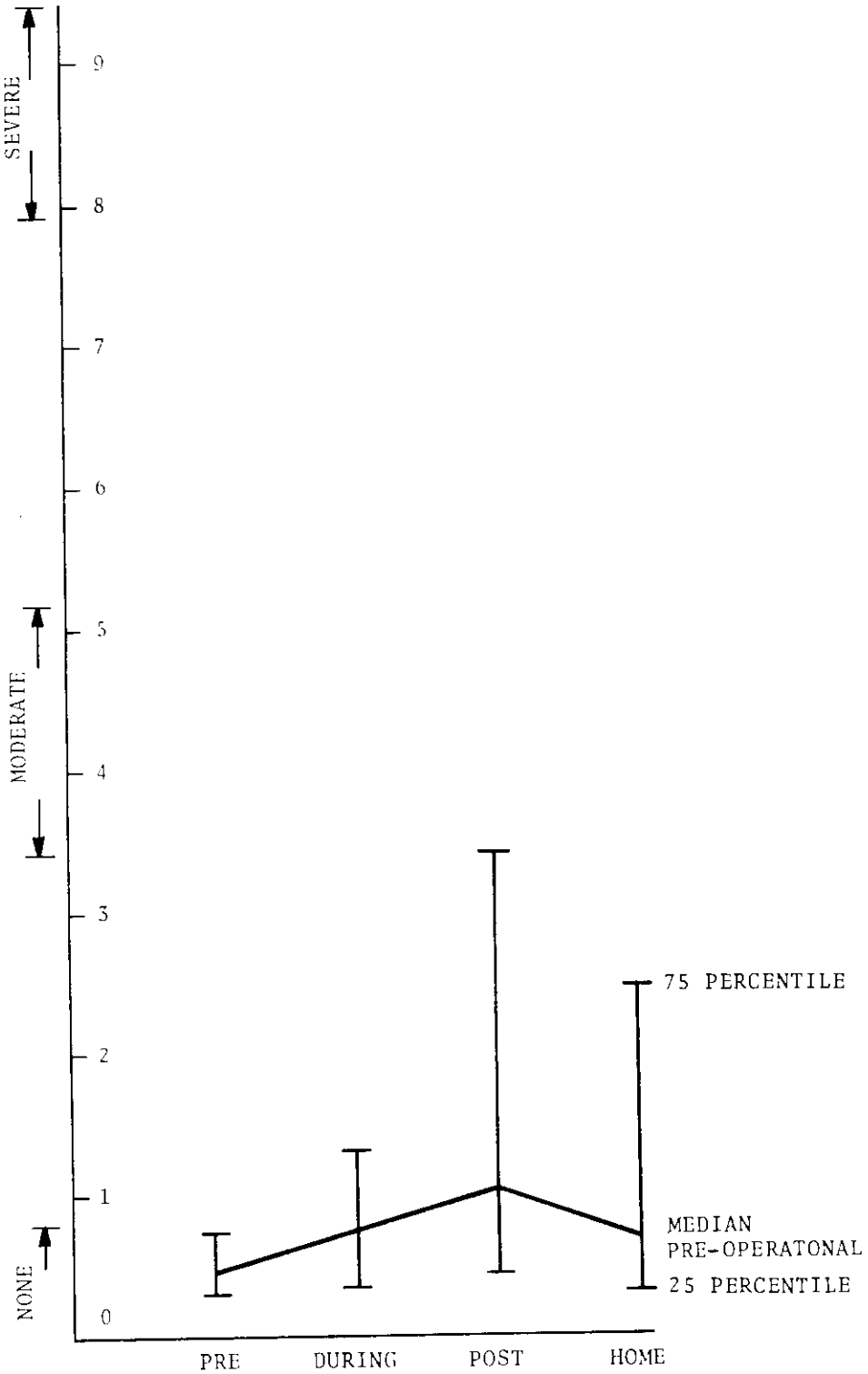


FIGURE C-1. SEVERITY RATINGS FOR ITEM, "ACHING, BURNING EYES" AVERAGED OVER 4 DAYS (N=5)

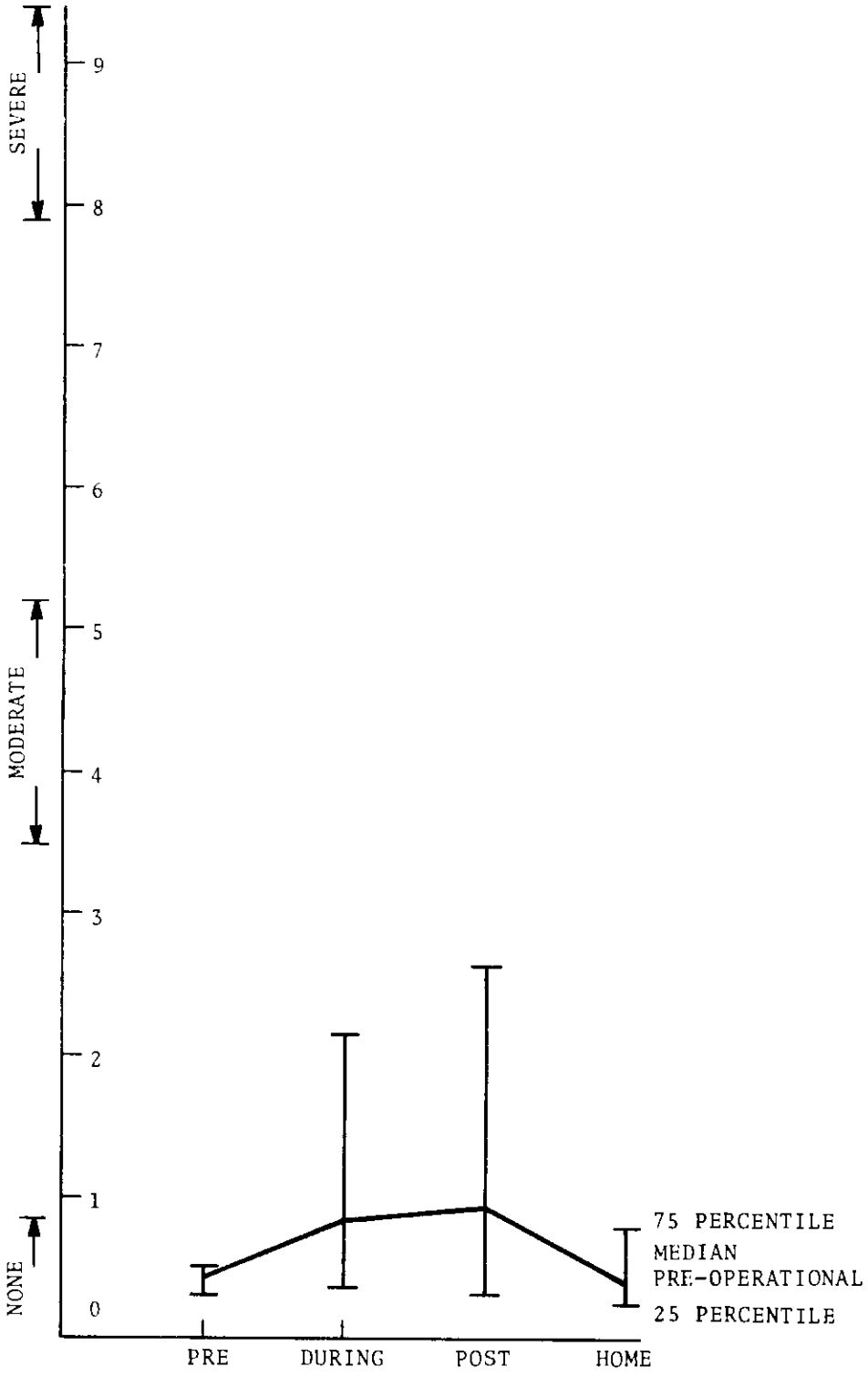


FIGURE C-2. SEVERITY RATINGS FOR ITEM "FIDGETY" AVERAGED OVER 4 DAYS (N=5)

