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USER'S MANUAL FOR SIMULATIONS OF MAN OVERBOARD AND ABANDON SHIP--ETC(U)
MAY 78 L B BROWN, R M DIJULIO, F J NICKELS DOT-CG-61276-A
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USER'S MANUAL FOR SIMULATIONS OF MAN OVERBOARD AND ABANDON SHIP CASUALTIES TO STUDY RESCUE BOAT PERFORMANCE

MAY 1978

FINAL REPORT

Prepared for

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

NOTICE

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
CG-D-8-78		

4. Title and Subtitle
User's Manual for Simulations of Man Overboard and Abandon Ship Casualties to Study Rescue Boat Performance

5. Report Date
May 1978

6. Performing Organization Code

7. Author(s)
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8. Performing Organization Report No.

9. Performing Organization Name and Address
CASDE Corporation
P.O. Box 1291
Torrance, CA 90505

10. Work Unit No. (TRAIS)
G-DSA-3309.01.02.1

11. Contract or Grant No.
DOT-CG-61276-A

12. Sponsoring Agency Name and Address
Department of Transportation
U.S. Coast Guard
Office of Research and Development
Washington, D.C. 20590

13. Type of Report and Period Covered
Final Report,
November 1976 -
May 1978

14. Sponsoring Agency Code
G-DSA-1/TP44

15. Supplementary Notes
The U.S. Coast Guard Office of Research and Development's technical representatives for the work performed herein were Mr. T.J. Sheehan and LCdr. S.H. Davis.

16. Abstract
This report is a User's Manual which describes the usage of the Man Overboard and the Abandon Ship Simulations discussed in detail in Report No.CG-D-7.78. The simulations provide a means by which rescue boat performance criteria may be determined; they may also be used to evaluate known rescue boat characteristics.

Both simulations have a standard use which allow the user to select a set of standard values to serve as a common base for variations in the rescue boat characteristics. The manual describes the usage of the standard simulation as well as the more flexible override mode. This latter mode is intended for the user who may want to investigate special conditions. The simulations provide a method for the user to override the standard values and substitute values of his own design. Separate sections in this report describe the override capability.

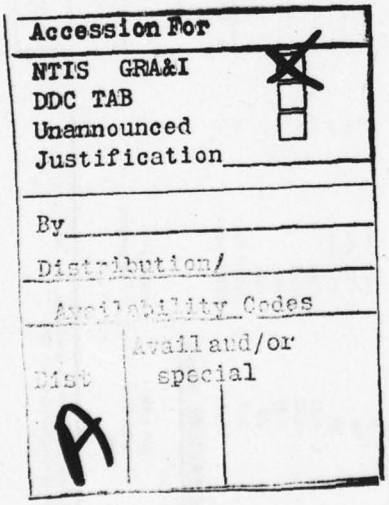
17. Key Words		18. Distribution Statement
Functional Requirements	Simulation	The document is available to the public through the National Technical Information Service, Springfield, VA 22151
Abandon Ship	Rescue Boat	
Man Overboard	MTTP	
Discrete Time Model	BASIC	
Survival System		
Performance Criteria		

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	48	

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

PREFACE

This report summarizes work conducted under Contract No.DOT-CG-61276-A by CASDE Corporation under the auspices of the U.S.Coast Guard, with Mr. T.J. Sheehan and LCdr. S.H. Davis serving as the Office of Research and Development's technical representatives for the work performed herein. The program manager was Dr. R. Saucedo. F.J. Nickels served as Naval Architect, R.M. DiJulio as Marine Engineer, and L.B. Brown as the System Analyst.



METRIC CONVERSION FACTORS

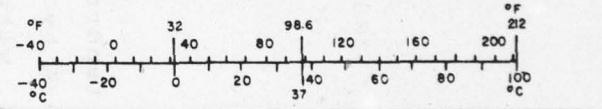
Approximate Conversions to Metric Measures

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

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures. Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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USER'S MANUAL

1. INTRODUCTION

This manual explains the usage of the Abandon Ship and the Man Overboard Simulation. The manual separates discussion of the two simulations for two reasons: 1) the mathematical models are quite different and 2) their implementation is also significantly different. Both simulations were designed for use on the Wang 2200 System. The Abandon Ship Simulation consists of one program while the Man Overboard Simulation consists of three programs. The operator programs for the simulations were written to provide both a standard and a more flexible way to use the program. This manual presents the standard use of the programs first and then presents their override capability. Therefore, if a user requires only the options provided by the standard use of the program, he need not concern himself with the override portion description. Finally, for reference purposes, all the information presented to the user appears in the appendices without a description of the meanings and implications of the questions.

2. Abandon Ship Simulation (Standard Use)

The Abandon Ship Simulation, written in BASIC* for the Wang 2200 System, was written to be easy and yet flexible enough to simulate virtually any type of casualty that might require abandonment of a ship. The program also formats the results of a simulation run to make interpretation as simple as possible. The simulation naturally divides into three parts: 1) the operator program which gathers the information needed to perform the run, 2) the body of the simulation, and 3) the output program which takes the results of the simulation and prints a summary report.

* BASIC is a registered trademark of Dartmouth University.

2.1 Operator program

The operator program presents a series of questions on the terminal device (usually a video display). The answers to the questions posed determine the input parameters for the simulation run. The specific questions asked and the significance of different acceptable replies appear below. The questions asked of the operator appear in all CAPITAL letters. For convenience the questions are divided into five sections. The first is a preamble, the second set of questions are those related to the ship characteristics, the third set of questions define the rescue boat characteristics, the fourth set provides a description of the casualty, and the fifth solicits the number of simulations. Appendix A shows all the questions presented to the user on the video display for the standard use of the Abandon Ship Simulation.

An Input Data Preparation Sheet such as shown in Appendix H should be used to organize the replies and to provide guidance for quantifying the appropriate parameters for the rescue boat.

2.1.1 The Preamble

The program is first loaded from whatever mass storage device the small computer uses (disk or tape). Next the operator types

RUN

The program then responds with

ABANDON SHIP SIMULATION
SERIAL NUMBER?

The serial number provides a means of identifying the run and in addition the program uses the integer part of the serial number to randomize the random number generator. The user then enters the serial number and the computer displays the message

INITIALIZING

The initializing process requires several seconds, after which, the computer goes to the next section to obtain the ship characteristics.

2.1.2 Ship Characteristics (Standard Use)

In this section the computer obtains the data necessary to describe the ship type under investigation. A list of ship types appears and

the user selects the ship desired. The simulation then uses the built-in ship characteristics for the ship type selected. The computer displays

SHIP CHARACTERISTICS.

1 TANKER
2 CONTAINER
3 LNG
4 FISHBOAT
5 TUG
6 BARGE CARRIER (LASH)
7 GREAT LAKES BULKER
8 FERRY

NUMBER?

The user then enters the number desired. The program then asks

WANT STANDARD SHIP
(1=YES; 0=NO)?

For conventional usage, a YES (enter a 1) reply is entered. If modification of the standard characteristics are desired then a NO (enter a 0) reply is entered. This override capability is described in section 4.1.1. Table 1 shows the standard ship characteristics for each ship type. The characteristics of the ship are the length of the ship, the number of people on board (POB), the number of lifeboats carried, the capacity of each lifeboat, the number of liferafts and capacity of each liferaft. In addition the program establishes standard values for the environmental and operational paramaters according to ship type. The environmental parameters thus set describe the water temperature and the significant wave height. For the water temperature the program requires two values (both entered automatically for standard): one, the mean mid-summer water temperature and the other the mean mid-winter water temperature. For the significant wave height, the program also requires a mid-summer and a mid-winter value. The significant wave height carries the definition of "the average of the one-third highest waves". This, studies have shown, corresponds closely to the estimate a trained observer would determine by observing the sea.

