

AD-A111 978

ECLECTECH ASSOCIATES INC NORTH STONINGTON CT

F/6 17/7

AT-SEA DATA COLLECTION FOR THE VALIDATION OF PILOTING SIMULATIO--ETC(U)

DEC 81 R B COOPER, R C COOK, K L MARINO

DOT-CG-835285-A

UNCLASSIFIED

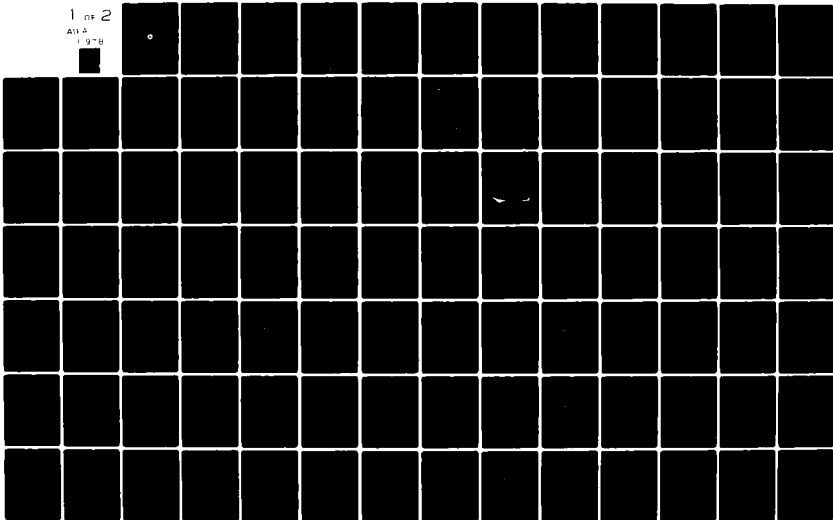
EA-81-U-078

USCG-D-60-81

NL

1 of 2

ADA  
1978





1.0

2.8 2.5



2.2



1.1



2.0



1.8



1.25



1.4



1.6

MILITARY RESOLUTION TEST TARGET  
NATIONAL BUREAU OF STANDARDS-1963-A

12

CG-D-60-81

ADA111978

AT-SEA DATA COLLECTION FOR THE  
VALIDATION OF PILOTING SIMULATION

Eclotech Associates, Inc.  
North Stonington Professional Center  
North Stonington, Connecticut 06359



December 1981

Interim Report

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION  
United States Coast Guard  
Office of Research and Development  
Washington, D.C. 20590

DTIC FILE COPY

DTIC  
ELECTE  
S MAR 12 1982 D  
H

DISTRIBUTION STATEMENT A  
Approved for public release;  
Distribution Unlimited

82 00 1 0 0

**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 the contents or use thereof.*

1. Report No. CG-D-60-81		2. Government Accession No. AD-444 957		3. Recipient's Catalog No.	
4. Title and Subtitle At-Sea Data Collection for the Validation of Piloting Simulation.				5. Report Date December 1981	
				6. Performing Organization Code	
7. Author(s) R.B.Cooper, R.C. Cook & K.L. Marino				8. Performing Organization Report No. EA-81-U-078	
9. Performing Organization Name and Address Eclectech Associates, Inc. North Stonington Professional Center North Stonington, Connecticut				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. DOT-CG-835285-A	
12. Sponsoring Agency Name and Address Department of Transportation U.S. Coast Guard Office Research and Development Washington, D.C. 20590				13. Type of Report and Period Covered Interim Report	
				14. Sponsoring Agency Code G-DST-1	
15. Supplementary Notes None					
16. Abstract  <p>The report describes a U.S. Coast Guard project to track piloted commercial vessels for the purpose of developing simulator validation criteria. The recording of precise ship's position was conducted on the upper Chesapeake Bay using the Raydist tracking system. At the same time all pilot activities were recorded and correlated with ship position. Variables included whether or not traffic was present, direction of travel in the waterway, ship design and response characteristics, and environmental conditions. The effects of these variables in shiphandling performance are presented as statistical plots of the ship tracks. Data will be used for validating the U.S. Coast Guard ship simulator at Eclectech Associates, and more specifically the results of all aids to navigation research conducted on this simulator.</p>					
17. Key Words simulator validation, pilot- ing simulation, ship simulation, ship tracking, at-sea data collection, pilot performance, aids to navigation piloting, Raydist				18. Distribution Statement Document is available to the public through the National Technical Inform- ation Service, Springfield, VA 22161	
19. Security Classif (of this report) UNCLASSIFIED		20. Security Classif (of this page) UNCLASSIFIED		21. No. of Pages 153	
				22. Price	

**BLANK PAGE**

### ACKNOWLEDGEMENTS

The authors, on behalf of the U.S. Coast Guard, wish to express their sincere appreciation to the Association of Maryland Pilots and in particular Captain George A. Quick, President, without whose close support and involvement in this project it could not have been accomplished. From the office staff, dispatchers, auto drivers, and launch captains to the pilots, themselves, all went out of their way to accommodate our unusual requests and make us feel very welcomed. We thank you! We are also indebted to the many masters who permitted us aboard their ships for the brief voyage through Baltimore Harbor, and the special hospitality shown by their crew members.

Finally, those of us on the "tracking team" would like to thank Captain J.T. Montonye, USCG, for his close support in the project; and QM1 Bruce McIntosh who performed as the RAYDIST equipment operator. Quartermaster McIntosh accepted enormous responsibility during this experiment, both in coordinating activities with the pilot office, and in ensuring installation, checkout, and operation of the portable tracking equipment carried aboard each ship. As evident in this report, the collection of experimental data at sea requires extensive logistical support and cooperation among all personnel involved. The success of this particular study must, therefore, be attributed to the keen interest and special dedication of all its participants. Again, our thanks!



<b>Accession For</b>	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/ _____	
Availability Codes	
Dist _____/or _____	
Dist _____/Special _____	
A	

## PREFACE

This experiment was conducted as part of an ongoing program by the U.S. Coast Guard to determine the effectiveness of various fixed, floating, and electronic aids to navigation for harbor pilotage. Along with a number of experiments conducted in ship's bridge simulators, two evaluations of the aids to navigation were conducted at sea. This report describes the first of the at-sea experiments, both which were performed on the upper Chesapeake Bay as "experiments of opportunity."

In the fall of 1980 worldwide demand for coal had produced a queing of as many as 40 coal ships in the Annapolis anchorage awaiting entrance to the Baltimore coal docks. Since inbound transits of these ships occurred at approximately once every 24 hours, an ideal opportunity arose for tracking a large number of ships within a relatively short period of time. This enabled the compilation of a statistically supportable data base for use in the validation of ship's bridge simulators. As an additional benefit, this course of events provided opportunities for tracking a variety of different ships, using pilots with whom excellent rapport had been established, and through a waterway in which accuracy of the automatic tracking equipment was verifiable. The result was an experiment and compilation of tracking data on 21 ships within a period of 1 month. The data was then categorized and analyzed by condition, and is presented in this report. This data will be used for validating the ship's bridge simulator built for the U.S. Coast Guard at Eclectech Associates and which was used in conducting most of the other experiments in the aids to navigation program.

# METRIC CONVERSION FACTORS

## Approximate Conversions to Metric Measures

Symbol When You Know Multiply by To Find Symbol

**LENGTH**

inches	2.5	centimeters	cm
feet	30	centimeters	cm
yards	0.9	meters	m
miles	1.6	kilometers	km

**AREA**

square inches	6.5	square centimeters	cm <sup>2</sup>
square feet	0.09	square meters	m <sup>2</sup>
square yards	0.8	square meters	m <sup>2</sup>
square miles	2.5	square kilometers	km <sup>2</sup>
acres	0.4	hectares	ha

**MASS (weight)**

ounces	28	grams	g
pounds	0.45	kilograms	kg
short tons (2000 lb)	0.9	tonnes	t

**VOLUME**

teaspoons	5	milliliters	ml
tablespoons	15	milliliters	ml
fluid ounces	30	milliliters	ml
cups	0.24	liters	l
pints	0.47	liters	l
quarts	0.95	liters	l
gallons	3.8	liters	l
cubic feet	0.03	cubic meters	m <sup>3</sup>
cubic yards	0.76	cubic meters	m <sup>3</sup>

**TEMPERATURE (exact)**

Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
------------------------	----------------------------	---------------------	----

## Approximate Conversions from Metric Measures

When You Know Multiply by To Find Symbol

**LENGTH**

millimeters	0.04	inches	in
centimeters	0.4	inches	in
meters	3.3	feet	ft
meters	1.1	yards	yd
kilometers	0.6	miles	mi

**AREA**

square centimeters	0.16	square inches	in <sup>2</sup>
square meters	1.2	square yards	yd <sup>2</sup>
square kilometers	0.4	square miles	mi <sup>2</sup>
hectares (10,000 m <sup>2</sup> )	2.5	acres	ac

**MASS (weight)**

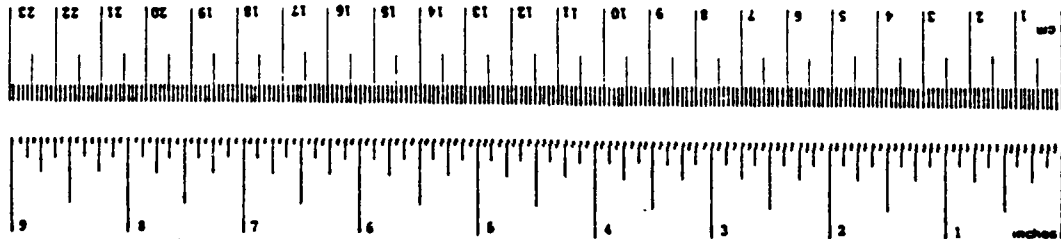
grams	0.035	ounces	oz
kilograms	2.2	pounds	lb
tonnes (1000 kg)	1.1	short tons	st

**VOLUME**

milliliters	0.03	fluid ounces	fl oz
liters	2.1	pints	pt
liters	1.06	quarts	qt
liters	0.26	gallons	gal
cubic meters	35	cubic feet	ft <sup>3</sup>
cubic meters	1.3	cubic yards	yd <sup>3</sup>

**TEMPERATURE (exact)**

Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F
---------------------	-------------------	------------------------	----



\* In U.S. 2.54 centimeters for copper exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weight and Measure, Price \$7.25, SO Catalog No. C13.10-104.

**BLANK PAGE**

VL

## TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
1	INTRODUCTION	1
	1.1 Overview of the Aids to Navigation Program	1
	1.2 Requirements for Simulator Validation	3
	1.3 Limitations of the Data Collection	4
2	METHODOLOGY	7
	2.1 Experimental Design and Variables	7
	2.2 Data Collection and Analysis	9
3	RESULTS AND CONCLUSIONS	15
	3.1 The Effect of Variables on Shiphandling	15
	3.2 Utilization of Data in Simulator Validation	34
	BIBLIOGRAPHY	37
<u>Appendix</u>		
A	INDIVIDUAL RUN DATA	A-1
B	OBSERVER'S DATA COLLECTION BOOKLET	B-1

## LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1	Upper Chesapeake Bay Where At-Sea Data was Collected	10
2	Data Computation Points	13
3	Effect of Traffic on Performance, Leg 1	16
4	Effect of Traffic on Performance, Leg 2	17
5	Effect of Direction on Performance, With Traffic	20
6	Effect of Direction on Performance, With No Traffic	21
7	Effect of Ship Length on Performance, Leg 1	24
8	Effect of Ship Length on Performance, Leg 2	25
9	Effect of Ship Beam on Performance, Leg 1	26
10	Effect of Ship Beam on Performance, Leg 2	27
11	Effect of Wind Speed on Performance, Leg 1	30
12	Effect of Wind Speed on Performance, Leg 2	31
13	Effect of Tidal Current on Performance, Leg 1	32
14	Effect of Tidal Current on Performance, Leg 2	33

## LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
1	At-Sea Data Collection Variables	8

Section 1  
INTRODUCTION

1.1 AN OVERVIEW OF THE AIDS TO NAVIGATION PROJECT

The United States Coast Guard is responsible for safety in U.S. harbors and channels and, therefore, for the aids to navigation (AN) necessary to ensure that safety. It is in fulfillment of this responsibility that the Coast Guard is sponsoring a simulator-based program of research into the performance of these aids to navigation. Interests include visual aids to navigation, radar navigation, and electronic radio aids to navigation. To reduce the overall evaluation to a workable size, the first experiments were restricted to buoys and electronic radio aids to navigation systems. Future plans are to expand the evaluation to ranges and leading lights, and to radar. The objectives of the project are the use of experimental data to derive design criteria for the placement of aids to navigation and to specify radio aids to navigation systems for restricted waterways navigation. Specifically, the program will produce an "AN Design Manual" for use by various offices of the Coast Guard. It will (1) establish maintenance priorities for short-range aids to navigation, (2) determine the minimum design configurations of these aids under a variety of implementation conditions, and (3) quantify the relative risk to navigation as a function of the AN configurations.

Components of the project completed to date are available as separate reports. The first of these was an analysis of the variables expected to affect visual piloting.<sup>1</sup> To enhance the applicability of the findings to real-world harbors, major U.S. ports were surveyed from charts, cataloging the conditions that presently exist.<sup>2</sup> Four experiments on visual piloting with floating aids have been completed.

---

<sup>1</sup>W.R. Bertsche and R.C. Cook. "Analysis of Visual Navigational Variables and Interactions." U.S. Coast Guard, Washington, D.C., October 1979.

<sup>2</sup>W.R. Bertsche and R.T. Mercer. "Aids to Navigation Configurations and the Physical Characteristics of Waterways in 32 Major U.S. Port." U.S. Coast Guard, Washington, D.C., October 1979.

These are the "CAORF,"<sup>3</sup> "Channel Width,"<sup>4</sup> "Ship Variables,"<sup>5</sup> and "One Side Channel Markings"<sup>6</sup> experiments. Related studies on pilotage using electronic radio aids to navigation displays were also performed.<sup>7,8,9</sup>

The first simulator experiment on floating aids to navigation was conducted on the U.S. Maritime Administration's Computer Aided Operations Research Facility (CAORF) located at Kings Point, New York. This simulator had been in use for more than 5 years and had been validated primarily in open sea conditions for collision avoidance experiments. The simulation of restricted waterways and harbor pilotage had not yet received a full validation with real-world conditions. Nevertheless, results of the early AN experiments were deemed appropriate for extrapolation to real-world performance. All subsequent experiments were conducted on a ship's simulator built for the U.S. Coast Guard and located at Eclectech Associates, Incorporated, North Stonington, Connecticut. Both simulators provide a fully equipped ships bridge with visual scene, and are computer controlled to replicate high fidelity ship systems, ship hydrodynamics, and environmental effects.

---

<sup>3</sup>M.W. Smith and W.R. Bertsche. "Aids to Navigation Report on the CAORF Experiment. The Performance of Visual Aids to Navigation as Evaluated by Simulation." U.S. Coast Guard, Washington, D.C., August 1980.

<sup>4</sup>M.W. Smith and W.R. Bertsche. "Aids to Navigation Principal Findings Report on the Channel Width Experiment: The Effects of Channel Width and Related Variables on Piloting Performance." U.S. Coast Guard, Washington, D.C., January 1981.

<sup>5</sup>W.R. Bertsche, D.A. Atkins, and M.W. Smith. "Aids to Navigation Principal Findings Report on the Ship Variables Experiment: The Effect of Ship Characteristics and Related Variables on Piloting Performance." U.S. Coast Guard, Washington, D.C., April 1981.

<sup>6</sup>K.L. Marino, M.W. Smith, and W.R. Bertsche. "Aids to Navigation Principal Findings Report: The Effect of One-Side Channel Marking and Related Conditions on Piloting Performance." U.S. Coast Guard, Washington, D.C., July 1981.

<sup>7</sup>R.B. Cooper and K.L. Marino. "Simulator Evaluation of Electronic Radio Aids to Navigation Displays - The Miniexperiment." U.S. Coast Guard, Washington, D.C., September 1980.

<sup>8</sup>R.B. Cooper, K.L. Marino, and W.R. Bertsche. "Simulation Evaluation of Electronic Radio Aids to Navigation Displays, The RA-1 Experiment." U.S. Coast Guard, Washington, D.C., January 1981.

<sup>9</sup>R.B. Cooper, K.L. Marino, and W.R. Bertsche. "Simulation Evaluation of Electronic Radio Aids to Navigation Displays, The RA-2 Experiment." U.S. Coast Guard, Washington, D.C., April 1981.

A detailed description and comparison between these simulators is presented in Channel Width<sup>10</sup> and Ship Variables<sup>11</sup> reports. While the studies cited were not originally intended to compare the simulators, certain parameters which were measured readily lent themselves to just such a comparison. The studies specifically addressed those aspects of simulation that are expected to affect pilotage performance; ship hydrodynamics, environmental effects, and visual effects. From a comparison of data between the two simulators, minor differences were found in some aspects of the environmental effects data base. Performance differences among conditions represented by identical scenarios were the same within each simulator. This led to the conclusion that the two simulators are similar in their usefulness for the exploration of relationships between aids to navigation and piloting performance. While the research addressed compatibility between CAORF and the USCG/EA simulator, a requirement to validate the USCG/EA simulator with real-world conditions persisted. Such an endeavor has been initiated by collecting and compiling the at-sea data which is presented in this report.

## 1.2 REQUIREMENTS FOR SIMULATOR VALIDATION

Since its conception, the philosophy of the AN program has been that the relationships between aids to navigation characteristics and resulting piloting performance is so complex that it must be studied in isolated parts. This requirement necessitated a high degree of experimental control, with the assurances that results of the experiments would be directly applicable to the real world. It was concluded that high fidelity, real-time simulation could fulfill both of these requirements better than the real-world environment itself. While the real-world does contain all relationships of interest, the impossibility of satisfactorily isolating and controlling its many variables makes simulation much more attractive. Through simulation, it is possible to select any condition, investigate the effects of as many variables as required, and recreate identical circumstances for needed repetition. All of these characteristics were necessary to adequately investigate the relationships of aids to navigation and channel design on piloting performance.

In using simulator-based research to derive design criteria for the placement and use of aids to navigation, the results must reflect those which would occur in the real world. A fundamental requirement of all simulator research is validation of the simulator and subsequently its results. To achieve this in the AN program it was decided to thoroughly analyze and document real world piloting performance; and to compare such performance with similar aids to navigation variables, ship types, channel designs, and environmental conditions. The quality of this comparison would represent validity both of the simulator and its results providing there were adequate assurances that the simulation did, in fact, cause the performance effect.

---

<sup>10</sup>M.W. Smith and W.R. Bertsche, op. cit., January 1981.

<sup>11</sup>W.R. Bertsche, D.A. Atkins, and M.W. Smith, op. cit.

### 1.2.1 Special Considerations

To validate the USCG/EA simulator, at-sea data on ship tracks and shiphandling performance of pilots in restricted waterways were required. From this, validation criteria were derived to test both comparability and transferability between the simulated and real-world runs. The derivation of these criteria are as follows:

a. Channel Design. The Craighill Channel and Craighill Channel Upper Range in the upper Chesapeake Bay were selected as sites for the collection of at-sea data for simulator validation. This selection was based upon channel size, angle of bends, and buoyage similar to those scenarios which appeared in the AN program simulations. While the at-sea and simulated waterways were not completely identical, the establishment of common goals (e.g., to keep on the channel centerline) and common measures (e.g., crosstrack distance) enabled comparisons of the pilotage performance.

b. Logistics Requirements. The fulfillment of adequate repetitions to accommodate a statistical analysis was possible due to the high frequency of vessel transits, relatively short duration of these transits, and ease of accessibility provided by the Association of Maryland Pilots. The accessibility enabled trained observers to accompany the pilots aboard each ship, thus replicating the observation capability of most simulators. This accessibility also permitted carrying aboard and installation of precision tracking equipment for the accurate recording of ship response data. In the simulator, these data are retained in computer memory. Logistics of the at-sea data collection were very favorable by traditional standards. Over 90 percent of the data was usable; and even though the operation was considered to be less cost effective than simulation per se, it was conducted on a most opportune occasion and in a timely fashion.

c. Ship Type and Hydrodynamics. Criteria for the validation of ship response characteristics were achieved by examining as many single type ships (i.e., coal carriers) as possible; but also including others when the opportunity arose. There was, of course, large variety in overall design characteristics even among the single type ships. Ship Variables<sup>12</sup> report, which addresses the effects of ship design and response characteristics on piloting performance, suggests that validation could be achieved between the real world and simulation even without replicating identical vessels. For this reason, all particulars of each ship transited were recorded (see Appendix A), and results of the at-sea analysis are categorized by those which did influence piloting performance.

### 1.3 LIMITATIONS OF THE DATA COLLECTION

Difficulties encountered as a result of real-world data collection are traditionally the limiting factor in validation. Events which occurred in the derivation and processing of at-sea data support this

---

<sup>12</sup>Ibid.

conclusion. Two types of difficulties were encountered, both of which could have had a major impact on the quality of data; but which have been overcome either by voiding the data or by acknowledging it for "what it is worth."

The first problem encountered was that although pilots were requested to stay as close to the channel centerline as possible, traffic in the waterway often required ownship to maneuver. Through radio communications with their colleagues, all pilots did their best to arrange passings which allowed ownship to remain on the centerline. To the extent that the other pilots accommodated and that environmental conditions permitted, the researchers are very grateful. Nevertheless, there were a total of 12 transits out of the 21 in which traffic affected ownship in at least one of the two legs of the waterway. Considering the analysis could be broken down into individual legs, this meant there were 30 out of a possible 41 transits of legs in which ownship did not maneuver for traffic and could have remained on the channel centerline. This provided sufficient data for reporting valid runs without traffic as well as runs which included maneuvering for traffic. The reader is reminded, however, that in runs with traffic, the pilot of the traffic ship was probably aware of ownship's desire to remain on the centerline. Subsequently, ownship may have been given an extra wide berth and responded with a smaller than normal maneuver. Particulars of the passing or overtaking such as distance abeam, relative speed, traffic ship description, etc., were not recorded in detail since no validation of traffic simulation was anticipated. All other data on these runs, however, have been compiled and are presented in the report.

The second problem encountered in the at-sea data collection was symptomatic of real-world measurement in general: system failure. Owing primarily to alignment requirements of the automatic tracking system, limitations in operator capability contributed as much to these problems as did hardware malfunction. Specifically, alignment of the tracking equipment required that it be initialized on specially constructed visual ranges. On two occasions these ranges were obscured voiding all tracking data for the run. In two other runs ships' electric power was either not compatible with the tracking system or was unreliable. This problem was resolved for the remainder of the experiment by carrying a power conversion unit aboard each ship with the tracking equipment. Of the remaining 17 transits, no tracking data was available on three due to printer malfunction or the unexplained loss of tracking on one line of position (LOP). The result was that 14 of the 21 runs were conducted with good tracking data and only this data is included in the analysis of piloting performance.

Required information regarding each ship's design and performance was readily available on its bridge. A full report of observed data was also produced during each run. All this data is presented in Appendix A.

(THIS PAGE INTENTIONALLY LEFT BLANK)

Section 2  
METHODOLOGY

The methodology employed in this experiment was passive in nature. Simply stated, pilots were instructed to remain on or as close to the channel centerline as possible, and their ship was tracked to determine how well they achieved this goal. There were, of course, extenuating circumstances with traffic, ship equipment, and ship personnel; as well as environmental factors, which affected pilots' performance. Data describing these circumstances were recorded manually to explain either why the goal might not have been achieved, or for inclusion in any simulator replication for validation purposes.

2.1 EXPERIMENTAL DESIGN AND VARIABLES

An experimental design was developed to accommodate uncontrollable pilot assignments to ships, the relative lack of control over ship characteristics and environment; yet the need to fulfill certain requirements of the data collection. Although pilots are assigned by rotation, there was no way to plan each individual's involvement. As a result, "subject selection" was considered to be random and "individual differences" were considered to be negligible. There were no repetitions of runs with the same pilot. To the extent practical, at least one observer in the tracking team had participated in most of the other runs. This ensured consistency in manual data collection, while the aligned system ensured repeatability.

The first consideration for simulator validation criteria was perceptual (i.e., ship appearance and equipment) and hydrodynamic (i.e., handling) characteristics. All inbound ships were in ballast. Since their drafts and propulsion characteristics varied relatively proportional to their size, they were categorized by ship length and beam width. Environmental conditions which affect the pilotage were recorded during each run. The data sheets listing these conditions are presented in Appendix A. The major differences noted in environmental conditions were wind speed and direction of tidal current. Wind direction and current speed, while it may have had some effect on individual runs, was too varied to obtain a statistical sample.

As discussed in Section 1.3 the absence or presence of traffic also produced significant effects on pilotage. Table 1 shows each run by number and variable. The compilation and review of data on these runs produced the subsequent categorization of variables for analysis:

<u>Variable</u>	<u>Level</u>
Traffic	Runs with traffic Runs with no traffic
Direction	Outbound runs with traffic Inbound runs with traffic  Outbound runs with no traffic Inbound runs with no traffic

TABLE 1. AT-SEA DATA COLLECTION VARIABLES

RUN#	1980 DATE	TRAFFIC DIRECTION		LIGHTING	SHIP TYPE	SIZE (000 dwt)	LENGTH (feet)	BEAM (feet)	WIND SPEED	WIND DIRECTION	CURRENT	DRAFT	HEIGHT OF EYE	
		Leg 1	Leg 2											
1	10/20	Y	Y	In	Day	USCG	.5	157	31	5	NW	NA	6'7"	NA
2	10/21	N	Y	In	Night	BULK	130	810	133	5	SW	EBB	34'	96'
3	10/22	N	Y	Out	Day	BULK	62	705	106	5	S	FLOOD	21'6"	90'
4	10/27	N	N	In	Day	BULK	50	657	95	5	SE	FLOOD	21'	72'
5	10/28	N	N	In	Day	BULK	79	775	105	15	NE	FLOOD	23'	75'
6	10/30	Y	N	Out	Day	BULK	35	586	88	5	NW	FLOOD	30'	62'
7	11/10	N	N	In	Day	BULK	63	698	105	15	NW	SLACK	20'	100'
8	11/13	N	Y	In	Day	TANK	31	565	85	5	W	FLOOD	32'	60'
9	11/19	Y	N	In	Night	BULK	51	646	105	5	W	SLACK	29'	72'
10	11/20	Y	N	In	Day	BULK	30	793	106	5	NW	EBB	23'	92'
11	12/3	Y	N	In	Night	CONT	16	610	78	20	NW	SLACK	26'	NA
12	12/5	N	N	In	Day	BULK	70	800	105	5	NW	FLOOD	24'	75'
13	12/8	N	N	In	Day	BULK	69	786	106	5	S	EBB	29'	NA
14	12/8	Y	N	In	Night	BULK	116	823	133	15	S	FLOOD	26'	NA
15	12/10	N	Y	In	Day	BULK	44	680	90	15	NW	FLOOD	21'	72'
16	12/10	Y	N	Out	Day	BULK	44	680	90	15	NW	SLACK	21'	72'
17	12/11	N	N	In	Day	TANK	32	530	85	0	NE	EBB	33'	100'
18	12/12	N	Y	In	Day	BULK	60	744	104	15	S	EBB	23'	75'
19	12/16	N	N	In	Day	BULK	62	705	106	5	NE	FLOOD	22'	90'
20	12/17	N	N	In	Day	BULK	18	481	67	15	NW	EBB	24'	70'
21	1/7	N	N	In	Day	USCG	.5	157	31	25	NW	NA	6.5'	NA

Ship characteristics	Ship length under 650 feet
	Ship length over 650 feet
	Ship beam under 90 feet
	Ship beam over 90 feet
Environment	Wind speed under 10 knots
	Wind speed over 10 knots
	Ebb tidal current
	Flood tidal current
	Slack tidal current

The comparison of piloting as a function of these variables is presented in Section 3.

## 2.2 DATA COLLECTION AND ANALYSIS

Figure 1 shows the chart segment of the waterway in which the at-sea data was collected. Data collection started when outbound abeam buoy "4B" in the Brewerton Channel, and when inbound at the entrance to Craighill Channel. The tracking equipment was aligned using two separate ranges on Sandy Point. These ranges were situated to correspond with known lines of position (LOPs). A lane correction factor could be added or subtracted to achieve the daily correction. As shown on the plots of Section 3, pilots normally departed from the centerline in the cutoff bend between buoys "9C" and "15C." Data within this area are not compared in the analysis and should be excluded from any validation criteria.

The following basic data are needed for simulator validation and have been accommodated in the at-sea experiment. They are divided into three categories: navigation scenario, vessel position, and pilot task and command data. A copy of the observer's data collection booklet which was carried aboard to record much of this data is presented in Appendix B.

### 2.2.1 Navigation Scenario

a. Vessel type. Available commercial vessels were used. They included bulk carriers (coal and sugar), container vessels and tankers. Vessel characteristics including dimensions, draft, propulsion, and maneuvering data were recorded.

b. Navigator type. Only pilots from the Maryland Association of Pilots participated.

c. Availability of shipboard navigation instruments. The onboard suite of bridge equipment and navigation instruments was documented.

d. Availability of aids to navigation. Aids to navigation in Craighill Channel and Craighill Channel Upper Range were assumed to be those shown on the most current chart available and documented in the Light List (1980). Any changes to the above configuration both reported (Local Notice to Mariners) or unreported were noted for each transit.

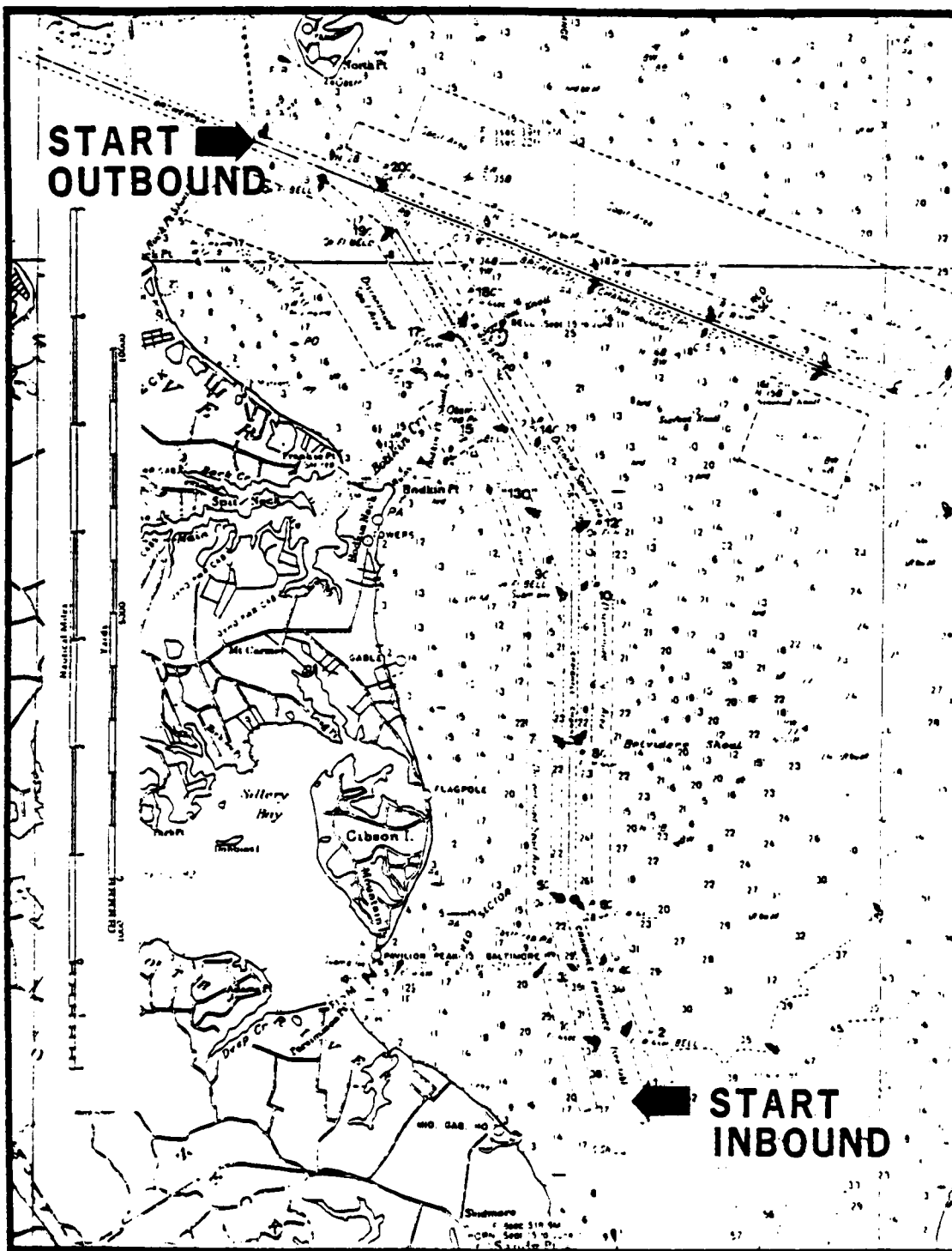


Figure 1. Upper Chesapeake Bay Where At-Sea Data was Collected

e. Visibility. The visibility range for each transit was expressed and documented as the range (in nautical miles) at which buoys of comparable size to those in Craighill Channel were first sighted. The criteria was applied for both inbound and outbound transits. It was also applied under both daylight and nighttime conditions. Any precipitation was noted.

f. Direction of travel. The direction of travel, inbound or outbound, was documented for each transit.

g. Traffic. The presence of traffic was documented for each transit. The size of the traffic ships, the time of first maneuver to adjust for traffic, and time of passing abeam was noted.

h. Time of day. The zone time at each event and at various geographical locations was recorded (e.g., abeam Sandy Point light, abeam Seven Foot Knoll, etc.).

i. Water depth. Water depth was determined from (h.) and the Tide Tables (1980) after each transit.

j. Current. Current was determined from (h.), the Tidal Current Tables and the Tidal Current Charts (1973) after each transit. Comments from the pilot concerning current were also recorded.

k. Wind. The true wind velocity and direction in the waterway were either measured or estimated prior to getting underway at the anchorage. Comments from the pilot which concerned the effects of wind during the transit were also recorded.