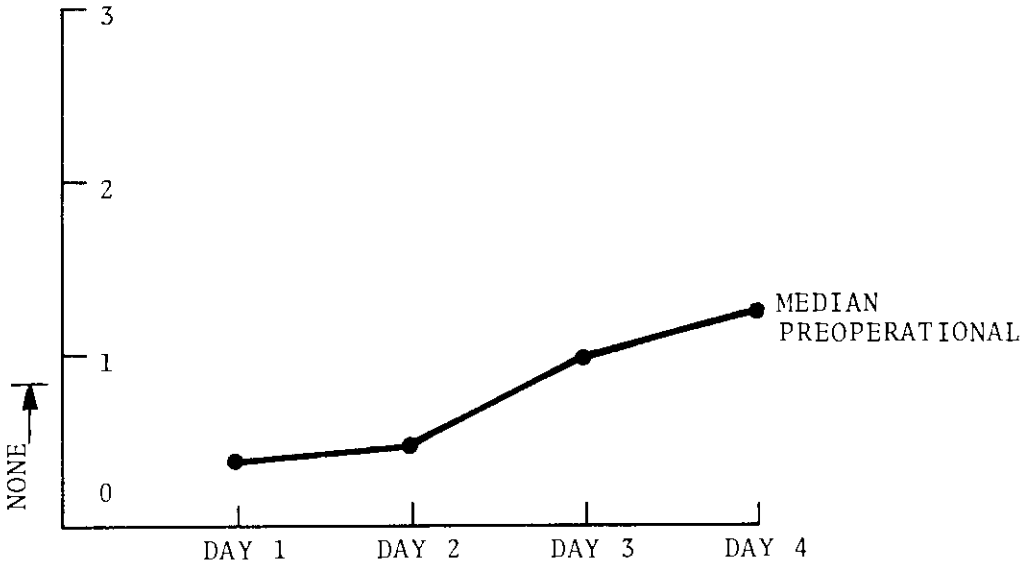


FIGURE C-3. MEDIAN RATINGS ON ITEM "ACHING, BURNING EYES" OVER 4 DAYS DURING PREOPERATIONAL PERIOD (N=5)

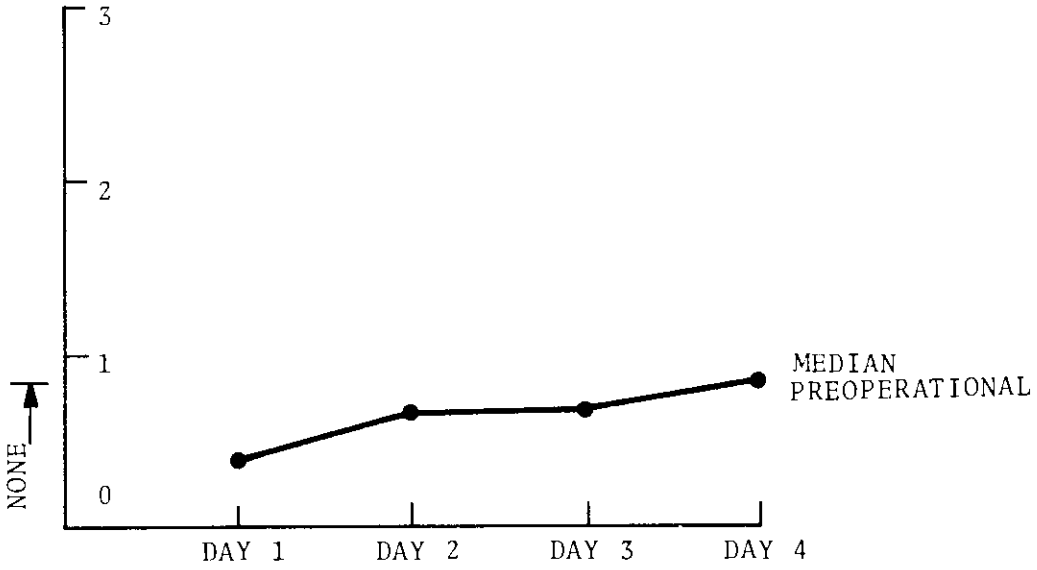


FIGURE C-4. MEDIAN RATINGS ON ITEM "FIDGETY" OVER 4 DAYS DURING PREOPERATIONAL PERIOD (N=5)

The pre-operational New Orleans stress results are compared with the original FAA survey in Table C-4 in rank order. These two rankings do not agree well at all (Spearman rank-order correlation = 0.38, not significant*) indicating a different rank order or pattern of responses.

The results of the survey conducted at the Houston-Galveston VTS are also presented in Tables C-4 and C-5 for the somatic and mood indices, respectively. A comparison of the somatic questionnaire results from these two centers revealed: a) different rank order or pattern of items for each center, and b) considerably lower levels of stress reported at the New Orleans VTS than at the Houston-Galveston VTS. Although stress data is also available from the Puget Sound VTS[4], these New Orleans VTS data were compared with those from the Houston-Galveston VTS because, when surveyed, watchstanders at both centers served an 8-hour shift, not 12 hours; utilized computer displays, not a map; serviced long, winding waterways, not an open harbor; and handled much the same kind of traffic.

"Aching or burning eyes" ranked highest for both centers; however, for New Orleans, no other items exceeded a rating of None. "Stiffness," "Difficulty staying awake," "Loss of temper," "Poor appetite," "Twitching muscles," and "Headache" all exceeded a rating of None at Houston, but not at New Orleans. In general, the two rankings do not agree well at all (Spearman rank-order correlation = 0.42, not significant).

The magnitude or level of stress reported at Pre-operational New Orleans was considerably less than that from the Houston-Galveston VTS. On the leading item, "Aching or burning eyes", the median POST shift response for watchstanders at New Orleans was

*A correlation coefficient is an index of the degree to which two sets of measures vary together: 1.00 indicates a perfect relationship, 0.00 indicates no relationship, and a negative value means that one measure increases as the other decreases. Statistical significance is based on an estimate of the likelihood that the value obtained was due to chance alone rather than to a true relationship. It is customary to accept as significant, only values that would have less than one chance in twenty ($p<0.05$) of ocurring by random variation.

TABLE C-4. PREOPERATIONAL NEW ORLEANS VTS RESULTS COMPARED WITH HOUSTON-GALVESTON AND FAA--SOMATIC

	Somatic Index			
	POST Median Scores		RANK	
Item	Pre-Operational NOLA VTS	Houston-Galveston VTS	FAA	Houston-Galveston VTS
Aching or burning eyes	1.03	2.39	1	1
Stiffness	<.85	1.27	4	2
Loose bowels			16	11
Insomnia			18	16
Headache	<.85	0.95	3	7
Difficulty staying awake	<.85	1.12	5	3
Indigestion			8	15
Constipation			11	12
Distracted by Noise			6	9
Twitching muscles	<.85	0.98	9	6
Sweating			2	8
Loss of temper	<.85	1.06	7	4
Nausea			14	19
Asthma			17	17
Chestpains			13	13
Breathing difficulty			12	14
Dizziness			15	10
Poor Appetite	<.85	1.03	10	5
Nightmares			19	18

TABLE C-5. PRE-OPERATIONAL NEW ORLEANS VTS RESULTS COMPARED WITH HOUSTON-GALVESTON--MOOD

	Mood Index		
	POST Median Scores		RANK
ITEM	PRE-OPERATIONAL NOLA VTS	HOUSTON-GALVESTON VTS	HOUSTON-GALVESTON VTS
Fidgety	0.95	1.57	3
Irritable	<.85	1.46	5
Tense	<.85	1.62	2
Anxious	<.85	1.35	6
On edge	<.85	1.55	4
Uncomfortable	<.85	0.90	8
Worry			9
Depressed			11
Upset			10
Drowsy	<.85	1.12	7
Tired	<.85	3.09	1

1.03 compared to 2.39 for those at the Houston-Galveston VTS. No other item at New Orleans produced a rating exceeding None while 6 out of the 18 others at Houston-Galveston did.