TABLE 1: STANDARD SHIP CHARACTERISTICS

Characteristics/Ship Number	Tanker	Containership	LNG	Fishboat	Tug	Barge Carrier (LASH)	Great Lakes Bulker	Ferry	UNITS
	1	2	3	4	5	6	7	8	
Ship Length	845	710	900	75	150	740	708	150	Feet
POB Ship	40	40	50	5	10	45	33	200	---
No. of Lifeboats	4	2	4	0	0	2	2	0	---
Capacity of Each L.B.	33	40	33	0	0	50	40	10	---
No. of Liferafts	1	1	2	1	1	1	2	8	---
Capacity of Each L.R.	25	25	25	10	10	25	10	25	---
Mode of Sign. Wave Hgts.--Mid-Winter	6.5	5	5	5	5	5	4	5	Feet
Mode of Sign. Wave Hgts.--Mid-Summer	3	3	3	3	3	3	2	3	Feet
Mean Water Temp.--Mid-Winter	38	38	38	38	38	38	42	38	Deg. F.
Mean Water Temp.--Mid-Summer	70	70	70	70	70	70	70	70	Deg. F.
Prob. Rescue Vessel Nearby	.2	.3	.25	.75	.8	.3	.4	.8	---

The simulation determines the wave height for each simulation by selecting a value from a Rayleigh statistical distribution; this requires the mode of the significant wave heights as a parameter. The mode of a statistical distribution is the most frequently occurring value. Therefore, the program contains the standard values for the modes of the significant wave height for mid-summer and mid-winter. The simulation selects a time of year (or season) from a uniform distribution that varies between mid-summer and mid-winter and linearly interpolates between the corresponding values for both mean water temperature and mode of significant wave height. An underlying assumption in the model is that the environment is keyed to the ship type since it assumes certain ship types generally operate in particular areas of the world. For standard use the program gives the operational parameter -- probability a rescue vessel is nearby -- a value depending upon ship type. However, if the user later selects a casualty type that involves a collision, the program substitutes the fixed value of 0.98 for the standard value selected by ship type.

When a YES reply is entered, the program immediately goes to the next section.

2.1.3 Rescue Boat Characteristics

In this section the computer gathers the data concerning the rescue boat characteristics required by the simulation. Since the focus of the simulation is upon the rescue boat, none of the rescue boat characteristics are built into the program. Therefore, the rescue boat characteristics always originate with the user; these are solicited by the computer in the form of questions. The questions appear in all capital letters; a brief explanation of each is given below.

RESCUE BOAT CHARACTERISTICS.
NO. OF RESCUE BOATS (1 OR 2)?

For some studies the effect of having more than one rescue boat might be desired; therefore the user may select one or two as the number of rescue boats aboard the ship.

BOAT CAPacity (no. EXCluding boat CREW)?

The capacity of the rescue boat may be varied from one (1) to fifty (50); the number in the crew is not considered as part of the rescue boat capacity.

NO. IN BOAT CREW?

The number in the rescue boat crew plus the answer to the last question determine the total capacity of the rescue boat. The program computes the size of boats from the total number of people aboard each type of boat.

MEAN TIME TO LAUNCH boat (MIN.)?

An estimate for the mean time (in minutes) is entered; this is used in the computer to define a normal statistical distribution; individual runs, consequently, will have different values as drawn from this distribution. The time entered should include the time to prepare the boat for launch, the time to load, the time to lower the boat to the water, and the time to release the falls. This time does not include the time for the crew and others (if any) to report to the rescue boat. The time for the crew to report has a built in mean of one (1) minute.

MEAN TIME TO PICK UP one survivor (MTTP) (Min.)?

This is a key parameter of the rescue boat. The mean time to pick up (MTTP) one man is a measure of the speed and agility of the rescue boat. The MTTP should be available as a result of appropriate tests; if it is not, it should be estimated as carefully as possible.

STD. MANUEVER TIME (MINutes)?

This characteristic reflects the rescue boats ability to manuever to and from another vessel or boat to transfer survivors from a filled-to-capacity rescue boat. It is entered as a mean time in minutes. The Standard Maneuver Time is also determined by tests in much the same manner as the MTTP. If the test time is not available, a judicious estimate must be made. Typically a conventional, 6 knot boat would have a Standard Maneuver Time of about one (1) minute.

MAXimum rated WAVE HEIGHT capability (FT.)?

The user supplies the maximum significant wave height, in feet, in which the rescue boat can safely be launched. This number is a characteristic of the boat which should be provided by the manufacturer. The program uses the value supplied to determine the probability of a successful rescue boat launch. The probability has a value of unity (1.0) for a calm sea and declines linearly to one-half (0.5) when the wave height of the sea equals the maximum wave height specified for the rescue boat. For a sea with a wave height of twice the specified capability of the rescue boat, the probability reaches zero (0.0).

MAXimum rated HEEL ANGLE of DAVIT (DEGrees)?

For casualties that involve a sinking, the model assumes the ship will attain some mean heel angle. The rescue boat is assumed to be davit launched. Present Coast Guard Regulations (1977) require a capability of launch with davit angles of 15^{o}. The model assumes the probability of launch (due to heel angle effects) is unity (1.0) for heel angles from zero degrees to the maximum heel angle specified for the rescue boat davits. Beyond this limit the probability declines with increasing heel angle at a rate that depends upon whether the rescue boat is on the high side or the low side. For a high side launch, the probability declines to zero (0.0) at a 30 degree heel angle; for a low side launch a 40 degree heel angle results in zero probability.

2.1.4 Casualty Characteristics

All the simulations for a given run involve the same type of casualty. This section selects the type of casualty. For the conventional use of the model the selection consists of supplying the number corresponding to the casualty types built into the program. Once the casualty type has been selected, the parameters relating to the casualty type are fixed. The computer displays the following.

TYPE OF CASUALTY

1 FIRE
2 COLLISION & FIRE
3 COLLISION & SINKING
4 EXPLOSION & FIRE

5 EXPLOSION & SINKING

6 STRUCTURAL FAILURE

7 GROUNDING

8 CAPSIZING

9 FOUNDERING

NUMBER?

The user supplies the number corresponding to the casualty type under study and the computer responds with

WANT STANDARD CASUALTY

(1=YES: 0=NO)?

A YES (1) reply fixes the standard casualty parameters. A NO (0) reply overrides the standard parameters and requires operator inputs; this is discussed in section 4.1.2. Table 2 shows the standard characteristics for each casualty type.

2.1.5 Number of Simulations

The only other information required at this point is the number of simulations to perform. The last question, then, is

NUMBER OF SIMULATIONS?

The user should select this number with the same care as the other data supplied. Since most of the information supplied to the program determines the mean value of a parameter, enough simulations are required in a run to make the results statistically significant. On the other hand, each simulation takes a certain amount of time. Therefore, if a great number of simulations are requested, the run will take a long time. The minimum number of simulations, however, to ensure statistical convergence is 300.

2.2 Abandon Ship Simulation Output Report

As soon as the user enters the last item requested, the number of simulations, the program starts typing the output report. At that point, however, the only information available consists of the information supplied by the operator program. The program prints everything up to and including the line RESULTS OF XXX SIMULATIONS: (see Appendix B). The program then performs the number of simulations requested by the user. Finally, the program prints the results of the run and stops. Appendix B shows sample reports of results.

TABLE 2: CASUALTY CHARACTERISTICS

Characteristics/Casualty Number	1 Fire	2 Collision & Fire	3 Collision & Sinking	4 Explosion & Fire	5 Explosion & Sinking	6 Structural Failure	7 Grounding	8 Capsizing	9 Foundering	UNITS
Mean Fraction of POB Killed	.05	.02	.02	.1	.1	0	0	.1	0	---
Mean No. of POB Knocked Overboard	0	.5	.5	1	1	0	0	2	0	---
Mean Fraction of POB Isolated	.05	.05	0	.05	.05	.05	0	0	0	---
Mean Fraction of Lifeboats Destroyed	.1	.1	0	.1	.1	0	0	0	0	---
Mean Length of Damage	0	20	20	0	0	0	0	0	0	Feet
Mean Heel Angle	0	0	20	0	20	20	20	30	20	Degrees
Mean Time for Casualty To Develop	30	30	30	5	20	15	20	5	20	Minutes

Turning to Appendix B, notice that the first half of the page describes the characteristics of the ship, the rescue boat, and the casualty while the second half displays the results of the simulations. The ship characteristics printed on the report include the length of the ship (LBP), the number of people on board (POB), and the number and capacity of the lifeboats and liferafts. There are other ship characteristics pertinent to the model, but they do not appear in the summary report. For the rescue boat all the values entered appear in the report. For the casualty only the values relative to the primary casualty appear.