#### 2.2.2 Vessel Position Data

a. The tracking equipment, specifically the DRS-H RAYDIST radio location system was leased by the Coast Guard Office of Navigation for the project. The equipment which consisted of an antenna, receiver, power supply, and strip chart recorder were carried aboard each ship, assembled, and operated. Instructions for initializing and calibrating the system for each transit are provided in Appendix B.

b. Vessel position was printed every 10 seconds on the strip chart along with clock time. Since all observed data were recorded with a time line, it was possible to reconstruct ownship's position at each observed and recorded event. Additionally, the strip chart was annotated by the RAYDIST operator at certain preselected points along the waterway, just to verify tracker operation.

Repeatable positioning accuracy of the RAYDIST system used is  $\pm 0.02$  lanes (approximately  $\pm 1$  meter) within the operational range of the system.<sup>13</sup> Total geographic accuracy is 2 meters RMS providing initialization alignment is within specification.

<sup>13</sup>C.E. Hastings and A.L. Comstock. "Pinpoint Positioning of Surface Vessels Beyond Line-of-Sight." A paper presented at the National Marine Navigation Meeting of ION, San Diego, California, November 1969.

RAYDIST position data was processed through a hyperbolic conversion program to an x,y coordinate system comparable with previous data collection and analysis methods of the AN program. For the analysis, the straight leg of the Craighill Channel and the straight leg of the Craighill Channel Upper Range were treated separately. Each leg was divided into 475-foot intervals as shown in Figure 2. These intervals are called "data lines." Crosstrack distance at every data line was then computed for each transit, and all transits in each condition (e.g., with traffic, with no traffic, etc.) were combined. The mean and standard deviation of crosstrack distances at each data line was computed for each condition. These statistics are shown in Section 3 as a plot of the mean at each data line with a band enclosing two standard deviations to either side. The two standard deviation band represents the area in which 95 percent of all ship tracks would be expected to occur under conditions similar to those which were sampled. The placement and width of this band within the boundaries of the channel are together a quantitative description of the set of transits under these conditions and, therefore, of the performance of the aids to navigation or piloting technique variables.

### 2.2.3 Pilot Task and Command Data

As part of understanding the pilotage process in a given geographic area, it is necessary to understand what information the pilot uses and identify the individual activities which comprise his pilotage. Consequently, all rudder orders, course orders, and engine orders were recorded on a time line. Additional attention was given to the following:

- a. Position fixing tasks. A description of the aids to navigation used and the navigational instruments employed.
- b. Ship control tasks. The timing, magnitude, and direction of course changes, rudder orders, or propulsion power changes.

In all, there was a major attempt to identify the causal factors involved in the pilotage and to understand what effect these factors may have had on the resultant ship's track.

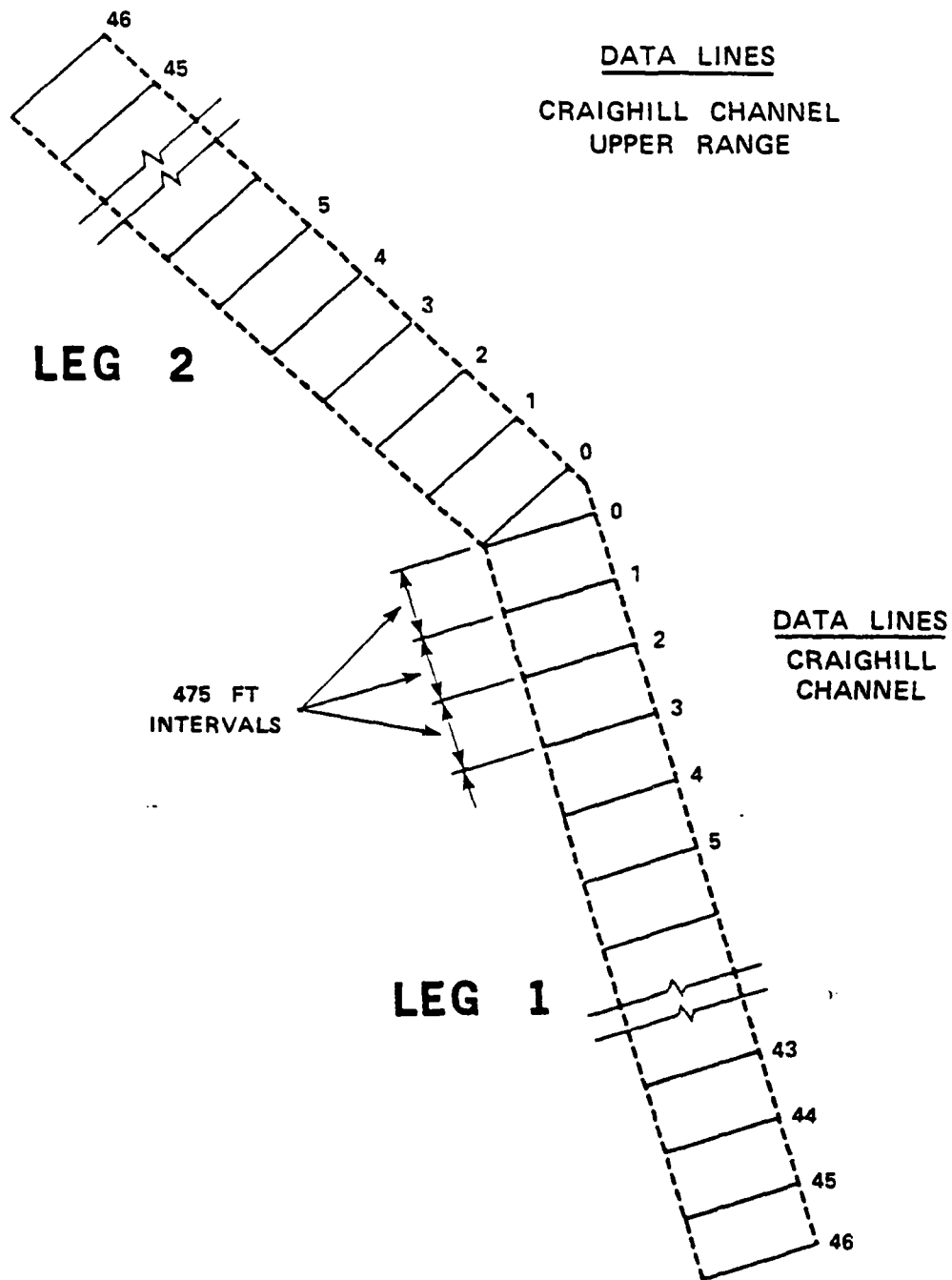


Figure 2. Data Computation Points

(THIS PAGE INTENTIONALLY LEFT BLANK)

Section 3  
RESULTS AND CONCLUSIONS

While this experiment represents only the initial, at-sea data collection phase of the simulator validation project, there are some notable results and conclusions worth reporting as potential validation criteria. First of all, the plots shown in this section indicate that, with the exception of traffic, all pilots endeavored to achieve the prescribed goal, that of keeping ownship on the centerline. Secondly, the differences between performance as shown in the plots follows logical rationale. For example, mean tracks of runs with passing traffic were substantially closer to the right side of the channel than mean tracks with no traffic. A wider crosstrack variation (i.e., larger standard deviation) among the group with this traffic was also evident, indicating different types of maneuvers with resultant different closest point of approaches (CPAs).

Some more subtle effects, such as those from wind, were more difficult to identify. In general, however, the results, both of the track plots and from the observations were very much as anticipated. It is concluded that the data which was collected is both valid and appropriate for use in simulator validation.

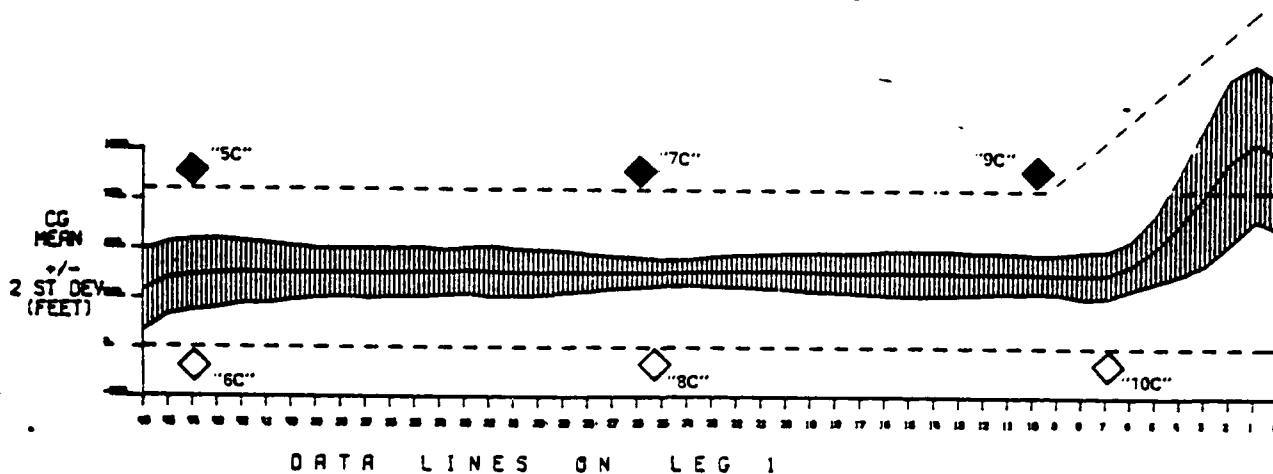
### 3.1 THE EFFECTS OF VARIABLES ON SHIPHANDLING PERFORMANCE

Four major variables were identified as having the greatest effect on overall shiphandling performance during the pilotage. They were (1) the existence or absence of traffic, (2) the direction of travel, (3) characteristics of the ship, and (4) wind and tidal current conditions. In any subsequent endeavor for the purpose of validating a ship control simulator or ship simulation characteristics, it is recommended that these variables be specifically and individually addressed. The evaluation of shiphandling performance in no way reflects upon pilot proficiency or the way pilots, themselves, perform their pilotage. Instead, the evaluation attempts to identify how pilotages differ as a result of the variables, and whether or not these effects reoccur in the simulation. Aside from conclusions that the data collected is appropriate to administer in a validation experiment, some additional findings are presented in a discussion of the track plots. These findings are presented as potential simulator validation criteria.

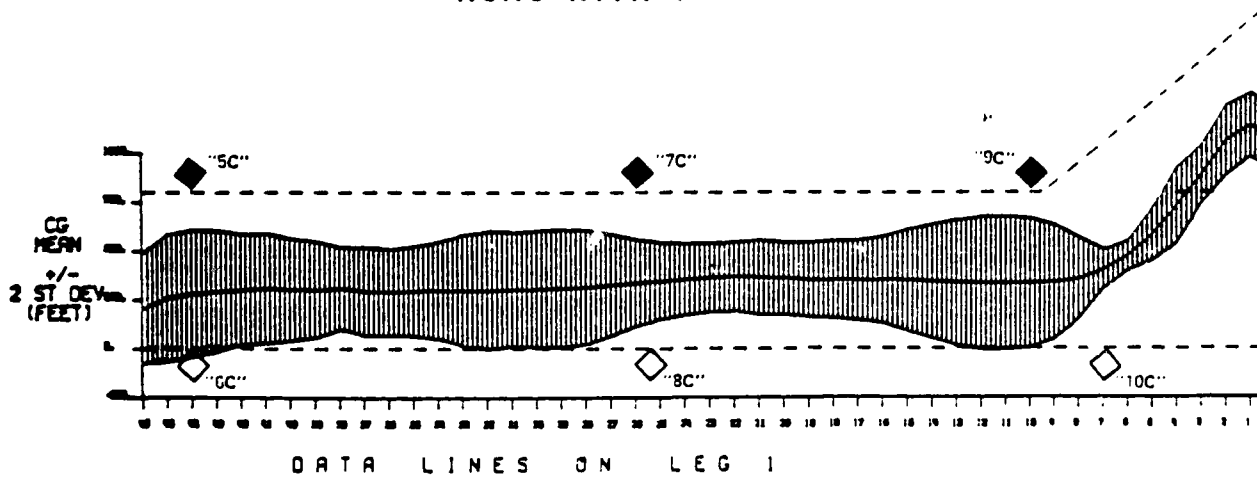
#### 3.1.1 The Effect of Traffic on Performance

As is illustrated in Figures 3 and 4, the existence of traffic in the channel during transits had the greatest overall effect on shiphandling performance of any other variable identified. All of the tracks analyzed are for inbound transits. All encounters were port-to-port meeting situations which are shown on the plots as bulges in the crosstrack deviation. On Figure 3, CPAs occurred almost abeam buoy "6C," just before "8C," and abeam "9C." On Figure 4, the largest maneuver for traffic occurred between "15C" and "17C." Other maneuvers were less prominent. In all transits with traffic the resultant mean

### RUNS WITH NO TRAFFIC



### RUNS WITH TRAFFIC

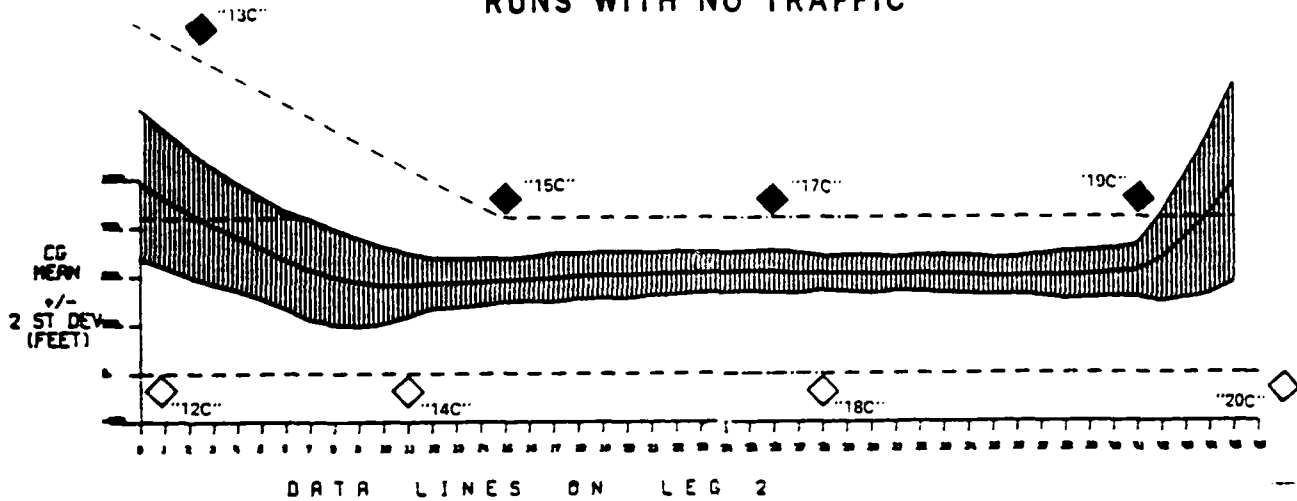


1 DATA LINE = 475 FEET

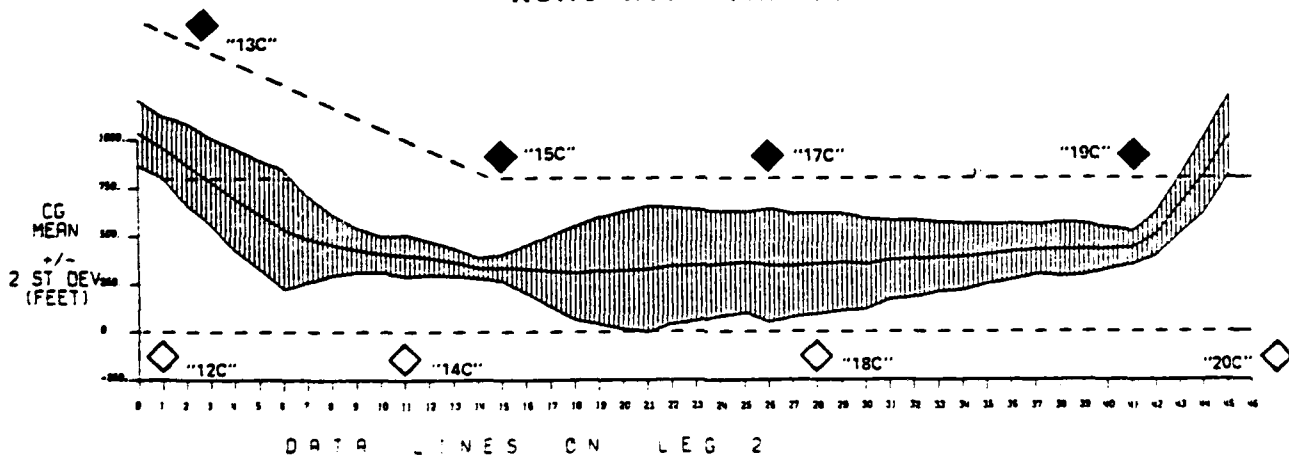
NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 3. Effect of Traffic on Performance, Leg 1

### RUNS WITH NO TRAFFIC



### RUNS WITH TRAFFIC



1 DATA LINE = 475 FEET

NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 4. Effect of Traffic on Performance, Leg 2

(THIS PAGE INTENTIONALLY LEFT BLANK)

track was just slightly to the right of the centerline. This is understandable since pilots immediately returned to the centerline once they were clear of the traffic ship. Runs with no traffic were of consistent and significantly narrower width. Their mean track was exactly on the centerline in leg 1 and slightly left of centerline in leg 2.

It can be concluded from this analysis that given ship types, traffic encounters and a waterway comparable to that evaluated, ship tracks resulting from simulation should produce the following characteristics:

With No Traffic

- A mean displaced no more than 50 feet off the centerline of the channel for much of the transit with a maximum displacement of no more than 100 feet
- A standard deviation of approximately 63 feet for much of the transit with a maximum standard deviation of no more than 88 feet

With Traffic (conditions approximately those observed)

- A mean displaced no more than 200 feet off the centerline of the channel
- A standard deviation at a CPA of no more than 175 feet

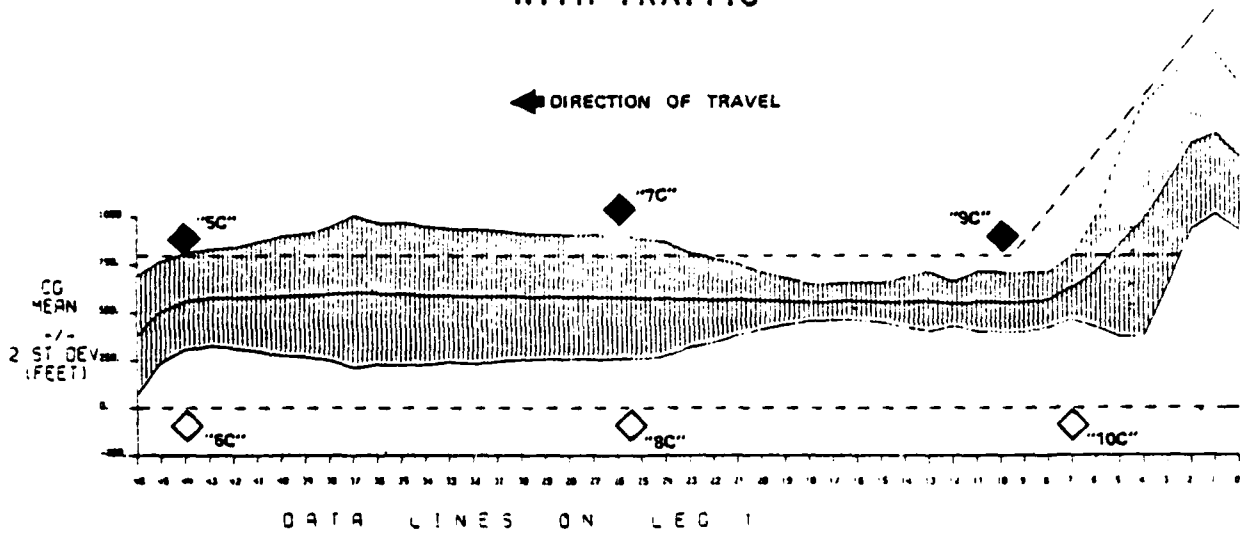
These values were obtained through the at-sea data collection described herein and they are illustrated by Figures 3 and 4.

3.1.2 The Effect of Direction on Performance

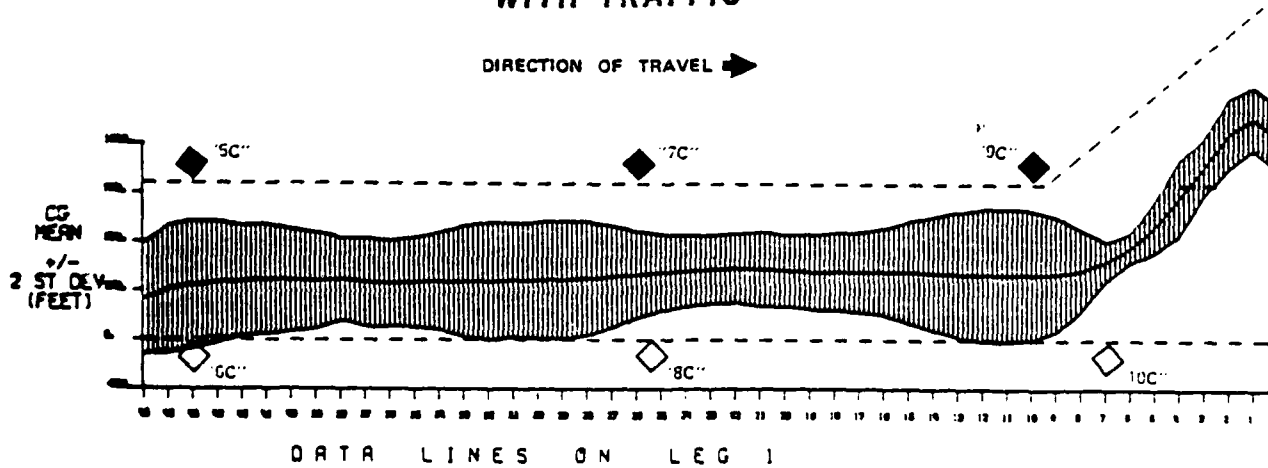
Direction of ship travel through the waterway, in itself, should have had no effect on shiphandling performance. With traffic, it would be expected that the mean track would appear on the right side of the centerline. Consequently, "CPA bulges" in the plot might also extend to the right channel boundary. There should, however, be no other apparent differences between inbound and outbound whether traffic was present or not. Due to limitations in the sample size, Figure 5 shows the effects of direction with traffic, but only for leg 1. Figure 6, on the other hand, shows the effects of direction with no traffic, but only for leg 2. Although they represent different legs, comparisons can be made to illustrate differences as a function of direction.

A comparison between inbound and outbound plots in Figure 5 shows differences in (1) where the traffic was passed and (2) the amount of maneuvering or size of berth which ownship gave to the traffic. In reviewing individual runs which comprised the outbound run plot, Figure 5 shows that one of the passings required ownship to maneuver well into the right outside quarter of the channel. It was this particular maneuver which produced both the large, lengthy bulge in the plot, and a subsequent overall mean track well to the right. Since this was an

## OUTBOUND RUNS WITH TRAFFIC



## INBOUND RUNS WITH TRAFFIC

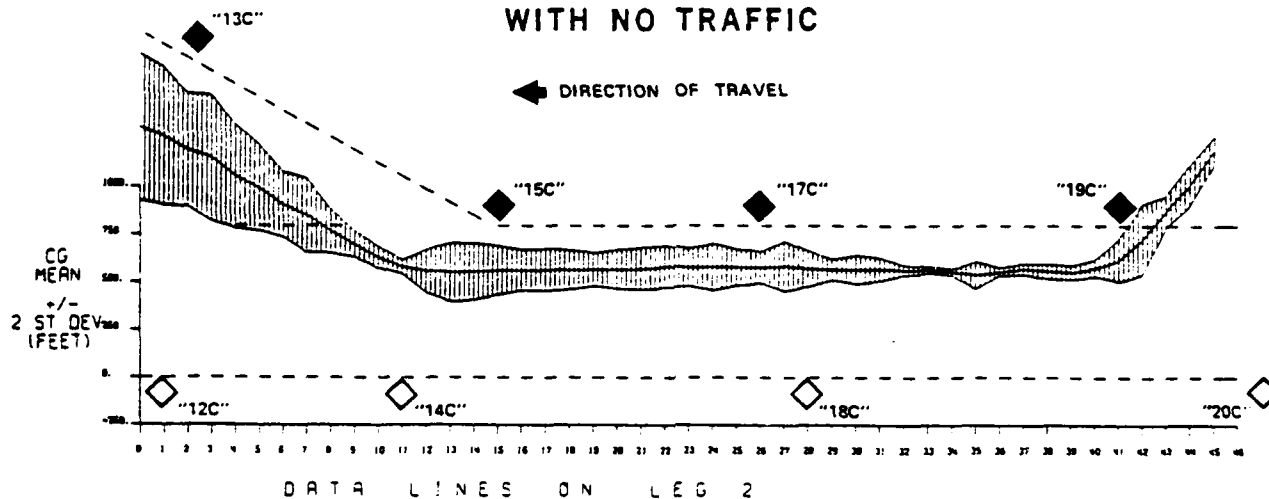


1 DATA LINE = 475 FEET

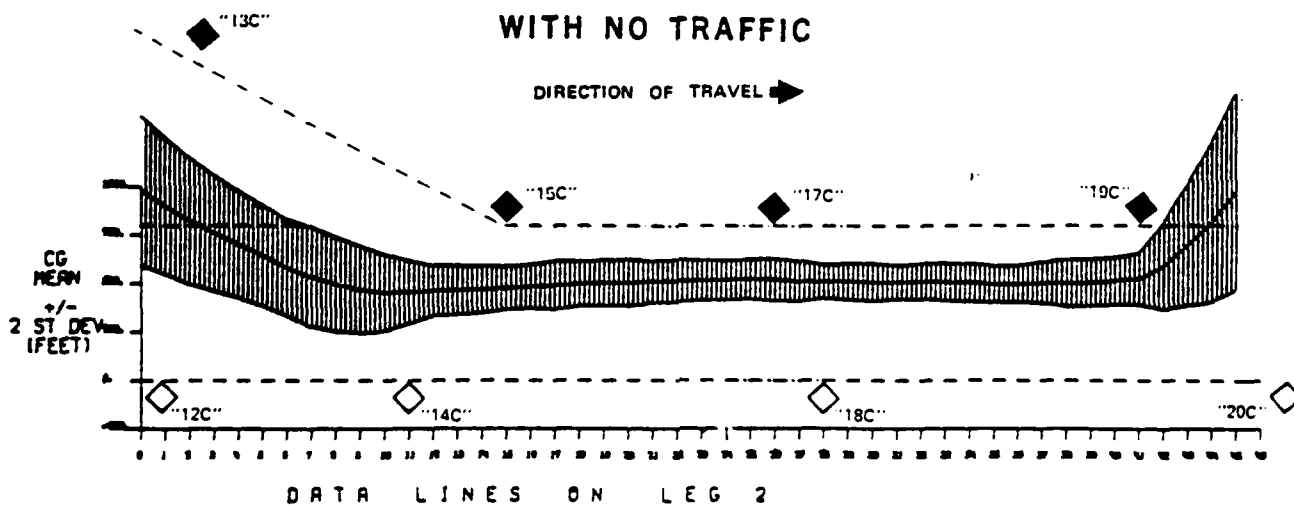
NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 5. Effect of Direction on Performance, With Traffic

### OUTBOUND RUNS WITH NO TRAFFIC



### INBOUND RUNS WITH NO TRAFFIC



1 DATA LINE = 475 FEET

NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 6. Effect of Direction on Performance, With No Traffic

(THIS PAGE INTENTIONALLY LEFT BLANK)

unusually large maneuver, it demonstrates how differently pilots react to traffic; and in particular, the need to address simulator validation with traffic as a whole separate issue.

With no traffic (Figure 6), inbound and outbound plots appear quite similar. The more jagged appearance of the outbound plot is caused by smaller sample size; however, average width of the plot and location of the mean trackline are approximately the same. There were no major shiphandling differences indicated as a result of which direction in the waterway ownship was traveling. It was concluded that because the configuration of aids to navigation were very similar in both directions (i.e., almost all were gated buoys), their arrangement did not have a major effect on pilotage.

### 3.1.3 The Effect of Ship Characteristics on Performance

Figures 7 through 10 illustrate the effects on shiphandling performance of ship design characteristics. Two categories of ship length were selected, those under 650 feet length-overall (LOA) and those over 650 feet LOA. Two categories of ship breadth were selected, those under 90-foot beam and those over 90 foot beam. The 650-foot LOA and 90-foot beam limit was based on the data available to achieve an equal sample size in each category and no other particular criteria. As a result, the smaller category consisted of two tankers, one container vessel, and the remainder were small 18,000 dwt to 32,000 dwt bulk carriers. The larger category consisted of all 30,000 dwt to 63,000 dwt bulk carriers. Owing to variations in hull design, some ships were in the larger length category, but smaller breadth category. Nevertheless, a review of all four figures shows high correlation in performance among the larger categories and among the smaller categories. In general, the "larger" ships produced a wider deviation plot than did the "smaller" ships.