Comparison of the Pre-operational New Orleans and Houston-Galveston results on the Mood index (Table C-5) again revealed: a) a different rank order or pattern of responses for each center and b) considerably lower levels reported at the New Orleans VTS than at the Houston-Galveston VTS. "Fidety" not only ranked highest at New Orleans, but also was the only item whose score exceeded None on the rating scale for Mood; "Tense" rated highest at Houston-Galveston. In general, the two rankings did not agree well at all (Spearman rank order correlation = 0.34, not significant).

The level of stress reported on the Mood index at New Orleans was considerably less than that from the Houston-Galveston VTS. On the leading item for New Orleans, "Fidgety", the median POST-shift response for watchstanders was 0.95 compared to 1.57 for those at Houston. No other Mood items produced a rating exceeding None at New Orleans while 7 out of the 8 others at Houston-Galveston did.

C.2.5 Discussion:

This survey of stress responses among watchstanders conducted during a pre-operation period at the New Orleans VTS demonstrated mild stress on both somatic and mood indices. In general, there was a worsening trend throughout the shift for the only two sensitive items at New Orleans, "Aching or burning eyes" on the somatic index and "Fidgety" on the mood index. More importantly, scores on both these indices were considerably less in magnitude than those for Houston-Galveston, an operational VTS similar to New Orleans.

The rank ordering of scores from New Orleans does not match those from either the FAA study, or Houston, although the ordering between the FAA and Houston does correlate well.

Comparison of both the magnitude and rank-order results indicate that the pre-operational conditions at New Orleans induce less stress than the operational conditions of either Houston or the FAA, and that the stress which does appear is a different type. The "Aching or burning eyes" item ranks high at both centers because watchstanders at both must make use of a computer-driven cathode-ray tube display but the magnitude of reported stress is much less at New Orleans. There were no other sensitive somatic items at New Orleans. "Fidgety" ranks high at New Orleans, and is the only sensitive mood item, while "Tired" is highest at Houston and lowest at New Orleans. At New Orleans, watchstanders reported being anxious to become operational and were responsible only for monitoring vessel movements, nothing further. The implication is that they were fidgety to commence operations rather than tired due to the responsibility.

C.3 OPERATIONAL STRESS LEVELS

C.3.1 Subjects: Eleven watchstanders at the New Orleans VTS served as subjects during breaks in their 12-hour shift. All watchstanders were in their early twenties, had served in the U.S. Coast Guard for a median of 4.9 years, and all but one had been at the New Orleans Center from the time it became operational in October 1977. Only two had participated in the pre-operational survey.

C.3.2 Apparatus: The questionnaire was identical to that used in the pre-operational survey, described previously.

C.3.3 Procedure: Watchstanders recruited for the critical incident interviews (see Section II) were asked to participate in this questionnaire survey of stress levels. For those watchstanders consenting to participate, the procedure was the same as that used in the pre-operational survey, described previously.

C.3.4 Results:

Seven watchstanders completed and returned their packets of 16 questionnaires. Table C-6 presents the results from the operational New Orleans VTS ordered by the magnitude of the post-shift median scores for those items whose post shift score exceeded a rating of None, 0.85. Of the 19 somatic items, 8 items -- "Loss of temper", "Headache", "Aching or burning eyes", "Difficulty staying awake", "Bothered by noise", "Backache", "Stiffness", and "Sweating" -- indicated appreciable stress. Responses to all of the 11 mood items also indicated appreciable stress. The leading mood item was "Tired" followed by "Drowsy".

The results for the most highly rated somatic and mood items, "Loss of temper" and "Tired", are presented graphically in Figures C-5 and C-6, respectively. Each figure presents the 75th percentile, median, and 25th percentile values for the four periods during the shift in which the questionnaire was completed: before going on duty (PRE), while on duty (DUR), just after going off duty (POST) and after arriving home (HOME). The numbers on the vertical axis indicate the distance (in centimeters) along the rating scale from None (0 to 0.85 cm) through Moderate (3.5 to 5.25 cm) to Severe (8.0 to 9.5 cm) at which watchstanders marked each item. These items are typical in that every item exhibited a worsening trend throughout the shift. The 75th and 25th percentile spread of ratings about the median is typical of the spread in scores for other items.

Finally, Figures C-7 and C-8 show trends of the most sensitive somatic and mood items over the four days. Both types of items exhibited somewhat decreasing levels across the four shifts.

The Operational New Orleans stess results are compared with the original FAA survey in Table C-7 in rank order. The two rankings agree very well (Spearman rank-order correlation = 0.81, $p<0.001$) lending support to the validity of the survey.

The results of the survey conducted at the Houston-Galveston VTS are also presented in Tables C-7 and C-8 for the somatic and mood indices, respectively. A comparison of the somatic

TABLE C-6. MEDIAN STRESS SCORES, OPERATIONAL NEW ORLEANS VTS

ITEM	PRE	DUR	POST	HOME
	SOMATIC INDEX			
Loss of temper	0.40	1.49	1.96	0.93
Headache	0.62	1.31	1.95	1.60
Aching or burning eyes	0.77	1.23	1.77	1.06
Difficulty staying awake	0.33	0.62	1.44	1.08
Bothered by noise	0.53	0.95	1.24	0.50
Backache	0.73	0.98	1.20	0.98
Stiffness	0.45	0.93	1.14	0.93
Sweating	0.50	0.86	0.93	0.50
	MOOD INDEX			
Tired	0.72	1.43	3.04	1.69
Drowsy	0.55	1.04	2.74	1.81
On edge	0.94	2.00	2.38	1.03
Tense	1.16	1.87	2.24	0.61
Irritable	0.97	1.32	2.20	0.79
Unconfortable	0.79	1.60	1.94	0.68
Depressed	0.53	1.48	1.73	0.91
Worry	0.60	0.97	1.73	0.55
Fidgety	1.11	1.48	1.66	0.69
Upset	0.65	1.38	1.47	1.09
Anxious	0.77	1.04	1.07	0.52

Note 1: The stress scores indicate the distance (in centimeters) along the scale from None (0.00 to 0.85 cm) through moderate (3.50 to 5.25 cm) to Severe (8.0 to 9.5 cm).

Note 2: Only those items for which the POST Median score exceeded 0.85, None, are tabulated.

Note 3: Median: The middlemost rating; half the ratings fall above the median, half below