The values for the ship characteristics shown in the report are all fixed values; that is the number of people on board, for example, remains exactly the number shown for all the simulations in a run. For the rescue boat characteristics, on the other hand, some values are deterministic, e.g., the number of rescue boats and rescue boat capacity, while some are mean values, e.g., the time to launch the rescue boat, the time to perform the standard maneuver, the time to pick up one man. For the characteristics of the casualty, all the variables that appear are mean values and serve to define a normal distribution. Note that the values presented in the report are for the primary casualty only. For some casualty types the secondary casualty also contributes to the total number of people who end up in the water. For example, for a standard casualty, a fire results in 5% of the people on board becoming isolated from the lifeboats and liferafts and thus being forced to jump into the water. An explosion also causes 5% of the people on board to become isolated from the lifeboats and liferafts and thus having to jump. For the casualty type explosion and fire, consequently ten percent (10%) of the people on board will, on the average, be isolated from the lifeboats and liferafts. The report, however, prints out only the percentage of the people isolated due to the primary casualty -- 5% for this example. The same thing occurs for the number of people killed and the percent of lifeboats damaged. For the percent killed and isolated the word CREW really means people on board. For the number of crewmen knocked overboard, the statement really should be people rather than crewmen.

The results of the simulations appear in the second half of the report. The most valuable single output of a run is the "OVERALL FRACTION OF MEN IN WATER RESCUED BY THE RESCUE BOAT". This is basically the payoff number used to measure the effectiveness of selected rescue boat characteristics. This number is computed by taking the total number of people saved by the rescue boat divided by the total number of people who end up in the water as a result of the casualty.

The remaining lines contain more detailed information about the simulations. The line NO. IN WATER, N has the number of simulations in the column headed NO. TIMES. The column headed MEAN contains the total number of people in the water divided by the number of simulations while the columns headed MIN. and MAX. contain the minimum and maximum number of people respectively who were in the water in any one simulation. In the line beginning NO. RESCUED BY BOAT, NS, the NO. TIMES column represents the number of times the rescue boat was deployed successfully; this number will never be greater than the number of simulations. The mean number is the total number of people rescued with the rescue boat divided by the number of times the rescue boat was deployed. The minimum and maximum apply to one simulation as above. The RATIO NS/N is computed for each simulation and added to the total ratio for the run. The mean is the total ratio divided by the number of times the rescue boat was successfully deployed. The minimum and maximum columns contain the minimum and maximum values of the ratio NS/N. The lines RESCUE BOAT DAMAGED and R.B. LAUNCH FAILED have entries for the number of times these events occur only. In the last two entries in the report *NRBRB means Not Rescued By Rescue Boat. For these lines, the number of times refers to the number of simulations in which the rescue boat failed in its mission for the reason stated. The mean is the total number of people not rescued by the rescue boat divided by the number of times the event occurred. When the number of times is zero, no mean is computed or printed and the minimum and maximum columns are filled with dashes.

3. MAN OVERBOARD SIMULATION (STANDARD USE)

The Man Overboard Simulation has three parts. The first is The Operator program, second is The Simulation Program and third is an Output Program. All three programs are written in BASIC for use on the Wang 2200 System.

3.1 Operator Program

The Operator Program presents a series of questions on the terminal device (usually a video display). The answers to questions posed determine the input parameters for the simulation run. The specific questions asked and the significance of different acceptable replies appear below. The questions asked of the operator appear in all CAPITAL letters. For convenience the discussion below begins with the preamble followed by the questions divided into two parts: Ship Characteristics and Rescue Boat Characteristics.

As in the Abandon Ship Simulation, an Input Data Preparation Sheet such as shown in Appendix H should be used to organize the replies and provide a guide for what characteristics ought to be evaluated.

3.1.1 The Preamble

The program is first loaded from whatever mass storage device the small computer uses (disk or tape). Next the operator types

RUN

The program responds with

FIRST SERIAL NUMBER

The user then enters the first serial number desired and the computer responds with

LAST SERIAL NUMBER

The user should enter a number at least large enough to include all the simulation runs desired during the session. The Operator Program gives the user an opportunity to truncate the session after entering the data for each simulation, but the program does not allow the user to add to the number of simulation runs in the session. Next the

computer requests

DATA FILE NAME

The program will open the file specified by the user and write the data from the session on the disk. Some computer systems require that a blank file by the name already existing on the disk before running the program; other computer systems do not place this restriction on the user. Next the computer responds with

INITIALIZING

The initializing process requires a few seconds. When the computer has completed initializing, the computer goes to the next section to obtain the ship characteristics.

3.1.2 Ship Characteristics

In this section the computer obtains the data necessary to describe the ship type. For the standard use of the program a list of ship types appears and the user selects the number corresponding to the type desired. The simulation then uses the built-in ship characteristics for the ship type selected. The computer displays the following.

SHIP CHARACTERISTICS

1. TANKER
2. CONTAINER
3. LNG
4. FISHING
5. TUG
6. BARGE CARRIER (LASH)
7. GREAT LAKES BULKER
8. FERRY

NUMBER OF SHIP DESIRED

The user then enters the number desired. Then the program asks

WANT STANDARD SHIP

(1=YES; 0=NO)?

A YES (enter a 1) reply ensures the standard ship characteristics. A NO (enter a 0) reply provides the ability to override the standard characteristics and insert others of the operators choosing. Section 5.1.1 discusses this in more detail. Table 3 shows the standard ship characteristics for each type of ship.

3.1.3 Resue Boat Characteristics

In this section the computer gathers the data concerning the rescue boat required by the simulations. Since the focus of the simulation rests upon the rescue boat, none of the recue boat characteristics are built into the program. Therefore, whether the user desires the standard or the override use of the program, the rescue boat characteristics always originate with the user. For each question asked by the computer, a brief explanation appears. The computer outputs appear in all capital letters

RESCUE BOAT CHARACTERISTICS

SPEED IN SMOOTH WATER (KNOTS)?

The program allows a minimum speed of three (3) knots and a maximum speed of 100 knots. The simulation program uses the speed in smooth water in conjunction with the wave height and the reply to the next question to compute the rescue boat speed for each simulation. The speed enters into the time spent in rescue boat searches.

SPEED IN 8 FT. WAVES (KNOTS)?

The program requires that this speed lie between 3 and 100 knots. As mentioned above, this value helps to define the rescue boat speed as a function of sea state.

FREEBOARD (FEET)?

This variable can range from 0.5 to 20. The freeboard affects the time to retrieve a man from the water.

PERCENT OF GUNWALE OPEN (%)?

This variable, which has an allowed range from 1% (almost a totally closed boat) to 100% (entirely open boat), also affects the time to retrieve a man from the water.

HEIGHT OF LOOKOUT'S EYE (FT)?

The higher the lookout's eye, up to a limit, the further a man in the water can be seen on a clear day. This variable, with an allowed range of 3 to 50, affects the search algorithm for those simulations that use the rescue boat for search.

MEAN TIME TO PREPARE (MIN)?

This variable has an allowed range from zero to ten (10) minutes. The variable is used in the simulation program as a mean value for a normally distributed time. The time to prepare affects the survival rate.

NUMBER OF FALLS?

Conventional lifeboats employ two falls; some survival systems (e.g. the Whitaker survival capsule) employ a single fall. The program allows the user to select one (1) or two (2) falls. It is generally assumed that a two fall boat would have a lower probability of recovery in a high sea state than a single fall boat (or system to include survival capsule). The model uses the number of falls and the wave height to assign a probability of successful recovery. Modern Coast Guard cutters employ a special two fall system known as tensioned falls; the model does not make a distinction between a conventional fall and a tensioned fall.