It can be concluded from the analysis that design characteristics of ships, specifically their size, does have an effect on shiphandling performance. This effect can be quantified for the purpose of simulator validation as follows:

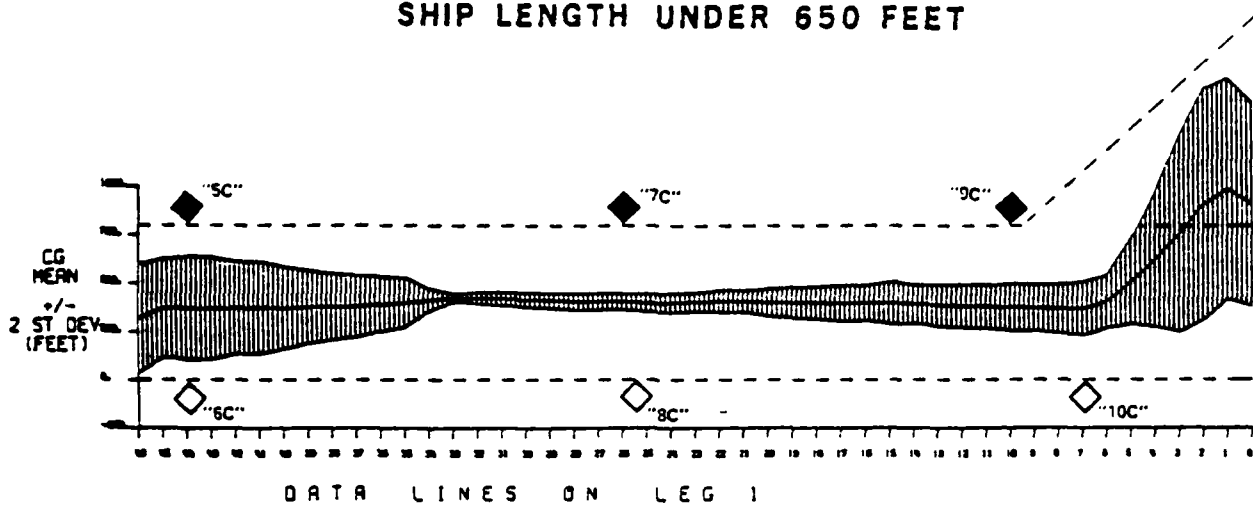
#### A Ship With Length Under 650 Feet and Beam 90 Feet or Less

- A mean displaced no more than 50 feet from the channel centerline anywhere in the transit
- A standard deviation of approximately 38 feet with extremes along the transit varying from 25 to 75 feet

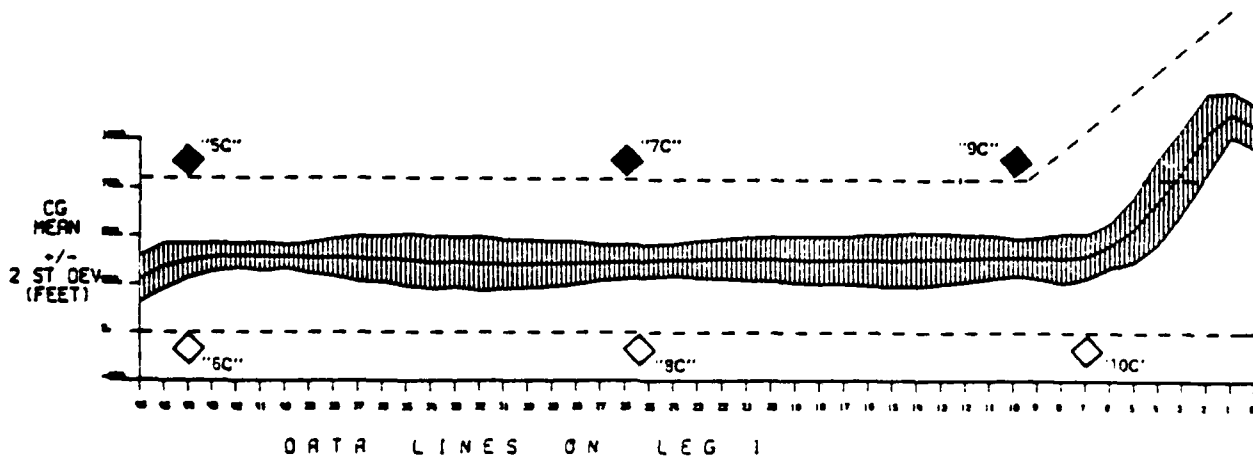
#### A Ship With Length Over 650 Feet and Beam Over 90 Feet

- A mean displaced no more than 100 feet from the channel centerline anywhere in the transit
- A standard deviation of approximately 250 feet with extremes along the transit varying from 200 to 300 feet

### SHIP LENGTH UNDER 650 FEET



### SHIP LENGTH OVER 650 FEET

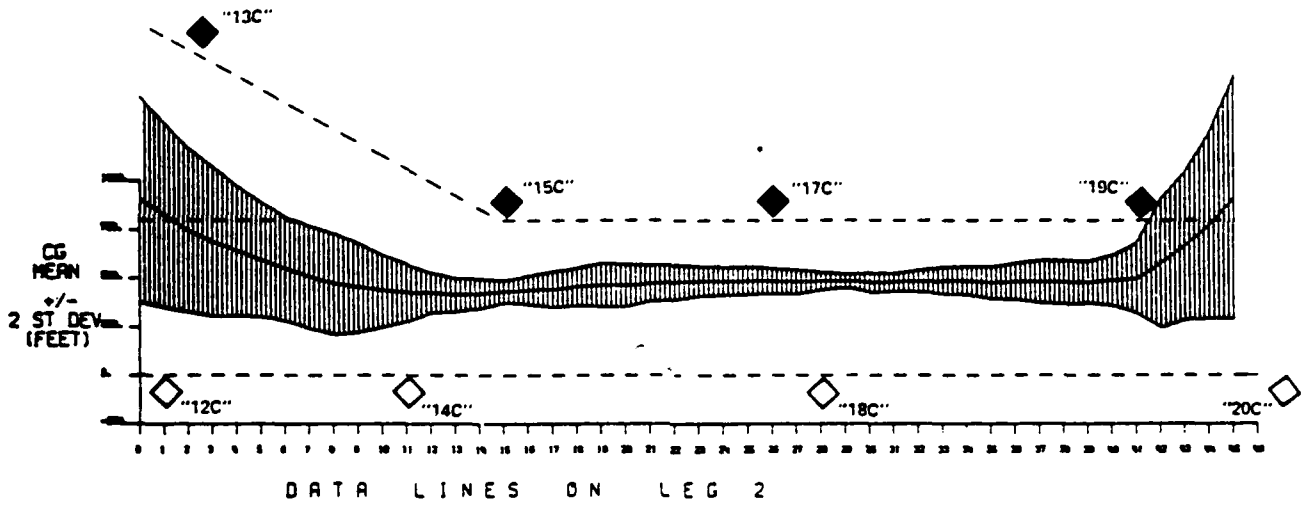


1 DATA LINE = 475 FEET

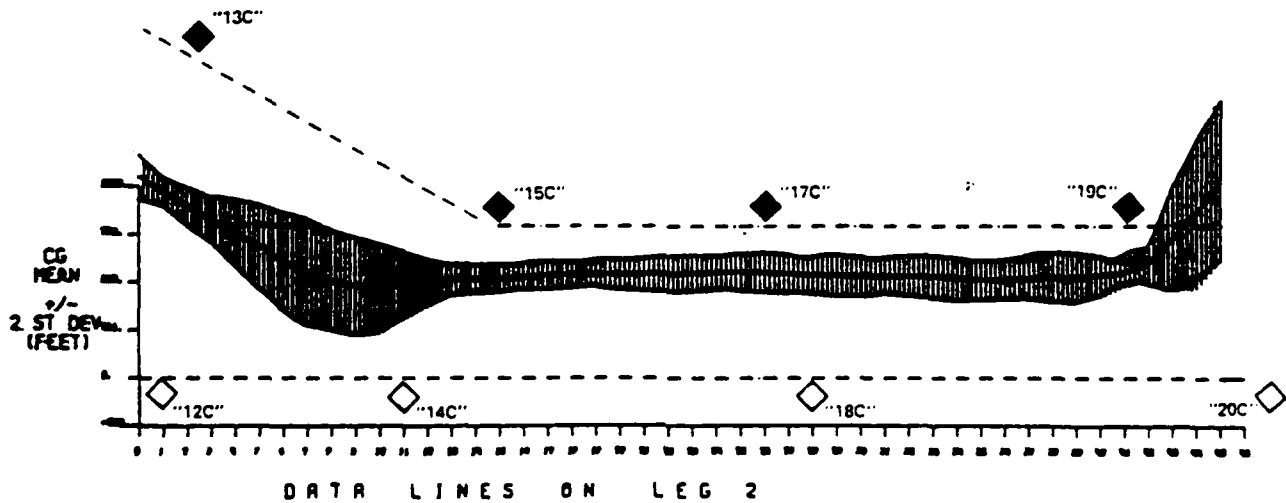
NOTE. Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 7. Effect of Ship Length on Performance, Leg 1

### SHIP LENGTH UNDER 650 FEET



### SHIP LENGTH OVER 650 FEET

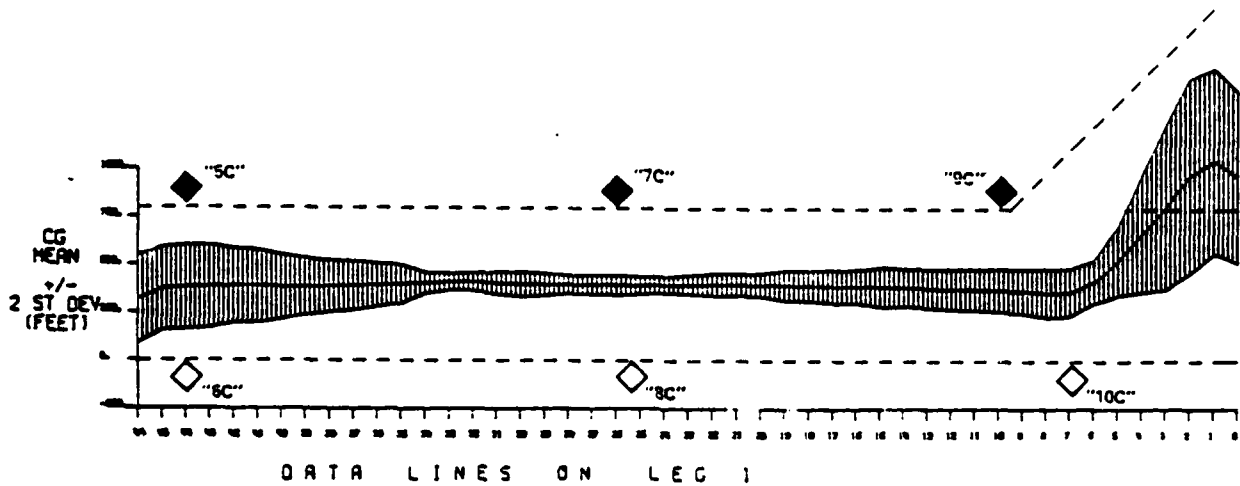


1 DATA LINE = 475 FEET

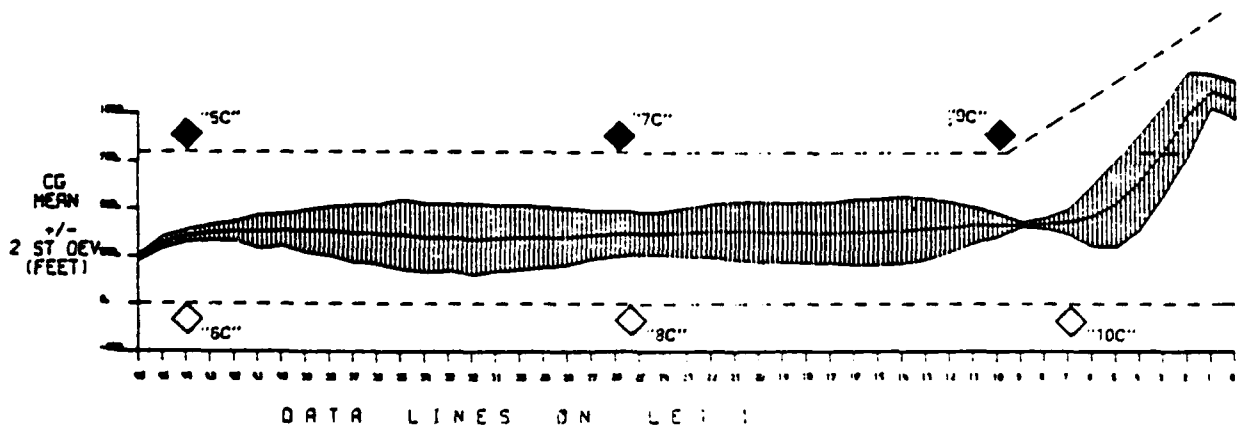
NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 8. Effect of Ship Length on Performance, Leg 2

### SHIP BEAM 90 FEET OR LESS



### SHIP BEAM OVER 90 FEET

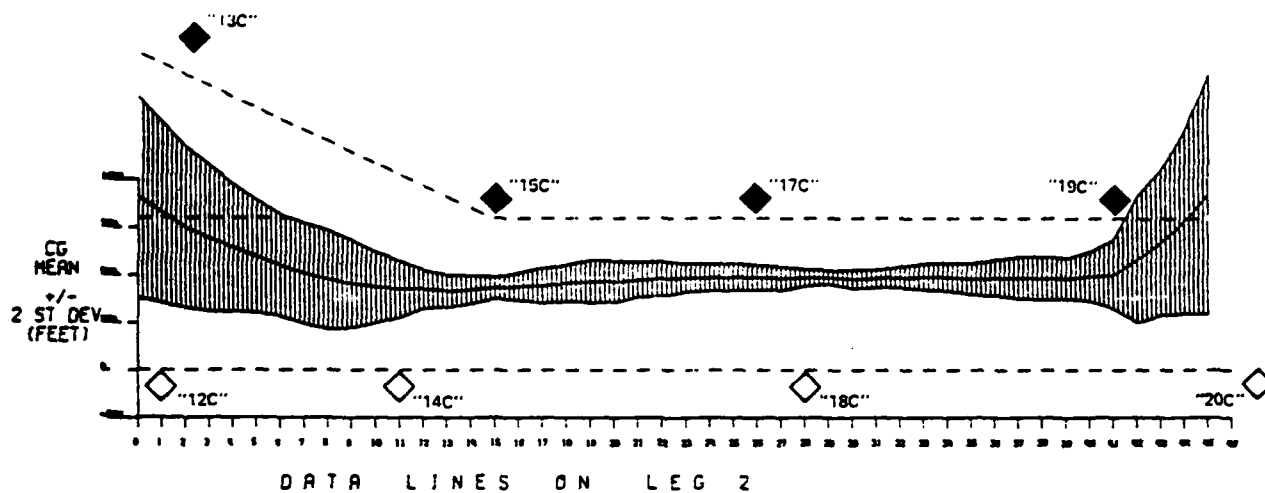


1 DATA LINE = 475 FEET

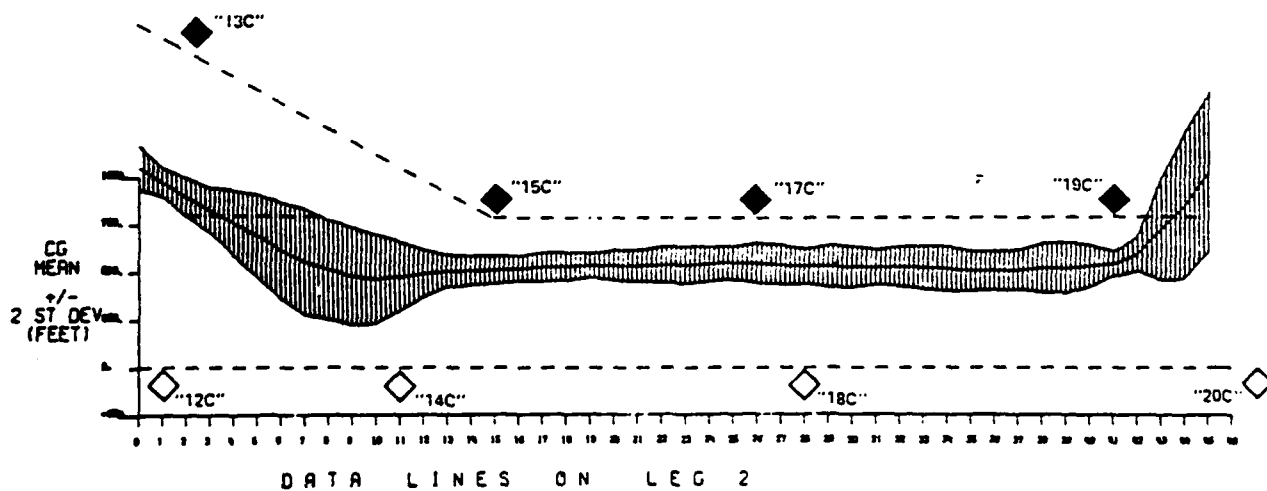
NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 9. Effect of Ship Beam on Performance, Leg 1

### SHIP BEAM 90 FEET OR LESS



### SHIP BEAM OVER 90 FEET



1 DATA LINE = 475 FEET

NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 10. Effect of Ship Beam on Performance, Leg 2

(THIS PAGE INTENTIONALLY LEFT BLANK)

From the above results (and their comparison with Figures 3 and 4), it is obvious that the smaller ships performed better than the larger ships in terms of track variability (standard deviation). A similar finding was shown in a simulator experiment which evaluated performance differences between a 30,000 dwt and an 80,000 dwt tanker.<sup>14</sup> It is recommended that for simulator validation purposes two ship sizes be used.

#### 3.1.4 The Effect of Environment on Performance

The effects of wind speed and tidal current on shiphandling performance are addressed separately and should be accorded separate validation. Wind direction which prevailed from the northwest is shown in Figures 11 and 12. Tidal current average speed and direction are shown in Figures 13 and 14.

Effects of Wind Speed. A review of Figure 11 indicates that while wind speed had no effect on variability of tracks (i.e., crosstrack standard deviation), the mean track for runs with wind speed over 10 knots is set an average of 50 feet to leeward. Figure 12 on the other hand shows mean tracks for both conditions in identical locations. Relative wind in this case, however, was approximately 30 degrees closer on the bow. It is concluded from this analysis that relative wind speed up to 20 knots at 10 to 20 degrees off the bow will not effect variability of pilots trackkeeping. There is some indication, however, that wind of this same speed but broader on the beam begins to set the vessel at a rate which is either not perceived by the pilots, or is not a concern to them in the conduct of their pilotage.

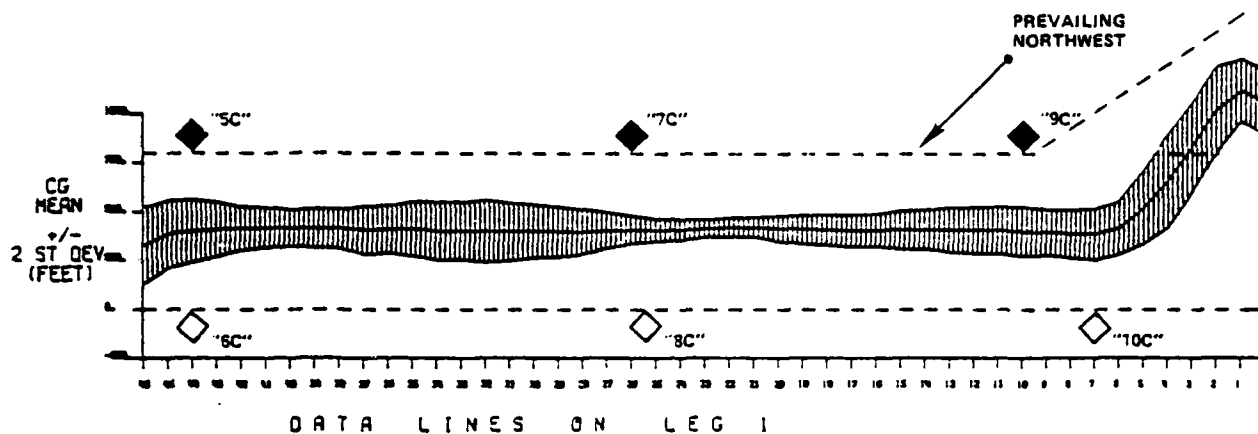
It is concluded that this information on the effect of wind and on shiphandling performance is usable for simulator validation. It is recommended, however, that before its implementation more detailed validation criteria be developed by further analyzing the interaction effects of different wind speeds from different directions.

Effects of Tidal Current. Figures 13 and 14 show these different segments of the tidal cycle: ebb, flood, and slack current. All transits are inbound moving left to right on the plots. While flow at maximum flood or ebb can approach as much as 0.9 knots in the Upper Chesapeake Bay, speeds calculated for the times at which transits were conducted never exceeded 0.5 knots. Current vectors indicated on the figures were derived from the Tidal Current Charts of the Upper Chesapeake Bay (Second Edition, 1973). The arrows are positioned to show the direction of flow on the surface of the channel and not the location of the measurement station. Pilots contend that the tidal current may actually flow even more parallel to the channel than illustrated. As a result, it is concluded that relatively little crosscurrent actually existed in any of the transits at the time data was collected, and that the flow which was experienced was actually in the form of head or following current.

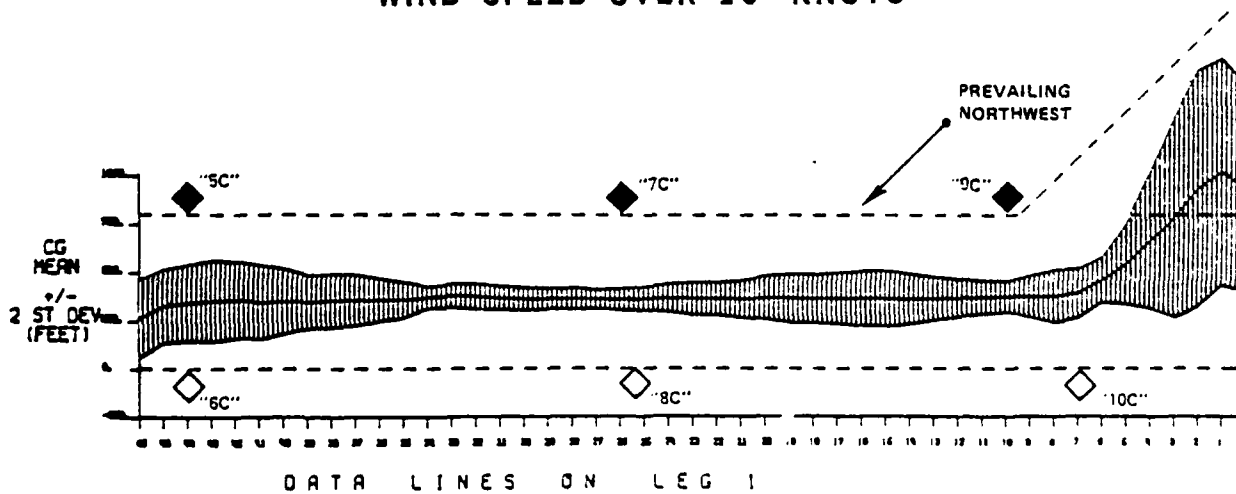
---

<sup>14</sup>W.R. Bertsche, D.A. Atkins, and M.W. Smith, op. cit.

### WIND SPEED UNDER 10 KNOTS



### WIND SPEED OVER 10 KNOTS

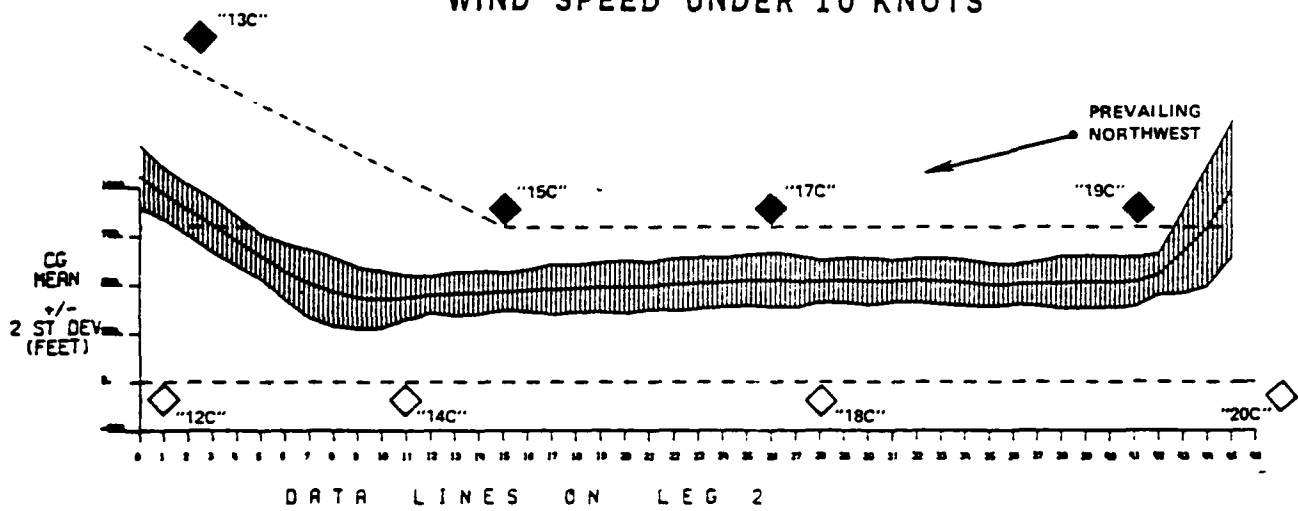


1 DATA LINE = 475 FEET

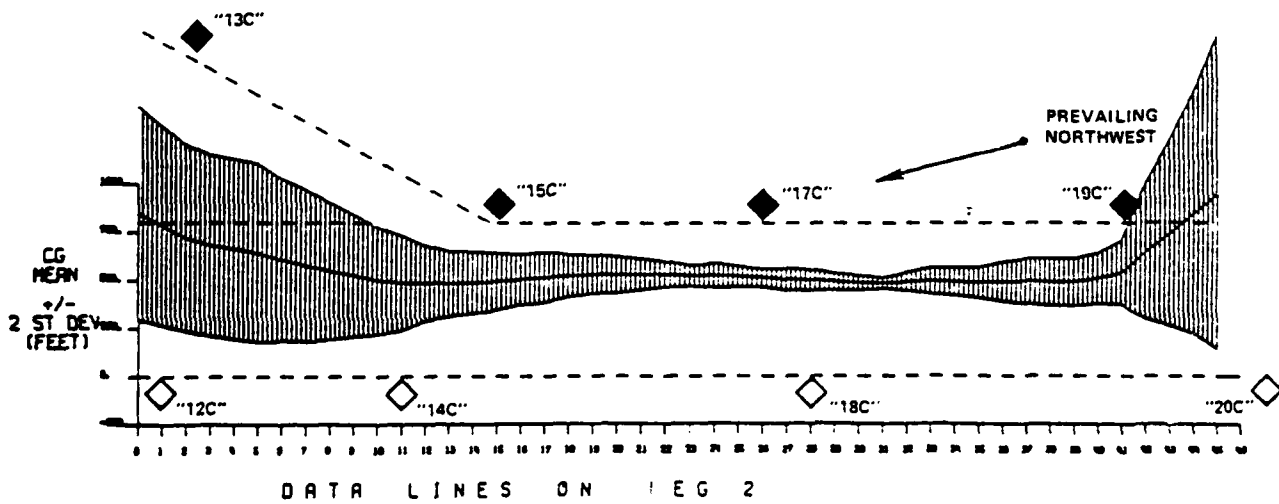
NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 11. Effect of Wind Speed on Performance, Leg 1

### WIND SPEED UNDER 10 KNOTS



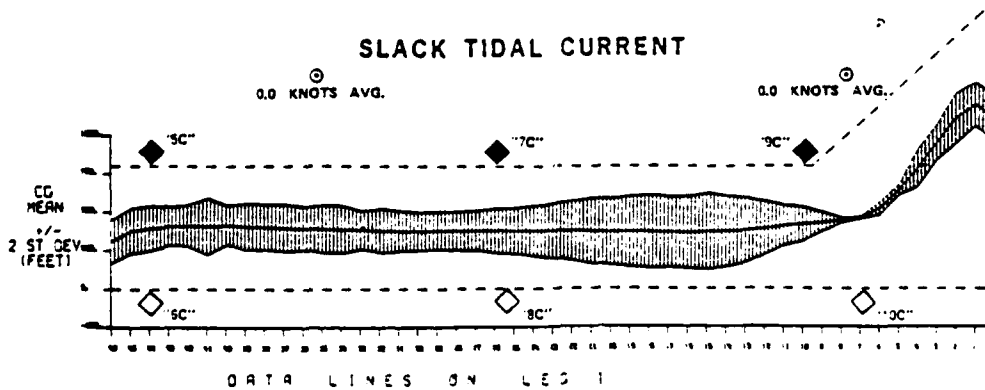
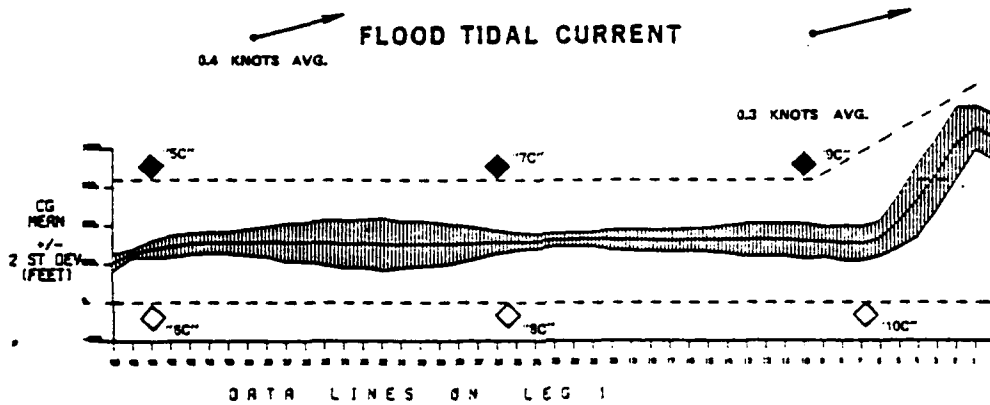
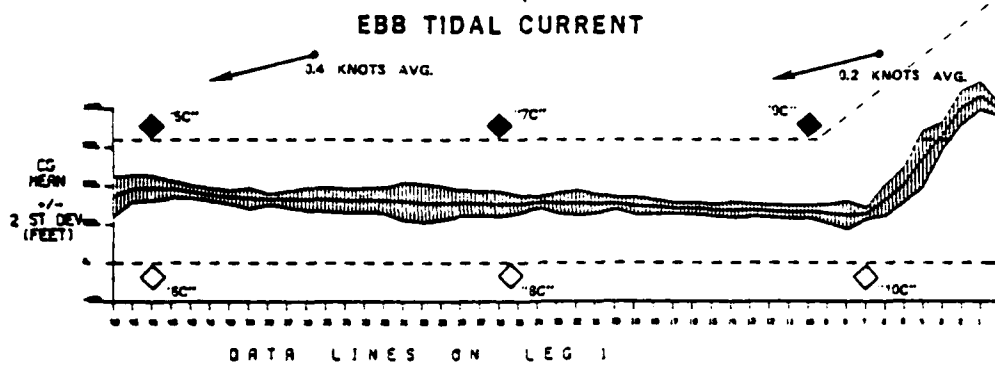
### WIND SPEED OVER 10 KNOTS



1 DATA LINE = 475 FEET

NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

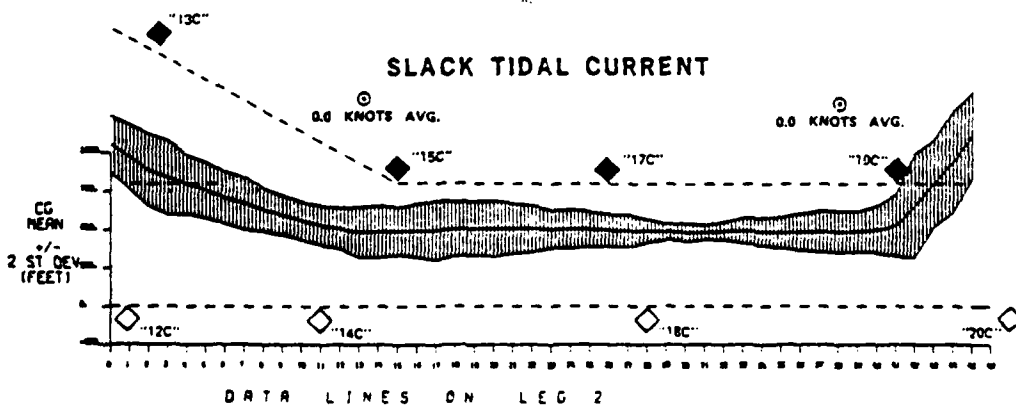
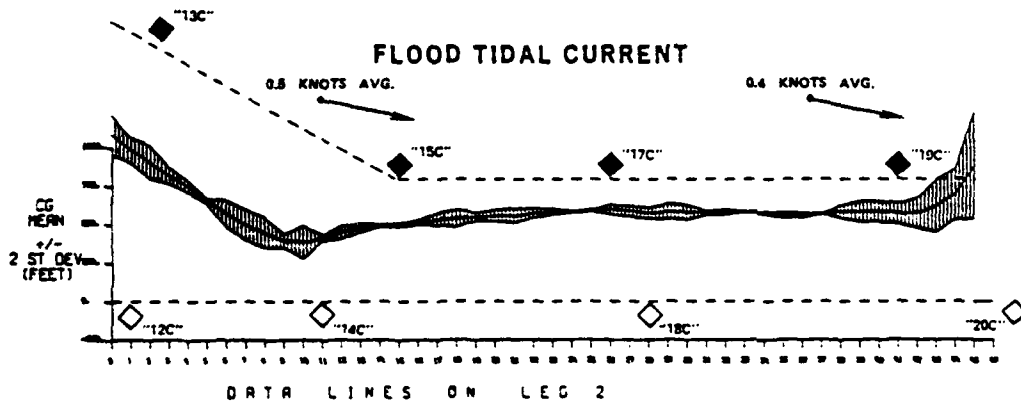
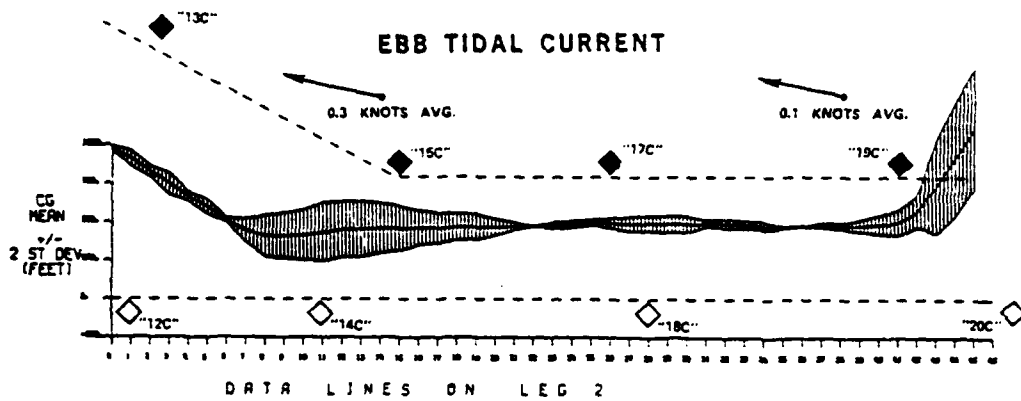
Figure 12. Effect of Wind Speed on Performance, Leg 2



1 DATA LINE = 475 FEET

NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 13. Effect of Tidal Current on Performance, Leg 1



1 DATA LINE = 475 FEET

NOTE: Buoys are positioned for the purpose of illustration and may not appear in their exact charted location.