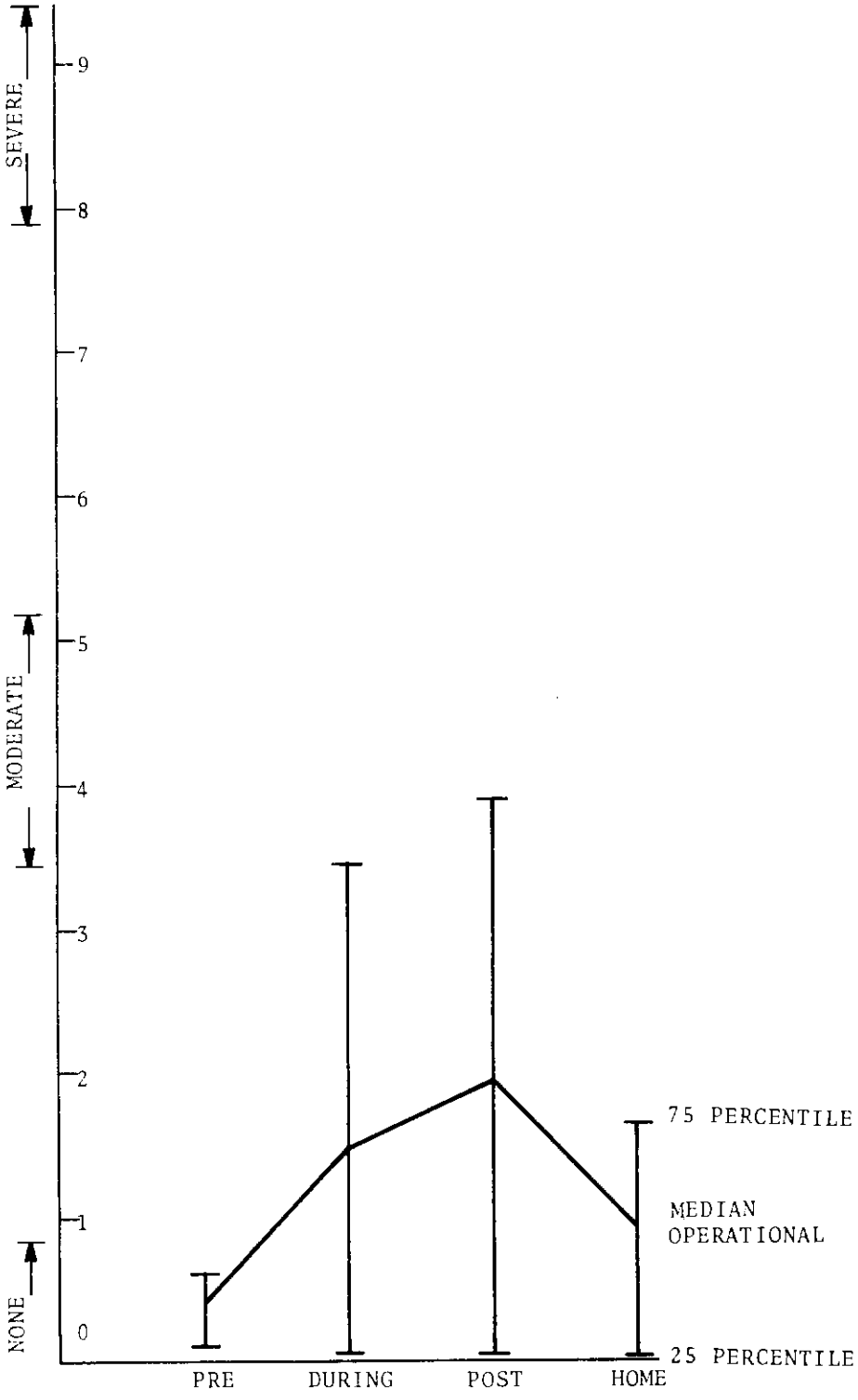


FIGURE C-5. SEVERITY RATINGS FOR ITEM "LOSS OF TEMPER" AVERAGED OVER 4 DAYS (N=7)

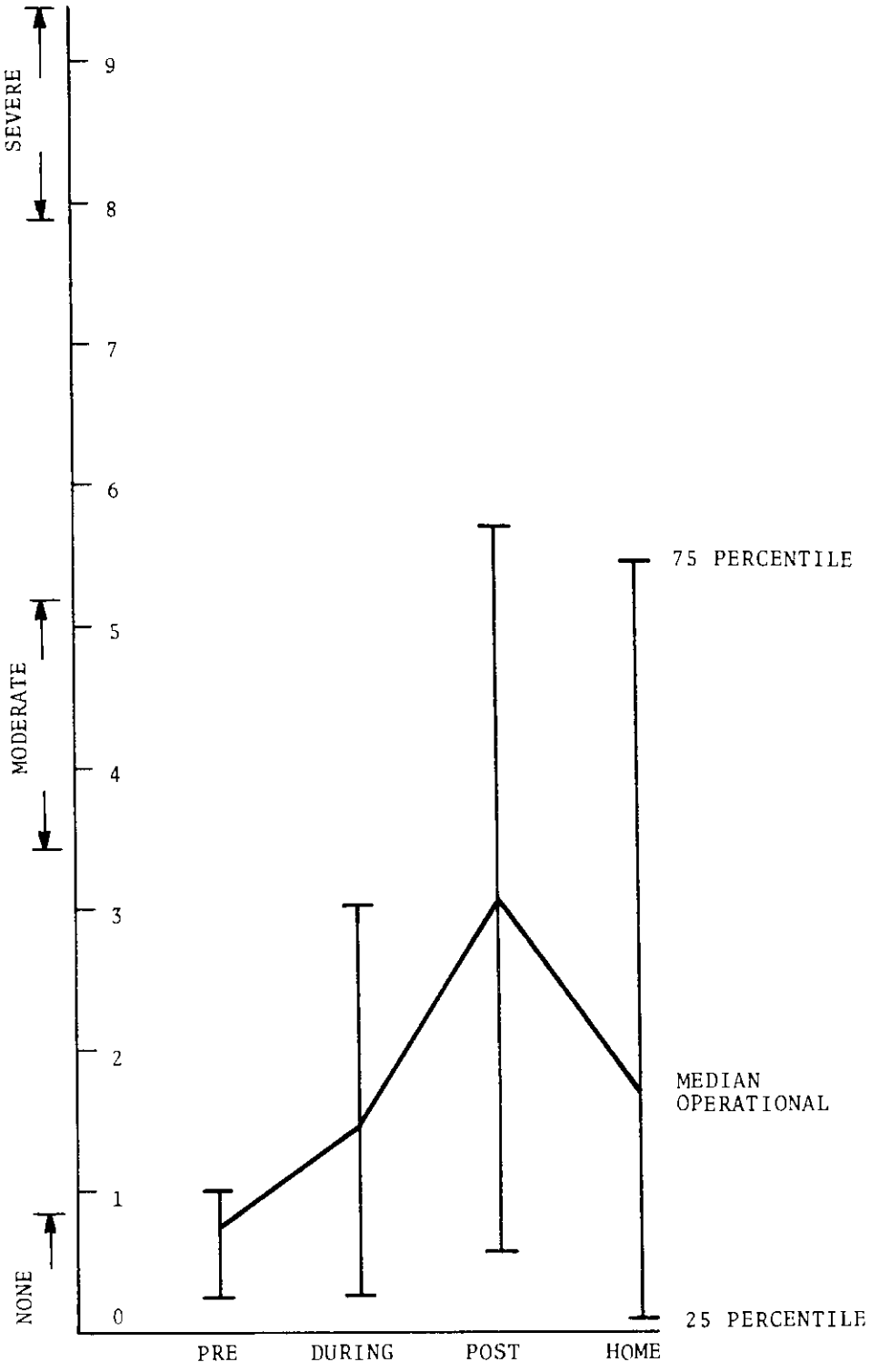


FIGURE C-6. SEVERITY RATINGS FOR ITEM "TIRED" AVERAGED OVER 4 DAYS (N=7)

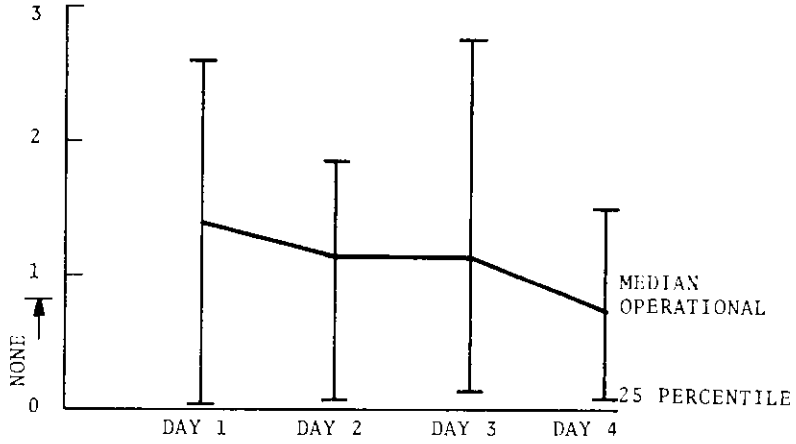


FIGURE C-7. RATINGS FOR ITEM "LOSS OF TEMPER" OVER 4 DAYS DURING OPERATIONAL PERIOD (N=7)