TABLE 3: STANDARD SHIP CHARACTERISTICS

Characteristics/Ship Number	Tanker 1	Containership 2	LNG 3	Fishboat 4	Tug 5	Barge Carrier (LASH) 6	Great Lakes Bulker 7	Ferry 8	UNITS
Length	845	710	900	75	150	740	708	150	Feet
Speed	16	23	20	10	7	21	14	16	Knots
Time To Slow To Stop	8.5	2.6	6.4	.5	8	6	9.4	.5	Minutes
Height Of Lookout's Eye	50	60	90	20	25	60	37	35	Feet
P_5, Probability Ship Restricted From Turning	.05	.05	.05	.1	.5	.05	.2	.15	---
Mode of Sign. Wave Height--Mid-Summer	3	3	3	2.2	2.2	3	2	3	Feet
Mode of Sign. Wave Height--Mid-Winter	6.5	5	5	4.9	4.9	5	4	5	Feet
Freeboard	10	24	54	10	10	25	13	8	Feet
Mean Water Temp.--Mid-Summer	70	70	70	70	70	70	60	70	Deg. F.
Mean Water Temp.--Mid-Winter	38	38	38	38	38	38	42	38	Deg. F.
P_{10}, Probability Ship Will Recover MOB Directly	.05	.05	.05	.5	.5	.05	.05	.5	---
Mean Navigational Error	1	1	1	2	2	1	1	2	Deg.

DESCENT SPEED (FT./MIN.)?

Combined with a function of the freeboard of the ship (a ship characteristic), the descent speed determines the time required to launch the rescue boat (once it has been prepared for launch). The descent speeds allowed, range from 10 to 500 feet per minute and provide the capability to include conventional boat descents as well as those of a "free-fall" boat.

MAX. LAUNCH SPEED (KNOTS)?

This parameter is intended to define the allowable ship speed for which the rescue boat launch can safely occur; it is used to determine the time required for the ship to slow from its normal operating speed to the launch speed. The program allows a minimum of zero (0) and a maximum of 100 knots.

MAX. WAVE HEIGHT (FEET)?

This parameter defines the maximum wave height at which the Captain would risk launching the rescue boat; it is presumed that the Captain's judgement is based primarily on an awareness of the rescue boat's characteristics. Strictly speaking the judgemental factors involve more than just the significant wave height, but the model uses only the wave height in this decision.

STD. MANEUVER TIME (MIN.)?

This parameter reflects the rescue boats ability to maneuver from the ship to the man overboard and to hold position in calm waters. It is entered as a mean time in minutes and is determined by tests. If the test time is not available, a judicious estimate must be made. Typically a conventional, 6 knot boat would have a Standard Maneuver Time of about one (1) minute. The program allows a parameter range from a minimum of zero (0) to a maximum of 10 minutes.

USE THE BOAT FOR SEARCH

(1=YES; 0=NO)?

A YES answer causes the model to use both the rescue boat and the ship for the search while a NO answer performs the search with the ship only unless the ship cannot turn and conduct the search.

SEARCH WITH R.B. ONLY
(1=YES; 0=NO)?

A YES answer to this question arranges the model (by setting P_5 to unity (1)) so all searches will employ the rescue boat only. This applies whether or not the man was seen going overboard. For the case in which the man was not seen going overboard a YES answer to this question overrides a NO answer to the last question (USE THE BOAT FOR SEARCH). On the other hand, a NO answer sets P_5 to a value that depends upon the type of ship from which the man fell overboard. P_5 determines whether or not the ship will return to the point the man supposedly fell overboard and search or whether the ship will send the rescue boat to perform the search. Next the computer asks the user,

NUMBER OF SIMULATIONS

The user should select this number with the same care as the other data supplied. Since most of the information supplied to the program determines the mean value of a parameter, too few simulations can result in statistically insignificant results. On the other hand; each simulation requires a certain amount of time on the average. Therefore, requesting a large number of simulations will take a long time; 1000 simulations are typical of the number used in most runs. At this point the program writes the input data on the disk and prints twelve lines having all the values selected by the user and a number of computed values that remain constant for all the simulations in the run. Appendix G shows this printed output for a typical run.

As soon as the print-out completes the computer displays, the following three lines appear,

WANT TO INPUT NEXT RUN?
SERIAL # XXX
(1=YES: 0=NO)

where the XXX receives the next higher serial number. If the user provides an affirmative reply, the program repeats the data gathering scenario. For the last serial number or for a negative reply the program displays the message

INPUT PHASE COMPLETE

closes the disk file and stops.

3.2 Simulation Program

The Man Overboard Simulation Program uses, as input, the disk file written by the Man Overboard Operator Program, performs one or more simulations and produces an output disk file which the Man Overboard Output Program can use. The program has, from an operational point of view, only two parts: a preamble and a simulation part. Whereas the preamble requires user attention, the simulation runs independently of user attention.

3.2.1 The Preamble

The program is first loaded from whatever mass storage device the small computer uses (disk or tape). Next the operator types

RUN

The program responds with

INITIALIZING

which requires only a second or two. Then the program proceeds to request information from the user. First,

DEBUG PRINT #1 (1=YES; 0=NO)?

This question and the following two should always receive a negative reply. An affirmative reply to any of these three questions will produce a large amount of output which only a programmer familiar with the internal workings of the program could intrepret. The following two questions are

DEBUG PRINT #2 (1=YES; 0=NO)?

and

DEBUG PRINT #3 (1=YES; 0=NO)?

Next the computer asks if the user wants two other print-outs with the questions

REGULAR PRINT (1=YES; 0=NO)?

and

COMPRESSED PRINT (1=YES; 0=NO)?

The user should select one of these but not both. The REGULAR PRINT, when selected, produces a one page report for each simulation run

which contains a summary of the input data and the results of the simulation run. This report is precisely the same report as the Output Program produces. A sample of this report appears in Appendix G. The COMPRESSED PRINT, when selected, produces five lines containing a summary of the results of the simulation. With the compressed print the user must refer to the printed output of the Operator Program to detemine the input parameters for the simulation run. The COMPRESSED PRINT provides a way of substantially reducing the volume of output when a large number of related simulation runs are made. Appendix G also contains a sample of the COMPRESSED PRINT output. The Output Program, then, can produce a few of the REGULAR PRINT reports for reporting purposes. After the user selects the kind of output desired, the computer asks

INPUT DATA FILE NAME?

This is the same disk file as the Operator Program produced. The user can make up several sets of input data, in different disk files, then run the simulations in any order desired. Since the Simulation Program also produces an output disk file, the computer asks the question

OUTPUT DATA FILE NAME?

to get the name of the disk file onto which to write the results of the simulation.

3.2.2 The Simulation

Once the program has the information supplied in the preamble, the computer proceeds to perform the simulations specified in the input data file. The program will perform as many simulation runs as the file contains input information. The program will rotate between the tasks of reading the input data, performing simulations, printing reports, and writing results on the output data file. As soon as the program detects an end-of-file in the input file, the program will close both files, print the message "FINISHED.", and stop. At this point the input data file remains unchanged and the output data file contains sets consisting of a copy of the input data

followed by the results of the simulations. There will be as many sets of input and output data on the output file as there were sets of input data on the input file. The output data file serves as an input file for the Man Overboard Output Program.

3.3 Output Program

The Man Overboard Output Program simply reads the disk file produced by the Man Overboard Simulation Program and produces one or more reports identical to the reports produced by the Simulation program when the user requests the REGULAR PRINT. The only interaction with the user consists of the single question

SIMULATION OUTPUT FILE NAME:

Once the user supplies the file name, the program proceeds automatically to produce report after report until the program detects an end-of-file in the simulation output file. The Output Program produces only printed output.