Figure 14. Effect of Tidal Current on Performance, Leg 2

Figure 13 shows very comparable (i.e., 0.4 knots and 0.2 to 0.3 knots) average speed for both ebb and flood tidal currents. Its effect on shiphandling performance as indicated by the plots shows possibly more ship control with the head current (i.e., ebb in this case). While this is easy to understand, it is surprising that an average 0.3-knot head current could significantly influence the control of a 10- to 12-knot ship. A review of mean tracks on Figure 13 shows that all are within 50 feet of the centerline and that there is no apparent set as a result of the current.

Figure 14 which is the second leg of the waterway, also shows relatively little effect of the current upon shiphandling. The major difference appears to be in the turn abeam buoy "14C." With ebb and slack tidal current, the mean track shows a gradual turn with little or no overshoot. On the flood current plot, a large overshoot is in evidence. Alignment of the mean track through the straight of the channel is the same for all three plots.

It is concluded, as a result of the analysis of shiphandling performance, that the data collected at sea is not sufficient for validating the effects of crosscurrent in simulators. This conclusion is based on a lack of sufficient data on crosscurrents of varying angles and magnitudes. The currents experienced at sea were not shown to have affected shiphandling performance except at one bend. It is recommended that the data can be used for validating comparable head or following current conditions, but any extrapolation of results to crosscurrent simulation would be speculative. The following conclusions apply with respect to using this data for simulator validation:

- There will be no verifiable difference in shiphandling performance between a ship traveling in excess of 8 knots in slack water, and one with a head or following current at less than 1/2 knot with angles relative to the bow or stern up to 20 degrees.
- Criteria for the validation of crosscurrent effects in simulators cannot be derived from this data.

### 3.2 UTILIZATION OF DATA IN SIMULATOR VALIDATION

In recognizing the complexity of the restricted waterway pilotage process and the critical nature of the research being conducted on simulators, there is sufficient justification for concern over simulator and simulation validity. The intent of this project was to obtain real world data at sea for the purpose of developing validation criteria and eventually applying it in a validation of the U.S. Coast Guard simulator located at Eclectech Associates in North Stonington, Connecticut. The overwhelming conclusion of this report is that the intent of the effort has been met. It should be apparent to the reader that the validation required of this simulator does not include all potential aspects of the pilotage. For example, there is no requirement to validate channel bank effects, slow speed maneuvering and docking effects, or the effects of heavy seas and weather. The validation should, instead, address only

those factors which are of concern to the aids to navigation research. These factors are ship hydrodynamic response at maneuvering and sea speed, the effects of normal environment on shiphandling, the effects of waterway design including aids to navigation, and pilot capabilities.

The at-sea data collection has provided a wealth of information not only in the form of track plots, but also on ship environment and pilot task characteristics. The analysis of track plots presented in section 3.1 should provide the first and most beneficial data for deriving validation criteria. Information contained in Appendix A and Table 1 can be further reduced if "cause and effect" is to be addressed in the validation.

In summary, this report recommends that data derived from the plots (Figures 3 through 13), and in some instances, the pilots themselves, be compared directly to previous simulation data from the AN program; and that this comparison, in itself, will provide a tentative form of validation. The report also recommends that special simulation be designed and conducted expressly for the purpose of performing a validation. This will require the development of specific validation criteria from the at-sea data, and a determination of what characteristics of each scenario will best accommodate the criteria. Finally, the absence of good crosscurrent information from the at-sea data suggests that if further opportunities should arise for ship tracking, this data base might be expanded to include a number of samples of different crosscurrent angles and relative velocities.

(THIS PAGE INTENTIONALLY LEFT BLANK)

## BIBLIOGRAPHY

Bertsche W.R., D.A. Atkins, and M.W. Smith. "Aids to Navigation Principal Findings Report on the Ship Variables Experiment: The Effect of Ship Characteristics and Related Variables on Piloting Performance." U.S. Coast Guard, Washington, D.C., April 1981.

Bertsche, W.R. and R.C. Cook. "Analysis of Visual Navigational Variables and Interactions." U.S. Coast Guard, Washington, D.C., October 1979.

Bertsche, W.R. and R.T. Mercer. "Aids to Navigation Configurations and the Physical Characteristics of Waterways in 32 Major U.S. Port." U.S. Coast Guard, Washington, D.C., October 1979.

Cooper, R.B., K.L. Marino, and W.R. Bertsche. "Simulation Evaluation of Electronic Radio Aids to Navigation Displays, The RA-2 Experiment." U.S. Coast Guard, Washington, D.C., April 1981.

Cooper, R.B., K.L. Marino, and W.R. Bertsche. "Simulation Evaluation of Electronic Radio Aids to Navigation Displays, The RA-1 Experiment." U.S. Coast Guard, Washington, D.C., January 1981.

Cooper, R.B. and K.L. Marino. "Simulator Evaluation of Electronic Radio Aids to Navigation Displays - The Miniexperiment." U.S. Coast Guard, Washington, D.C., September 1980.

Hastings, C.E., and A.L. Comstock. "Pinpoint Positioning of Surface Vessels Beyond Line-of-Sight." A paper presented at the National Marine Navigation Meeting of ION, San Diego, California, November 1969.

Marino, K.L., M.W. Smith, and W.R. Bertsche. "Aids to Navigation Principal Findings Report: The Effect of One-Side Channel Marking and Related Conditions on Piloting Performance." U.S. Coast Guard, Washington, D.C., July 1981.

Smith, M.W. and W.R. Bertsche. "Aids to Navigation Principal Findings Report on the Channel Width Experiment: The Effects of Channel Width and Related Variables on Piloting Performance." U.S. Coast Guard, Washington, D.C., January 1981.

Smith, M.W. and W.R. Bertsche. "Aids to Navigation Report on the CAORF Experiment. The Performance of Visual Aids to Navigation as Evaluated by Simulation." U.S. Coast Guard, Washington, D.C., August 1980.

Appendix A  
INDIVIDUAL RUN DATA

This appendix contains both raw data manually recorded by observers aboard each ship during each transit, and the composite ship track computed and plotted from RAYDIST tracker data.

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT  
(circle one)


Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm 2.5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

2 hours 29 minutes since slack FLOOD EBB (circle one) from tables

7 hours 11 minutes since sun RISE SET (circle one) from tables

SHIP DESCRIPTION

Type USCG Buoy Tender  
 Propulsion Diesel  
 Shaft horsepower 2900 hp at \_\_\_\_\_ RPM  
 Length overall 157 (units) ft  
 Length between perpendiculars \_\_\_\_\_ (units) \_\_\_\_\_  
 Beam 31 (units) ft  
 Depth \_\_\_\_\_ (units) \_\_\_\_\_  
 Dead weight tonnage 525  
 Gross tonnage \_\_\_\_\_  
 Net tonnage \_\_\_\_\_  
 Design draft \_\_\_\_\_ (units) \_\_\_\_\_  
 Actual draft  6'7" FORWARD, \_\_\_\_\_ AFT (units) \_\_\_\_\_  
 Height of eye \_\_\_\_\_ (units) \_\_\_\_\_  
 Bridge to bow \_\_\_\_\_ (units) \_\_\_\_\_  
 Bridge to stern \_\_\_\_\_ (units) \_\_\_\_\_  
 Antenna to ship centerline \_\_\_\_\_ feet PORT STARBOARD (circle one)  
 \_\_\_\_\_ feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	_____	_____
SLOW	_____	_____
HALF	_____	_____
FULL MANEUVERING	_____	_____
FULL NAVIGATION	_____	_____

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM  
 \_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds  
 Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



13:3600 at Bay Bridge mark  
Ship centerline \_\_\_\_\_ feet EAST WEST (circle one) of mark

13:4300 on green range

13:4500 on red range

13:5900 abeam Baltimore Light

IF OUTBOUND



14:3000 abeam 7 Foot Knoll

       abeam "4B"

Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>      </u>		
	RPM at start <u>      </u>		
	abeam "1C"		
13:3600	Under Bridge		
13:4100	Buoy 83 30yds Port Beam 493.10 - Red 1220.76 - Green		
13:4300	480.36 Red South Range 1206.63 Green		
13:4500	469.27 Red North Range Course 350		
13:5200	Abeam "2C" entering Craighill Entrance		
13:5900	Abeam Baltimore Light		
14:1800	Abeam "10C"		
14:2500	Abeam "14C"		
14:3000	Abeam 7' Knoll Light		
14:3200	Buoy 17-18		

RUN 1

United States Coast Guard Buoytender  
Red Birch: 0.5 dwt, 157 LOA  
Wind: 5 knots

(No tracking data was available for this run.)

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON


INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

1 hours 40 minutes since slack FLOOD EBB (circle one) from tables  
2 hours 31 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulk-Coal</u>
Propulsion	<u>Diesel</u>
Shaft horsepower	<u>23,000</u> at <u>122</u> RPM
Length overall	<u>856</u> (units) <u>ft</u>
Length between perpendiculars	<u>810</u> (units) <u>ft</u>
Beam	<u>133</u> (units) <u>ft</u>
Depth	(units) _____
Dead weight tonnage	<u>130,000</u>
Gross tonnage	<u>70,363</u>
Net tonnage	<u>46,166</u>
Design draft	(units) _____
Actual draft	 <u>58</u> FORWARD, <u>34</u> AFT (units) <u>ft</u>
Height of eye	<u>96</u> (units) <u>ft</u>
Bridge to bow	<u>705</u> (units) <u>ft</u>
Bridge to stern	<u>151</u> (units) <u>ft</u>
Antenna to ship centerline	<u>0</u> feet PORT STARBOARD (circle one)
	<u>0</u> feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>40</u>	<u>5.5</u>
SLOW	<u>60</u>	<u>8</u>
HALF	<u>70</u>	<u>10</u>
FULL MANEUVERING	<u>80</u>	<u>11</u>
FULL NAVIGATION	<u>116</u>	<u>15</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

\_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

NOT NOTED

TRANSIT EVENTS  
(local time)

IF INBOUND



19:5000 at Bay Bridge mark  
Ship centerline      feet EAST WEST (circle one) of mark

- on green range
- on red range
- abeam Baltimore Light
- abeam 7 Foot Knoll
- abeam "4B"

IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

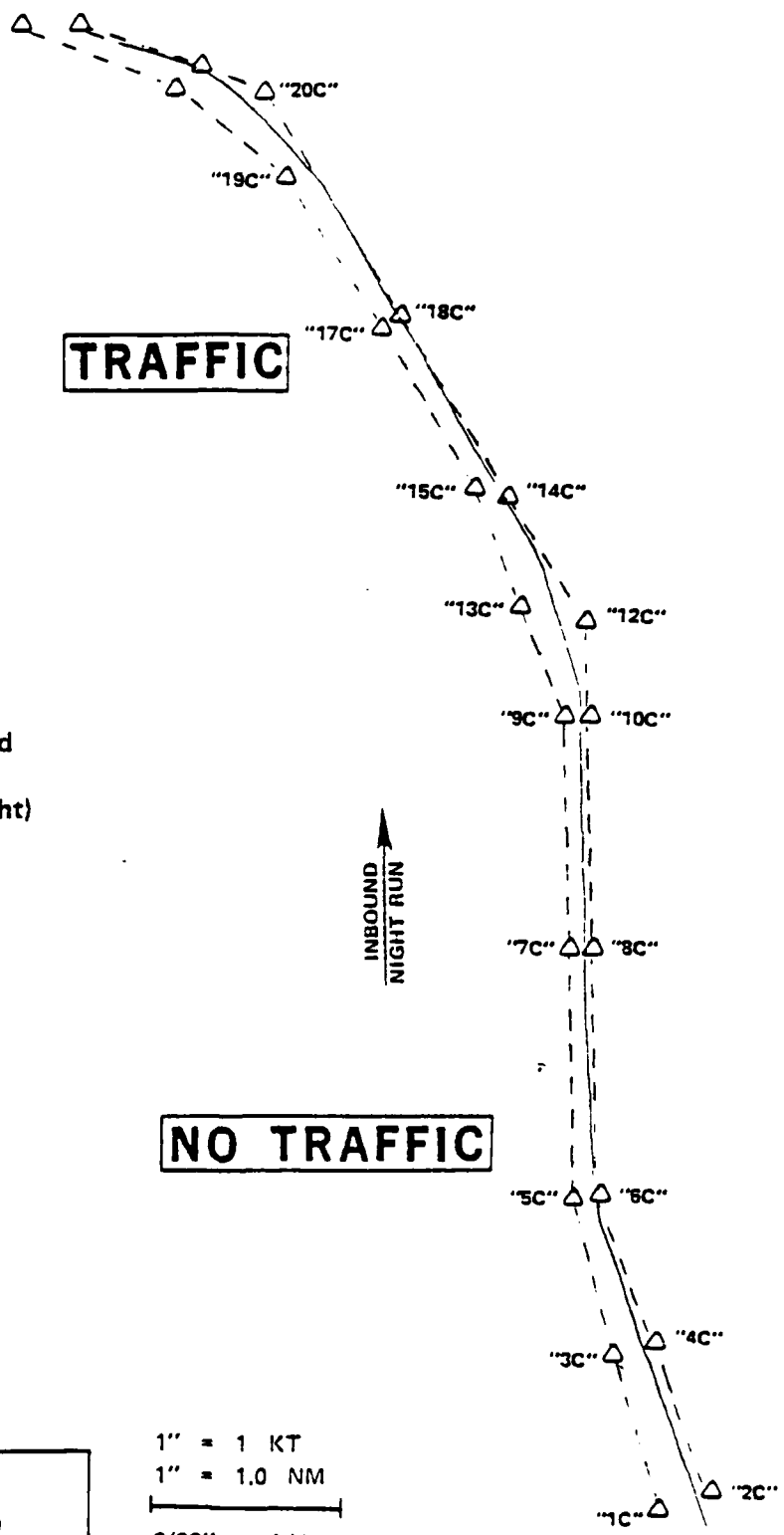
Local Time	Event	Local Time	Event
	Course at start <u>018</u>	20:1345	RR10
	RPM at start <u>110</u>	1355	MS
<u>19:5000</u>	abeam "1C"	1400	RL10
5300	Abeam "83"	1418	MS
5500	Abeam Sandy Point	1500	RR05
5600	RL15	1520	CC359
5710	MS	1644	CC000
5700	RR10	1948	RR15
5721	MS	1955	MS
5808	RR10	2014	RL10
5836	CC343	2016	MS
20:0000	Freighter traffic abeam	2020	CC001
0400	Abeam 2C-tug ahead	2050	Slow to 95 rpm to stop vibration
0600	Tug abeam	2335	CC000
0900	CC342	2600	CC002
1300	RR20		

Local Time	Event
20:3000	RL10
3030	CC345
3510	RL10
3520	RL20
3530	RR10
3545	MS
3550	RR10
3625	MS
3638	RR10
3700	MS
3720	CC331
3800	Half ahead - Traffic ahead outbound
3900	CC332
3930	Slow ahead
4043	CC334
4255	CC332 - Pilot noted helmsman tends to steer left - pilot compen- sating with orders
4517	CC330
4640	Dead slow ahead
4700	CC334

Local Time	Event
20:4940	Traffic rounding turn ahead
5023	Slow ahead
5300	RR10
5310	Half ahead
5321	MS
5340	RR10
5350	RR20
5400	Traffic abeam - Bulker
5432	Full ahead
5507	RR05
5515	RR10
5552	MS
5615	RR10
5650	MS
5752	RR05
5800	MS
21:0230	CC292
0400	CC290
0500	CC292

TAPE IN ENVELOPE?

\* USCG initial \_\_\_\_\_



(Tracking error was caused by inability to initialize on raydist ranges at night)

**RUN 2**  
**BULKER: 130 K, 810 LOA**  
**WIND: 5 KTS**  
**CURRENT: EBB (0.6 KT AVG)**

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1dI

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON


INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

2 hours 0 minutes since slack FLOOD EBB (circle one) from tables  
7 hours 54 minutes since sun RISE SET (circle one) from tables

SHIP DESCRIPTION

Type Bulk-Coal  
 Propulsion Diesel  
 Shaft horsepower \_\_\_\_\_ at \_\_\_\_\_ RPM  
 Length overall 737 (units) ft  
 Length between perpendiculars 705 (units) ft  
 Beam 106 (units) ft  
 Depth 58 (units) ft  
 Dead weight tonnage 61,745  
 Gross tonnage 35,800  
 Net tonnage 31,270  
 Design draft 41 (units) ft  
 Actual draft  19 FORWARD, 24 AFT (units) ft  
 Height of eye 90 (units) ft  
 Bridge to bow 611 (units) ft  
 Bridge to stern 125 (units) ft  
 Antenna to ship centerline 0 feet PORT STARBOARD (circle one)  
0 feet AFT of bridge bulkhead

	(rpm)	(knots)	
DEAD SLOW	_____	_____	
SLOW	_____	_____	
HALF	_____	_____	NOT NOTED
FULL MANEUVERING	_____	_____	
FULL NAVIGATION	_____	_____	

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

NOT NOTED

\_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



\_\_\_\_\_ at Bay Bridge mark  
Ship centerline \_\_\_\_\_ feet EAST WEST (circle one) of mark

15:1905 on green range

\_\_\_\_\_ on red range

15:0500 abeam Baltimore Light

\_\_\_\_\_ abeam 7 Foot Knoll

IF OUTBOUND

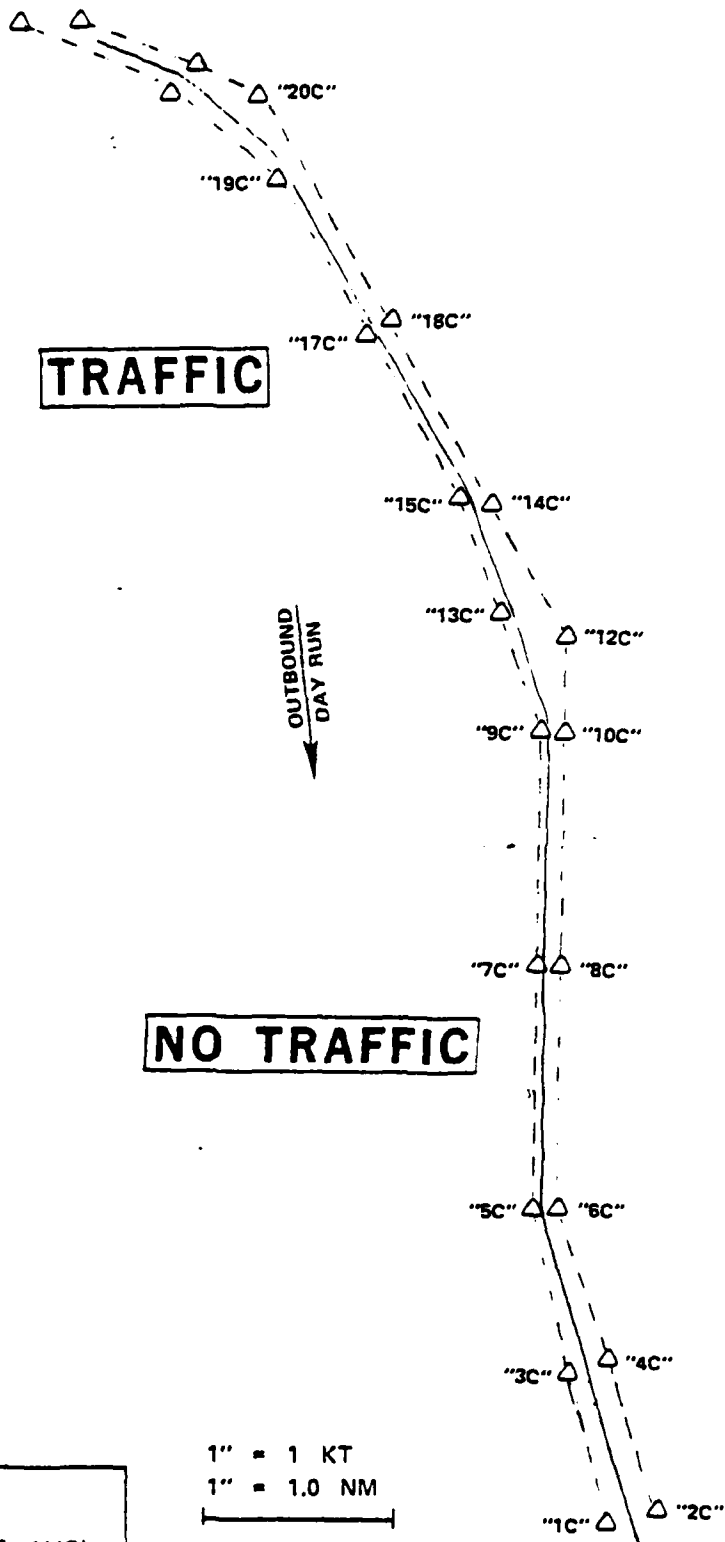


14:2100 abeam "4B"

Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>110</u>	14:3430	Abeam #17 & #18
	RPM at start <u>12Kts</u>	3700	Tug ab am on stbd side
	abeam "1C"	3855	RR10
14:2303	RR10	3930	RR05
2350	MS	3950	MS
2400	RL10	4000	CC160
2412	MS	4620	RR10
2420	CC127	4630	RR20
2630	RR10	4650	RR10
2730	RR05	4720	MS
2740	MS	4730	RL10
2750	RL10	4740	MS
2815	MS	4750	CC179
2820	CC149	5300	CC178
2830	CC148	15:0110	RL10
2900	Overtaking tug 1000 yds ahead on stbd side	0200	MS





**RUN 3**  
**BULKER: 62 K, 705 LOA**  
**WIND: 5 KTS**  
**CURRENT: FLOOD (0.6 KT AVG)**

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1dl

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

5 hours 36 minutes since slack FLOOD EBB (circle one) from tables  
9 hours 28 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulk-Coal</u>	
Propulsion	<u>Diesel</u>	
Shaft horsepower	<u>16,100</u>	at _____ RPM
Length overall	<u>699</u>	(units) <u>ft</u>
Length between perpendiculars	<u>657</u>	(units) <u>ft</u>
Beam	<u>95</u>	(units) <u>ft</u>
Depth	_____	(units) _____
Dead weight tonnage	<u>50,356</u>	
Gross tonnage	<u>27,587</u>	
Net tonnage	<u>16,438</u>	
Design draft	_____	(units) _____
Actual draft	<div style="display: inline-block; vertical-align: middle; text-align: center;"> </div> <u>5.6</u>	FORWARD, <u>6.6</u> AFT (units) <u>meters</u>
Height of eye	<u>72</u>	(units) <u>ft</u>
Bridge to bow	_____	(units) _____
Bridge to stern	_____	(units) _____
Antenna to ship centerline	<u>none</u>	feet PORT STARBOARD (circle one)
	<u>none</u>	feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>40</u>	<u>5.6</u>
SLOW	<u>60</u>	<u>8.4</u>
HALF	<u>70/75</u>	<u>9.8/10.5</u>
FULL MANEUVERING	<u>80/85</u>	<u>11.2/11.9</u>
FULL NAVIGATION	_____	_____

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

\_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

NOT NOTED

TRANSIT EVENTS  
(local time)

IF INBOUND



\_\_\_\_\_ at Bay Bridge mark  
Ship centerline \_\_\_\_\_ feet EAST WEST (circle one) of mark

\_\_\_\_\_ on green range  
\_\_\_\_\_ on red range  
\_\_\_\_\_ abeam Baltimore Light  
\_\_\_\_\_ abeam 7 Foot Knoll  
\_\_\_\_\_ abeam "4B"

IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

Local Time	Event
	Course at start <u>343</u>
	RPM at start <u>80</u>
	abeam "1C"
16:1815	RR10
1830	RR15
1845	CC000
2010	CC001
2400	CC000
2910	CC001
3615	CC343
3720	RR20
4350	CC330
4730	CC331
5615	RL10
5645	MS
5910	RR10

Local Time	Event
16:5940	CC308
17:0125	RL15
0220	CC295
0240	CC292

RUN 4

Bulker: 50K, 657 LOA  
Wind: 5 knots  
Current: Flood

(No tracking data was available for this run.)

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT  
(circle one)


Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

3 hours 45 minutes since slack FLOOD EBB (circle one) from tables

3 hours 12 minutes since sun RISE SET (circle one) from tables

SHIP DESCRIPTION

Type Bulk-Coal  
 Propulsion Diesel  
 Shaft horsepower \_\_\_\_\_ at \_\_\_\_\_ RPM  
 Length overall 805 (units) ft  
 Length between perpendiculars 775 (units) ft  
 Beam 105 (units) ft  
 Depth \_\_\_\_\_ (units) \_\_\_\_\_  
 Dead weight tonnage 78,637  
 Gross tonnage 42,141  
 Net tonnage 28,187  
 Design draft \_\_\_\_\_ (units) \_\_\_\_\_  
 Actual draft  6 FORWARD, 7 AFT (units) meters  
 Height of eye 23 (units) meters  
 Bridge to bow 666 (units) ft  
 Bridge to stern 139 (units) ft  
 Antenna to ship centerline 5 feet PORT STARBOARD (circle one)  
0 feet AFT of bridge bulkhead

	(rpm)	(knots)	
DEAD SLOW	_____	_____	
SLOW	_____	_____	
HALF	_____	_____	NOT NOTED
FULL MANEUVERING	_____	_____	
FULL NAVIGATION	_____	_____	

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

NOT NOTED

\_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

TRANSIT EVENTS

(local time)

IF INBOUND



\_\_\_\_\_ at Bay Bridge mark  
 Ship centerline \_\_\_\_\_ feet EAST WEST (circle one) of mark

\_\_\_\_\_ on green range  
 \_\_\_\_\_ on red range  
10:1700 abeam Baltimore Light  
 \_\_\_\_\_ abeam 7 Foot Knoll  
 \_\_\_\_\_ abeam "4B"

IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>015</u>	10:3614	Port 20
	RPM at start <u>90</u>	3643	Port 10
	abeam "1C"	3656	Port 05
09:5714	Port 10	3710	MS
5739	Port 20	3722	Stbd 10
5828	MS	3740	MS
5844	RR10	3749	CC339
5900	MS	4228	Port 10
5910	CC343	4245	Port 05
10:1657	Abeam Baltimore Light	4300	MS
1816	Port 20	4310	Stbd 05
2000	MS	4322	Stbd 10
2012	CC000	4325	Stbd 20
2356	CC001	4331	MS
3319	CC000	4343	CC330



RUN 5

Bulker: 79K, 775 LOA  
Wind: 15 knots  
Current: Flood

(No tracking data was available for this run.)