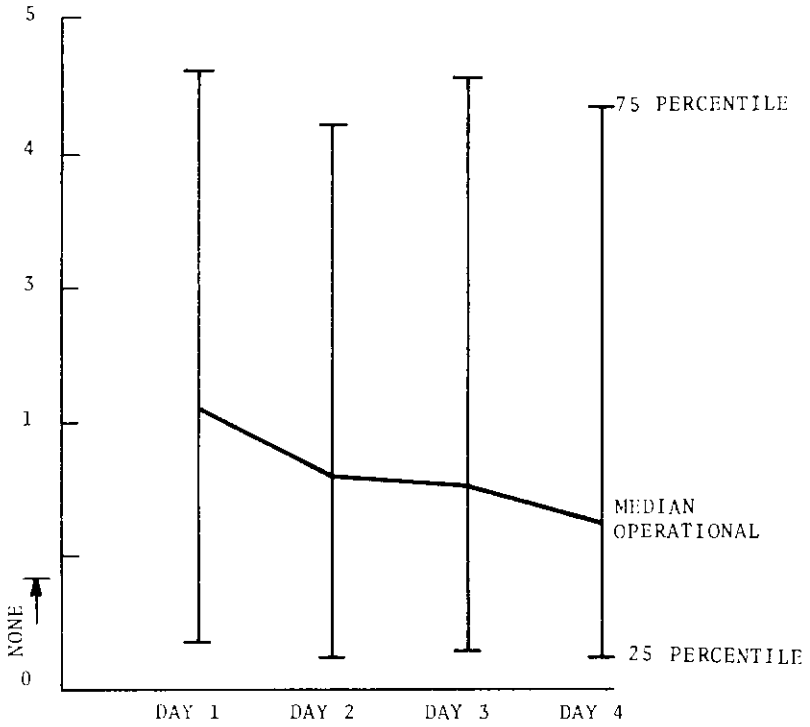


FIGURE C-8. RATINGS FOR ITEM "TIRED" OVER 4 DAYS DURING OPERATIONAL PERIOD (N=7)

TABLE C-7. OPERATIONAL NEW ORLEANS VTS RESULTS COMPARED WITH HOUSTON-GALVESTON AND FAA--SOMATIC

SOMATIC INDEX

	POST MEDIAN SCORES		RANK	
ITEM	OPERATIONAL NOLA VTS	HOUSTON-GALVESTON VTS	FAA	HOUSTON-GALVESTON VTS
Loss of Temper	1.96	1.06	7	4
Headache	1.95	0.95	3	7
Aching eyes	1.77	2.39	1	1
Difficulty staying awake	1.44	1.12	5	3
Bothered by noise	1.24	<.85	6	9
Stiffness	1.14	1.27	4	2
Sweating	0.93	<.85	2	8
Indigestion			8	15
Poor appetite	<.85	1.03	10	5
Nausea			14	18
Loose bowels			16	11
Twitching muscles	<.85	0.98	9	6
Chest pains			13	13
Dizziness			15	10
Constipation			11	12
Insomnia			18	16
Asthma			17	17
Breathing difficulty			12	14

TABLE C-8. OPERATIONAL NEW ORLEANS VTS RESULTS COMPARED WITH HOUSTON-GALVESTON--MOOD

MOOD INDEX

	POST MEDIAN SCORES		RANK
ITEM	OPERATIONAL NOLA VTS	HOUSTON-GALVESTON VTS	HOUSTON-GALVESTON VTS
Tired	3.04	3.09	1
Drowsy	2.74	1.12	7
On edge	2.38	1.55	4
Tense	2.24	1.62	2
Irritable	2.20	1.46	5
Uncomfortable	1.94	0.90	8
Depressed	1.73	<.85	11
Worry	1.73	<.85	9
Fidgety	1.66	1.57	3
Upset	1.47	<.85	10
Anxious	1.07	1.35	6

questionnaire results from these two centers revealed: a) a similar rank order or pattern of items for each center, and b) considerably higher levels of stress reported at the New Orleans VTC than at the Houston-Galveston VTC. Operational New Orleans, however, had switched to a 12-hour shift. "Loss of temper" and "Headache" both ranked higher at operational New Orleans than "Aching or burning eyes" which ranked highest not only at Houston-Galveston but also at Puget Sound. Of the remaining items exceeding rating of None, watchstanders at New Orleans agreed well with those at Houston-Gavelston in terms of the rank order of the somatic items (Spearman rank-order correlation = 0.71 $p<0.001$).

The level of stress reported at the operational New Orleans VTS was considerably greater than that from the Houston-Galveston VTS. On the two higher ranking New Orleans items, the median POST shift response was 1.96 for "Loss of temper" compared to 1.06 and 1.95 for "Headache" compared to 0.95 at Houston-Galveston. "Difficulty staying awake", "Bothered by noise", and "Sweating" all received higher ratings at New Orleans than at Houston-Galveston. Only "Stiffness", "Poor appetite" and "Twitching muscles" rated higher at Houston.

Comparison of the operational New Orleans and Houston-Galveston results on the Mood index (Table C-8) again revealed: a) a similar rank order or pattern of items for each center, and b) considerably higher levels of stress reported at the New Orleans VTS than at the Houston-Galveston VTS. "Tired" ranked highest at both centers with "Drowsy" next at New Orleans but "Tense" next at Houston. Inspection of the two rankings in Table C-8 indicates that, in general, these two rankings are similar (Spearman rank-order correlation = 0.49, $p<0.05$), though not strongly so.

The magnitude or level of stress reported on the Mood index at New Orleans was considerably greater than that from the Houston-Galveston VTS. Except for the highest ranking item from both centers, "Tired"; all items at New Orleans produced ratings often much higher than at Houston. The magnitude for "Tired" was the same for both centers.

C.3.5 Discussion:

This survey of stress responses among watchstanders conducted during an operational period at the New Orleans VTS demonstrated high levels of stress on both somatic and mood indices. There was a worsening trend throughout the shift for all items. The following somatic items ranked especially high: "Loss of temper", "Headache", and "Aching or burning eyes", and the following mood items ranked high: "Tired" and "Drowsy".

More importantly, scores on both these indices were considerably greater in magnitude than those for Houston-Galveston, an operational VTC similar to New Orleans.

The rank ordering of scores from New Orleans agreed with those from both the FAA study and Houston.

Comparison of both the magnitude and rank order results indicate that the operational conditions at New Orleans induce greater stress than the operational conditions of either Houston or the FAA, and that the stress is of a similar type.

C.4 COMPARISON OF PREOPERATIONAL AND OPERATIONAL STRESS RESPONSES

C.4.1 Introduction:

The two previous sections have presented and discussed the results obtained from the New Orleans VTS during pre-operational and operational conditions. This section compares these two sets of results on the basis of levels and pattern of recorded stress.

C.4.2 Comparison:

The results based on the responses of five pre-operational and seven operational watchstanders ordered by the magnitude of the post-shift median scores are compared in Table C-9 for the somatic and the mood items. Comparison reveals: a) a different rank order or pattern of responses between the two conditions, and b) considerably lower levels of stress reported for the pre-operational condition.

TABLE C-9. COMPARISON OF PREOPERATIONAL AND OPERATIONAL STRESS RESPONSES OBTAINED AT THE NEW ORLEANS VTS

SOMATIC INDEX

ITEM	POST MEDIAN SCORES		RANK	
	PRE	OPERATIONAL	PRE	OPERATIONAL
Aching or burning eyes	1.03	1.77	1	3
Stiffness	0.77	1.14	2	6
Loose bowels	0.63	0.44	3	11
Insomnia	0.60	0.28	4	16
Headache	0.59	1.95	5	2
Diff. staying awake	0.52	1.44	6	4
Indigestion	0.52	1.76	7	8
Constipation	0.51	0.29	8	15
Distracted by noise	0.48	1.24	9	5
Twitching muscles	0.46	0.43	10	12
Sweating	0.42	0.93	11	7
Loss of temper	0.39	1.96	12	1
Nausea	0.38	0.54	13	10
Asthma	0.35	0.26	14	17
Chest pains	0.35	0.30	15	13
Breathing difficulty	0.34	0.25	16	18
Dizziness	0.33	0.29	17	14
Poor appetite	0.33	0.68	18	9
Nightmares	0.30	1.20		

MOOD INDEX

ITEM	POST MEDIAN SCORES		RANK	
	PRE	OPERATIONAL	PRE	OPERATIONAL
Fidgety	0.95	1.66	1	9
Irritable	0.75	2.20	2	5
Tense	0.67	2.24	3	4
Anxious	0.58	1.07	4	11
On edge	0.55	2.38	5	3
Uncomfortable	0.52	1.94	6	6
Worry	0.52	1.73	7	8
Depressed	0.43	1.73	8	7
Upset	0.43	1.47	9	10
Drowsy	0.42	2.74	10	2
	0.35	3.04	11	1

Comparison of the rank-orders of the somatic items shows "Aching or burning eyes" to rank highest for the pre-operational condition while "Loss of temper" ranks highest for the operational condition, followed by "Headache" then "Aching or burning eyes." In general, the two rankings do not agree (Spearman rank-order correlation = 0.42, not significant).