4. Abandon Ship Simulation (Override Mode)

Section 2 discussed the standard use of the Abandon Ship Simulation; this section concerns the use of the simulation in an override mode. Only the additional questions applicable to this usage of the simulation appear in this section. The user should consult section 2 for the standard use questions and explanations. Appendix E shows the questions for the override use of the Abandon Ship Simulation as they appear on the video display without any explanation of the questions.

4.1 Operator Program

Of the five sections into which the operator program divides, only two sections differ from the standard use discussion: namely, those of the Ship Characteristics and the Casualty.

4.1.1 Ship Characteristics

For a more flexible usage, the program allows the user to override any or all of the ship characteristics. Under this mode of operation the user can select a "non-standard" ship by supplying values for the different characteristics of his choosing. This procedure is implemented as follows: when the TV displays

WANT STANDARD SHIP
(1=YES; 0=NO)?

the user replies NO (by entering a 0). The program will continue with

(STD. SHIP LENGTH = XXX)
SHIP LENGTH?

The XXX contains the standard length of the ship type selected (see section 2.1.2) for comparative purposes; the user then enters the ship length desired. The program accepts any value between 20 and 5000; the program expects the length in feet. Next the program presents the following

(STD. POB SHIP = XXX)
POB SHIP?

As for the ship length, the number of people on board (POB) the standard ship type fills in the XXX for comparative purposes; the user provides the number of POB desired for his particular simulation. The number may range from 2 to 5000. In a like manner the program asks for each characteristic in turn. Listed below are

the characteristics which can be changed; in each case the format appears exactly as in the two examples given above. The minimum and maximum values indicated below do not appear on the screen.

NO. OF LIFEBOATS (minimum zero, maximum 200)

CAPACITY OF EACH L.B. (minimum zero, maximum 100)

NO. OF LIFERAFTS (minimum zero, maximum 200)

CAPACITY OF EACH L.R. (minimum zero, maximum 100)

MODE OF SIGN. WAVE HGTS.--MID-WINTER (minimum 0, maximum 50)

The mode is the most frequently occurring value. The program linearly interpolates between the mid-winter and mid-summer significant wave heights using a value for the season that has a uniform distribution between mid-summer and mid-winter. This mode number is used to define a Rayleigh statistical distribution from which the specific significant wave heights are drawn for each simulation.

MODE OF SIGN. WAVE HGTS.--MID-SUMMER (minimum 0, maximum 50)

MEAN WATER TEMP.--MID-WINTER (minimum 20°F., maximum 100°F.)

The program expects the mean water temperature in degrees fahrenheit; it is used to define a normal statistical distribution from which specific water temperatures are drawn. The program linearly interpolates between mid-winter and mid-summer values using the same value, for any given simulation, as for the significant wave height.

MEAN WATER TEMP.--MID-SUMMER (minimum 20°F., maximum 100°F.)

PROB. RESCUE VESSEL NEARBY (minimum 0, maximum 1)

For a collision this value gets changed to 0.98 regardless of the value entered here; otherwise this value will be used by the program. This question and response concludes the section on ship characteristics; the program continues with the rescue boat characteristics (see section 2.1.3) followed by the casualty (see section 2.1.4 and below).

4.1.2 Casualty Characteristics

The flexible use of the program to override the standard casualty characteristics is invoked by answering NO to the following question.

WANT STANDARD CASUALTY

(1=YES; 0=NO)?

With a NO response the program next asks

(STD. MEAN FRACTION OF POB KILLED = XXX)
MEAN FRACTION OF POB KILLED?

Note that for this and all other cases the number supplied affects only the primary casualty. Thus, for a collision and fire, only the number killed by the collision can change as a result of the reply to the question; the number killed by the fire remains the same. Note that for some casualties, a secondary casualty is not assumed. Following this question and reply, the program asks

(STD. MEAN NO. OF POB KNOCKED OVERBOARD = XXX)
MEAN NO. OF POB KNOCKED OVERBOARD?

Note that in this case it is not the fraction of POB but rather the total number. The program limits the number between zero and one; fractional values are acceptable. For the following only the question that appears on the screen will be presented along with the minimum and maximum values the program allows.

MEAN FRACTION OF POB ISOLATED (minimum 0, maximum 1)

MEAN FRACTION OF LIFEBOATS DESTROYED (minimum 0, maximum 1)

Note that for the primary casualty of a collision this characteristic has a standard value of zero.

MEAN LENGTH OF DAMAGE (minimum 0, maximum 200)

This value, in feet, determines the probability that a lifeboat will be damaged during a collision.

MEAN HEEL ANGLE (minimum 0^{o}, maximum 180^{o})

The program uses this value only for those casualties that involve a sinking; the value is in degrees.

MEAN TIME FOR CASUALTY TO DEVELOP (minimum 0, maximum 480)

The time in minutes from the beginning of the casualty until the abandon ship signal is given.

5. Man Overboard Simulation (Override Mode)

Section 3 discussed the standard use of the Man Overboard Simulation; this section discusses the capability to override some of the standard characteristics assumed. Only those additional questions applicable to this capability appear in this section. The user should consult section 3 for the standard usage and explanations. Appendix F shows the questions for the override use of the Man Overboard Simulation as they appear on the video display.

5.1 Operator Program

The override use of the operator program involves only the Ship Characteristics; the remainder of the characteristics remain the same as for the standard use of the program discussed in section 3.

5.1.1 Ship Characteristics

The override use of the program allows modification of only three of the ship characteristics. The override use of the program begins when the user answers the following question in the negative

WANT STANDARD SHIP
(1=YES; 0=NO)?

With a NO answer, the program responds with

(STD. SHIP LENGTH = XXX)
SHIP LENGTH?

The XXX contains the length of the standard ship assumed for comparative purposes; the user supplies the length desired, which may be the same as the standard or some different value. The program accepts any value between 10 and 2000 feet. The program then asks

(STD. SHIP SPEED = XXX)
SHIP SPEED?

The user can supply any value between 10 and 50 knots. Finally, the program asks

(STD. MEAN HEADING ERROR (DEG.) = XXX)
MEAN HEADING ERROR (DEG.)?

The user response must lie between 0 and 5 degrees. Following this response by the user the program proceeds to the next section, that of the Rescue Boat Characteristics, which always requires the user to supply all the characteristics. The Rescue Boat Characteristics are inputted in the manner discussed in section 3.1.3

REFERENCES

1. Brown, DiJulio, Nickels and Saucedo, "Study of Rescue Boat Performance for Selected Commercial Vessel Casualty Profiles", DOT Report No.CG-D-7-78, May 1978.

2. Brown, DiJulio, Nickels, and Saucedo, "Programmer's Manual for Computer Programs Involved in a Study of Rescue Boat Performance for Selected Commercial Vessel Casualties", DOT Report No.CG-D-9-78, May 1978.

APPENDICES

APPENDIX A: Standard Use of Abandon Ship Simulation

The following pages have the exact messages and questions that appear on the terminal device (video display) during the standard use of the Abandon Ship Simulation. Each screen is shown as it appears on the CASDE small computer, but a different system may have a different number of questions per screen. Screens that have an asterisk (*) in the upper right hand corner will always begin the same since the program performs a home and erase before starting the screen. The xxx indicates information supplied by the user.

```
ABANDON SHIP SIMULATION                    *

SERIAL NUMBER? xxx

INITIALIZING
```

```
SHIP CHARACTERISTICS.                                    *
1  TANKER
2  CONTAINER
3  LNG
4  FISHBOAT
5  TUG
6  BARGE CARRIER (LASH)
7  GREAT LAKES BULKER
8  FERRY
NUMBER? xxx
WANT STANDARD SHIP
  (1=YES; 0=NO)? xxx
```

```
RESCUE BOAT CHARACTERISTICS                              *
NO. OF RESCUE BOATS (1 OR 2)? xxx
BOAT CAP. (EXC. CREW)? xxx
NO. IN BOAT CREW? xxx
MEAN TIME TO LAUNCH (MIN.)? xxx
MEAN TIME TO PICK UP? xxx
STD. MANEUVER TIME (MIN.)? xxx
MAX. WAVE HEIGHT (FT.)? xxx
```

```
MAX. HEEL ANGLE (DEG.)? xxx
```

```
TYPE OF CASUALTY                                    *
1  FIRE
2  COLLISION & FIRE
3  COLLISION & SINKING
4  EXPLOSION & FIRE
5  EXPLOSION & SINKING
6  STRUCTURAL FAILURE
7  GROUNDING
8  CAPSIZING
9  FOUNDERING
NUMBER? xxx
WANT STANDARD CASUALTY
  (1=YES; 0=NO)? xxx
NUMBER OF SIMULATIONS? xxx
```

APPENDIX B: Sample Outputs of the Abandon Ship Simulation

The following pages consist of the outputs of actual simulation runs. Enough examples appear to show all possible situations that can occur.