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON


INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

0 hours 33 minutes since slack FLOOD EBB (circle one) from tables  
0 hours 48 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulk-Sugar</u>
Propulsion	<u>Diesel</u>
Shaft horsepower	<u>14,500</u> at _____ RPM
Length overall	<u>193</u> (units) <u>meters</u>
Length between perpendiculars	<u>178</u> (units) <u>meters</u>
Beam	<u>27</u> (units) <u>meters</u>
Depth	<u>16</u> (units) <u>meters</u>
Dead weight tonnage	<u>35,339</u>
Gross tonnage	<u>19,411</u>
Net tonnage	<u>12,378</u>
Design draft	_____ (units) _____
Actual draft	 <u>29</u> FORWARD, <u>30</u> AFT (units) <u>ft</u>
Height of eye	<u>62</u> (units) <u>ft</u>
Bridge to bow	<u>495</u> (units) <u>ft</u>
Bridge to stern	<u>138</u> (units) <u>ft</u>
Antenna to ship centerline	<u>20</u> feet PORT <u>STARBOARD</u> (circle one) <u>0</u> feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>45</u>	<u>6</u>
SLOW	<u>55</u>	<u>8</u>
HALF	<u>80</u>	<u>12</u>
FULL MANEUVERING	<u>90</u>	<u>13</u>
FULL NAVIGATION	<u>100</u>	<u>15</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

\_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

NOT NOTED

TRANSIT EVENTS  
(local time)

IF INBOUND



09:2930 at Bay Bridge mark  
Ship centerline 20 feet EAST WEST (circle one) of mark

09:2430 on green range

09:2250 on red range

09:0905 abeam Baltimore Light

IF OUTBOUND



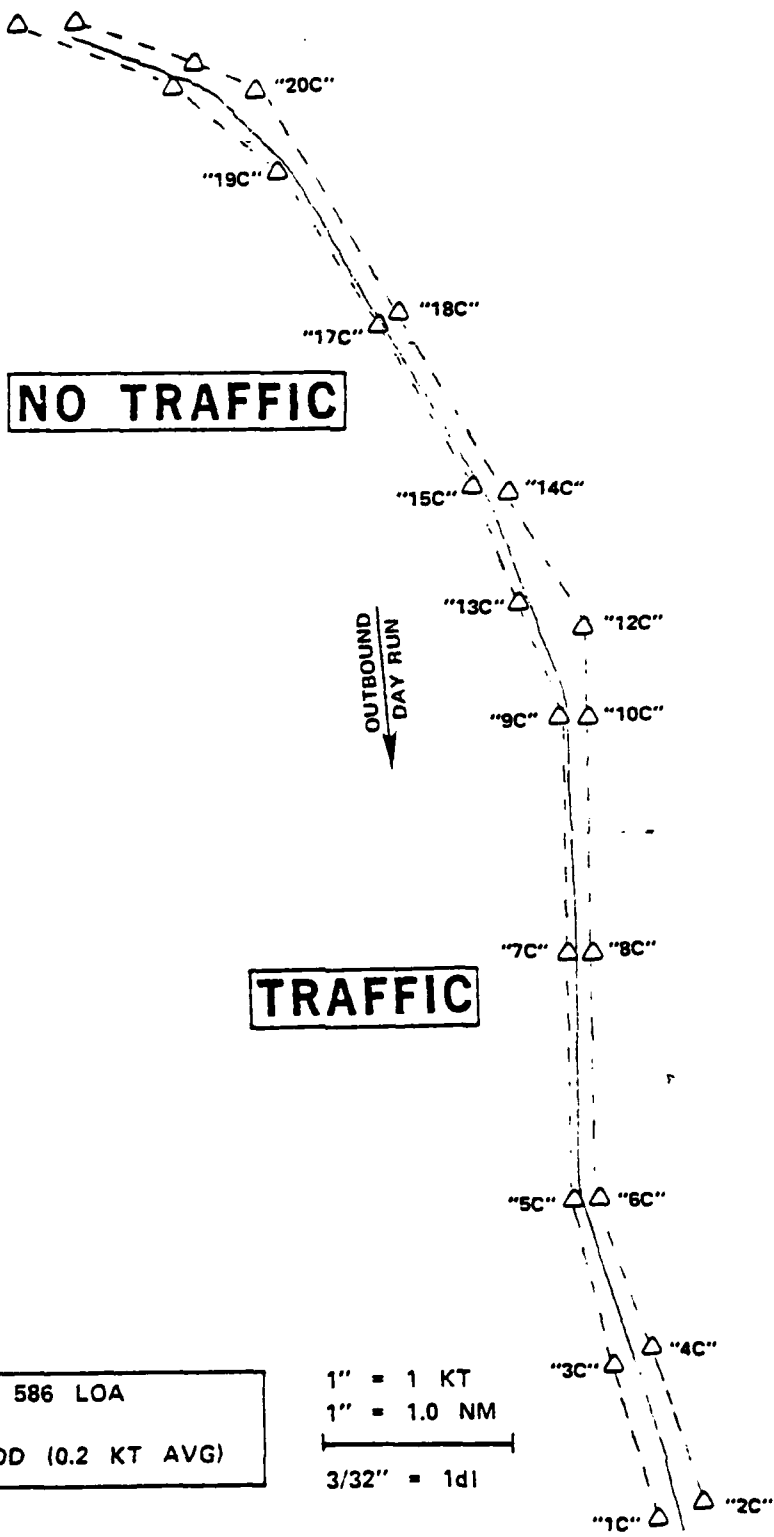
08:3845 abeam 7 Foot Knoll

08:2340 abeam "4B"

Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
08:2340	Course at start <u>110</u> RPM at start <u>95</u> abeam "1C"	08:4340	MS
		4345	Port 10
		4355	MS
08:2700	Stbd 10	4500	CC159
2800	MS	4920	Stbd 10
2830	Port 10	4940	Stbd 20
2900	MS	5005	Stbd 10
2910	CC134	5030	MS
3045	Stbd 20	5050	Port 10
3115	Stbd 10	5110	MS
3120	MS	5115	CC179
3125	Port 10	5245	Traffic ship on port side maneuvered to stbd
3150	MS	5330	CC176
3220	CC149	5645	CC179
3640	CC148		
4240	Stbd 10		





**RUN 6**  
 BULKER: 35 K, 586 LOA  
 WIND: 5 KTS  
 CURRENT: FLOOD (0.2 KT AVG)

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1dl

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

0 hours 04 minutes since slack FLOOD EBB (circle one) from tables  
2 hours 54 minutes since sun RISE SET (circle one) from tables

SHIP DESCRIP

Type Bulk

Propulsion Diesel

Shaft horsepower 12,600 at 118 RPM

Length overall 731 (units) ft

Length between perpendiculars 698 (units) ft

Beam 105 (units) ft


Depth 60 (units) ft

Dead weight tonnage 62,500

Gross tonnage 31,220

Net tonnage 22,103

Design draft \_\_\_\_\_ (units) \_\_\_\_\_

Actual draft  12ft 6in FORWARD, 22ft 6in AFT (units) \_\_\_\_\_

Height of eye 47 (units) meters from keel

Bridge to bow 617 (units) ft

Bridge to stern 125 (units) ft

Antenna to ship centerline 0 feet PORT STARBOARD (circle one)

0 feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>35</u>	<u>5</u>
SLOW	<u>45</u>	<u>6</u>
HALF	<u>70</u>	<u>9</u>
FULL MANEUVERING	<u>85</u>	<u>11</u>
FULL NAVIGATION	<u>110</u>	<u>16</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

2096 ADVANCE, 1256 TRANSFER (units) ft / 2 minutes 52 seconds

Crash stop to dead in water, 8000 DISTANCE (units) ft / 10 minutes 0 seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



09:3410 at Bay Bridge mark  
Ship centerline 30 feet EAST WEST (circle one) of mark

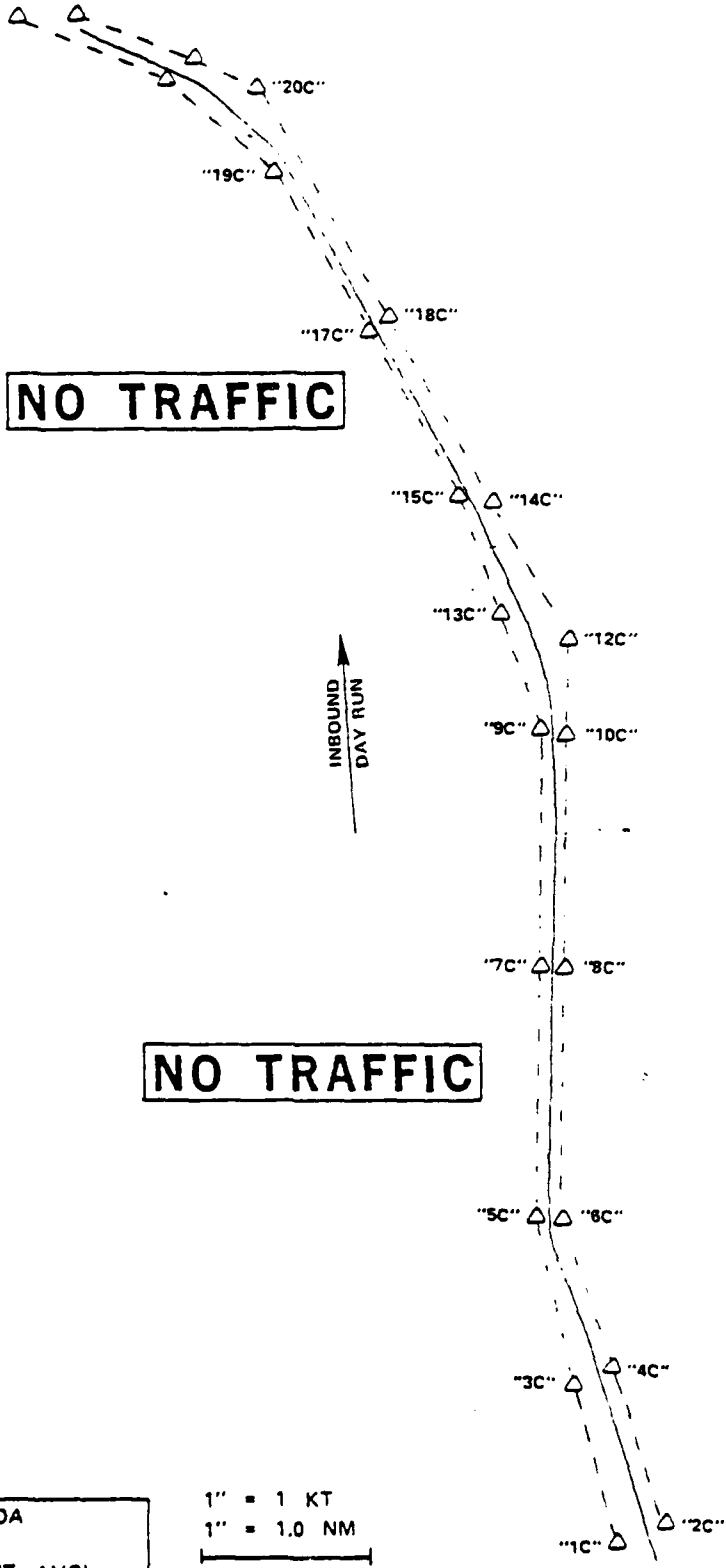
09:3926 on green range  
09:4125 on red range  
09:5427 abeam Baltimore Light  
           abeam 7 Foot Knoll  
10:4330 abeam "4B"

IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>340</u>	10:1516	CC332
	RPM at start <u>105</u>	1557	CC330
<u>09:4740</u>	abeam "1C"	1642	CC328
09:5251	CC337	1752	CC329
5505	Stbd 10	2515	CC328
5552	MS	2639	Port 10
5645	CC358 Steering to stbd to pass container ship outbnd	2720	MS
5820	Abeam container ship	2800	CC310
10:0718	CC355	2923	Port 10
0936	CC345 Pilot believes ship on center now	3012	MS
1037	CC340	3044	CC292
1112	CC335	3142	CC291
1214	CC332	3430	Abeam "4B"
1400	CC334	3536	CC291



**RUN 7**  
 BULKER: 63 K, 698 LOA  
 WIND: 15 KTS  
 CURRENT: SLACK (0 KT AVG)

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1dI

SHIP TRACKING REPORT

RUN CONDITION

(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT


(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

1 hours 13 minutes since slack FLOOD EBB (circle one) from tables

1 hours 14 minutes since sun RISE SET (circle one) from tables

SHIP DESCRIPTION

Type	<u>Oil-Tanker</u>
Propulsion	<u>Diesel</u>
Shaft horsepower	<u>11,600</u> at <u>124</u> RPM
Length overall	<u>602</u> (units) <u>ft</u>
Length between perpendiculars	<u>565</u> (units) <u>ft</u>
Beam	<u>85</u> (units) <u>ft</u>
Depth	<u>47</u> (units) <u>ft</u>
Dead weight tonnage	<u>30,698</u>
Gross tonnage	<u>20,703</u>
Net tonnage	<u>16,363</u>
Design draft	_____ (units) _____
Actual draft	 <u>32</u> FORWARD, <u>33</u> AFT (units) <u>ft</u>
Height of eye	<u>18.4</u> (units) <u>meters</u>
Bridge to bow	<u>475</u> (units) <u>ft</u>
Bridge to stern	<u>127</u> (units) <u>ft</u>
Antenna to ship centerline	<u>20</u> feet PORT <u>STARBOARD</u> (circle one) <u>20</u> feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>40</u>	<u>6</u>
SLOW	<u>60</u>	<u>9</u>
HALF	<u>75</u>	<u>11</u>
FULL MANEUVERING	<u>90</u>	<u>14</u>
FULL NAVIGATION	<u>120</u>	<u>18</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, 105 RPM Full loaded

.3 ADVANCE, .18 TRANSFER (units) nm, 9 minutes 30 seconds

Crash stop to dead in water, .55 DISTANCE (units) \_\_\_\_\_, 14 minutes 10 seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



08:0815 at Bay Bridge mark  
Ship centerline 30 feet EAST WEST (circle one) of mark

08:1343 on green range

08:1550 on red range

08:2944 abeam Baltimore Light

08:5950 abeam 7 Foot Knoll

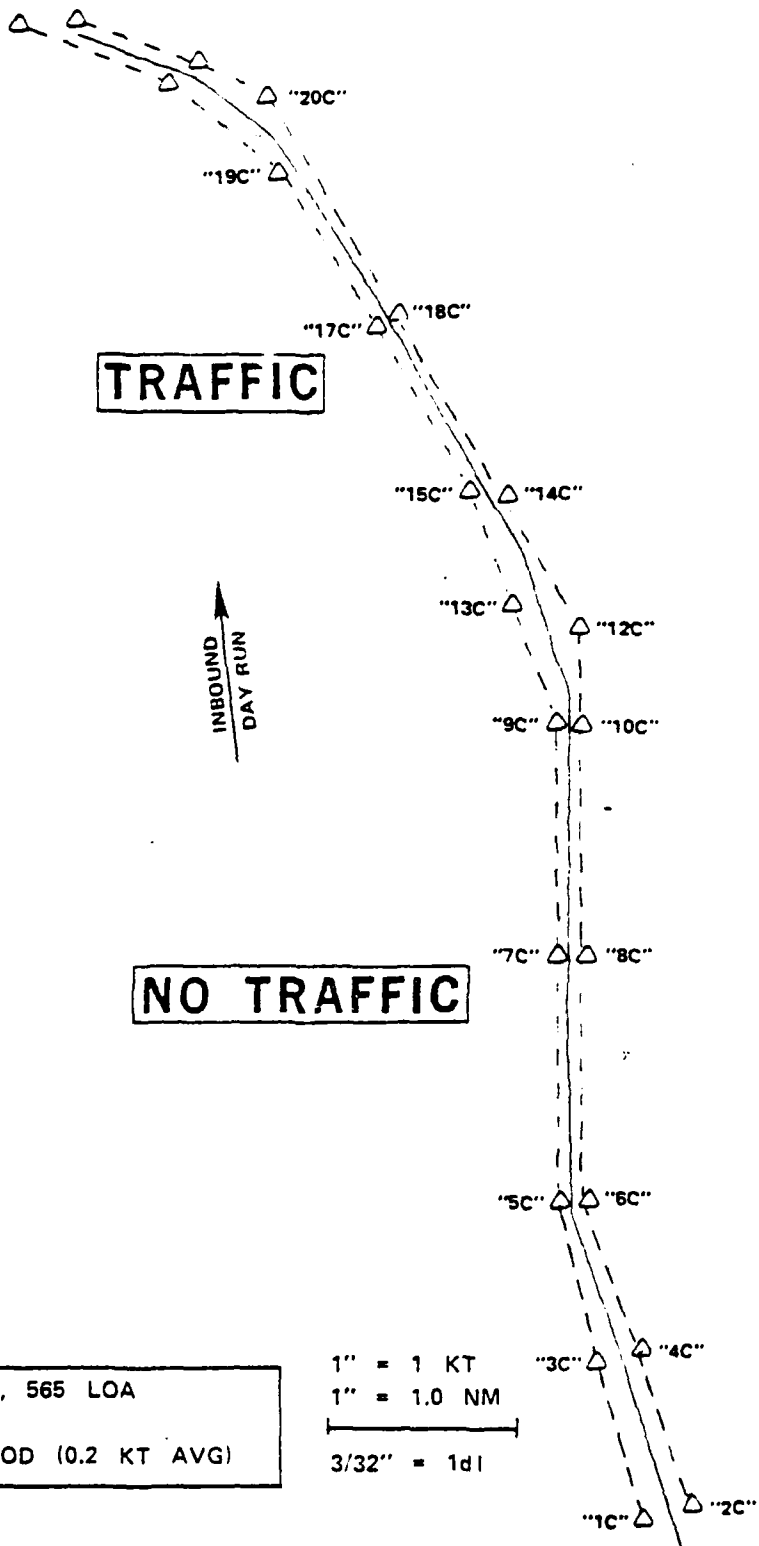
IF OUTBOUND



09:1454 abeam "4B"

Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>344</u>	08:5228	MS
	RPM at start <u>85</u>	08:5245	CC330
	abeam "1C"	08:5710	CC332 Moving Right for outbnd traffic - 1 whistle
08:2400	Steering to right of center overtaking tug/barge		Abeam outbnd traffic
2600	Abeam tug/barge	09:0108	CC329
2935	CC342	09:0628	Port 10
3055	Stbd 10	09:0656	MS
3145	MS	09:0745	CC310
3210	CC000	09:0820	CC308
3718	CC002	09:0940	Port 10
4702	Port 10	09:1038	MS
4742	MS	09:1040	CC290
4807	CC343	09:1124	CC291
5152	Port 10	09:1454	Abeam "4B"



**RUN 8**  
 TANKER: 31 K, 565 LOA  
 WIND: 5 KTS  
 CURRENT: FLOOD (0.2 KT AVG)

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1 dl

SHIP TRACKING REPORT

RUN CONDITION

(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT


(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): < 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

0 hours 02 minutes since slack FLOOD EBB (circle one) from tables

12 hours 01 minutes since sun RISE SET (circle one) from tables

SHIP DESCRIPTION

Type Bulk-Coal  
 Propulsion Diesel  
 Shaft horsepower 14,000 at 122 RPM  
 Length overall 682 (units) ft  
 Length between perpendiculars 646 (units) ft  
 Beam 105 (units) ft  
 Depth 58 (units) ft  
 Dead weight tonnage 50,864  
 Gross tonnage 29,148  
 Net tonnage 19,608  
 Design draft \_\_\_\_\_ (units) \_\_\_\_\_  
 Actual draft  29 FORWARD, 29 AFT (units) ft  
 Height of eye 72 (units) ft  
 Bridge to bow 552 (units) ft  
 Bridge to stern 130 (units) ft  
 Antenna to ship centerline 5 feet PORT STARBOARD (circle one)  
0 feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>25</u>	<u>3.2</u>
SLOW	<u>50</u>	<u>6.4</u>
HALF	<u>70</u>	<u>8.8</u>
FULL MANEUVERING	<u>95</u>	<u>12.1</u>
FULL NAVIGATION	<u>120</u>	<u>15.4</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, 106 RPM 23,892 DISPLACEMENT TONS  
750 ADVANCE, 260 TRANSFER (units) meters 2 minutes 15 seconds  
 Crash stop to dead in water, 1,952 DISTANCE (units) meters 9 minutes 20 seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



04:5000 at Bay Bridge mark  
Ship centerline 55 feet EAST WEST (circle one) of mark

04:5842 on green range  
— on red range  
— abeam Baltimore Light  
— abeam 7 Foot Knoll  
05:0942 abeam "4B"

IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>340</u>	05:2132	CC358
	RPM at start <u>100</u>	2312	CC000 Maneuvering for over-taking vessel
<u>05:0833</u>	abeam "1C" Traffic vessel astern overtaking	2519	CC358 Tug outbnd outside the channel won't effect O.S.
1831	Stbd 15	2802	Stbd 10
1853	Stbd 10	2810	CC000
1902	MS	3130	Abeam outbnd tug/barges to port side
1910	Port 10	3219	CC358
1932	MS	3440	Abeam container ship over-taking O.S. on port side
1940	Stbd 10	3446	MS
1950	MS	3500	Port 15
2050	Port 10		
2100	MS		
2126	Stbd 10		

Local Time	Event
05:3509	MS
3514	Stbd 10
3538	MS
3600	Stbd 10
3609	MS
3620	Port 10
3629	MS
3635	Stbd 10
3556	MS
3730	Stbd 15
3745	MS
3800	Port 10
3825	MS
3935	Stbd 10
3944	MS
4048	Stbd 10
4048	MS
4215	Stbd 10
4230	MS
4236	CC328
4348	CC326 Pilot tending to keep to stbd side of channel since being overtaken
5000	CC328
5243	CC330 Inbnd traffic crossing to stbd has to fall ahead of O.S.

Local Time	Event
05:5911	Port 10
5932	MS Abeam CG Cutter outside channel to port side
06:0038	Stbd 10
0104	MS
0111	CC310
0240	Port 10
0259	MS
0350	Stbd 10
0359	MS
0410	Port 10
0418	MS
0442	Stbd 10
0459	Stbd 15
0508	MS
0520	CC290
0845	CC292
0942	Abeam "4B"

TAPE IN ENVELOPE?

\* USCG initial \_\_\_\_\_

**NO TRAFFIC**

(Tracking error was caused  
by inability to initialize  
on raydist ranges at night)

↑  
INBOUND  
NIGHT RUN

**TRAFFIC**

RUN 9

BULKER: 51 K, 646 LOA

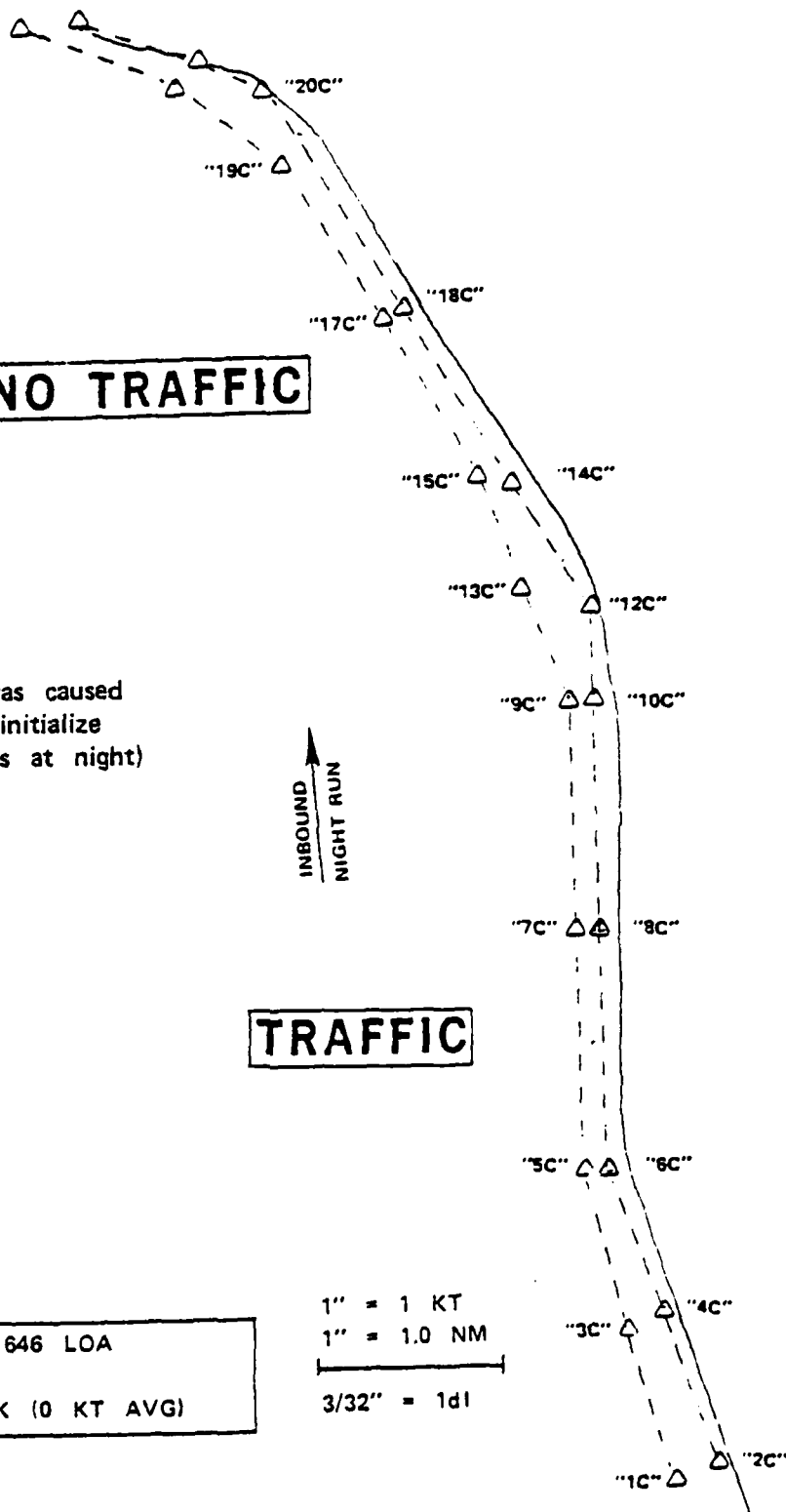
WIND: 5 KTS

CURRENT: SLACK (0 KT AVG)

1" = 1 KT

1" = 1.0 NM

3/32" = 1dl



SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON


INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

3 hours 00 minutes since slack FLOOD EBB (circle one) from tables  
1 hours 37 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulk-Coal</u>
Propulsion	<u>Diesel</u>
Shaft horsepower	<u>16,800</u> at _____ RPM
Length overall	<u>817</u> (units) <u>ft</u>
Length between perpendiculars	<u>793</u> (units) <u>ft</u>
Beam	<u>106</u> (units) <u>ft</u>
Depth	<u>64</u> (units) <u>ft</u>
Dead weight tonnage	<u>30,373</u>
Gross tonnage	<u>42,724</u>
Net tonnage	<u>30,918</u>
Design draft	_____ (units) _____
Actual draft	 <u>23</u> FORWARD, <u>23</u> AFT (units) <u>ft</u>
Height of eye	<u>92</u> (units) <u>ft</u>
Bridge to bow	<u>698</u> (units) <u>ft</u>
Bridge to stern	<u>120</u> (units) <u>ft</u>
Antenna to ship centerline	<u>15</u> feet <u>PORT</u> STARBOARD (circle one) <u>5</u> feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>35</u>	<u>5.3</u>
SLOW	<u>50</u>	<u>7.4</u>
HALF	<u>70</u>	<u>10.4</u>
FULL MANEUVERING	<u>90</u>	<u>13.4</u>
FULL NAVIGATION	<u>102</u>	<u>14.6</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data 47 MEAN DRAFT (units) ft, 102 RPM

.51 ADVANCE, .51 TRANSFER (units) nm, 6 minutes 35 seconds

Crash stop to dead in water, 1.6 DISTANCE (units) nm, 7 minutes 51 seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



08:5549 at Bay Bridge mark  
Ship centerline 50 feet EAST WEST (circle one) of mark

— on green range  
— on red range  
— abeam Baltimore Light  
— abeam 7 Foot Knoll

IF OUTBOUND



09:4244 abeam "4B"

Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>342</u>	0900	CC000
	RPM at start <u>95</u>	0910	Pilot estimates in centerline
<u>08:5546</u>	abeam "1C"	1739	Port 10
09:0215	Stbd 05	1818	Port 05
0226	Stbd 10	1838	MS
0240	Stbd 05	1914	Stbd 05
0344	MS	1938	Half ahead - slowing for tug/barge
0407	Port 05	1940	MS
0415	MS - Traffic vessel outbnd	2000	CC339
0530	Stbd 15	2202	Port 05
0618	Stbd 10	2257	MS - Moving right to pass outbnd tug/barge
0640	MS - Abeam Coal Carrier	2315	Stbd 05
0646	CC357	2328	Stbd 10
0804	CC358	2420	Full ahead
0840	CC359		



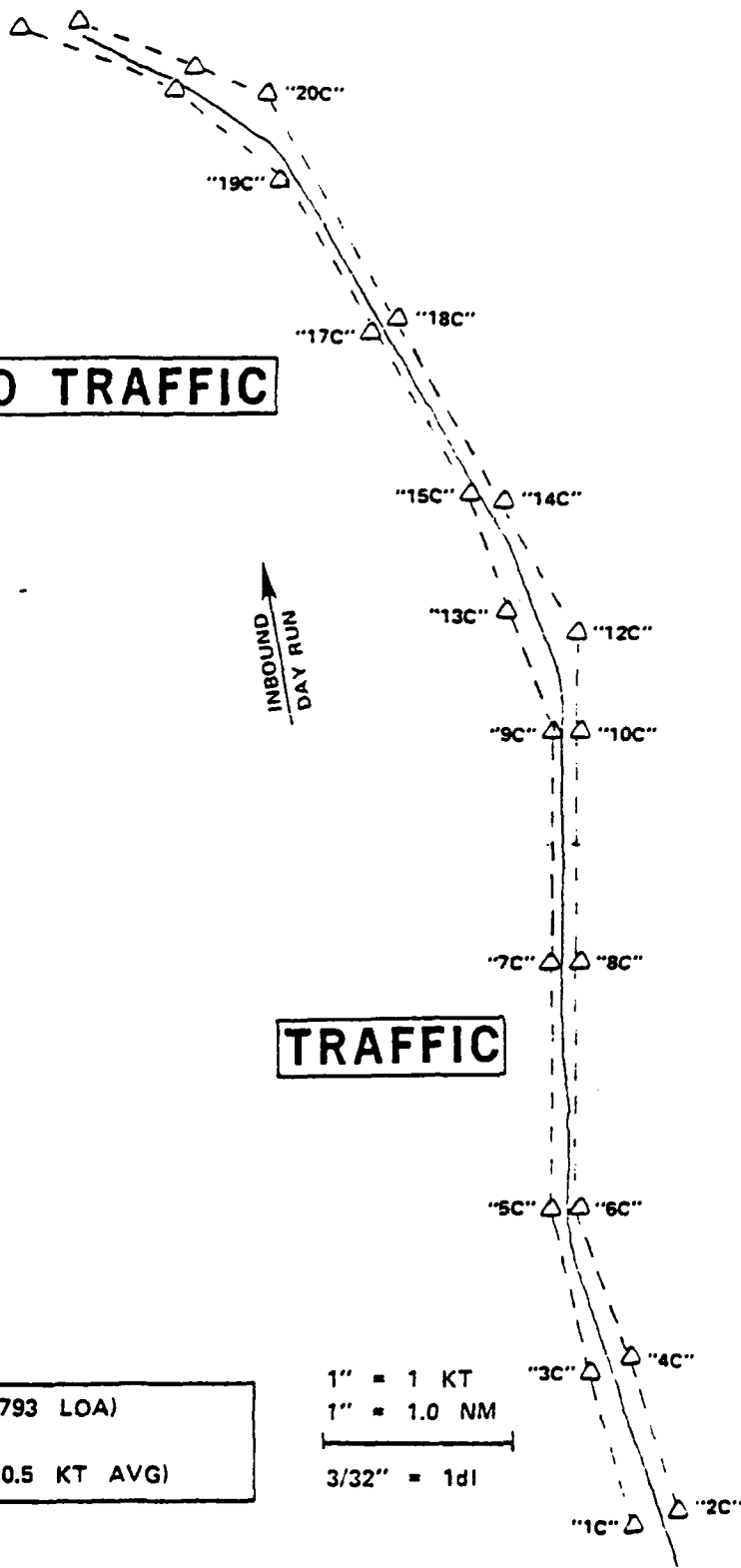
**NO TRAFFIC**

↑  
INBOUND  
DAY RUN

**TRAFFIC**

RUN 10  
BULKER: 30 K, 793 LOA)  
WIND: 5 KTS  
CURRENT: EBB (0.5 KT AVG)

1" = 1 KT  
1" = 1.0 NM  
3/32" = 1dl



SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): < 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

0 hours 26 minutes since slack FLOOD EBB (circle one) from tables  
12 hours 21 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Container</u>	
Propulsion	<u>Steam Turbine</u>	
Shaft horsepower	<u>18,500</u>	at _____ RPM
Length overall	<u>610</u>	(units) <u>ft</u>
Length between perpendiculars	_____	(units) _____
Beam	<u>78</u>	(units) <u>ft</u>
Depth	_____	(units) _____
Dead weight tonnage	<u>16,205</u>	
Gross tonnage	<u>17,902</u>	
Net tonnage	_____	
Design draft	<u>31</u>	(units) <u>ft</u>
Actual draft	<u>26</u>	FORWARD, _____ AFT (units) _____
Height of eye	<u>unknown</u>	(units) _____
Bridge to bow	<u>87</u>	(units) <u>ft</u>
Bridge to stern	<u>523</u>	(units) <u>ft</u>
Antenna to ship centerline	<u>5</u>	feet <u>PORT</u> STARBOARD (circle one)
	<u>0</u>	feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>10</u>	<u>2.6</u>
SLOW	<u>20</u>	<u>4.8</u>
HALF	<u>40</u>	<u>8.6</u>
FULL MANEUVERING	<u>60</u>	<u>10.4</u>
FULL NAVIGATION	_____	_____