In terms of magnitude only "Aching or burning eyes" showed appreciable stress in the pre-operational condition, while eight somatic items exceeded a rating of None for the operational condition. This difference indicates considerably lower levels of somatic stress for the pre-operational condition.

Comparison of the rank-orders for the mood items shows "Fidgety" to rank highest for the pre-operational condition while "Tired" then "Drowsy" lead a list of eight mood items which rank higher than "Fidgety" for the operational condition. In general, the two ratings do not agree (Spearman rank-order correlation = -0.34, not significant).

In terms of magnitude, only "Fidgety", showed appreciable stress in the pre-operational condition, while all 11 mood items showed appreciable stress for the operational condition. Scores on the 11 mood items were greater for the operational than the pre-operational mood items.

C.4.3 Discussion:

Although only 5 out of 12 pre-operational and 7 out of 11 operational watchstanders who received the forms participated and the forms for the operational condition were returned very slowly, the results are not unexpected. These results indicate:

- A very low pre-operational stress level, lower than at operational Houston-Galveston,
- A very high operational stress, higher than at operational Houston-Galveston,
- A different pattern of stress response for the high stress operational condition than for the low stress pre-operational condition.

In essence, the pre-operational situation at New Orleans generated very little stress and a pattern differing from operational Houston-Galveston or the FAA. The operational stress levels were clearly higher, while being similar to operational Houston-Galveston and the FAA. This increase in stress from pre-operational to operational levels is probably due to the responsibility of being fully operational and the change to a twelve hour shift. However, the operational levels at New Orleans exceeded those at a similar VTS Houston-Galveston. Unlike the Houston-Galveston VTS the New Orleans VTS lacks any form of positive surveillance. New Orleans watchstanders do not have radar or television for definite location and continuation of vessel positions and relative movements. Watchstanders glean such information by monitoring bridge-to-bridge and other radio communications activity in a voluntary system with an unknown level of participation. This absence of accurate position information leads to considerable uncertainty. This uncertainty underlies the increased levels of stress obtained.

C.4.4 Recommendation:

- Provide positive surveillance at the New Orleans VTS.

C.4.5 References:

1. Caplan, R.D., Cobb, S., French, J.R.F., Van Hurrison, R., and Pinneau, S.R., HEW Publication No. (NIOSH) 75 - 160, April 1975.

2. Hauty, G.T., Trites, D.K., and Berkley, W.J., Biomedical Survey of ATC Facilities: Incidence of Self Reported Symptoms. FAA Report (ADG89806), March 1965.

3. Devoe, D.B., Abernethy, C.N., and Kearns, K.S., Houston-Galveston Vessel Traffic Service Watchstander Analysis. U.S. Coast Guard Report No. CG-D-24-78, May 1978.

4. Devoe, D.B., Royal, J.W., Abernethy, C.N., Kearns, K.J., Puget Sound Vessel Traffic Service Watchstander Analysis. U.S. Coast Guard Report No. CG-D-82-78, December 1978.

C.5 CRITICAL INCIDENT INTERVIEWS CONDUCTED AT THE NEW ORLEANS VTS CENTER ON 10-14 APRIL 1978

C.5.1 Introduction:

The elevated levels of stress reported by watchstanders in a previous survey conducted in September, 1977, at the Houston-Galveston VTS prompted a need to uncover the sources of these elevated stress levels. In the Houston survey, watchstanders indicated degree of stress from none through moderate to severe on a linear scale for each of the 30 survey items describing physical and emotional symptoms of stress. Watchstanders reported appreciable stress on 7 of 19 somatic items (e.g., "tense", "worry"). The most sensitive items were "aching or burning eyes" and "tiredness". More importantly, respondents to every item exhibited a worsening trend throughout the watchstander's shift. These results are fully reported in Reference 1.

The survey at Houston and the two additional surveys conducted at New Orleans (see C.2-C.4) demonstrated elevated stress levels, but their sources remain unknown. If known, these sources might be relieved through changes in equipment, layout, or procedures. However, these stress levels may also arise from such uncontrollable sources as an individual's predisposition towards stress, or from specific, unanticipated incidents, such as accidents.

One technique for determining the sources of these stresses is to ask the watchstanders, using a structured interview method developed by Flanagan (Reference 2) known as the critical incident technique. This method has proved useful in finding causes of accidents and near accidents. The technique involves identifying a particular kind of incident and then obtaining details about the incident itself and the events which led up to it. For example, Fitts and Jones (Reference 3) used this technique to ask pilots to: "Describe in detail an error in the operation of a cockpit control (flight control, engine control, toggle switch, selector switch, trim tab, etc.) which was made by yourself or by another person

whom you were watching at the time." They uncovered several systematic errors: substitution errors, adjustment errors, forgetting errors, reversal errors, unintentional activation, and inability to reach controls.

In the present study a structured interview was developed to ask watchstanders to recall an incident in which they experienced stress. The incident need not be of major proportions or obviously stress-inducing like a collision, ramming, or grounding, but might, for instance, only involve difficulties with a particular pilot. Details about the incident are obtained in order to determine: 1) possible changes in equipment, layout, and procedures which could reduce or eliminate these stresses; 2) individual differences in stress responses; and 3) specific incidents which are stressful.

C.5.2 Subjects: Twelve watchstanders, one watch officer and two watch supervisors (CPO's) participated in this interview. All had participated in or had knowledge of the stress surveys conducted in October 1977, and April 1978. Participants came from two different shifts. All watchstanders were in their early twenties, had served in the U.S. Coast Guard for a median of 4.9 years, and all but one had served in the New Orleans VTS from the time it became operational in October 1977. The one exception had just completed training. The chiefs and supervisor were older and had considerably more U.S. Coast Guard experience. Each had been relieved briefly from duty to participate in this interview.

C.5.3 Apparatus: Each interview proceeded as outlined in the form presented as Table C-10. Each question required discussion by the watchstander. Questions included general inquiries about stress sources as well as requests for overall recommendations for changes at the VTS and elaboration of specific incidents.

This interview is a revised version of that used at the Houston-Galveston VTS in March, 1978. On the basis of data gathered at that center, this interview emphasized certain topics. These topics included suggestions for new equipment, descriptors of

TABLE C-10. CRITICAL WATCHSTANDER STRESS INCIDENTS STRUCTURED INTERVIEW

Preface:

The survey administered at this Vessel Traffic Service Center revealed the presence of stress. The purpose of this interview is to uncover the sources of that stress and to assess the form of these stresses. Do you agree that there is stress present at the VTS Center?

Yes No

A. General:

1. Sources: Please indicate those sources of stress which in your opinion exist at this VTS Center.

2. Changes: What changes do you suggest be implemented to reduce or eliminate these sources of stress?

Equipment:

New Equipment:

Layout:

Procedures:

TABLE C-10. (CONTINUED)

B. Descriptors:

1. Stress respondent: In comparison to others, rate your response to stress on the following scale:

Much more than others	Same as others	Much less than others

2. Stress response: Please describe those stress responses which you usually experience?

3. Motivation for VTS duty: After this tour of duty expires, what would motivate you to continue on as a watchstander in the U.S. Coast Guard?