ABANDON SHIP SIMULATION

SIMULATION SERIAL NO. AS 131

CONTAINER
LBF = 710 FEET
POB = 40
2 - 40 MAN LIFEBOATS
1 - 25 MAN LIFERAFTS

NUMBER OF RESCUE BOATS = 1
RESCUE BOAT CAPACITY = 7 + 2 MAN CREW (EACH BOAT)
MEAN TIME TO LAUNCH RESCUE BOAT = 2 MINUTES
MEAN TIME TO PERFORM STANDARD MANEUVER = 1 MIN.
MEAN TIME TO PICK UP ONE MAN FROM WATER = 1 MIN.
RATED HEEL ANGLE OF RESCUE BOAT DAVITS = 20 DEGS.
RATED SEA STATE CAPABILITY = 20 FT. SIGN . WAVE HGT.

EXPLOSION & SINKING
ON AVG.: 10 % OF CREW KILLED BY CASUALTY
1 CREWMEN KNOCKED OVERBOARD
5 % OF CREW ISOLATED FROM LIFEFOATS
10 % OF LIFEBOATS DAMAGED
20 MIN. FROM BEGINNING OF CASUALTY
TO BEGINNING OF ABANDON SHIP.
20 DEGREES HEEL ANGLE

RESULTS OF 300 SIMULATIONS:

OVERALL FRACTION OF MEN IN WATER RESCUED BY RESCUE BOAT: ******** * .345 * ********

	NO. TIMES	MEAN	MIN.	MAX.
NO. IN WATER, N	300	2.95	0	6
NO. RESCUED BY BOAT, NS	204	1.5	0	5
RATIO NS/N	204	.48	0	1
RESCUE BOAT DAMAGED	8			
R.B. LAUNCH FAILED	86			
*NRBRB , ALL BOATS FILLED TO CAPACITY BEFORE LAUNCH	2	4	3	5
*NRBRB, RESCUE BOAT & ALL BOATS & RAFTS IN WATER FILLED TO CAPACITY	2	1.5	1	2

ABANDON SHIP SIMULATION

SIMULATION SERIAL NO. AS 173

LNG
LBP = 900 FEET
POB = 50
4 - 33 MAN LIFEBOATS
2 - 25 MAN LIFERAFTS

NUMBER OF RESCUE BOATS = 1
RESCUE BOAT CAPACITY = 15 + 2 MAN CREW (EACH BOAT)
MEAN TIME TO LAUNCH RESCUE BOAT = 2 MINUTES
MEAN TIME TO PERFORM STANDARD MANEUVER = 1 MIN.
MEAN TIME TO PICK UP ONE MAN FROM WATER = 1 MIN.
RATED HEEL ANGLE OF RESCUE BOAT DAVITS = 20 DEGS.
RATED SEA STATE CAPABILITY = 20 FT. SIGN . WAVE HGT.

FIRE
ON AVG.: 5 % OF CREW KILLED BY CASUALTY
0 CREWMEN KNOCKED OVERBOARD
5 % OF CREW ISOLATED FROM LIFEBOATS
10 % OF LIFEBOATS DAMAGED
30 MIN. FROM BEGINNING OF CASUALTY
TO BEGINNING OF ABANDON SHIP.

RESULTS OF 300 SIMULTIONS:

OVERALL FRACTION OF MEN IN WATER RESCUED BY RESCUE BOAT

****
* .425 *
****

	NO. TIMES	MEAN	MIN.	MAX.
NO. IN WATER, N	300	2.46	0	5
NO. RESCUED BY BOAT,NS	220	1.43	0	4
RATIO NS/N	220	.54	0	1
RESCUE BOAT DAMAGED	41			
R.B. LAUNCH FAILED	39			
*NRBRB , ALL BOATS FILLED TO CAPACITY BEFORE LAUNCH	0	----	----	
*NRBRB, RESCUE BOAT & ALL BOATS & RAFTS IN WATER FILLED TO CAPACITY	0	----	----	

ABANDON SHIP SIMULATION

SIMULATION SERIAL NO. AS 208

FISHBOAT
LBP = 75 FEET
POB = 5
0 - 0 MAN LIFEBOATS
1 - 10 MAN LIFERAFTS

NUMBER OF RESCUE BOATS = 1
RESCUE BOAT CAPACITY = 3 + 2 MAN CREW (EACH BOAT)
MEAN TIME TO LAUNCH RESCUE BOAT = 2 MINUTES
MEAN TIME TO PERFORM STANDARD MANEUVER = 1 MIN.
MEAN TIME TO PICK UP ONE MAN FROM WATER = .5 MIN.
RATED HEEL ANGLE OF RESCUE BOAT DAVITS = 20 DEGS.
RATED SEA STATE CAPABILITY = 20 FT. SIGN . WAVE HGT.

CAPSIZING
ON AVG.: 10 % OF CREW KILLED BY CASUALTY
2 CREWMEN KNOCKED OVERBOARD
0 % OF CREW ISOLATED FROM LIFEBOATS
0 % OF LIFEBOATS DAMAGED
5 MIN. FROM BEGINNING OF CASUALTY
TO BEGINNING OF ABANDON SHIP.
30 DEGREES HEEL ANGLE

RESULTS OF 300 SIMULTIONS:

OVERALL FRACTION OF MEN IN WATER RESCUED BY RESCUE BOAT

****
* .23 *
****

	NO. TIMES	MEAN	MIN.	MAX.
NO. IN WATER, N	300	2.09	0	4
NO. RESCUED BY BOAT,NS	105	1.37	0	4
RATIO NS/N	105	.63	0	1
RESCUE BOAT DAMAGED	0			
R.B. LAUNCH FAILED	195			
*NRBRB , ALL BOATS FILLED TO CAPACITY BEFORE LAUNCH	0	---	---	---
*NRBRB, RESCUE BOAT & ALL BOATS & RAFTS IN WATER FILLED TO CAPACITY	5	0	0	0

ABANDON SHIP SIMULATION

SIMULATION SERIAL NO. AS 298

CONTAINER
LBP = 710 FEET
FOB = 40
2 - 40 MAN LIFEBOATS
1 - 25 MAN LIFERAFTS

NUMBER OF RESCUE BOATS = 1
RESCUE BOAT CAPACITY = 15 + 2 MAN CREW (EACH BOAT)
MEAN TIME TO LAUNCH RESCUE BOAT = 2 MINUTES
MEAN TIME TO PERFORM STANDARD MANEUVER = 1 MIN.
MEAN TIME TO PICK UP ONE MAN FROM WATER = 4 MIN.
RATED HEEL ANGLE OF RESCUE BOAT DAVITS = 20 DEGS.
RATED SEA STATE CAPABILITY = 20 FT. SIGN . WAVE HGT.