Maneuvering data at full ahead, ballast condition and starboard turn

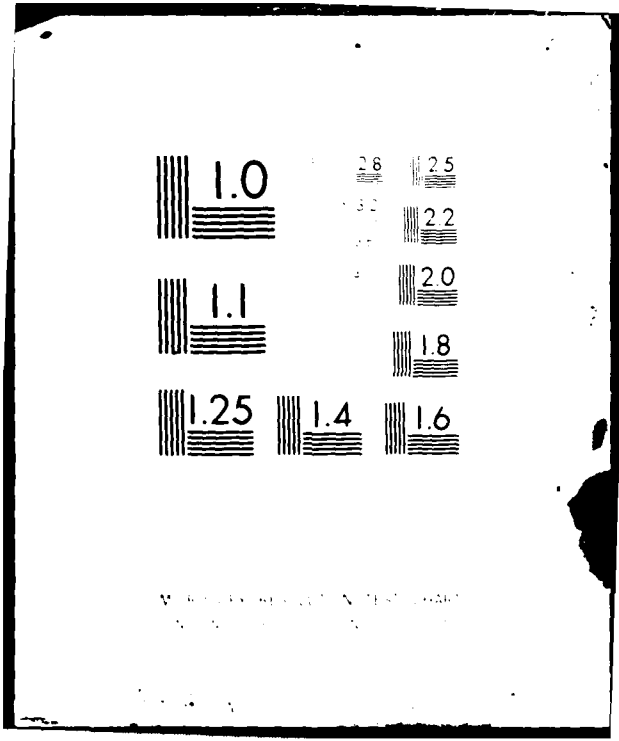
NOT NOTED

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

\_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds





1.0

2.8 2.5

3.2 2.2

1.1

2.0

1.8

1.25

1.4

1.6

Resolution Test Chart

TRANSIT EVENTS  
(local time)

IF INBOUND



05:0500 at Bay Bridge mark  
Ship centerline 20 feet EAST WEST (circle one) of mark

       on green range

       on red range

05:2400 abeam Baltimore Light

05:5000 abeam 7 Foot Knoll

IF OUTBOUND

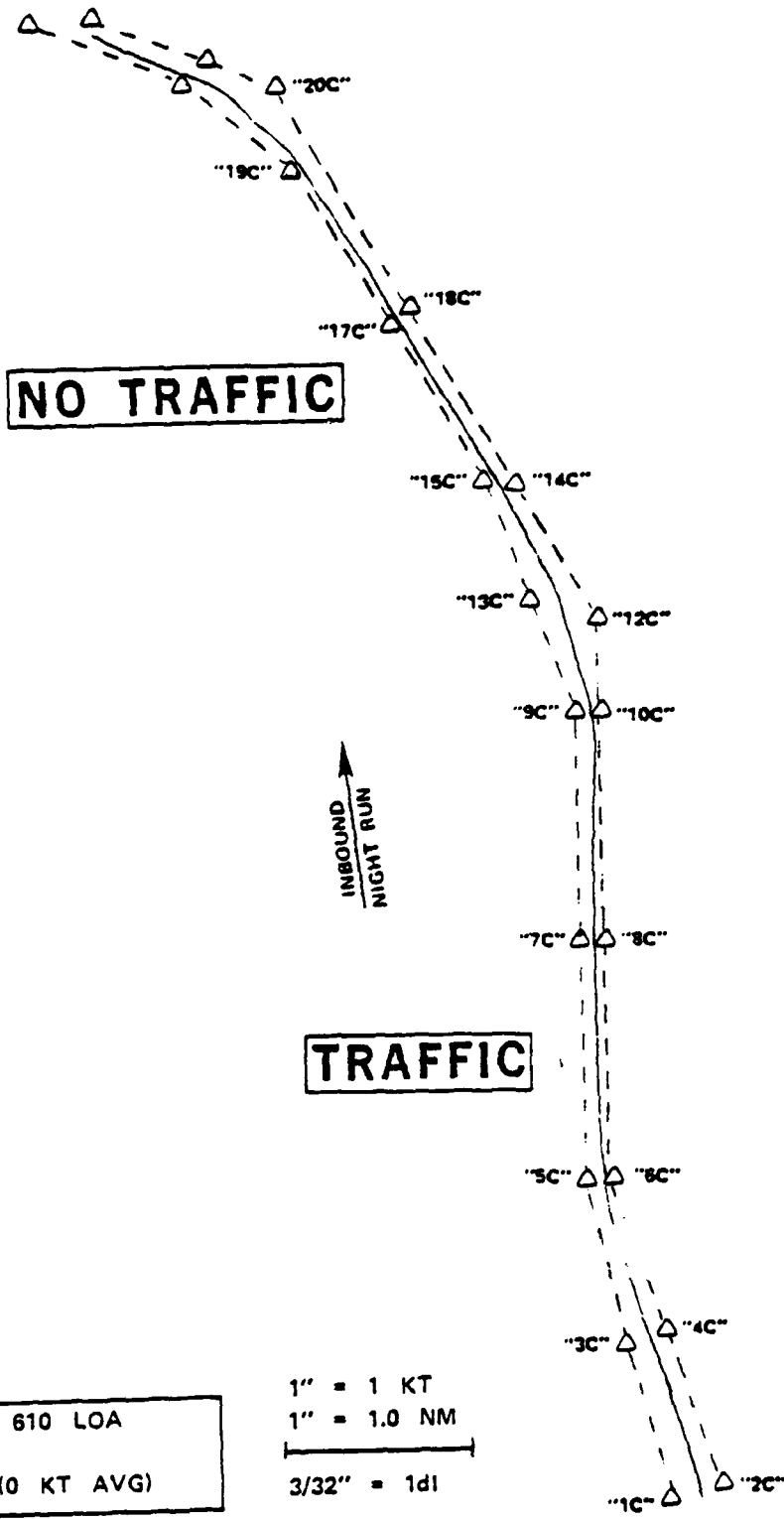


06:0400 abeam "4B"

Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>347</u>	05:3819	CC000
	RPM at start <u>60</u>	3910	MS
<u>05:1800</u>	abeam "1C"	3950	Abeam traffic ship
05:1910	CC345	4012	CC344
1956	CC342	4311	RL10
2306	CC344	4335	CC333
2546	RR10	4625	CC330
2607	RR05	4755	CC328
2620	MS	4954	CC330
2629	CC356	5317	CC328
2730	CC358	5704	RL10
2918	CC000	5727	CC312
3759	CC002	5947	RL10
	Keeping to right to pass outbnd traffic ship port side		





RUN 11  
 CONTAINER: 16 K, 610 LOA  
 WIND: 20 KTS  
 CURRENT: SLACK (0 KT AVG)

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON


INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

1 hours 29 minutes since slack FLOOD EBB (circle one) from tables  
6 hours 15 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulker</u>
Propulsion	<u>Diesel</u>
Shaft horsepower	<u>18,400</u> at <u>122</u> RPM
Length overall	<u>833.79</u> (units) <u>ft</u>
Length between perpendiculars	<u>800.52</u> (units) <u>ft</u>
Beam	<u>105.64</u> (units) <u>ft</u>
Depth	<u>57.74</u> (units) <u>ft</u>
Dead weight tonnage	<u>69,689</u> summer/67,816 winter
Gross tonnage	<u>35,723</u>
Net tonnage	<u>26,402</u>
Design draft	_____ (units) _____
Actual draft	 <u>9</u> FORWARD, <u>24</u> AFT (units) <u>ft</u>
Height of eye	<u>75</u> (units) <u>ft</u>
Bridge to bow	<u>685</u> (units) <u>ft</u>
Bridge to stern	<u>148</u> (units) <u>ft</u>
Antenna to ship centerline	<u>4</u> feet <u>PORT</u> STARBOARD (circle one)
	<u>0</u> feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>30</u>	<u>4.6</u>
SLOW	<u>45</u>	<u>7.6</u>
HALF	<u>65</u>	<u>9.4</u>
FULL MANEUVERING	<u>80</u>	<u>11.4</u>
FULL NAVIGATION	<u>122</u>	<u>16</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

875 ADVANCE, 450 TRANSFER (units) meters 2 minutes 2 seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



13:3416 at Bay Bridge mark  
Ship centerline 100 feet EAST WEST (circle one) of mark

13:3900 on green range

13:4100 on red range

13:5300 abeam Baltimore Light

14:2000 abeam 7 Foot Knoll

IF OUTBOUND



           abeam "4B"

Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>344</u>	14:0925	MS
	RPM at start <u>90</u>	1005	Stbd 10
	abeam "1C"	1022	MS
13:5425	Stbd 10	1030	Stdy 342
5525	MS	1330	Port 10
5535	Stbd 10	1406	MS
5604	MS - Aligned to Stbd side of channel	1414	Stbd 10
5653	Stbd 05	1453	MS
5703	MS	1500	Stdy 330
5711	Stdy 004	1714	Stdy 331
5720	MS	1902	Stdy 332
14:0000	Passing Car carrier	2540	Port 10
0030	Stdy 001 crossing to C <sub>L</sub>	2640	MS
0435	Port 10	2708	Stbd 10

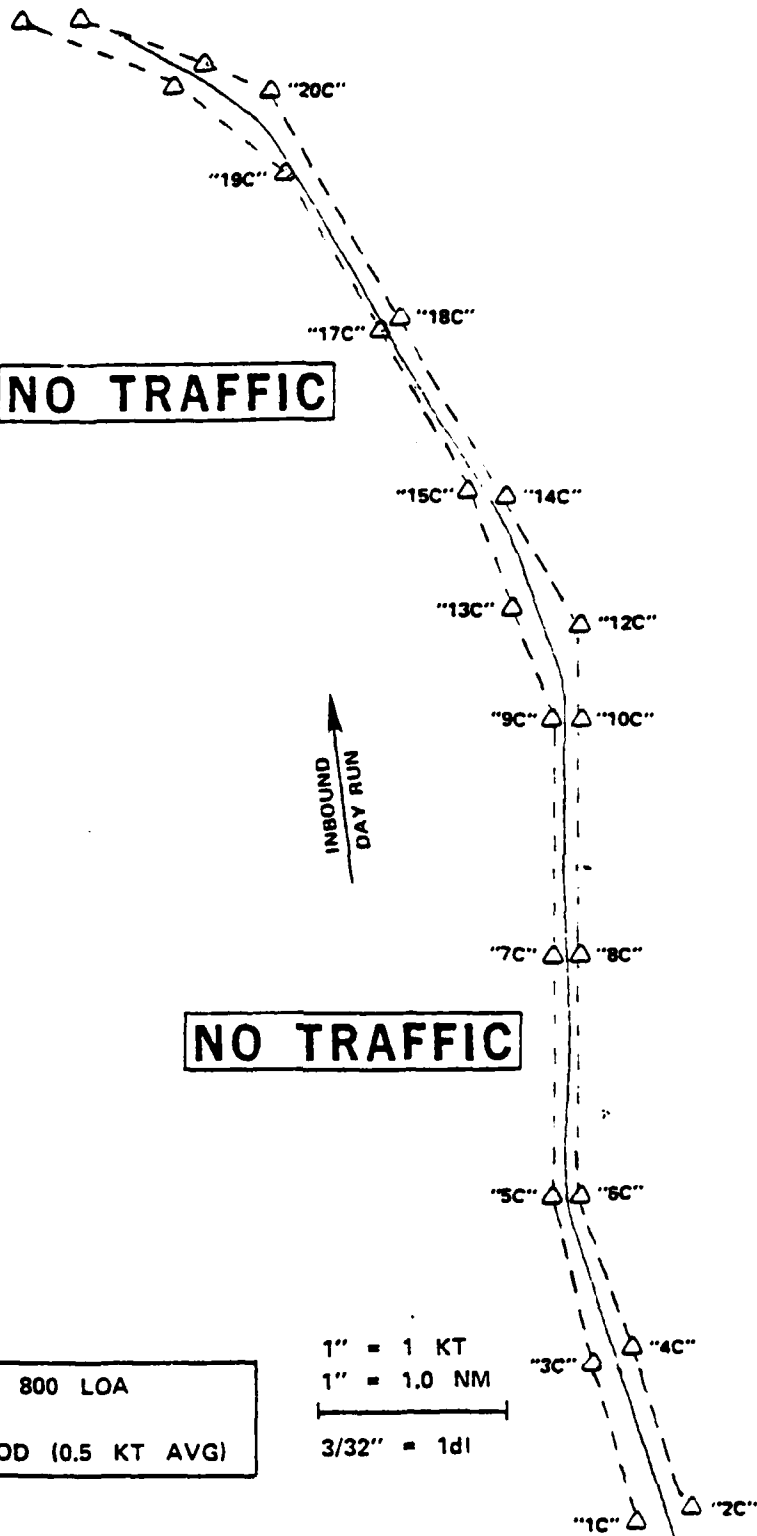


**NO TRAFFIC**

**NO TRAFFIC**

**RUN 12**  
**BULKER: 70 K, 800 LOA**  
**WIND: 5 KTS**  
**CURRENT: FLOOD (0.5 KT AVG)**

1" = 1 KT  
1" = 1.0 NM  
3/32" = 1d



SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: (INBOUND) OUTBOUND  
 Time: (DAY) NIGHT  
 Method: (VISUAL) RADAR PATH RACON


INITIAL ENVIRONMENT  
(circle one)

Weather: (STABLE) IMPROVING DETERIORATING  
 Sky: (CLEAR) PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: (NONE) DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm (3 nm) 5 nm  
 Sun-moon brilliance: BRIGHT-FULL (HAZY) QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD (AFT) PORT /STARBOARD  
 Air temperature (F): 30 30-50 (51-70) 70  
 Sea temperature (F): 30 (30-50) 51-70 70  
 True wind direction: N NE E SE (S) SW W NW  
 True wind speed: 3 (3-10) 11-20 21-30 30  
 Sea state: (CALM) SLIGHT SMALL MEDIUM LARGE

4 hours 36 minutes since slack FLOOD (EBB) (circle one) from tables

4 hours 06 minutes since sun (RISE) SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulker</u>
Propulsion	<u>Diesel</u>
Shaft horsepower	_____ at _____ RPM
Length overall	<u>800</u> (units) <u>ft</u>
Length between perpendiculars	<u>786</u> (units) <u>ft</u>
Beam	<u>106</u> (units) <u>ft</u>
Depth	<u>60</u> (units) <u>ft</u>
Dead weight tonnage	<u>68,785</u>
Gross tonnage	<u>35,625</u>
Net tonnage	<u>29,947</u>
Design draft	<u>41 ft 5 in</u> (units) _____
Actual draft	 <u>23</u> FORWARD, <u>29</u> AFT (units) <u>ft</u>
Height of eye	_____ (units) _____
Bridge to bow	_____ (units) _____
Bridge to stern	_____ (units) _____
Antenna to ship centerline	_____ feet PORT STARBOARD (circle one)
	_____ feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>40</u>	<u>4.69</u>
SLOW	<u>50</u>	<u>6.08</u>
HALF	<u>60</u>	<u>7.39</u>
FULL MANEUVERING	<u>85</u>	<u>11.14</u>
FULL NAVIGATION	_____	_____

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

1200 ADVANCE, \_\_\_\_\_ TRANSFER (units) nm, 5 minutes \_\_\_\_\_ seconds

Crash stop to dead in water, 3200 DISTANCE (units) nm, 13 minutes \_\_\_\_\_ seconds

TRANSIT EVENTS

(local time)

IF INBOUND



\_\_\_\_\_ at Bay Bridge mark  
Ship centerline 100 feet EAST WEST (circle one) of mark

11:2135 on green range

11:2410 on red range

11:3936 abeam Baltimore Light

12:1153 abeam 7 Foot Knoll

12:2729 abeam "4B"

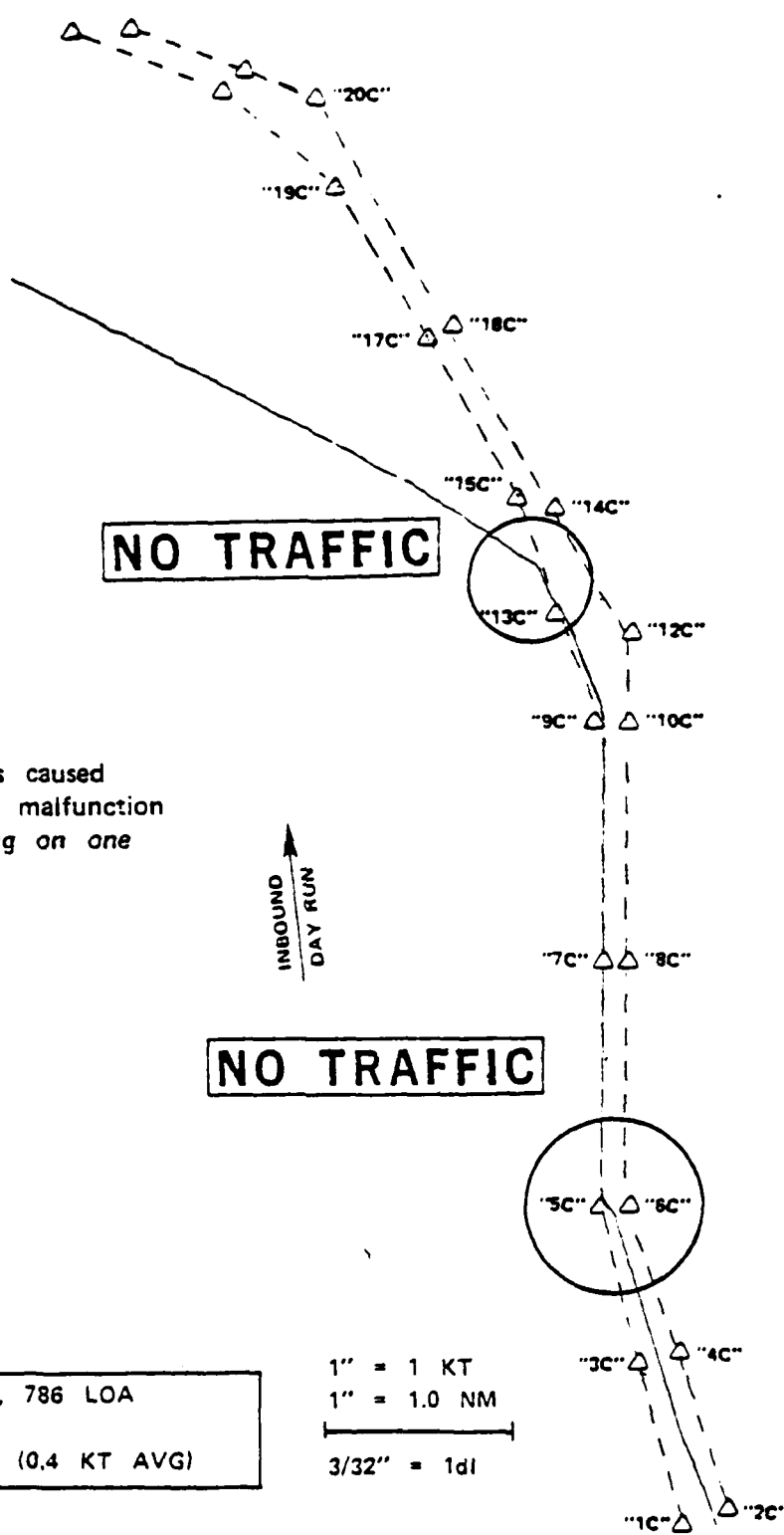
IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>337</u>	11:5840	Port 05
	RPM at start <u>85</u>	5850	MS
<u>11:3156</u>	abeam "1C"	5982	Stbd 20
11:3400	Stbd 10 Stdy 341 - Should be close to CL	5925	Stbd 10
3500	Stdy 342	5930	Stbd 05
4050	Stbd 15	5939	Stbd 10
4120	Stbd 05	5947	Stbd 20
4129	MS	12:0002	Stdy 337
4205	Port 20	0527	Port 10
4223	MS	0555	Port 05
4235	Stbd 10	0602	MS
4245	MS	0620	Stbd 20
4256	Port 10	0630	Hard stbd
4304	MS	0640	MS
4310	Stdy 359	0648	Port 15





(Tracking error was caused by raydist printer malfunction or loss of tracking on one L.O.P)

**NO TRAFFIC**

**NO TRAFFIC**

RUN 13  
 BULKER: 69 K, 786 LOA  
 WIND: 5 KTS  
 CURRENT: EBB (0.4 KT AVG)

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1dl

SHIP TRACKING REPORT

RUN CONDITION

(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT

(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

3 hours 20 minutes since slack FLOOD EBB (circle one) from tables

0 hours 29 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulker</u>	
Propulsion	<u>                    </u>	
Shaft horsepower	<u>23,300</u>	at <u>114</u> RPM
Length overall	<u>865</u>	(units) <u>ft</u>
Length between perpendiculars	<u>823</u>	(units) <u>ft</u>
Beam	<u>133</u>	(units) <u>ft</u>
Depth	<u>71</u>	(units) <u>ft</u>
Dead weight tonnage	<u>116,190</u>	
Gross tonnage	<u>53,520</u>	
Net tonnage	<u>41,798</u>	
Design draft	<u>                    </u>	(units) <u>                    </u>
Actual draft	<u>22</u>	FORWARD, <u>26</u> AFT (units) <u>ft</u>
Height of eye	<u>111</u>	(units) <u>ft</u>
Bridge to bow	<u>717</u>	(units) <u>ft</u>
Bridge to stern	<u>148</u>	(units) <u>ft</u>
Antenna to ship centerline	<u>21</u>	feet <u>PORT</u> STARBOARD (circle one)
	<u>21</u>	feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>30/40</u>	<u>4.3/5.8</u>
SLOW	<u>50/60</u>	<u>7.2/8.7</u>
HALF	<u>70/80/90</u>	<u>10.1/11.8/12.0</u>
FULL MANEUVERING	<u>                    </u>	<u>                    </u>
FULL NAVIGATION	<u>                    </u>	<u>                    </u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data            MEAN DRAFT (units)           ,            RPM

910 ADVANCE, 1000 TRANSFER (units) nm, 3 minutes            seconds

Crash stop to dead in water,                      DISTANCE (units)           ,            minutes            seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



— at Bay Bridge mark  
Ship centerline 0 feet EAST WEST (circle one) of mark

17:0441 on green range

17:0650 on red range

17:1810 abeam Baltimore Light

17:4255 abeam 7 Foot Knoll

— abeam "4B"

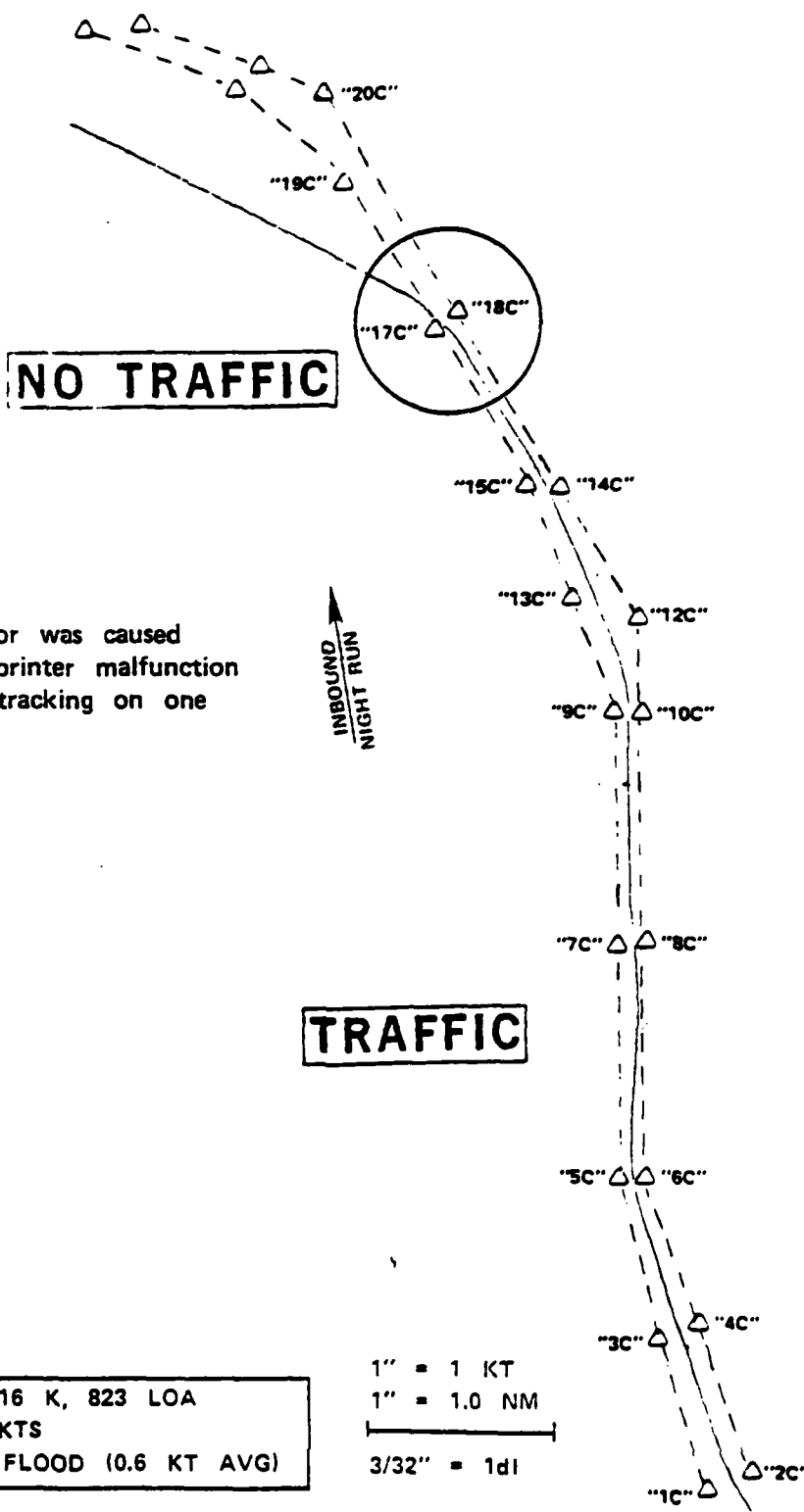
IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>342</u>	17:2400	Stbd 10
	RPM at start <u>95</u>	2430	MS
<u>17:1300</u>	abeam "1C"	2440	Stbd 10
17:1643	Stdy 343	2500	Passing traffic ship
1813	Stbd 10	2505	Stbd 05
1910	MS	2525	MS
2050	Port 15	2550	Stbd 10
2105	MS	2700	MS
2112	Stdy 004	2720	Stbd 10
2150	Stdy 005	2735	MS
2230	Port 15	2740	Port 15
2248	MS	2758	MS
2256	Stbd 10	2835	Stdy 001
2305	MS	3200	Port 10
2335	Stbd 10 - 1 Whistle	3245	MS
2350	MS	3253	Stbd 15





**NO TRAFFIC**

(Tracking error was caused  
by raydist printer malfunction  
or loss of tracking on one  
L.O.P)

**TRAFFIC**

RUN 14  
 BULKER: 116 K, 823 LOA  
 WIND: 15 KTS  
 CURRENT: FLOOD (0.6 KT AVG)

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1dl

SHIP TRACKING REPORT

RUN CONDITION

(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT


(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

2 hours 54 minutes since slack FLOOD EBB (circle one) from tables  
0 hours 33 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulker</u>
Propulsion	<u>Diesel</u>
Shaft horsepower	<u>12000</u> at <u>105</u> RPM
Length overall	<u>718</u> (units) <u>ft</u>
Length between perpendiculars	<u>680</u> (units) <u>ft</u>
Beam	<u>90</u> (units) <u>ft</u>
Depth	<u>52</u> (units) <u>ft</u>
Dead weight tonnage	<u>44,000</u>
Gross tonnage	<u>27,000</u>
Net tonnage	<u>18,800</u>
Design draft	<u>39</u> (units) <u>ft</u>
Actual draft	 <u>16"</u> FORWARD, <u>20'6"</u> AFT (units) <u>ft</u>
Height of eye	<u>72</u> (units) <u>ft</u>
Bridge to bow	<u>588</u> (units) <u>ft</u>
Bridge to stern	<u>120</u> (units) <u>ft</u>
Antenna to ship centerline	<u>5</u> feet <u>PORT</u> STARBOARD (circle one) <u>0</u> feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>32</u>	<u>4.2</u>
SLOW	<u>55</u>	<u>7.7</u>
HALF	<u>75</u>	<u>12.5</u>
FULL MANEUVERING	<u>85</u>	<u>13.3</u>
FULL NAVIGATION	<u>112</u>	<u>14.6</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data        MEAN DRAFT (units)       ,        RPM

.46 ADVANCE, .35 TRANSFER (units) nm, 4 minutes 8 seconds

Crash stop to dead in water, .708 DISTANCE (units) nm, 5 minutes 22 seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



07:5700 at Bay Bridge mark  
Ship centerline 10 feet EAST WEST (circle one) of mar

08:0332 on green range

08:0548 on red range

08:2126 abeam Baltimore Light

08:5458 abeam 7 Foot Knoll

IF OUTBOUND



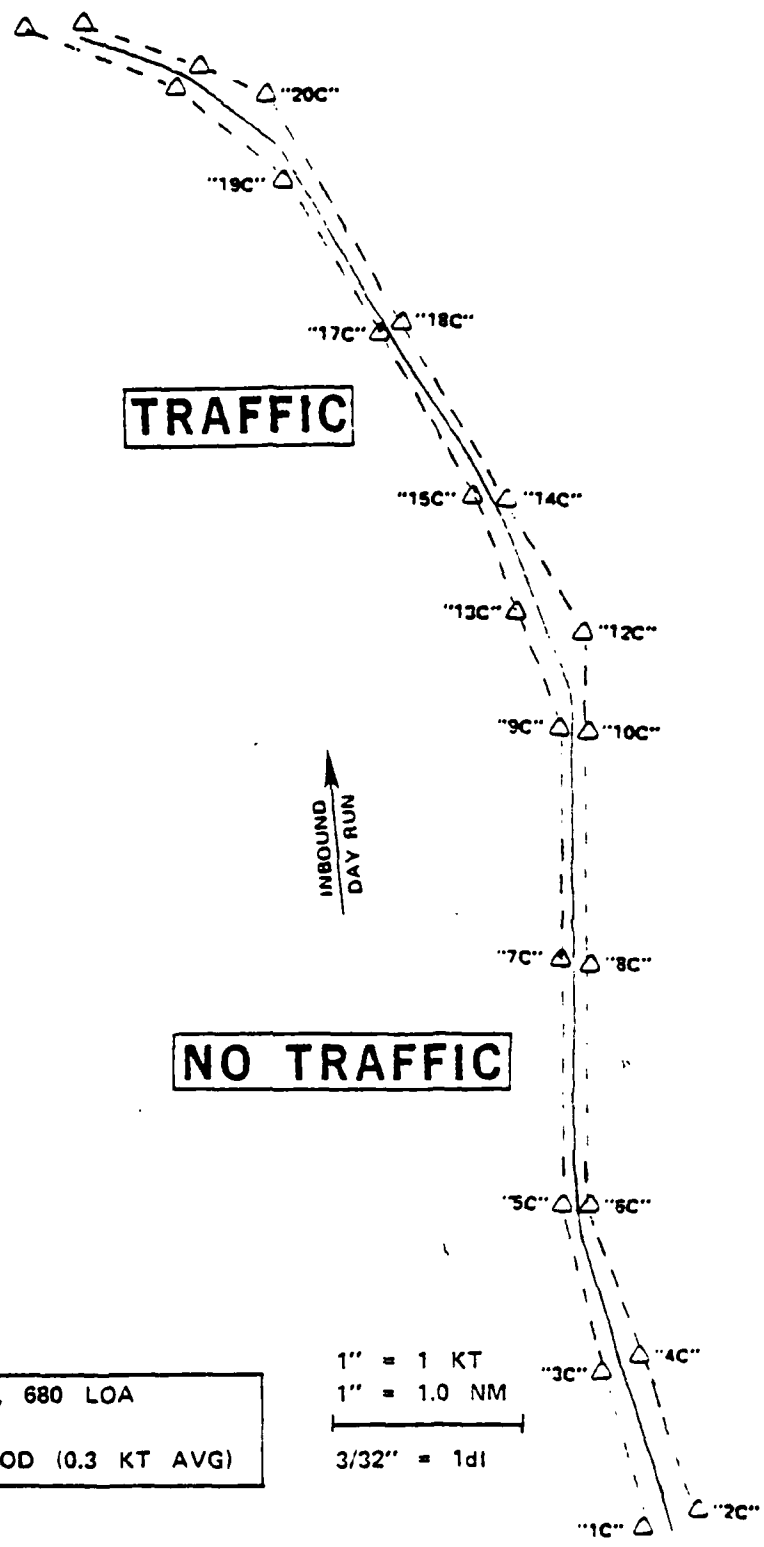
-- abeam "4B"