C. Incident:

Please describe a recent stressful incident occuring while you were standing watch at the VTS center. This incident need not be of major proportions, only one in which you experienced stress.

Description:

How recently did this event occur?

TABLE C-10. (CONCLUDED)

What made this a stressful incident?
What stress sensations did you feel?
For how long after the incident did you feel this way?
What changes in the equipment, layout, or procedures would you suggest to prevent such an incident from recurring?

watchstander's potential or predisposition for stress response and type of stress response, and inquiries about the stressor and the behavior, mood, and sensations experienced during critical incidents.

C.5.4 Procedure: Interviews were conducted in the observation room adjacent to the operations room, where both the interviewer and the respondent could remain comfortably seated and uninterrupted for the 20-minute interview period. The interviewer began by reintroducing himself to the watchstanders, and explaining that since the previous survey had identified the presence of stress, the purpose of the present interview was to uncover the sources of that stress. If the watchstander agreed to participate, the interview proceeded. All watchstanders approached in this way agreed to participate. The interviewer then asked each question from the inverview form in a conversational manner, rather than merely reading the question aloud. The watchstander's responses were recorded in writing on the form, and the interviewer often probed for further details.

C.5.5 Results:

The nature and frequency of responses obtained from these critical incident interviews are summarized in Table C-11. It was found that the stress source reported by most watchstanders involved the radio. Apparently, listening to the voice transmissions plus static on the radio is normally fatiguing, but becomes very stressful during surges in traffic loads (more than three or four mariners calling in at the same time). These surges produce a situation in which one pilot or operator breaks in on another on the radio channel, making communications very difficult. Further complications arise from the U.S. Army Corps of Engineer's transmitters at the locks. Vessels communicating with the locks sometimes overpower all other radio activity. Other sources of communication problems are switching among transcievers in Sector I and non-participant or abusive pilots and mariners.

A second source of stress involves boredom, on the one hand, and at the other, extreme high traffic loads (20 to 25 vessels) and long hours. The third major source is interpersonal conflict between the watchstander and supervisor or the watchstanders and other watchstanders. An additional source of stress is the feelings of inadequacy to perform a good job with the available equipment and procedures.

The most frequent suggestions for new equipment revolved around acquiring various types of surveillance equipment. Such equipment would allow watchstanders to identify vessels, fix their positions, and determine their speeds more easily. This equipment would permit improved acquisition of this information while reducing the need for radio usage. Other suggestions to reduce or eliminate noise and clutter on the radio channel included the use of filters and noise limiters.

The watchstanders suggested two ways to improve the present equipment layout: 1) by positioning the communications console at an angle to the computer display so that watchstanders could reach it without moving their chairs, and 2) by centrally locating the supervisor's position so that watchstanders do not disturb others while requesting his assistance.

Suggested changes in equipment to reduce or eliminate sources of stress concerned the computer, the radio communications, and the intercom between the watchstander and supervisor. Suggested improvements in the computer system include those for the tabular displays and those for the map. In addition to adding another display area, a number of improvements to the present displays were suggested. These are listed in Table C-11. From the discussions about the map, it became apparent that the map should convey more information about the river, destination points, and adjoining sectors. Improvements suggested for radio communications involved the reduction or elimination of interfering radio traffic. Suggestions specific to each sector are presented in Table C-11. Finally, the need for the intercom between supervisor and watchstander is questioned.

The procedural change most desired by the watchstanders would be to alter the radio communications style making it more acceptable to the mariners; this change would facilitate courteous communications and might possibly increase participation. Several other suggestions are listed in Table C-11. Most notable are the last two concerning rearrangements of Sector II boundaries, in order to reduce radio interference.

Several suggestions concerning personnel were offered (see Table C-11., the most notable being a request for more watchstanders to make shorter, 8-hour shifts possible.

Table C-11 contains a catagory entitled "Descriptors". These two items were incorporated to find out how watchstanders actually respond in general to stress. From Item 1, it appears that they tend to respond "less than others". However, from Item 2, no conclusive pattern of responses tends to emerge. These data are reported for information and for later comparison with other centers.

Thirteen critical incidents are reported in Table C-11. (Only watchstander incidents are reported since this is the position of interest). The critical incidents reported are interesting in their variety and the explanations of why they are stressful. There were, in essence, 13 different instances, but explanations of what was stressful about the incident involved only three main items: indefinite radio communications with the mariners, difficult coordination with the Captain of the Port's office, and inability to find written information rapidly.

Finally, the closing question, "Do you have anything you wish to add?", brought forth many responses. Those falling into the catagories outlined in Table C-11 are included therein. The several other responses are listed without comment in Table C-12. These further responses can be described by four categories: Comments about their job, about their career, about specific problems, and about other suggestions for improvements.

C.5.6 Discussion:

No difficulties were encountered in conducting the interviews. The watchstanders were familiar with the interviewer from two previous visits to the New Orleans VTS. Watchstanders began answering questions immediately and appeared confident of their privacy. They also displayed an understanding of the need for such an interview, often by requesting to participate. Watchstanders did display some nervousness during the interview; however, this nervousness was probably due to the process of being interviewed, not to the subject matter at hand.

This critical incident technique proved effective in eliciting information unobtainable by the other data gathering methods employed. Tbe responses tbroughout the inverviews dealt with radio communications, acquisition of surveillance equipment, and feelings of inadequacy to perform the job. This last item was emphasized greatly in response to the closing interview question, "Do you have anything you wish to add?"

It appears that the absence of any positive surveillance apparatus in the New Orleans VTS system necessitates increased reliance on radio communications for information concerning the whereabouts of the vessels. Watchstanders know their sole source of information comes from the pilots and mariners who are often inaccurate or, at best, casual about the information they give, who are at times reluctant to participate, or who simply do not participate. Watchstanders also encounter considerable difficulties with the radio itself in terms of background noise and clutter, non-VTS users, very powerful transmitters, and mariners' breaking in. Consequently, there is considerable uncertainty about the completeness and validity of the information, resulting in stress for the watchstanders and feelings of inadequacy about doing the job well. Stress levels should be reduced considerably by the installation of positive surveillance equipment such as radar, television and so on.

These results are based on 15 interviews taken from watchstanders in two different day shifts. There are a total of 33

operational personnel split into four 12-hour shifts at New Orleans. The sample taken is considered representative of the operational contingent at NOLA VTS.

C.5.7 Conclusions:

In general, the greatest stresses experienced by VTS watch-standers at the New Orleans Center appear to be difficulties in radio communication, a need for positive surveillance systems and boredom alternating with overload from high traffic loads or surges. Their descriptions of stress indicate that most watch-standers perceive themselves as responding less than other watch-standers in stressful situations, but no consistent pattern of responses appears across individuals. The critical incidents also reveal no consistent pattern in stress sensations, although most subside quickly.

C.5.8 Recommendations:

1. Equipment changes most strongly recommended were:
   - Acquisition of positive surveillance equipment such as radar, closed-circuit television, etc.
   - Installation of noise filters and noise limiters into the radio
   - Provision of a second tabular display area for the computer display.

2. Radio communications should be reduced by:
   - Rearranging sector boundaries
   - Relocating radio transceiver antennas
   - Assigning a different radio frequency to each sector
   - Removing non-VTS users from the radio channels.