COLLISION & SINKING
ON AVG.: 2 % OF CREW KILLED BY CASUALTY
.5 CREWMEN KNOCKED OVERBOARD
0 % OF CREW ISOLATED FROM LIFEBOATS
0 % OF LIFEBOATS DAMAGED
30 MIN. FROM BEGINNING OF CASUALTY TO BEGINNING OF ABANDON SHIP.
20 FT. LENGTH OF COLLISION DAMAGE
20 DEGREES HEEL ANGLE

RESULTS OF 600 SIMULTIONS:

OVERALL FRACTION OF MEN IN WATER RESCUED BY RESCUE BOAT ******** * .056 * ********

	NO. TIMES	MEAN	MIN.	MAX.
NO. IN WATER, N	600	.48	0	1
NO. RESCUED BY BOAT, NS	382	.04	0	1
RATIO NS/N	382	.04	0	1
RESCUE BOAT DAMAGED	21			
R.B. LAUNCH FAILED	184			
*NRBRB , ALL BOATS FILLED TO CAPACITY BEFORE LAUNCH	13	22.08	21	23
*NRBRB, RESCUE BOAT & ALL BOATS & RAFTS IN WATER FILLED TO CAPACITY	0		---	---

APPENDIX C: Standard Use of Man Overboard Operator Program

The following pages have the exact messages and questions that appear on the terminal device (video display) during the standard use of the Man Overboard Operator Program. Each screen is shown as it appears on the CASDE small computer, but a different system may have a different number of questions per screen. Screens that have an asterisk (*) in the upper right hand corner will always begin the same since the program performs a home and erase before starting the screen. The xxx indicates information supplied by the user which will also appear on the screen.

```
                OPERATOR PROGRAM                *

FIRST SERIAL NUMBER XXX
LAST SERIAL NUMBER XXX
DATA FILE NAME XXX
INITIALIZING
```

```
SHIP CHARACTERISTICS                    *

1  TANKER

2  CONTAINER

3  LNG

4  FISHBOAT

5  TUG

6  BARGE CARRIER (LASH)

7  GREAT LAKES BULKER

8  FERRY

NUMBER OF SHIP DESIRED XXX
```

```
WANT STANDARD SHIP                      *

  (1=YES: 0=NO)? xxx
```

```
RESCUE BOAT CHARACTERISTICS                    *
SPEED IN SMOOTH WATER (KNOTS)? xxx
SPEED IN 8 FT. WAVES (KNOTS)? xxx
FREEBOARD (FEET)? xxx
PERCENT OF GUNWALE OPEN (%)? xxx
```

```
HEIGHT OF LOOKOUTS EYE (FT)? xxx
MEAN TIME TO PREPARE (MIN)? xxx
NUMBER OF FALLS? xxx
DESCENT SPEED (FT./MIN.)? xxx
MAX. LAUNCH SPEED (KNOTS)? xxx
MAX. WAVE HEIGHT (FEET)? xxx
STD. MANEUVER TIME (MIN.)? xxx
```

```
USE THE BOAT FOR SEARCH
  (1=YES; 0=NO)? xxx
SEARCH WITH R.B. ONLY
  (1=YES; 0=NO)? xxx
```

APPENDIX D: Sample Outputs of Man Overboard Simulation Programs

1. Man Overboard Operator Program Output

CONTAINER	710	23	2.6	60	0.05	3
	5	24	70	38	0.05	1
RESCUE BOAT	6	3	2	100	8	2
	2	100	2	20	1.25	0
PROBABILITIES	0.63	0.12	0.03	0.26	0.05	0
	1	0.5	0.9	0.05	0.8	0.9
	0	0.65	0.97			

S/N	# OF SIM.	T(SL)	T(TW)	T(LS(0))	ALPHA(LS)
200	1000	2.37391304348	4.25069109758	15	30

2. Man Overboard Simulation Program COMPRESSED PRINT Output

S/N	NOTIFY	REACH P	FIND	IN R.B.	SAVED	NOTIFY	REACH P	FIND	IN R.B.	SAVED
	SEEN = 626		R.B. DEPLOYED = 521			NOT SEEN = 374		R.B. FAILED = 0		
200	624	530	515	428	300	98	25	25	13	7
	1.019	5.771	5.959	8.556	8.557	8.79	15.998	15.998	22.482	19.248
329	2	19.213	19.213	20.456	20.067	30.423	65.096	65.096	70.172	35.235
	0	.391	3.737	5.293	5.293	1.004	6.259	6.259	9.897	9.897

FINISHED.

3. Man Overboard Simulation Program REGULAR PRINT Output and Man Overboard Output Program Output

A sample of the print-out produced by the Man Overboard Simulation Program when the user selects REGULAR PRINT or the print-out produced by the Man Overboard Output Program appears on the next page (page G-2).

MAN OVERBOARD SIMULATION

SIMULATION SERIAL NO. MOB 200

CONTAINER

LENGTH = 710 FEET SPEED = 23 KNOTS
NAVIGATIONAL HEADING ERROR = 1 DEGREE(S)
PROBABILITY SHIP WILL BE RESTRICTED FROM TURNING = 0.05
PROBABILITY SHIP WILL RECOVER MOB DIRECTLY = 0.05

RESCUE BOAT
SPEED: 6 KNOTS IN CALM WATER
3 KNOTS IN 8' SIGNIFICANT WAVE HEIGHT SEA
FREEBOARD = 2 FEET WITH 100 % OF GUNWALE OPEN
HEIGHT OF LOOKOUT'S EYE = 8 FEET
MEAN TIME TO PREPARE RESCUE BOAT FOR LAUNCH = 2 MINUTES
2 FALL(S) HAVING 100 FT./MIN. DESCENT SPEED
MAXIMUM SHIP SPEED FOR SAFE RESCUE BOAT LAUNCH = 2 KNOTS
RATED SEA STATE CAPABILITY = 20 FOOT SIGNIFICANT WAVE HEIGHT
MEAN TIME TO PERFORM STANDARD MANEUVER = 1.25 MINUTE(S)
PROBABILITY RESCUE BOAT WILL BE DEPLOYED TO SEARCH WITH SHIP = 0

RESULTS OF 1000 SIMULATIONS:

OVERALL FRACTION OF ********
MOB'S RESCUED * 0.307*
BY RESCUE BOAT ********

RESCUE BOAT DEPLOYED 521 TIMES
RESCUE BOAT LAUNCH FAILED 0 TIMES DUE TO SEA STATE

	MOB SEEN 626 TIMES				MOB NOT SEEN 374 TIMES			
	NO. TIMES	MEAN	MIN.	MAX.	NO. TIMES	MEAN	MIN.	MAX.
MOB ALIVE WHEN:								
BRIDGE NOTIFIED	624	1.02	0.00	2.00	98	8.79	1.00	30.42
MOB'S POS. REACHED	530	5.77	0.39	19.21	25	16.00	6.26	65.10
MOB FOUND	515	5.96	3.74	19.21	25	16.00	6.26	65.10
ABOARD RESCUE BOAT	428	8.56	5.29	20.46	13	22.48	9.90	70.17
MOB SAVED	300	8.56	5.29	20.07	7	19.25	9.90	35.23