Aids to navigation discrepancies (use attached chart):

Local Time	Event
	Course at start <u>348</u>
	RPM at start <u>95</u>
<u>08:1324</u>	abeam "IC"
1400	CC346
2250	RR15
2310	RR10
2320	RR05
2340	MS
2405	RL10
2415	MS
2440	RL05
2455	RL05
2500	MS
2530	CC001
2536	CC002
2624	CC001

Local Time	Event
08:2700	CC002
3035	CC001
3559	CC002
3600	"Helmsman, steer on leading light"
4050	RL10
4143	RL05
4159	MS
4216	RR10
4228	RR15
4240	MS
4249	CC340
4717	RL10
4740	RL05
4743	MS





RUN 15  
 BULKER: 44 K, 680 LOA  
 WIND: 15 KTS  
 CURRENT: FLOOD (0.3 KT AVG)

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1dl

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON


INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

0 hours 18 minutes since slack FLOOD EBB (circle one) from tables  
8 hours 11 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulker</u>
Propulsion	<u>Diesel</u>
Shaft horsepower	<u>8000</u> at <u>150</u> RPM
Length overall	<u>506'10"</u> (units) _____
Length between perpendiculars	<u>481'</u> (units) _____
Beam	<u>67'8"</u> (units) _____
Depth	<u>38'7"</u> (units) _____
Dead weight tonnage	<u>18,526</u>
Gross tonnage	<u>10,209</u>
Net tonnage	<u>6,340</u>
Design draft	<u>30'8"</u> (units) _____
Actual draft	 <u>24</u> FORWARD, <u>21</u> AFT (units) <u>ft</u>
Height of eye	<u>70</u> (units) <u>ft</u>
Bridge to bow	<u>380'7"</u> (units) _____
Bridge to stern	<u>126'3"</u> (units) _____
Antenna to ship centerline	<u>2</u> feet <u>PORT</u> STARBOARD (circle one)
	<u>0</u> feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>55</u>	<u>6.0</u>
SLOW	<u>60</u>	<u>6.5</u>
HALF	<u>70</u>	<u>8.0</u>
FULL MANEUVERING	<u>100</u>	<u>11.0</u>
FULL NAVIGATION	<u>128</u>	<u>13.8</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

.27 ADVANCE, .23 TRANSFER (units) nm, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



\_\_\_\_\_ at Bay Bridge mark  
Ship centerline \_\_\_\_\_ feet EAST WEST (circle one) of mark

\_\_\_\_\_ on green range

\_\_\_\_\_ on red range

16:1915 abeam Baltimore Light

15:5006 abeam 7 Foot Knoll

IF OUTBOUND



15:3528 abeam "4B"

Aids to navigation discrepancies (use attached chart):

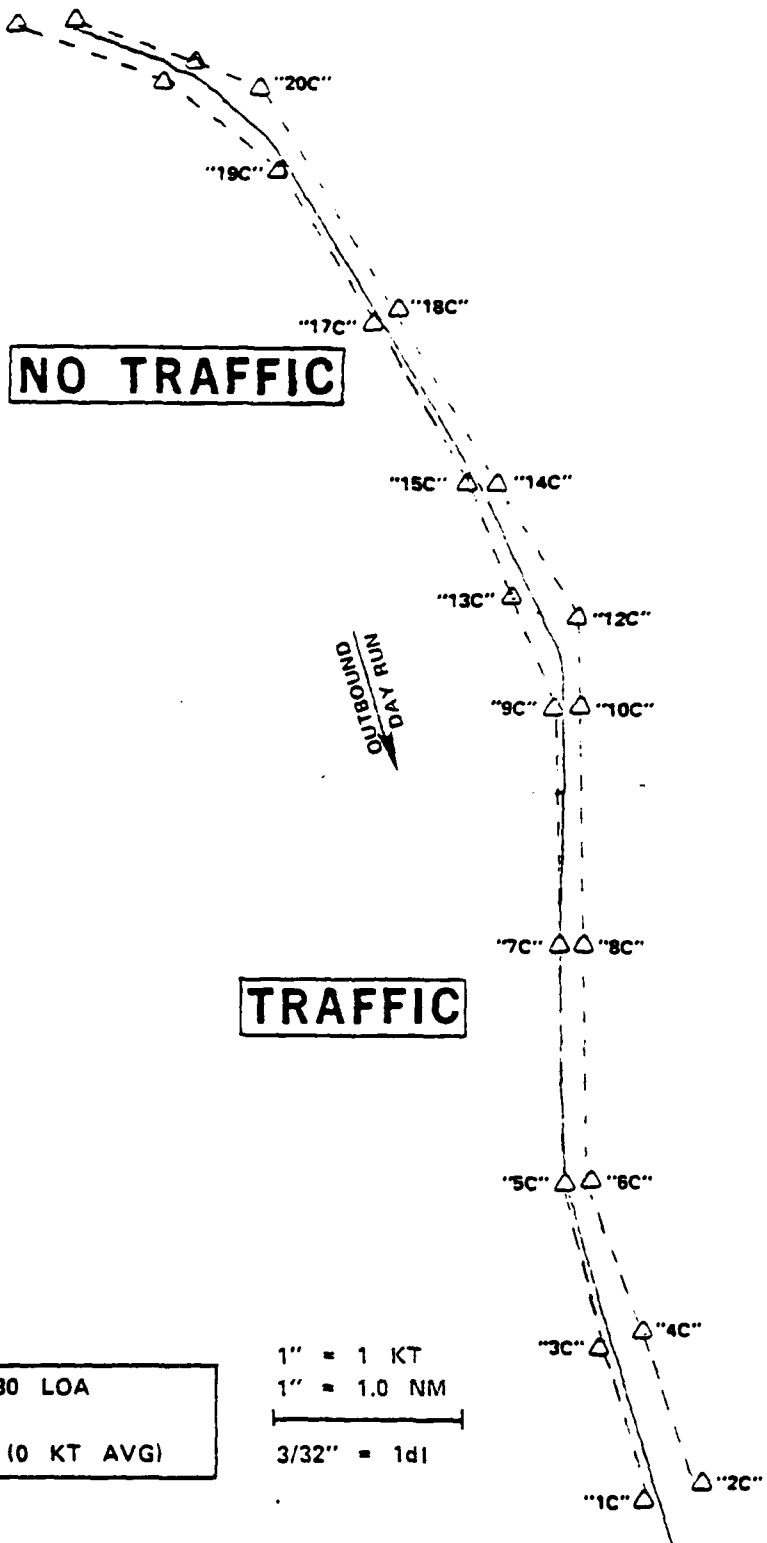
Local Time	Event	Local Time	Event
	Course at start <u>112</u>	15:4735	CC151
	RPM at start <u>95</u>	5020	CC150
<u>15:35+</u>	abeam "4B"	5145	CC151
15:3616	CC111	5419	Stbd 15
3830	Stbd 15	5435	MS
3915	MS	5446	CC156
3932	Port 10	5929	Stbd 15
3954	MS	5935	Stbd 20
4000	CC133	16:0013	MS
4137	Stbd 15	0021	Port 15
4155	Stbd 10	0038	MS
4218	MS	0050	CC180
4255	Port 10	0202	Radioed to traffic Altered course to Stbd
4309	MS	0405	CC181
4315	CC150	0806	CC180
4422	CC149	0903	CC179
4512	CC150		

Local Time	Event
16:1231	RL05
1238	Traffic abeam
1245	MS
1252	RR10
1303	MS
1310	CC176
1426	Radioed to traffic
1518	Port 10
1553	MS
1619	Stbd 10
1646	MS
1810	CC162
2108	CC161
2858	Traffic ship seen on radar beyond bridge
3224	Stbd 15
3246	Radioed traffic ship beyond bridge
3332	MS
3408	Port 15
3412	MS
3420	CC194
3506	CC193
3706	CC194

Local Time	Event
16:3910	CC195
	Under bridge
4014	Stbd 10
4028	Stbd 05

TAPE IN ENVELOPE?

\* USCG initial \_\_\_\_\_



RUN 16  
 BULKER: 44 K, 680 LOA  
 WIND: 15 KTS  
 CURRENT: SLACK (0 KT AVG)

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: < 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

4 hours 15 minutes since slack FLOOD EBB (circle one) from tables  
7 hours 41 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Tanker</u>
Propulsion	<u>Diesel</u>
Shaft horsepower	<u>12,000</u> at <u>122</u> RPM
Length overall	<u>170.624</u> (units) <u>meters</u>
Length between perpendiculars	<u>161.936</u> (units) <u>meters</u>
Beam	<u>26.024</u> (units) <u>meters</u>
Depth	<u>14.445</u> (units) <u>meters</u>
Dead weight tonnage	<u>31,944</u>
Gross tonnage	<u>18,203</u>
Net tonnage	<u>12,332</u>
Design draft	<u>36'11"</u> (units) _____
Actual draft	<u>33</u> FORWARD, <u>33</u> AFT (units) <u>ft</u>
Height of eye	<u>100</u> (units) <u>ft</u>
Bridge to bow	<u>420</u> (units) <u>ft</u>
Bridge to stern	<u>136</u> (units) <u>ft</u>
Antenna to ship centerline	<u>15</u> feet <u>PORT</u> STARBOARD (circle one)
	<u>0</u> feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>35</u>	<u>4.81</u>
SLOW	<u>45</u>	<u>6.18</u>
HALF	<u>60</u>	<u>8.24</u>
FULL MANEUVERING	<u>90</u>	<u>12.37</u>
FULL NAVIGATION	<u>125</u>	<u>16.76</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data 8.3 MEAN DRAFT (units) meters, 106 RPM

394 ADVANCE, 258 TRANSFER (units) meters 1 minutes 23 seconds

Crash stop to dead in water, .45 DISTANCE (units) nm, 3 minutes 35 seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



15:0115 at Bay Bridge mark  
Ship centerline \_\_\_\_\_ feet EAST WEST (circle one) of mark

15:0732 on green range

15:0950 on red range

15:2330 abeam Baltimore Light

15:5408 abeam 7 Foot Knoll

IF OUTBOUND



16:0850 abeam "4B"

Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>345</u>	15:4612	CC335
	RPM at start <u>90</u>	4942	Port 10
<u>15:1600</u>	abeam "1C"	4945	CC330
16:0003	CC340 Stbd 10 pilot is Greek hard to understand	16:0105	Port 10
2523	MS	0108	MS
2614	CC000	0141	Stbd 10
2641	Steady 000	0215	MS
2731	CC001 1/2 degree gyro error	0609	CC292
3703	CC000 - Overtaking tug/barge		
3929	Half ahead passing tug/barge		
4111	Port 10		
4116	MS		
4218	Stbd 20		
4329	CC340		
4343	Full ahead		

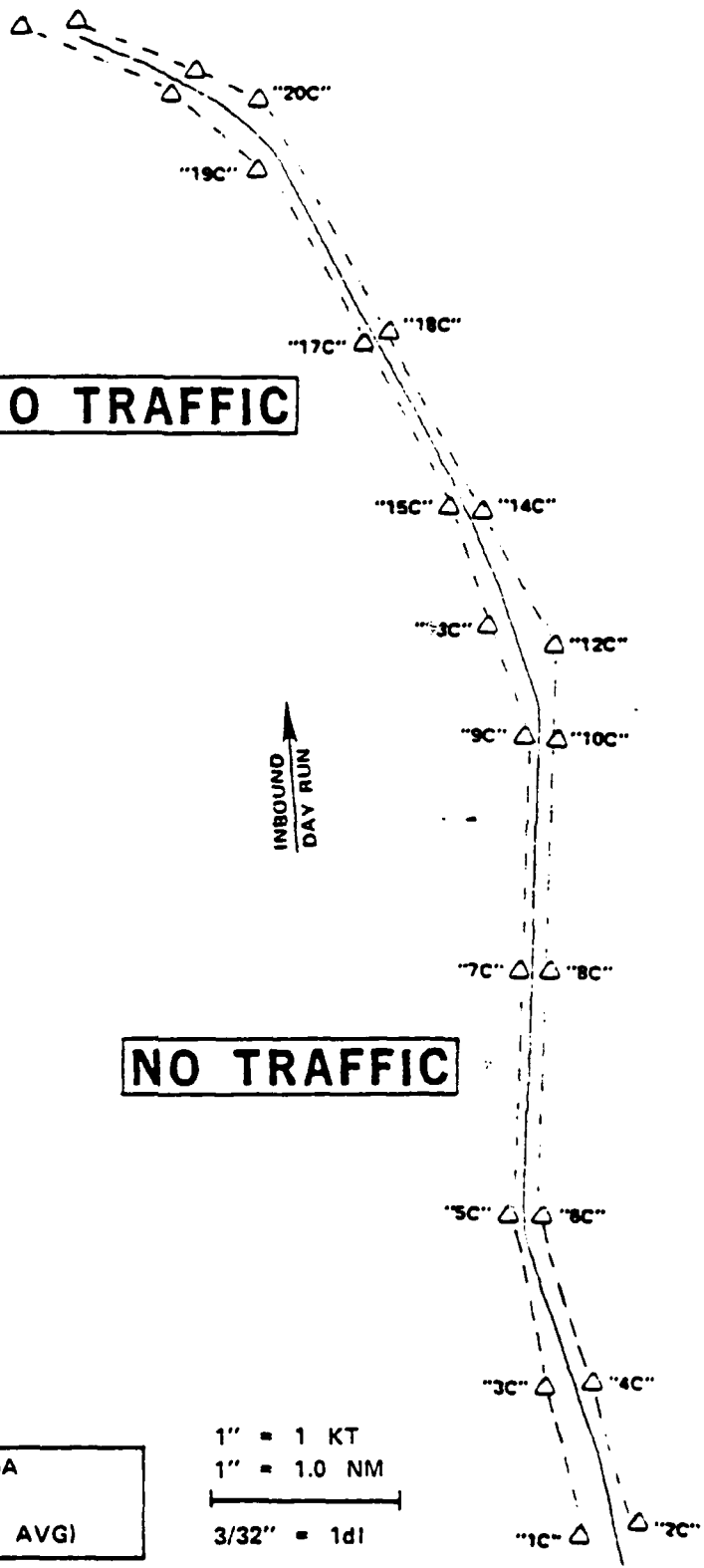
**NO TRAFFIC**

**NO TRAFFIC**

↑  
INBOUND  
DAY RUN

RUN 17  
TANKER: 32 K, 530 LOA  
WIND: 0 KTS  
CURRENT: EBB (0.2 KT AVG)

1" = 1 KT  
1" = 1.0 NM  
3/32" = 1dl



SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON


INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

0 hours 32 minutes since slack FLOOD EBB (circle one) from tables  
5 hours 03 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Coal-Bulker</u>		
Propulsion	<u>Turbine</u>		
Shaft horsepower	<u>17,500</u>	at <u>110</u>	RPM
Length overall	<u>789.6</u>	(units)	<u>ft</u>
Length between perpendiculars	<u>844.1</u>	(units)	<u>ft</u>
Beam	<u>104</u>	(units)	<u>ft</u>
Depth	<u>57</u>	(units)	<u>ft</u>
Dead weight tonnage	<u>59,780</u>		
Gross tonnage	<u>33,290</u>		
Net tonnage	<u>21,914</u>		
Design draft	<u>42</u>	(units)	<u>ft</u>
Actual draft	 <u>12.6</u>	FORWARD, <u>23.6</u>	AFT (units) <u>ft</u>
Height of eye	<u>75</u>	(units)	<u>ft</u>
Bridge to bow	<u>200</u>	(units)	<u>ft</u>
Bridge to stern	<u>48</u>	(units)	<u>ft</u>
Antenna to ship centerline	<u>0</u>	feet PORT STARBOARD	(circle one)
	<u>3</u>	feet AFT of bridge bulkhead	

	(rpm)	(knots)
DEAD SLOW	<u>20</u>	<u>3.3</u>
SLOW	<u>35</u>	<u>5.8</u>
HALF	<u>50</u>	<u>8.3</u>
FULL MANEUVERING	<u>70</u>	<u>11.6</u>
FULL NAVIGATION	<u>      </u>	<u>      </u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data        MEAN DRAFT (units)       ,        RPM

       ADVANCE,        TRANSFER (units)       ,        minutes        seconds

Crash stop to dead in water, 1.207 DISTANCE (units) meters, 8 minutes 26 seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



12:5820 at Bay Bridge mark  
Ship centerline 0 feet EAST WEST (circle one) of mark

13:0357 on green range

13:0548 on red range

— abeam Baltimore Light

13:4614 abeam 7 Foot Knoll

— abeam "4B"

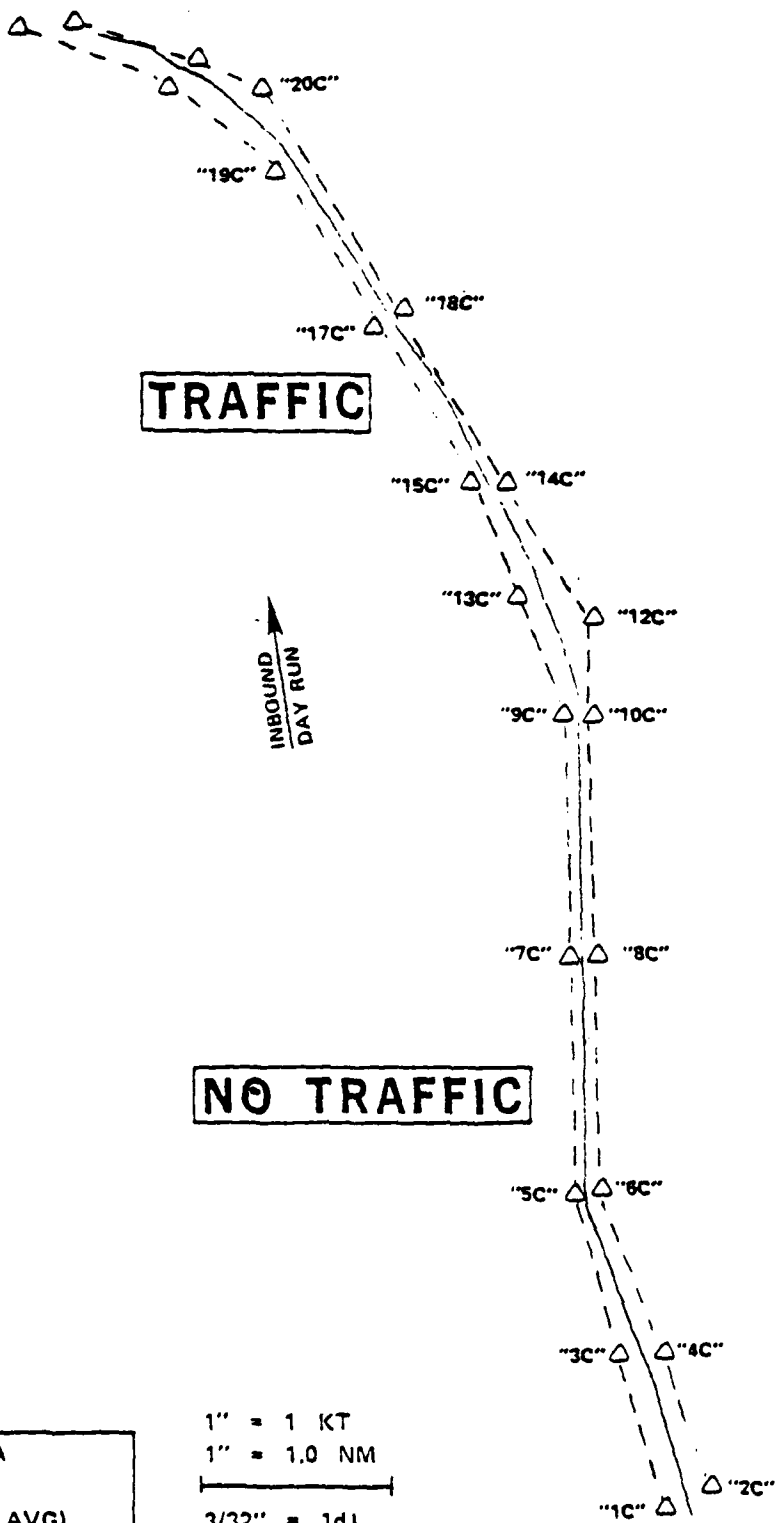
IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>346</u>	13:3515	Port 15
	RPM at start <u>70</u>	3552	Ease to Port 10
<u>13:1222</u>	abeam "1C"	3608	MS
	Moving to right on visual will move to left before turn No traffic	3615	Stbd 10
13:1448	CC342	3635	MS
1600	Pilot using radar	3643	CC342
2005	Stbd 10	3759	CC340
2051	MS	4005	CC338
2111	Port 15	4010	CC337
2130	MS	4058	CC335
2140	Port 10	4152	CC333
2155	CC003	4226	Changed to 1½ mile scale on radar to match traffic
2319	CC002	4242	CC335
2645	CC001	4323	CC336
2940	CC002	4459	½ mile scale on radar





RUN 18  
 BULKER: 60 K, 744 LOA  
 WIND: 15 KTS  
 CURRENT: EBB (0.2 KT AVG)

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1d1

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

5 hours 05 minutes since slack FLOOD EBB (circle one) from tables

6 hours 28 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>Bulk-Coal</u>	
Propulsion	<u>Diesel</u>	
Shaft horsepower	_____	at _____ RPM
Length overall	<u>737</u>	(units) <u>ft</u>
Length between perpendiculars	<u>705</u>	(units) <u>ft</u>
Beam	<u>106</u>	(units) <u>ft</u>
Depth	<u>58</u>	(units) <u>ft</u>
Dead weight tonnage	<u>61,745</u>	
Gross tonnage	<u>35,800</u>	
Net tonnage	<u>31,270</u>	
Design draft	<u>41</u>	(units) <u>ft</u>
Actual draft	<u>19</u>	FORWARD, <u>24</u> AFT (units) <u>ft</u>
Height of eye	<u>90</u>	(units) <u>ft</u>
Bridge to bow	<u>611</u>	(units) <u>ft</u>
Bridge to stern	<u>125</u>	(units) <u>ft</u>
Antenna to ship centerline	<u>0</u>	feet PORT STARBOARD (circle one)
	<u>0</u>	feet AFT of bridge bulkhead

	(rpm)	(knots)	
DEAD SLOW	_____	_____	
SLOW	_____	_____	
HALF	_____	_____	NOT NOTED
FULL MANEUVERING	_____	_____	
FULL NAVIGATION	_____	_____	

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

NOT NOTED \_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



13:4300 at Bay Bridge mark  
Ship centerline 0 feet EAST WEST (circle one) of mark

     on green range

     on red range

     abeam Baltimore Light

     abeam 7 Foot Knoll

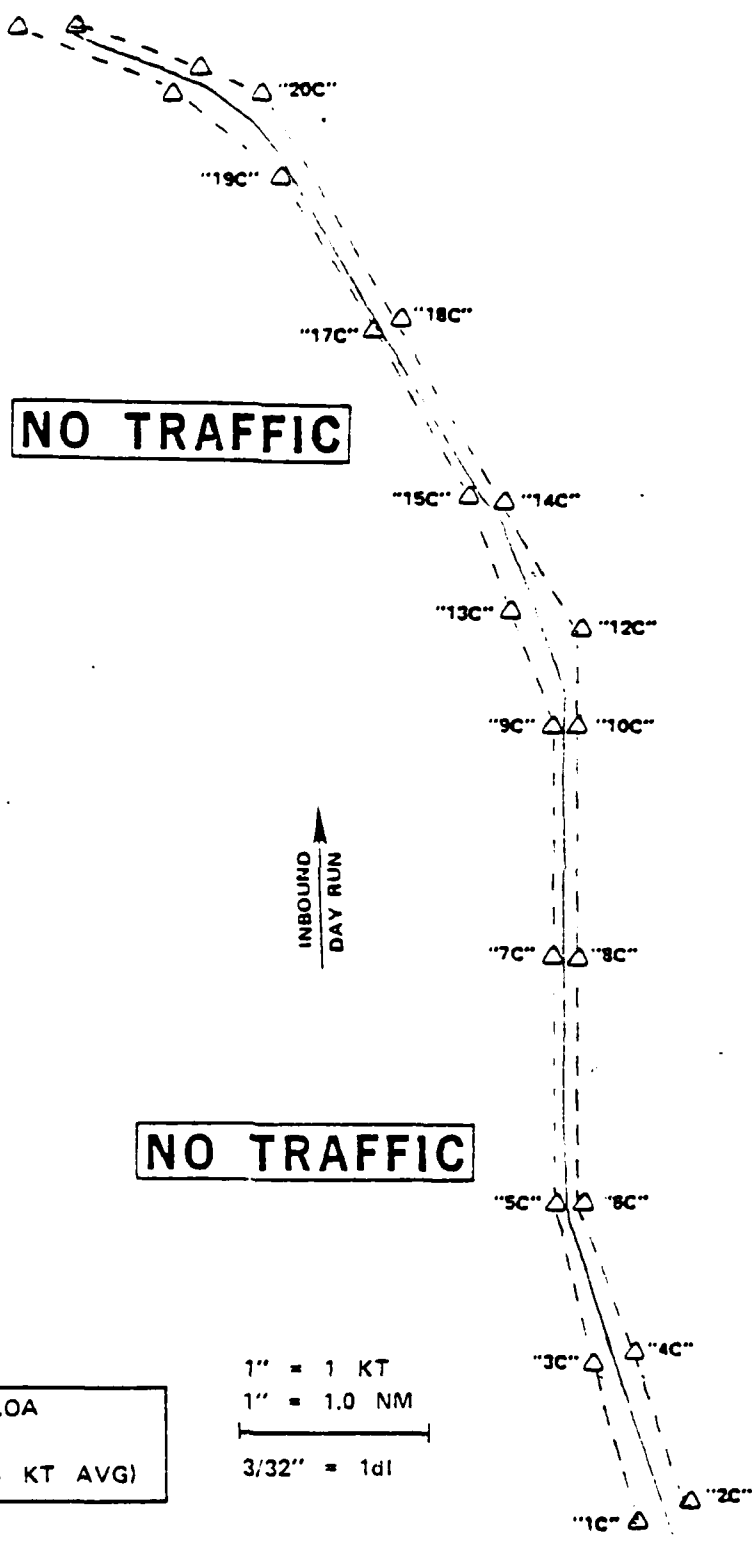
     abeam "4B"

IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>342</u>	14:2800	Stdy 243
	RPM at start <u>89</u>	3255	Stdy 243
<u>13:5610</u>	abeam "1C"	3940	Port 20
14:0000	Stdy 342	3950	Passing tug/barge port side
0430	Stbd 15	4000	MS
0508	MS	4135	Stbd 10
0525	Port 10	4240	Port 20
0545	Stdy 000	4307	MS
0740	Stdy 000	4325	Stbd 15
1720	Stdy 001	4335	Stdy 239
2015	Port 20		
2100	MS		
2105	Stdy 339		
2600	Stbd 20		
2750	MS		




NO TRAFFIC

NO TRAFFIC

RUN 19  
 BULKER: 62 K, 705 LOA  
 WIND: 5 KTS  
 CURRENT: FLOOD (0.4 KT AVG)

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1 dl

SHIP DESCRIPTION

Type Bulker  
 Propulsion Diesel  
 Shaft horsepower 8000 at 150 RPM  
 Length overall 506'10" (units) \_\_\_\_\_  
 Length between perpendiculars 481' (units) \_\_\_\_\_  
 Beam 67'8" (units) \_\_\_\_\_  
 Depth 38'7" (units) \_\_\_\_\_  
 Dead weight tonnage 18,526  
 Gross tonnage 10,209  
 Net tonnage 6,340  
 Design draft 30'8" (units) \_\_\_\_\_  
 Actual draft  24 FORWARD, 21 AFT (units) ft  
 Height of eye 70 (units) ft  
 Bridge to bow 380'7" (units) \_\_\_\_\_  
 Bridge to stern 126'3" (units) \_\_\_\_\_  
 Antenna to ship centerline 2 feet PORT STARBOARD (circle one)  
0 feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	<u>55</u>	<u>6.0</u>
SLOW	<u>60</u>	<u>6.5</u>
HALF	<u>70</u>	<u>8.0</u>
FULL MANEUVERING	<u>100</u>	<u>11.0</u>
FULL NAVIGATION	<u>128</u>	<u>13.8</u>

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

.27 ADVANCE, .23 TRANSFER (units) nm, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥5 nm  
 Sun-moon brilliance: BRIGHT FULL HAZY-QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT STARBOARD  
 Air temperature (F): <30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

5 hours 28 minutes since slack FLOOD EBB (circle one) from tables  
1 hours 14 minutes since sun RISE SET (circle one) from tables

TRANSIT EVENTS  
(local time)

IF INBOUND



08:4202 at Bay Bridge mark  
Ship centerline 10 feet EAST WEST (circle one) of mark

08:5023 on green range

08:5343 on red range

09:1117 abeam Baltimore Light

09:4658 abeam 7 Foot Knoll

— abeam "4B"

IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

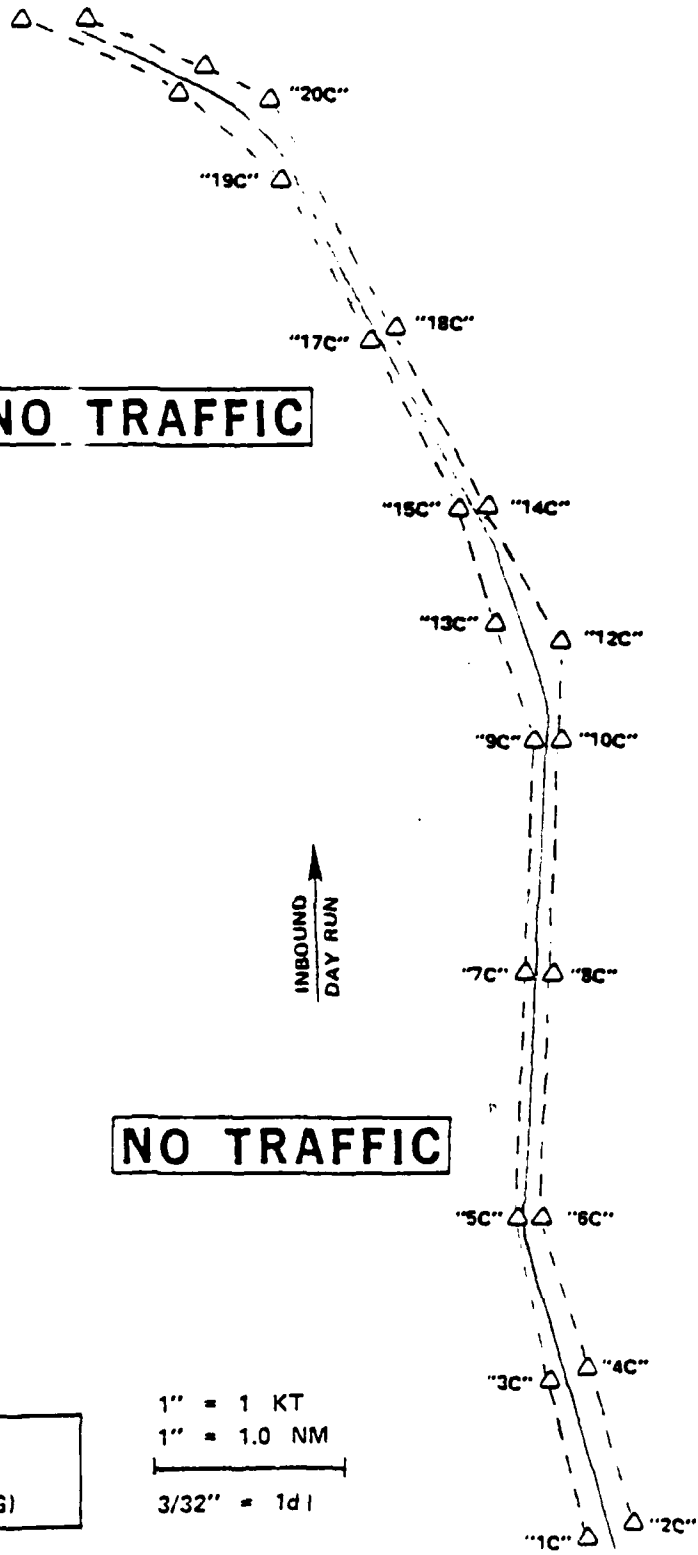
Local Time	Event	Local Time	Event
	Course at start <u>345</u>	09:5346	RL10
	RPM at start <u>100</u>	5505	MS
<u>09:0218</u>	abeam "1C"	5548	RL10
09:1314	RR10	5602	RL05
1355	MS	5708	MS
1448	CC002	5737	CC295
3222	RL10	10:0228	Finex
3230	Half ahead - Slowing for CG buoy tender towing buoy		
3328	MS		
3357	Slow ahead		
3634	Full ahead		
3955	RL10		
4015	MS		
4115	CC331 - Gyro error to 329		
4639	CC331		
4943	CC332		