TABLE C-11. RESULTS FROM NEW ORLEANS CRITICAL INCIDENT INTERVIEWS

A. Stressor Sources:

	Freq.
Background noise and Non-VTS activity on the radio channel (especially in Sector 3).	5
More than three or four mariners calling in simultaneously.	3
Necessary switching between transceivers in Sector I.	3
Pilots and mariners not participating or abusive when they do.	3
Boredom.	3
Traffic load exceeding 20 to 25 vessels.	2
Long hours (12 hour shift).	1
Difficulty with supervisors	4
Difficulty with other watchstanders.	1
Feeling inadequate to perform the job.	3

B. Changes suggested to reduce or eliminate stress sources:

1. Equipment

Computer Tables

Provide two tabular display areas on the computer display.	5
Add a function to display the vessels underway listing in alphabetical order.	1
Add to a vessel's critical traffic summary those vessels docked or anchored at his destination.	1
Provide listings of standard vessel name and geographic location abbreviations accessed using the PEM.	1
Provide for more than 10 characters in the vessel status display to reduce or eliminate abbreviations.	1

Total exceeds 15 because most reported more than one stressor source.

TABLE C-11. (Cont'd)

	Freq.
Map	
Provide a precise map of the river.	1
Display more destination points on the map.	1
Display a portion of the bordering sectors.	1
Radio Communications	
Sector I. Establish one transceiver site per sector even if Sector boundaries must be charged.	7
Section III. Either provide another VTS channel or remove other users.	7
Sectors II and IV. Either place on different frequencies or reduce power to eliminate cross talk.	2
Intercom	
Provide each watchstander with equipment to both receive and transmit on all channels or	2
Install a better intercom between watchstanders and supervisors.	1
2. New Equipment	
Positive Surveillance	
Closed circuit television	8
Radar	8
Patrol boat	3
Helicopter	2
Cover windows with Mylar sheets to replace drapes.	1
Radio Receiver	1
Filter all frequencies below 300 Hz. and above 3000 Hz.	1
Install a fast responding automatic noise limiter circuit.	1
Place depth indicating buoys in river especially near banks.	1

TABLE C-11. (Cont'd)

	Freq
3. Layout	
Position communications console at an angle to the computer display facilitating reach.	2
Place supervisor's position on a raised platform in the middle of the watchstanders' positions.	2
4. Procedures	
Change radio communications procedures from strict military to a more courteous interaction with the public.	6
Eliminate the long, disturbing procedure of requesting the supervisor to permit radio transmissions on other frequencies.	2
Space checkpoints more evenly.	1
Make training more appropriate and effective.	1
Conduct bridge-to-bridge communications so that watchstanders know who is passing whom and where.	1
Ease the adjustment from day shift to night shift by having watchstanders repeatedly stand the same watch.	1
Move Industrial Canal to Sector 2 (because of proximity of radio antenna).	1
Extend Sector 2 to the next bridge beyond H.P. Long.	1
Make an estimated advisory subject to revision when a vessel calls in, to speed response.	1
5. Personnel	
More watchstanders are needed, enough for an extra section, so that 8-hour shifts with reasonable amounts of time off between shifts will become possible.	2
More recognition for this job is needed.	1
More appropriate ranks and rates for this job must be determined.	1

TABLE C-11. (Cont'd)

	Freq.
Change from Coast Guard to Civil Service since the military manner interferes with public acceptence.	1

C. Descriptors

1. Stress Responder, Self-Reported ("In comparison with other watchstanders, how would you rate your response to stress?").

Rating	
Much more than others	1
More than others	4
Same as others	4
Less than others	3
Much less than others	3

2. Stress Response, Self Reported ("Please describe those stress responses which you usually experience.").

Behavioral Response	Mood Response	Somatic Response
Hyperactive - 2	Mad/angry - 3	Growing uneasiness - 2
Talks louder - 2	Short tempered - 2	Tension headaches - 2
Yells - 1	Controlled - 2	Anxious - 2
Shouts - 1	Irritable - 1	Feels adrenlin flow - 2
Curses - 1	Intolerant of errors - 1	Hyped-up - 1
Argues - 1	"Clutching out" -1	Shook-up - 1
Forgets more - 1	Frustrated - 1	Nervous - 1
	Apprehensive - 1	Shaking - 1
	Uneasiness - 1	Tight - 1
		Wound-up - 1
		Tense - 1

TABLE C-11 (Cont'd)

D. Incidents			
Incident	Stressor	Sensation	Duration
Had a bad day.	Felt picked on.	Mild anger	3 hours
Highway bridge broke 1 down, backed up 1 traffic, tied up radio	Inability to get through to vessels on radio.	Felt like walking out, telling them off.	2 hours
Sector 3: Trying to give a traffic summary when the lock operator broke in.	Confusing situation because did not know how much mariner had received-	Anger	2-3 minutes
Sector 4: Two talking who will neither get off or let us break in	Unable to communicate.	Angry.	20 minutes
Sector 2: First day on with 38 vessels calling in. Just after Center's opening	High traffic load coupled with being closely watched.	Tenseness fear, dejection, anger	2 hours
Ship dragging anchor in foggy weather striking several others. Notified COTP office.	Consequences to other traffic + uncertainty about actions of the COTP office.	Frustrated, not rested.	after a night's sleep
Two vessels requesting information at the same time, two awaiting entry, one supply boat, and one other	Getting backed up as all vessels' information must be entered into computer	Nervous	Quite a while
Vessel called in stating he was at a certain point, however, there was no idea who he was.	No idea what vessel it was.	Mad, angry, upset.	10-15 minutes
Tug sank killing 3.	Last person in contact with them.	Angry because neither pilots nor rescue informed him so that he might have done something	5 minutes

TABLE C-11. (Cont'd)

D. Incidents (Cont'd)			
Incident	Stressor	Sensation	Duration
Middleman between tow and a ship. Ship broke tow. Neither participants. Ten hrs. later tow calls to identify ship for legal purposes	Does not like being caught between two users.	Uneasiness	During most of 12 hr. shift.
System went off the air	Count not find manual describing steps to bring it up.	Excited and concerned.	3 minutes
Sector 2: contained 15 vessels when locks opened at 1730: four entered from Industrial and three from Harvey Locks. Two vessels away from pier. Requested and obtained aid.	Uable to get information to mariners	Frustrated, butterfly's in stomach.	2-3 minutes
Sector 2 contained 33 vessels. Worked solid for 3 hours	Very high number of vessels.	Tenseness in shoulders, back of neck, very tight.	1 hour

TABLE C-12. GENERAL COMMENTS FROM NEW ORLEANS WATCHSTANDERS

Comments:

About their job:

- Total simulation makes it all unreal.
- Watchstanders are limited in what they can say by the information they have.
- Absence of any positive surveillance produces doubt and uncertainty.
- Would like more accurate information so that they are not operating in a vacuum.
- No feedback as to how well watchstanders are doing as individuals, sections are evaluated on the basis of the percent of participants.
- Sometimes leave out information to clear radio channel quickly.

About their career:

- Recognition for this job is not high.
- Job is not perceived as challenging or meaningful.
- Does not believe system is useful.
- Problem with distribution of ranks and rates; watch officers and chiefs do the same job.
- Desires sea duty, no career advancement at the VTS center since there is no VTS rating.

On specific problem:

- One reported documented hearing loss.
- Another claims headaches resulting from headphone pressure.
- A third is taking medication for undiagnosed headaches.

Other suggestions for improvement:

- Establish emergency procedures.
- Rules are not well established, creating doubt and uncertainty of action.
- Make advisories cover ferries.

C.5.9 References:

1. Devoe, D.B., Abernethy, C.N., and Kearns, K.S., Houston-Galveston Vessel Traffic Service Watchstander Analysis. U.S. Coast Guard Report No. CG-D-24-78, May 1978.

2. Flanagan, J.C., The critical incident technique. Psychological Bulletin, 1954, 51, 327-358.

3. Fitts, P.M. and Jones, R.E., Psychological Aspects of Instrument Display I. Analysis of 270 "pilot-error" experiences in reading and interpreting aircraft instruments. U.S. Air Force Air Materiel Command, Engineering Division, Aero Medical Laboratory (Wright-Patterson Air Force Base, Ohio), Report No. TSEAA-694-12A, October 1, 1947.

125 copies

U.S. DEPARTMENT OF TRANSPORTATION
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
TRANSPORTATION SYSTEMS CENTER
KENDALL SQUARE, CAMBRIDGE, MA. 02142

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF TRANSPORTATION
513