APPENDIX E: Override Use of Abandon Ship Simulation

Appendix A showed the standard use messages and questions for the Abandon Ship Simulation. This appendix shows those screens that differ for the override use of the Abandon Ship Simulation. Each screen is shown as it appears on the CASDE small computer, but a different system may have a different number of questions per screen. Screens that have an asterisk (*) in the upper right hand corner will always begin the same since the program performs a home and erase before starting that screen. The xxx indicates information supplied by the user which can have any allowed value; an underlined (_) reply indicates a specific user reply required to enter the override use mode. XXX indicates variable information supplied by the program from the standard characteristics.

```
SHIP CHARACTERISTICS                                    *

1  TANKER

2  CONTAINER

3  LNG

4  FISHBOAT

5  TUG

6  BARGE CARRIER (LASH)

7  GREAT LAKES BULKER

8  FERRY

NUMBER? xxx

WANT STANDARD SHIP

  (1=YES; 0=NO)? 0

  (STD. SHIP LENGTH = XXX)

SHIP LENGTH? xxx
```

```
  (STD. POB SHIP = XXX)
POB SHIP? xxx
  (STD. NO. OF LIFEBOATS = XXX)
NO. OF LIFEBOATS? xxx
  (STD. CAPACITY OF EACH LB. = XXX)
CAPACITY OF EACH L.B.? xxx
  (STD. NO. OF LIFERAFTS = XXX)
NO. OF LIFERAFTS? xxx
  (STD. CAPACITY OF EACH L.R. = XXX)
CAPACITY OF EACH L.R.? xxx
```

```
  (STD. MODE OF SIGN. WAVE HGTS.--MID-WINTER = XXX)
MODE OF SIGN. WAVE HGTS.--MID-WINTER? xxx
  (STD. MODE OF SIGN. WAVE HGTS.--MID-SUMMER = XXX)
MODE OF SIGN. WAVE HGTS.--MID-SUMMER? xxx
  (STD. MEAN WATER TEMP.--MID-WINTER = XXX)
MEAN WATER TEMP.--MID-WINTER? xxx
```

```
  (STD. MEAN WATER TEMP.--MID-SUMMER = XXX)
MEAN WATER TEMP.--MID-SUMMER? xxx
  (STD. PROB. RESCUE VESSEL NEARBY = XXX)
PROB. RESCUE VESSEL NEARBY? xxx
```

```
TYPE OF CASUALTY                                    *
1  FIRE
2  COLLISION & FIRE
3  COLLISION & SINKING
4  EXPLOSION & FIRE
5  EXPLOSION & SINKING
6  STRUCTURAL FAILURE
7  GROUNDING
8  CAPSIZING
9  FOUNDERING
NUMBER? xxx
WANT STANDARD CASUALTY
  (1=YES; 0=NO)? 0
  (STD. MEAN FRACTION OF POB KILLED = XXX)
MEAN FRACTION OF POB KILLED? xxx
```

```
  (STD. MEAN NO. OF POB KNOCKED OVERBOARD = XXX)
MEAN NO. OF POB KNOCKED OVERBOARD? xxx
  (STD. MEAN FRACTION OF POB ISOLATED = XXX)
MEAN FRACTION OF POB ISOLATED? xxx
  (STD. MEAN FRACTION OF LIFEBOATS DESTROYED = XXX)
MEAN FRACTION OF LIFEBOATS DESTROYED? xxx
```

```
  (STD. MEAN LENGTH OF DAMAGE = XXX)
MEAN LENGTH OF DAMAGE? xxx
  (STD. MEAN HEEL ANGLE = XXX
MEAN HEEL ANGLE? xxx
  (STD. MEAN TIME FOR CASUALTY TO DEVELOP = XXX
MEAM TIME FOR CASUALTY TO DEVELOP? xxx
NUMBER OF SIMULATIONS? xxx
```

APPENDIX F: Override Use of Man Overboard Operator Program

Appendix C showed the Standard use messages and questions for the Man Overboard Operator Program. This appendix shows those screens that differ for the override use of the program. Each screen is shown as it appears on the CASDE small computer, but a different system may have a different number of questions per screen. Screens that have an asterisk (*) in the upper right hand corner will begin the same on any system since the program commands a home and erase before starting those screens. The XXX indicates variable information supplied from the standard characteristics; xxx indicates data supplied to the user. Entrance to the override use messages and questions requires the specific response with an underscore (_).

```
WANT STANDARD SHIP                                    *
  (1=YES;0=NO)? 0
  (STD. SHIP LENGTH = XXX)
SHIP LENGTH? xxx
  (STD. SHIP SPEED = XXX)
SHIP SPEED? xxx
  (STD. MEAN HEADING ERROR (DEG.) = XXX)
MEAN HEADING ERROR (DEG.)? xxx
```

APPENDIX G: Input Data Preparation Sheet for Abandon Ship Simulation

ABANDON SHIP SIMULATION MODEL

INPUT DATA PREPARATION SHEET

SHIP CHARACTERISTICS	RUN NUMBER	
1. SHIP TYPE? (Enter index No. of ship type desired) 1=Tanker 4= Fishboat 7=Great Lakes Bulker 2=Containership 5=Tug 8=Ferry 3=LNG Ship 6=Barge Carrier (LASH)		
2. WANT STANDARD SHIP? (Enter "No" if you want to run simulation with specific values of ship characteristics; otherwise enter "Yes")		
3. IF ANSWER TO ABOVE IS "No", THEN: SHIP LENGTH (FEET)?		
NUMBER OF PEOPLE ON BOARD?		
NUMBER/CAPACITY (EACH) OF LIFEBOATS?		
NUMBER/CAPACITY (EACH) OF LIFERAFTS?		
RESCUE BOAT CHARACTERISTICS		
1. NO. OF RESCUE BOATS (1 or 2)?		
2. BOAT CAPACITY (Excluding Crew) (NO)?		
3. NO. OF BOAT CREW? (NO).		
4. MEAN TIME TO LAUNCH BOAT? (MIN.)		
5. MEAN TIME TO PICK UP ONE SURVIVOR (MTTP)? (MIN.)		
6. STD. MANEUVER TIME? (MINUTES)		
7. RATED SEA STATE CAPABILITY? (FEET)		
8. RATED HEEL ANGLE OF DAVIT? (DEGREES)		
CASUALTY CHARACTERISTICS		
1. CASUALTY TYPE? (Enter index No. of casualty type desired) 1=Fire 5=Explosion & Sinking 2=Collision & Fire 6=Structural Failure 3=Collision & Sinking 7=Grounding 4=Explosion & Fire 8=Capsizing 9=Foundering		
2. WANT STANDARD CASUALTY CHARACTERISTICS? (Enter "No" if you want to run simulation with specific values of casualty characteristics; otherwise enter "Yes")		
3. IF ANSWER TO ABOVE IS "NO", THEN: % of POB KILLED BY CASUALTY?		
NUMBER POB KNOCKED OVERBOARD?		
% OF POB ISOLATED FROM LIFEBOATS?		
% OF LIFE BOATS DAMAGED?		
MEAN LENGTH OF COLLISION DAMAGE? (FEET)		
MEAN TIME ANGLE? (DEGREES)		
MEAN TIME FOR CASUALTY TO DEVELOP? (MINUTES)		
1. NUMBER OF SIMULATIONS?		

APPENDIX H : Input Data Preparation Sheet for Man Overboard Simulation

MAN OVERBOARD SIMULATION MODEL

Input Data Preparation Sheet

SHIP CHARACTERISTICS	Run Number	
1. SHIP TYPE? (Enter index No. of ship type desired) 1=Tanker 4=Fishboat 7=Great Lakes 2=Containership 5=Tug 8=Ferry 3=LNG Ship 6=Barge Carrier (LASH)		
2. WANT STANDARD SHIP? (Enter "no" if you want to run simulation with specific values of ship length, speed, or heading error, otherwise enter "Yes"		
3. IF ANSWER TO ABOVE IS "No", THEN: SHIP LENGTH (FEET)?		
SHIP SPEED (KNOTS)?		
MEAN HEADING ERRORS (DEGREES)?		
RESCUE BOAT CHARACTERISTICS		
1. SPEED IN SMOOTH WATER (KNOTS)?		
2. SPEED IN 8 FT. WAVES (KNOTS)?		
3. FREEBOARD (FEET)?		
4. PERCENT OF GUNWALE OPEN? (100=completely open boat, 0=completely covered boat)		
5. HEIGHT OF LOOKOUT'S EYE (FEET)? (Above W.L.)		
6. MEAN TIME TO PREPARE (MIN.)? (To prepare boat to launch)		
7. NUMBER OF FALLS?		
8. DESCENT SPEED (FT./MIN)?		
9. MAX. LAUNCH SPEED (KNOTS)? (Max. ship speed at which boat can be launched)		
10. MAX. WAVE HEIGHT (FEET)? (Max. significant wave height in which boat can be safely launched)		
11. STD. MANEUVER TIME (MIN)? (Enter boat's rated time to perform the standard R.B. maneuver)		
12. USE BOAT FOR SEARCH? (Would this boat be dispatched immediately to search for MOB instead of held on ship until ship reached MOB-"yes" or "no")		
13. SEARCH WITH R.B. ONLY?		