NO TRAFFIC

NO TRAFFIC

RUN 20  
BULKER: 18 K, 481 LOA  
WIND: 15 KTS  
CURRENT: EBB (0.2 KT AVG)

1" = 1 KT  
1" = 1.0 NM  
3/32" = 1d1



SHIP TRACKING REPORT

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
 Time: DAY NIGHT  
 Method: VISUAL RADAR PATH RACON

INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
 Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
 Precipitation: NONE DRIZZLE RAIN SNOW FOG  
 Visibility: 1/2 nm 1 nm 3 nm ≥ 5 nm  
 Sun-moon brilliance: BRIGHT-FULL HAZY QUARTER OBSCURE-NEW  
 Sun-moon direction: FORWARD AFT PORT /STARBOARD  
 Air temperature (F): 30 30-50 51-70 70  
 Sea temperature (F): 30 30-50 51-70 70  
 True wind direction: N NE E SE S SW W NW  
 True wind speed: 3 3-10 11-20 21-30 30  
 Sea state: CALM SLIGHT SMALL MEDIUM LARGE

---

4 hours 47 minutes since slack FLOOD EBB (circle one) from tables  
7 hours 33 minutes since sun RISE SET (circle one) from tables

### SHIP DESCRIPTION

Type	<u>USCG Buoy Tender</u>	
Propulsion	<u>Diesel</u>	
Shaft horsepower	<u>2900 hp</u> at _____ RPM	
Length overall	<u>157</u> (units) <u>ft</u>	
Length between perpendiculars	_____ (units) _____	
Beam	<u>31</u> (units) <u>ft</u>	
Depth	_____ (units) _____	
Dead weight tonnage	<u>525</u>	
Gross tonnage	_____	
Net tonnage	_____	
Design draft	_____ (units) _____	
Actual draft	<u>6'7"</u> FORWARD, _____ AFT (units) _____	
Height of eye	_____ (units) _____	
Bridge to bow	_____ (units) _____	
Bridge to stern	_____ (units) _____	
Antenna to ship centerline	_____ feet PORT STARBOARD (circle one)	
	_____ feet AFT of bridge bulkhead	

	(rpm)	(knots)
DEAD SLOW	_____	_____
SLOW	_____	_____
HALF	_____	_____
FULL MANEUVERING	_____	_____
FULL NAVIGATION	_____	_____

Maneuvering data at full ahead, ballast condition and starboard turn

Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM

\_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

TRANSIT EVENTS  
(local time)

IF INBOUND



15:0746 at Bay Bridge mark  
Ship centerline 20 feet EAST WEST (circle one) of mark

15:1410 on green range

15:1638 on red range

— abeam Baltimore Light

— abeam 7 Foot Knoll

IF OUTBOUND



— abeam "4B"

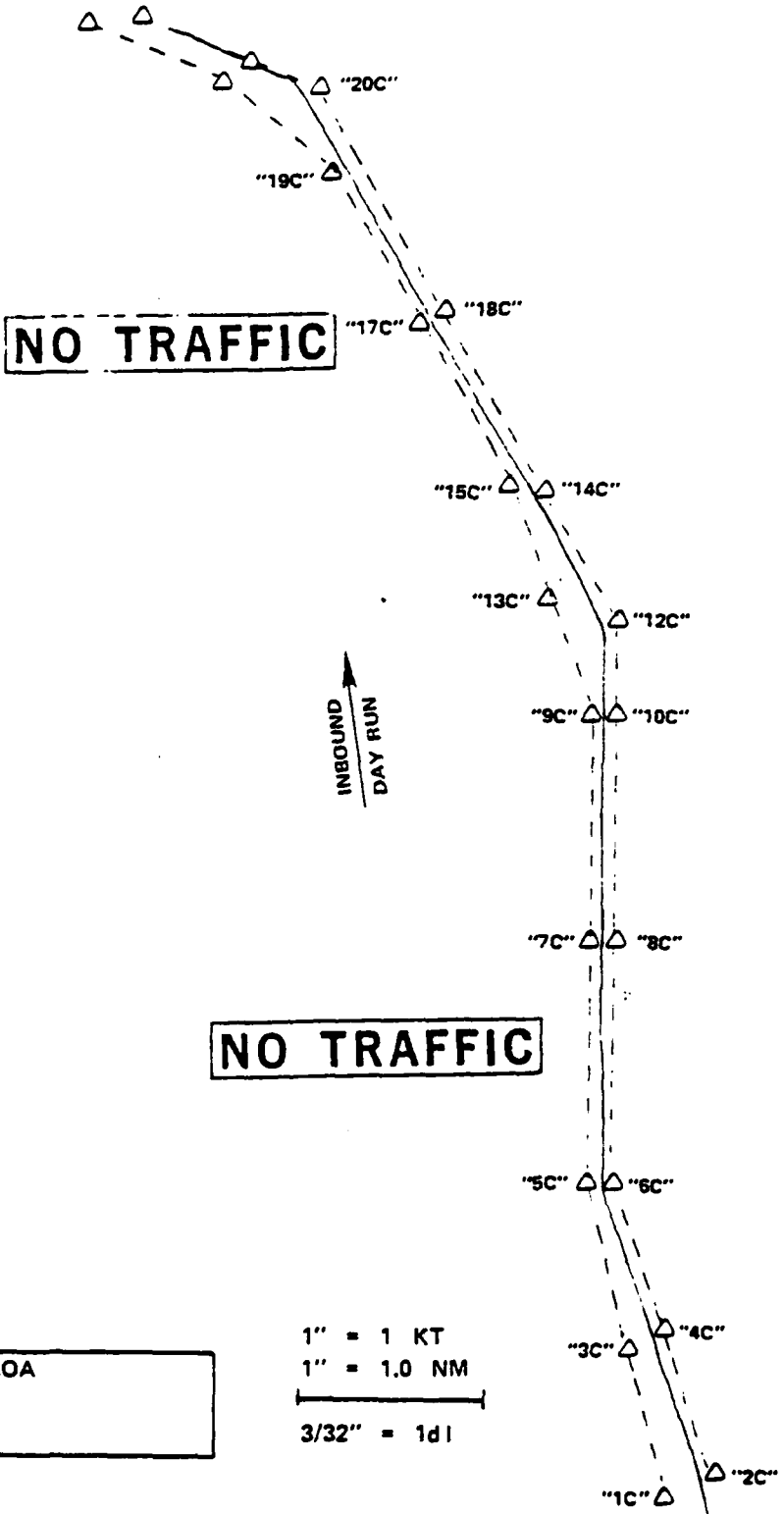
Aids to navigation discrepancies (use attached chart):

Local Time	Event	Local Time	Event
	Course at start <u>—</u>	15:4400	CC355
	RPM at start <u>10Kts</u>		Noted crab angle of 3-4 deg
	abeam	4600	CC356
15:34	Abeam 6C CC359	4700	CC358
3510	CC357 Radioed traffic ship	4900	CC357
3630	CC355	5000	CC356
3900	RL10	5310	RL10
3910	MS - RR05	5320	RL05
3920	RR10	5325	MS
3930	MS	5330	RR05
3940	RR05	5340	RR10
3945	MS	5343	MS
4000	CC358	5350	CC332
4100	CC357	5400	CC330
4300	CC356	5430	CC329
		5600	CC328

Local Time	Event	Local Time	Event
15:5700	CC327		
5800	CC326		
5900	CC324		
16:0000	Estimated wind speed 30-35Knots NW		
0100	CC325		
0300	CC326		
0400	15ft West of $C_L$		
0500	CC327		
0800	On $C_L$		
1300	End Range Run		
1410	RL10		
1430	RL05		
1445	MS		
1455	RR05		
	MS		
16:1500	CC291		

TAPE IN ENVELOPE?

\* USCG initial \_\_\_\_\_



RUN 21  
 USCG: .5 K, 157 LOA  
 WIND: 15 KTS  
 CURRENT:

1" = 1 KT  
 1" = 1.0 NM  
 3/32" = 1 dl

(THIS PAGE INTENTIONALLY LEFT BLANK)

Appendix B  
OBSERVER'S DATA COLLECTION BOOKLET

This appendix is a copy of the Data Collection Booklet which was carried aboard each ship for the purpose of recording relevant ship design data, environmental conditions, and transit events. The booklet also contains information necessary to conduct the experiment such as RAYDIST operating instructions and logistics information.

RUN NUMBER \_\_\_\_\_

SHIP TRACKING REPORT

Date \_\_\_\_\_ (circle one)

Pilot's name \_\_\_\_\_

Tracking crew \_\_\_\_\_ EA USCG  
\_\_\_\_\_ EA USCG  
\_\_\_\_\_ EA USCG

RUN CONDITION  
(circle one)

Direction: INBOUND OUTBOUND  
Time: DAY NIGHT  
Method: VISUAL RADAR ONLY WITHOUT RANGES


INITIAL ENVIRONMENT  
(circle one)

Weather: STABLE IMPROVING DETERIORATING  
Sky: CLEAR PARTLY CLOUDY PARTLY CLEAR OVERCAST  
Precipitation: NONE DRIZZLE RAIN SNOW FOG  
Visibility:  $\leq 1/2$  nm 1 nm 3 nm  $\geq 5$  nm  
Sun-moon brilliance: BRIGHT-FULL HAZY-QUARTER OBSCURE-NEW  
Sun-moon direction: FORWARD AFT PORT STARBOARD  
Air temperature (F): <30 30-50 51-70 >70  
Sea temperature (F): <30 30-50 51-70 >70  
True wind direction: N NE E SE S SW W NW  
True wind speed: <3 3-10 11-20 21-30 >30  
Sea state: CALM SLIGHT SMALL MEDIUM LARGE  
Ice concentration: NONE OPEN WATER OPEN PACK CLOSED PACK

---

\_\_\_\_\_ hours \_\_\_\_\_ minutes since slack FLOOD EBB (circle one) from tables  
\_\_\_\_\_ hours \_\_\_\_\_ minutes since sun RISE SET (circle one) from tables

SHIP DESCRIPTION

Vessel name \_\_\_\_\_  
 Registry \_\_\_\_\_  
 Official number \_\_\_\_\_  
 Year built \_\_\_\_\_  
 Type \_\_\_\_\_  
 Propulsion \_\_\_\_\_  
 Shaft horsepower \_\_\_\_\_ at \_\_\_\_\_ RPM  
 Length overall \_\_\_\_\_ (units) \_\_\_\_\_  
 Length between perpendiculars \_\_\_\_\_ (units) \_\_\_\_\_  
 Beam \_\_\_\_\_ (units) \_\_\_\_\_  
 Depth \_\_\_\_\_ (units) \_\_\_\_\_  
 Dead weight tonnage \_\_\_\_\_  
 Gross tonnage \_\_\_\_\_  
 Net tonnage \_\_\_\_\_  
 Design draft \_\_\_\_\_ (units) \_\_\_\_\_  
 Actual draft  \_\_\_\_\_ FORWARD, \_\_\_\_\_ AFT (units) \_\_\_\_\_  
 Height of eye \_\_\_\_\_ (units) \_\_\_\_\_  
 Bridge to bow \_\_\_\_\_ (units) \_\_\_\_\_  
 Bridge to stern \_\_\_\_\_ (units) \_\_\_\_\_  
 Antenna to ship centerline \_\_\_\_\_ feet PORT STARBOARD (circle one)  
 \_\_\_\_\_ feet AFT of bridge bulkhead

	(rpm)	(knots)
DEAD SLOW	_____	_____
SLOW	_____	_____
HALF	_____	_____
FULL MANEUVERING	_____	_____
FULL NAVIGATION	_____	_____

Maneuvering data at full ahead, ballast condition and starboard turn  
 Maneuvering data \_\_\_\_\_ MEAN DRAFT (units) \_\_\_\_\_, \_\_\_\_\_ RPM  
 \_\_\_\_\_ ADVANCE, \_\_\_\_\_ TRANSFER (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds  
 Crash stop to dead in water, \_\_\_\_\_ DISTANCE (units) \_\_\_\_\_, \_\_\_\_\_ minutes \_\_\_\_\_ seconds

<u>ID</u>	<u>BRIDGE EQUIPMENT</u>	<u>ONBOARD</u>	<u>MFG-MODEL</u>	<u>ERROR</u>
1	Steering stand	—	_____	
2	EOT	—	_____	
3	Gyro repeater	—	_____	_____ (direction) _____
4	Rudder angle indicator	—	_____	
5	RPM indicator	—	_____	
6	Rate of turn indicator	—	_____	
7	Clinometer	—	_____	
8	Clock	—	_____	<u>USED BY</u> <u>PILOT</u>
9	Radar #1	—	_____	—
10	Radar #2	—	_____	—
11	ARPA	—	_____	—
12	Depth sounder	—	_____	
13	Wind indicator	—	_____	
14	Speed log	—	_____	
15	Bell log	—	_____	
16	Whistle control	—	_____	
17	VHF comm	—	_____	
18	Inter comm	—	_____	
19	Radio aids to nav	—	_____	
20	PILOTS PRIMARY STATION			
21	PILOTS SECONDARY STATIONS			
22	RAYDIST EQUIPMENT LOCATION			

(Sketch of bridge and location of equipment)





TRANSIT EVENTS  
(local time)

IF INBOUND



\_\_\_\_\_ at Bay Bridge mark  
Ship centerline \_\_\_\_\_ feet EAST WEST (circle one) of mark

\_\_\_\_\_ on green range

\_\_\_\_\_ on red range

\_\_\_\_\_ abeam Baltimore Light

\_\_\_\_\_ abeam 7 Foot Knoll

\_\_\_\_\_ abeam "4B"

IF OUTBOUND



Aids to navigation discrepancies (use attached chart):

Local Time	Event
	Course at start _____
	RPM at start _____
_____	abeam "1C"

Local Time	Event

Local  
Time

Event

Local  
Time

Event

TAPE IN ENVELOPE?

\* USCG initial \_\_\_\_\_

F-FLOOD, DIR. 025° TRUE E-EBB, DIR. 190° TRUE

NOVEMBER										DECEMBER																									
DAY	SLACK WATER			MAXIMUM CURRENT			DAY	SLACK WATER			MAXIMUM CURRENT			DAY	SLACK WATER			MAXIMUM CURRENT																	
	TIME	H.M.	VEL.	TIME	H.M.	VEL.		TIME	H.M.	VEL.	TIME	H.M.	VEL.		TIME	H.M.	VEL.	TIME	H.M.	VEL.															
1	0245	0607	0.3E	16	0209	0534	0.8E	1	0253	0609	0.6F	16	0219	0543	0.8E	2	0341	0702	0.3E	17	0302	0623	0.3E	2	0347	0706	0.3E	17	0314	0634	0.8E				
SA	0932	1236	0.7F	SU	0858	1201	0.7F	M	0931	1251	0.9F	TU	0851	1220	1.0F	W	0935	1309	1.1F	W	0935	1309	1.1F	TH	0411	0727	0.5F	18	0411	0727	0.5F				
	1549	1839	0.5E		1516	1807	0.5E		1621	1917	0.6E		1551	1850	0.7E		1645	1951	0.3E		1612	1909	0.7E		1709	2013	0.7E		1645	1951	0.3E				
	2133				2058				2224				2206				2319				2214				2328				2319						
2		0043	0.7F	17		0004	0.6F	2		0106	0.5F	17		0040	0.5F	3		0139	0.7F	18		0105	0.6F	3		0201	0.5F	18		0142	0.5F				
SU	0341	0702	0.3E	M	0302	0623	0.3E	TU	0347	0706	0.3E	W	0314	0634	0.8E	M	0435	0751	0.3E	TU	0355	0710	0.3E	W	0439	0752	0.7E	TH	0411	0727	0.5F				
	1317	1329	0.3F		0937	1252	0.3F		1012	1340	0.9F		0935	1309	1.1F		1100	1416	0.9F		1016	1340	1.0F		1051	1423	1.0F		1020	1402	1.2F				
	1646	1942	0.7E		1612	1909	0.7E		1709	2013	0.7E		1645	1951	0.3E		1735	2033	0.7E		1704	2007	0.8E		1753	2102	0.8E		1736	2046	1.0E				
	2242				2214				2328				2319				2344				2324														
3		0139	0.7F	18		0105	0.6F	3		0201	0.5F	18		0142	0.5F	4		0234	0.6F	19		0207	0.6F	4		0226	0.5F	19		0223	0.243	0.5F			
M	0435	0751	0.3E	TU	0355	0710	0.3E	W	0439	0752	0.7E	TH	0411	0727	0.5F	TH	0525	0836	0.8E	F	0509	0820	0.8E	W	0529	0836	0.7E	F	0509	0820	0.8E				
	1100	1416	0.9F		1016	1340	1.0F		1051	1423	1.0F		1020	1402	1.2F		1139	1502	0.3F		1107	1451	1.3F		1129	1509	1.0F		1107	1451	1.3F				
	1735	2033	0.7E		1704	2007	0.8E		1753	2102	0.8E		1736	2046	1.0E		1820	2124	0.8E		1826	2139	1.1E		1835	2145	0.9E		1826	2139	1.1E				
	2344				2324												2344																		
4		0234	0.6F	19		0207	0.6F	4		0226	0.5F	19		0223	0.243	5		0323	0.5F	20		0302	0.6F	5		0319	0.346	0.5F	20		0340	0.5F			
TU	0525	0836	0.8E	W	0448	0800	0.8E	TH	0529	0836	0.7E	F	0509	0820	0.8E	W	0612	0920	0.3E	TH	0541	0847	0.3E	TH	0618	0919	0.5E	F	0618	0919	0.5E				
	1139	1502	0.3F		1057	1429	1.1F		1129	1509	1.0F		1107	1451	1.3F		1215	1540	1.0F		1205	1547	1.1F		1205	1547	1.1F		1205	1547	1.1F				
	1820	2124	0.8E		1754	2102	1.0E		1835	2145	0.9E		1826	2139	1.1E		1901	2208	0.3E		1914	2230	1.0E		1914	2230	1.0E		1914	2228	1.2E				
5		0323	0.5F	20		0302	0.6F	5		0319	0.346	0.5F	20		0340	0.5F	W	0612	0920	0.3E	TH	0641	0947	0.3E	F	0618	0919	0.5E	SA	0607	0911	0.8E			
W	0612	0920	0.3E	TH	0541	0847	0.3E	F	0618	0919	0.5E	SA	0607	0911	0.8E	W	1215	1540	1.0F		1205	1547	1.1F		1205	1547	1.1F		1205	1547	1.1F				
	1215	1540	1.0F		1139	1514	1.2F		1205	1547	1.1F		1156	1540	1.3F		1901	2208	0.3E		1914	2230	1.0E		1914	2230	1.0E		1914	2228	1.2E				
	1901	2208	0.3E		1842	2154	1.1E		1914	2230	1.0E		1914	2228	1.2E																				
6		0412	0.6F	21		0357	0.6F	6		0208	0433	0.5F	21		0212	0.434	TH	0657	0959	0.7E	F	0633	0936	0.8E	SA	0705	1000	0.5E	21		0212	0.434	0.6F		
TH	0657	0959	0.7E	F	0633	0936	0.8E	SA	0705	1000	0.5E	SU	0705	1007	0.7E	W	0903	1208	0.3E		1250	1618	1.0F		1240	1624	1.1F		1246	1629	1.3F				
	1250	1618	1.0F		1223	1601	1.3F		1240	1624	1.1F		1246	1629	1.3F		1323	1655	1.0F		1337	1721	1.2E		1337	1721	1.2E		1337	1721	1.2E				
	1940	2251	0.3E		1930	2245	1.2E		1953	2309	1.0E		2001	2320	1.2E		2018	2332	1.0E		2001	2320	1.2E		2001	2320	1.2E		2001	2320	1.2E				
7		0455	0.5F	22		0449	0.6F	7		0255	0518	0.5F	22		0300	0526	0.6F	F	0739	1037	0.7E	SA	0725	1025	0.3E	7		0255	0518	0.5F	22		0300	0526	0.6F
M	0739	1037	0.7E	SA	0725	1025	0.3E	SU	0750	1041	0.6E	M	0802	1058	0.7E	W	0903	1208	0.3E		1323	1655	1.0F		1308	1648	1.4F		1316	1732	1.1F		1337	1721	1.2E
	1323	1655	1.0F		1308	1648	1.4F		1316	1732	1.1F		1337	1721	1.2E		2018	2332	1.0E		2031	2320	1.2E		2031	2320	1.2E		2031	2320	1.2E				
	2018	2332	1.0E		2017	2334	1.2E		2031	2351	1.1E		2047																						
8		0537	0.6F	23		0540	0.5F	8		0339	0601	0.5F	23		0006	1.2E	SA	0821	1114	0.4E	SU	0818	1114	0.4E	23		0339	0601	0.5F	23		0006	1.2E		
SA	0821	1114	0.4E	SU	0818	1114	0.4E	M	0835	1123	0.5E	TU	0846	1151	0.6E	W	0903	1208	0.3E		1356	1731	1.1F		1356	1731	1.1F		1356	1731	1.1F				
	1356	1731	1.1F		1356	1731	1.1F		1353	1741	1.1F		1429	1806	1.2F		2056																		
	2056				2104				2110				2132																						
9		0613	1.0E	24		0623	1.2E	9		0032	1.1E	24		0052	1.2E	SU	0903	1208	0.3E	M	0402	0632	0.6F	24		0422	0645	0.5F	24		0052	1.2E			
SU	0903	1208	0.3E	M	0402	0632	0.6F	TU	0422	0645	0.5F	W	0430	0707	0.7F	TH	0903	1208	0.3E		0903	1208	0.3E		0921	1204	0.5E		0956	1245	0.7E				
	1429	1808	1.0F		1445	1826	1.3F		1433	1823	1.1F		1523	1857	1.1F		1429	1806	1.2F		1445	1826	1.3F		1433	1823	1.1F		1523	1857	1.1F				
	2135				2152				2149				2216																						
10		0656	1.0E	25		0112	1.2E	10		0115	1.0E	25		0139	1.1E	M	0418	0704	0.5F	TU	0452	0726	0.7F	25		0503	0727	0.5F	25		0139	1.1E			
M	0418	0704	0.5F	TU	0452	0726	0.7F	W	0503	0727	0.5F	TH	0514	0758	0.7F	W	0946	1232	0.5E		1011	1259	0.7E		1009	1249	0.5E		1057	1339	0.6E				
	0946	1232	0.5E		1011	1259	0.7E		1009	1249	0.5E		1057	1339	0.6E		1504	1849	1.0F		1538	1918	0.7E		1517	1904	1.0F		1619	1948	1.0F				
	1504	1849	1.0F		1538	1918	0.7E		1517	1904	1.0F		1619	1948	1.0F		2215																		
	2215				2239				2229				2300																						
11		0737	1.0E	26		0200	1.2E	11		0155	1.0E	26		0222	1.1E	TU	0524	0751	0.3F																

# SUN'S RISING AND SETTING AT NEW YORK (THE BATTERY)

74° W 40° 42' N

Add one hour for Daylight Saving Time, covering the summer months  
FOR THE YEAR

1980

Day of Month	July		Aug.		Sept.		Oct.		Nov.		Dec.	
	Rises H. M.	Sets H. M.	Rises H. M.	Sets H. M.	Rises H. M.	Sets H. M.	Rises H. M.	Sets H. M.	Rises H. M.	Sets H. M.	Rises H. M.	Sets H. M.
1	4:29	7:31	4:52	7:12	5:23	6:29	5:52	5:39	6:26	4:52	7:00	4:29
2	4:29	7:30	4:53	7:11	5:24	6:27	5:53	5:37	6:27	4:51	7:01	4:29
3	4:30	7:30	4:54	7:10	5:24	6:25	5:54	5:35	6:28	4:50	7:02	4:29
4	4:30	7:30	4:55	7:09	5:25	6:24	5:55	5:34	6:30	4:48	7:03	4:29
5	4:31	7:30	4:56	7:07	5:26	6:22	5:56	5:32	6:31	4:47	7:04	4:29
6	4:31	7:30	4:57	7:06	5:27	6:20	5:57	5:31	6:32	4:46	7:05	4:29
7	4:32	7:29	4:58	7:04	5:28	6:19	5:58	5:29	6:33	4:45	7:06	4:29
8	4:32	7:29	4:59	7:03	5:29	6:17	5:59	5:29	6:34	4:44	7:07	4:29
9	4:33	7:29	5:00	7:02	5:30	6:15	6:00	5:26	6:36	4:43	7:08	4:29
10	4:33	7:28	5:01	7:00	5:32	6:14	6:02	5:24	6:37	4:42	7:09	4:29
11	4:34	7:28	5:02	6:59	5:33	6:12	6:03	5:23	6:38	4:41	7:10	4:29
12	4:35	7:27	5:03	6:57	5:34	6:10	6:04	5:21	6:39	4:40	7:10	4:29
13	4:36	7:26	5:04	6:56	5:35	6:08	6:05	5:19	6:40	4:39	7:11	4:30
14	4:37	7:26	5:05	6:55	5:36	6:07	6:06	5:18	6:42	4:38	7:12	4:30
15	4:37	7:25	5:06	6:53	5:37	6:05	6:07	5:16	6:43	4:37	7:12	4:30
16	4:38	7:25	5:07	6:52	5:38	6:03	6:08	5:15	6:44	4:37	7:13	4:30
17	4:39	7:24	5:08	6:50	5:39	6:02	6:09	5:13	6:45	4:36	7:13	4:31
18	4:40	7:24	5:09	6:49	5:40	6:00	6:10	5:12	6:46	4:35	7:14	4:31
19	4:41	7:23	5:10	6:48	5:41	5:58	6:11	5:10	6:48	4:35	7:15	4:31
20	4:41	7:22	5:11	6:46	5:41	5:57	6:13	5:09	6:49	4:34	7:15	4:32
21	4:42	7:22	5:12	6:45	5:42	5:55	6:14	5:07	6:50	4:34	7:16	4:32
22	4:43	7:21	5:13	6:43	5:43	5:53	6:15	5:06	6:51	4:33	7:16	4:33
23	4:44	7:20	5:14	6:42	5:44	5:51	6:16	5:05	6:52	4:33	7:17	4:33
24	4:45	7:19	5:15	6:41	5:45	5:50	6:17	5:03	6:53	4:32	7:17	4:34
25	4:45	7:18	5:16	6:39	5:46	5:48	6:18	5:02	6:54	4:32	7:18	4:34
26	4:46	7:17	5:17	6:38	5:47	5:47	6:19	5:00	6:55	4:31	7:18	4:35
27	4:47	7:17	5:18	6:36	5:48	5:45	6:20	4:59	6:56	4:31	7:19	4:35
28	4:48	7:16	5:19	6:35	5:49	5:43	6:21	4:58	6:57	4:30	7:19	4:36
29	4:49	7:15	5:20	6:33	5:50	5:42	6:22	4:56	6:58	4:30	7:20	4:36
30	4:50	7:14	5:21	6:32	5:51	5:40	6:24	4:55	6:59	4:30	7:20	4:37
31	4:51	7:13	5:22	6:30			6:25	4:53			7:20	4:38

For correct SETTING of Sun any day of the year at places specified below, FOR FLAG USE, add or subtract from above table.

	July 15	Aug. 15	Sept. 15	Oct. 15	Nov. 15	Dec. 15
Hampton Rds., Va.	-1	+2	+7	+13	+18	+20
Oxford, Md.	+3	+5	+8	+11	+14	+15
Annapolis, Md.	+5	+7	+9	+12	+14	+15
Cape May, N. J.	-1	+1	+3	+6	+8	+9
Atlantic City	-2	0	+2	+4	+6	+6
Mannasquan, N. J.	-2	-1	0	+1	+2	+2
Port Jefferson, N. Y.	-3	-3	-4	-4	-5	-5
Bridgeport, Ct.	-1	-2	-3	-4	-4	-5
New Haven	-3	-3	-4	-5	-6	-7

## METERS TO FEET

Meters	0	1	2	3	4	5	6	7	8	9
0	0.00	3.28	6.56	9.84	13.12	16.40	19.68	22.97	26.25	29.53
10	32.81	36.09	39.37	42.65	45.93	49.21	52.49	55.77	59.06	62.34
20	65.62	68.90	72.18	75.46	78.74	82.02	85.30	88.58	91.86	95.14
30	98.42	101.71	104.99	108.27	111.55	114.83	118.11	121.39	124.67	127.95
40	131.23	134.51	137.80	141.08	144.36	147.64	150.92	154.20	157.48	160.76
50	164.04	167.32	170.60	173.88	177.16	180.45	183.73	187.01	190.29	193.57
60	196.85	200.13	203.41	206.69	209.97	213.25	216.54	219.82	223.10	226.38
70	229.66	232.94	236.22	239.50	242.78	246.06	249.34	252.62	255.90	259.19
80	262.47	265.75	269.03	272.31	275.59	278.87	282.15	285.43	288.71	291.99
90	295.28	298.56	301.84	305.12	308.40	311.68	314.96	318.24	321.52	324.80

## INSTRUCTIONS FOR U.S.C.G. RAYDIST OPERATOR

1. Await Master's permission.
2. Assemble equipment, install antenna on forward bridge centerline.
3. Power ON, check monitor for signal reception.
4. Set time into printer, coordinate with EA representative.
5. Set phase meters to standby.
6. Set Bay Bridge coordinates — RED: 520.00, GREEN: 1252.00
7. Set print interval to 10 seconds.
8. At Bay Bridge mark, initialize auto tracker.
9. Mandatory tape annotation.

INBOUND



- a. Bay Bridge mark
- b. Green range 294 degrees T (GREEN: 1206.60)
- c. Red range 250 degrees T (RED: 469.17)
- d. Abeam 1C
- e. Abeam 3C
- f. Abeam Baltimore Light
- g. Abeam 5C
- h. Abeam 7C
- i. Abeam 9C
- j. Abeam 13C
- k. Abeam 15C
- l. Range 7-foot knoll with Craighill Channel Leading Light
- m. Abeam 17C
- n. Abeam 19C
- o. Abeam 3B
- p. Abeam 4B



OUTBOUND

10. Check tape for complete annotation.
11. Insert tape in booklet envelope and initial.
12. Stow equipment.

**LMED**

**-8**